



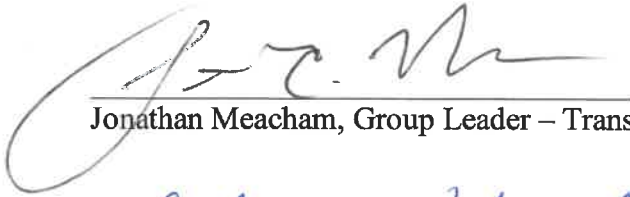
Planning Coordinator and/or Transmission Planner

**TRANSMISSION SYSTEM PLANNING
GUIDELINES**

Effective Date: September 11, 2017

TRANSMISSION SYSTEM PLANNING GUIDELINES

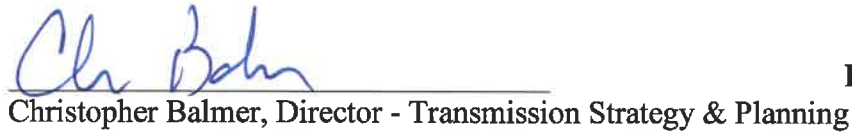
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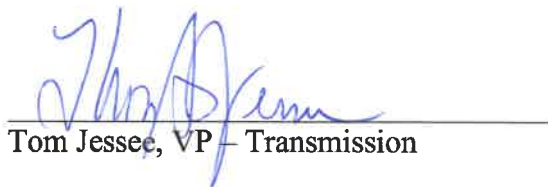
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Revision History

Date	Version	Description
June 6, 1998	0.0	Initial LG&E document to establish guidelines applicable to both LG&E/KU
March 11, 2005	1.0	Expanded Table 1
March 1, 2007	2.0	Added NERC Categories to Table 1 and expanded
May 7, 2007	3.0	Better quantified thermal overload and voltage violations and added Section 4 – Impacted Facilities
September 11, 2007	4.0	Added section describing how Guidelines exceed NERC requirements
May 1, 2008	5.0	Added effective date, signatures, Revision History, Contingency Selection criteria, updated Tables 2 & 3 and updated certain references
July 1, 2008	6.0	Updated performance requirements and incorporated SOL Methodology
August 14, 2009	7.0	Added statement reiterating comparable treatment of service requests per FERC Order.
November 30, 2010	8.0	Changed Company name from E.ON to LG&E/KU; edited to match other guidelines; added detail to stability section
September 1, 2012	9.0	General Update Added detail to stability analysis section
December 20, 2013	10.0	General Update Added detail to multiple sections to provide clarification
December 30, 2013	11.0	Correct error in footnote 13 on page 8
July 30, 2014	12.0	Changes required to address new TPL-001-4 standard
October 30, 2014	13.0	Make corrections; section 5.8, 5.10, 6.4, 7.2, 7.5.2, 8.2, Attachment A
September 15, 2015	14.0	Section 1: applicability to 2015 TEP removed; section 5.4 details of load scenarios described; section 5.6 DNR changed to NITS capacity; added section 5.8 to described ratings in off-peak models; removed unnecessary paragraph 5.10.1; section 5.12 added language in case ERAG models are late; section 6 and 6.7 removed flowgate analysis requirement; added section 6.2.1.1 details of sensitivity study requirements; section 6.6 added language to match TPL-001-4 2.5; section 6.7 added NITS capacity sensitivity study; previous section 8.2 “Corrective Action Plan” moved to new section 10; section 8.2 added clarification for TPL-001-4 footnote 12; revised stability criteria to accommodate load inductor model section 8 and 9.2; RC requested changes to Instability Identification Section 9.1 and 9.2.
September 28, 2016	15.0	Make changes for MOD-032 data requests. Change identification of Cascading/Instability; Correct error in 7.7.1 that says “single line to ground”. Clarify which 69 kV buses are monitored for voltage (Section 8.2); corrected angular stability in Section 8.3.1;

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		made criteria for generator synchronism match TPL-001-4 (Section 8.3.5 through 8.3.7).
September 11, 2017	16.0	Various sections were modified to enhance clarity; pointed reader to NERC Glossary terms; added filtering criteria in Section 6.1; made changes to the off-peak model; removed NITS capacity sensitivity scenario. Effective for the 2018 TEP and Planning Assessment performed in 2017 and 2019 TEP and Planning Assessment performed in 2018

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1 Purpose

This *Transmission System Planning Guidelines* Document (this “Document”) describes the requirements for planning Louisville Gas & Electric Company and Kentucky Utilities Company’s (collectively “LG&E/KU”) Transmission System and related Transmission Expansion Plan (“TEP”). This Document is developed in accordance with NERC Reliability Standard TPL-001-4. LG&E/KU is registered as both a Planning Coordinator (“PC”) and Transmission Planner (“TP”). The LG&E/KU Transmission Planning Group performs the functions for both the PC and TP. This Document establishes the minimum planning criteria for the LG&E/KU Transmission System, including equipment and Facilities operated at 69 kV and above.

2 Overview

The primary purpose of LG&E/KU's Transmission System is to reliably transmit electrical energy from Designated Network Resources to Network Loads. Interconnections to other transmission systems have been established to increase the reliability of LG&E/KU's Transmission System and to provide access to emergency generation sources for Network Customers.

The Federal Energy Regulatory Commission (“FERC”) requires all public utilities that own, control or operate facilities used for transmitting electric energy in interstate commerce have a non-discriminatory Open Access Transmission Tariff (“OATT”). LG&E/KU have an OATT on file with FERC to provide Point to Point Transmission Service and Network Integration Transmission Service.

3 NERC Reliability Standards Compliance

NERC Reliability Standard TPL-001-4 governs the requirements for planning the interconnected Bulk Electric System (BES) such that the network can be operated to supply real and reactive forecasted loads and projected Firm (non-recallable reserved) Transmission Services. LG&E and KU's Transmission System Planning Guidelines is intended to meet or exceed the requirements of TPL-001-4.

4 Definitions

The following is a list of NERC definitions used in these Planning Guidelines and can be found in the NERC Glossary or the TPL-001-4 Standard:

Balancing Authority (BA)
Bulk Electric System (BES)
Bus-tie Breaker
Cascading

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Capacity Benefit Margin (CBM)
Consequential Load
Contingency
Corrective Action Plan(s)
Demand Side Management (DSM)
Element
Extra High Voltage (EHV)
Facility
Facility Rating
Fault:
Firm Transmission Service
High Voltage (HV)
Load
Load Serving Entity (LSE)
Long-Term Transmission Planning Horizon
Near-Term Transmission Planning Horizon:
Network Integration Transmission Service
Non-Consequential Load Loss
Off-Peak
On-Peak
Operating Reserve
Planning Assessment
Planning Authority
Planning Coordinator
Point to Point Transmission Service
Protection System
Resource Planner
Scenario
Special Protection System (SPS) or Remedial Action Scheme
Stability
System
Transmission
Transmission Reliability Margin (TRM)
Transmission Planner (TP)
Year One

The following are LG&E/KU defined terms:

50/50 Load Forecast: On Peak Demand which represents a 50% probability of Load being higher than forecast and 50% probability of Load being lower than forecast

90/10 Load Forecast: Loads for more extreme weather and On-Peak Demand has a 90% probability of being below this forecast and a 10% probability of being higher than this forecast.

Base Case Models: A set of models which includes year two for summer peak, winter peak, off-peak(s); year five for summer peak, winter peak, off-peak(s); and year ten for summer peak, winter peak, off-peak(s). There are at least nine models in the Base Case Models. The models are developed using the MOD-032 data received using a 50/50 Load Forecast. The Base Case Models do not include revisions for Long Lead items, Sensitivities as described in TPL-001-4 2.1.4 and 2.4.3 or Other Models as described in these Planning Guidelines.

Case: A Case is a group of models which includes (but is not limited to) year two for summer peak, off-peak(s) winter peak; year five for summer peak, off-peak(s), winter peak; and year ten for summer peak, off-peak(s), winter peak which have the set of modeling assumptions. For example all models in the Case have the same generator retirements see TPL-001-4 2.1.4 or 2.4.3 or another example would be all models in the Case contain higher than normal Load Forecasts.

NITS Capacity: Maximum net capacity for each resource over the 10 year horizon as submitted by the Network Customer in their annual 10 year forecast submitted in compliance with MOD-032. See *LG&E/KU Business Practices* for additional information.

Extreme Event Report: Report of the results for the extreme events studies for TPL-001-4 Table 1 extreme events.

5 Models

This section describes the models that are built for compliance with TPL-001-4. NERC has defined Year One as, “*The first twelve month period that a Planning Coordinator or a Transmission Planner is responsible for assessing. For an assessment started in a given calendar year, Year One includes the forecasted peak Load period for one of the following two calendar years. For example, if a Planning Assessment was started in 2011, then Year One includes the forecast peak Load period for either 2012 or 2013.*” Based on this, LG&E/KU has elected to utilize year two and year five for the near-term models and a year ten model for the Long-Term Transmission Planning Horizon.

5.1 Normal System Condition Models

In accordance with TPL-001-4 R1, LG&E/KU maintains normal System condition models for its respective area in order to perform the studies needed to satisfy TPL-001-4. The models use data consistent with that required in MOD-032 (which has superseded the now retired MOD-010 and MOD-012 standards), supplemented by other sources as needed, and shall represent projected System conditions. The process for developing the steady state and stability models are described in this section. Normal System condition models shall include:

- Existing Elements¹: model of 69 kV and above lines, transformers, substations etc.
- Known Outage (s) of generation or Transmission facilities described below.
- New planned Elements and Facilities and changes to existing Elements and Facilities as described below.
- Real and Reactive Forecasted Load as described below.
- Known commitments for Firm Transmission Service as described below.
- Resources (supply or demand side) required for Load

The above models represent normal System conditions and must meet the performance requirements of TPL-001-4 Table 1 Category P0.² The applicable Facility Rating for TPL-001-4 Table 1 Category P0 is the seasonal Normal Rating. For purposes of these Planning Guidelines the Normal System Condition Models are called Base Case Models and include Forecasted Loads that represent 50/50 Load Forecast as defined above.

5.2 Known Outages

Known outages in the Near -Term Transmission Planning Horizon of either generation or transmission Elements and Facilities with an outage duration of at least six months will be modeled for the seasons and years in which the outage is scheduled in both the System Peak and Off-Peak models³. Models will be developed, and an assessment of the System with these outages will be completed by analyzing Categories P0 and P1 planning events in Table 1 of TPL-001-4⁴.

Outages lasting longer than six months are supplied by the GO and TO to the PC through the MOD-032 data submittal.

5.3 New and Existing Elements and Facilities

The steady state and stability models developed will include projects as documented in the Planning Assessment including new planned Elements and Facilities and changes to existing and planned Elements and Facilities.⁵ For both steady state and stability models, projects from the previous year's TEP are included according to the expected in-service dates. In addition, all projects that were completed after the completion of the previous year's TEP will be included in the Base Case Models .

¹ TPL-001-4 1.1.1

² TPL-001-4 R1

³ TPL-001-4 1.1.2

⁴ TPL-001-4 2.1.3

⁵ TPL-001-4 1.1.3

Since the group that performs the functions for the LG&E/KU TP also performs the functions for the LG&E/KU PC, there is no need for a MOD-032 data submittal from TP to PC for new planned Elements and Facilities.

5.4 Real and Reactive Forecasted Load

Load Serving Entities (LSEs) and Distribution Providers submit delivery point forecast for real power and power factor per the MOD-032 data submittal. The reactive load is calculated with the real power and power factor by the TP. The LSE load forecast for network load levels are included in the models.⁶

Load forecasts are typically provided for the following conditions:

- Summer and Winter Peak – 50/50 peak forecast
- Summer and Winter Peak – 90/10 peak forecast
- Off-Peak⁷ –
 - 60% of the 50/50 summer peak Load Forecast or forecasted load for a 60 degree ambient temperature; ratings of Facilities are based on a 60 degree Fahrenheit ambient temperature;
 - Light Load – Lowest loads typically observed in the middle of the night or early morning on a spring day (e.g., Easter morning)
 - Summer Shoulder – 70% to 80% of summer peak load

Additional forecasts may be requested on an as needed basis.

5.5 Transmission Service Request (TSR)

For both steady state and stability models, firm transmission service requests that are annual, confirmed, and have a contract period of five or more years may be included⁸ in the models. A list of the TSRs included in the Base Case Models are documented in the Planning Assessment report. TSRs that are not included in the models will be evaluated in the Other Studies section in this Document.

TSR information is supplied to the LG&E/KU PC from the appropriate Resource Planner (RP) through the MOD-032 data submittal and OASIS.

5.6 Real Power Resource Modeling

This section applies to real power resource modeling of units connected to the LG&E/KU transmission system.

⁶ TPL-001-4 1.1.4

⁷ TPL-001-4 2.1.2

⁸ TPL-001-4 1.1.5

The real power resource modeling, for generating units connected to the LG&E/KU transmission system, for steady state and stability models is provided by GO and/or RP, and includes capabilities for both On-Peak and Off-Peak Scenarios⁹. Off-Peak Scenarios are described in Section 5.4. The generation that is on-line initially comes from a merit order that is also provided to the TP by the RP. Operating Reserves are modeled if sufficient generation is available. The process of modeling Operating Reserves dispatches large units (25 MW or greater) to some value less than their maximum output, so that the sum total of available output for online units meets or exceeds the reserve requirements.

There could be instances where there may not be enough generation resources to cover the load, particularly in the Long-Term Transmission Planning Horizon models. In those instances, the TP may choose to model a future expected generating unit, fictitious generating Facility, or energy imports. The TP will not utilize these options solely to meet Operating Reserves.

Maximum output will be the value provided by the Generator Owner (GO) in their MOD-032 data submittal or the Network Integrated Transmission Service (NITS) Capacity value posted on the LG&E/KU OASIS plus firm point to point transmission, whichever is lower. Units are dispatched using the Merit Order (MO) provided by the GO in their MOD-032 data submittal.

5.7 Reactive Power Resource Modeling¹⁰

This section applies to reactive power resource modeling of units connected to the LG&E/KU transmission system.

The reactive power resource capability for the steady state and stability models is supplied by the Generator Owner (GO) and/or RP to the LG&E/KU PC per the MOD-032 data submittal. The transmission level voltage at the power plants will be regulated in the Base Case Models to the target voltage in Table 1 of the LG&E/KU *Voltage and Reactive Power Schedule (VAR-001)* document. The Voltage and Reactive Power Schedules are supplied to the PC from the TOP per the MOD-032 data submittal.

Capacitor banks will be modeled with the actual voltages (or typical settings for future installations) at which the capacitor bank turns on and off for regulating voltage.

5.8 Facility Ratings

Facility Ratings are based on the ambient temperature in the seasonal models. The TP models Facility Ratings based on the following ambient temperatures:

⁹ TPL-001-4 1.1.6

¹⁰ TPL-001-4 1.1.6

- Summer Peak: 104°F
- Winter Peak: 23°F
- Light Load: 60°F
- Off-Peak: 60°F

The LG&E/KU PC has access to the LG&E/KU Transmission Owner Facility Ratings through LOAD database. Generator Owner Facility Ratings are provided to the TP/PC through a MOD-032 data submittal.

5.9 Base Case Models

Steady state Base Case Models are developed for Near-Term Transmission Planning Horizon and Long-Term Transmission Planning Horizon.

Each model in the Base Case Models contains a detailed representation of the LG&E/KU Balancing Authority control area from 69 kV through 500 kV.

Portions of the models outside the LG&E/KU model area are taken from the most recent NERC Eastern Interconnection Reliability Assessment Group (ERAG) Base Case Series. The specific ERAG model used will be the same time-frame as, or a model nearest the time-frame of, the target model being built. LG&E/KU may coordinate models with neighboring TPs, and may alter their Systems in the ERAG models to reflect that coordination.

Base Case Models will be provided to the ITO for review as soon as available after all data checks are complete.

The Base Case Models are the starting point for the annual Planning Assessment, and are used for the development of the TEP.

5.10 Final Planning Assessment Models

At the completion of the annual Planning Assessment, TEP projects are identified and timed. A set of final Case models are created for use in future studies. Both steady state and stability final Case models are created. At the completion of the Planning Assessment process, the final Case models are delivered to both the Reliability Coordinator (RC) and the ITO.

5.11 Steady State Models

Steady State models are developed for winter On-Peak, summer On-Peak and Off-Peak Load conditions. Transmission Base Case Models for steady state analysis are developed on an annual basis to reflect the most current information and assumptions available concerning the modeling of future years' System load level and load distribution

(provided by the LSE), generation (provided by the GO) and the previous year's ITO approved TEP.

Steady state models in the Near-Term Transmission Planning Horizon will include summer and winter On-Peak load models for year two and year five¹¹; at least one Off-Peak model in the Near-Term Transmission Planning Horizon is developed. Long-term Transmission Planning Horizon On-Peak Load models will generally include year ten only. A year ten model is used since it is expected that the loads will be higher than years six through nine¹².

5.12 Stability Models

Stability models are developed using the final Case steady state models which include the most recent TEP. Stability models are developed for summer On-Peak and Off-Peak conditions. At least one On-Peak and one Off-Peak model in the Near-Term Transmission Planning Horizon will be developed. Long-term stability models will be developed to address the impact of proposed material generation additions or changes, if any, in that timeframe. If there are no material generation additions or changes, a stability model in the Long-Term Transmission Planning Horizon will not be built. The Planning Assessment will include documentation to support the technical rationale for determining generation material changes¹³. A minimum of at least one stability model with maximized generation, utilizing the generation interconnection capacity (GIC) values (posted on OASIS), within the LG&E/KU BA will be developed. LG&E/KU Business Practices document posted on OASIS defines GIC. Other stability models may be developed as necessary. The GIC maximized generation model meets the requirements of TPL-001-4 R2.4.3 related to 2.4.1. An Off-Peak model with changes in generation dispatch is developed to meet requirements of TPL-001-4 R2.4.3 related to 2.4.2. Corrective Actions Plans will be identified for violations in the GIC Maximized Model.

The LG&E/KU dynamics parameters are also updated to the latest available data. All dynamics models are tested under no-fault conditions to ensure that voltage and rotor angles have no oscillation (flat line) for twenty seconds.

The stability models for areas outside LG&E/KU transmission System for the Planning Assessment come from the ERAG MMWG set of models. Currently, ERAG is the designee for model development in the eastern interconnection (MOD-032-1 R4). The models have roots in a previous year's ERAG steady state models. Although uncommon, it is possible that the current year ERAG models may not be available in time for stability model development. In this situation the ERAG dynamic models from the previous year will be utilized for the outside world.

¹¹ TPL-001-4 2.1.1

¹² TPL-001-4 2.2.1

¹³ TPL-001-4 2.5

The ERAG stability models are updated within the LG&E/KU BA with the most recent load forecast. Generation levels use merit order and also incorporate Operating Reserves as described in Real Power Resource Modeling Section.

The final stability models will match the topology of the steady state models for the LG&E/KU BA. Due to the ERAG Dynamic Model Building process, the outside world may not match between the stability and steady state models.

5.13 Short Circuit Models

LG&E/KU maintains a perpetually updated short circuit model that reflects the current topology of the LG&E/KU Transmission System with Elements and Facilities in their normal status. LG&E/KU participates in the SERC Short Circuit Database Working Group (SCDWG) process in which a SERC regional model is developed annually, in accordance with the SCDWG procedure manual. The procedure manual requires models be developed for the Near-Term Transmission Planning Horizon and Long-Term Transmission Planning Horizon and the SCDWG coordinates its schedules with the SERC Multi-Regional Modeling Working Group (MMWG) process. In conjunction with SCDWG process, LG&E/KU incorporates a reduction of the most recent SCDWG near-term model each year to represent the Transmission Network outside LG&E/KU, and also incorporates a current detailed model of East Kentucky Power Cooperative (EKPC) short circuit model during the annual update.

The current short circuit model is used to perform the annual breaker duty study of the current Transmission System¹⁴. It will be modified as needed to perform other ad hoc studies, including, where appropriate, replacing the outside world model with a reduced SCDWG long-term model.

The short circuit model is limited to one model in the Near-Term Transmission Planning Horizon and one model in the Long-Term Transmission Planning Horizon.

6 Annual Planning Assessment Per TPL-001-4 R2

LG&E/KU conducts an annual Planning Assessment in order to plan the transmission System to meet performance requirements in TPL-001-4. The annual Planning Assessment includes analysis of both the Near-Term Transmission Planning Horizon and Long-Term Transmission Planning Horizon. The Planning Assessment simulates contingencies for steady state, Stability analysis, and short circuit studies¹⁵. If there are no material generation additions or changes in the Long-Term Transmission Planning

¹⁴ TPL-001-4 2.3

¹⁵ TPL-001-4 2.3

Horizon, a Stability study for the Long-Term Transmission Planning Horizon will use a past study¹⁶.

6.1 Study Impacts¹⁷

The following is a filter criteria used only for Other Studies and Long Lead items as described in sections below.

Corrective Action Plans are required in the Planning Assessment for any criteria violations which were not found in the Base Case Models.

Corrective Action Plans which were identified in the Base Case Models in the current Planning Assessment are required to be accelerated if at least one of the following conditions are met:

- The overload on a Facility increases by 1% or more when compared to the overload identified in the Base Case Models for the same contingency(ies)
- The voltage of a Facility increases a high voltage violation by 0.5% or decreases a low voltage violation by 0.5% or more when compared to the voltage violation identified in the Base Case Models for the same contingency(ies).

6.2 Non-BES Annual Assessment

The *LG&E/KU BES Definition* document does not include any 69 kV Facilities. BES transformers are those transformers with a primary and at least one secondary voltage operated above 100 kV. For purposes of this document, LG&E/KU non-BES elements are elements operated at 69 kV and those transformers whose secondary voltage is operated at 69 kV. An annual planning assessment of the 69 kV Elements is performed for the Near-Term Transmission Planning Horizon as well as the Long-Term Transmission Planning Horizon. The non-BES planning assessment only includes contingencies and performance requirements for P0, P1 and P3 of TPL-001-4 Table 1. Stability analysis as well as P2, P4-P7 and extreme events for steady state is not analyzed on non-BES Elements. Non-BES elements are not monitored for steady state analysis of P2, P4-P7 and extreme events for either Stability or steady state assessments.

The non-BES annual Planning Assessment may utilize a qualified past study or a current study to meet the requirements of TPL-001-4 Table 1 P0, P1 and P3. If a qualified past study is used, it must meet the requirements of TPL-001-4 2.6. Material changes in determination of a qualified past study would include substantial changes to the System represented in the study. If a qualified past study is used, the study reports will be included as attachments in the Planning Assessment.

¹⁶ TPL-001-4 2.5

¹⁷ This filter will not be used for studies where the model had an outaged OMU generator until such time as OMU system is combined in area 363.

6.3 Steady State BES Assessment for the Near-Term Transmission Planning Horizon

The Planning Assessment in the Near-Term Transmission Planning Horizon will include steady state analysis of the BES based on computer simulation of contingency events¹⁸. The study is performed using computer simulations of planning and extreme events to determine whether the BES meets the performance requirements of TPL-001-4 Table 1¹⁹. The contingency selection for the planning events is discussed in section 7 of this document. The annual Planning Assessment for the Near-Term Transmission Planning Horizon may utilize a qualified past study or a current study to meet the requirements of TPL-001-4. If used, a qualified past study must meet the requirements of TPL-001-4 2.6. Material changes in determination of a qualified past study would include substantial changes to the System represented in the study. If a qualified past study is used, the study reports will be included as attachments in the Planning Assessment report. The Near-Term Transmission Planning Horizon assessment will simulate P1 through P7 planning events and extreme events for BES Facilities using the performance requirements of TPL-001-4 Table 1²⁰. In the event that the Contingency analyzed does not meet the respective performance requirements of TPL-001-4 Table 1 P1 through P7, a Corrective Action Plan(s) will be developed to ensure that the System meets the required performance requirements. The Corrective Action Plan(s) are documented in the Planning Assessment report.

The extreme event analysis for Near-Term Transmission Planning Horizon will use the identification of System instability for conditions such as Cascading, voltage instability, or uncontrolled islanding criteria described in section 9.1. If the extreme event shows potential for System instability, then an evaluation of possible actions designed to reduce the likelihood or mitigate the consequences is conducted and documented in the Extreme Event Report.

6.3.1 Steady State Sensitivity Studies for Near-Term Transmission Planning Horizon

The Near-Term Transmission Planning Horizon portion of the steady state analysis will include an assessment of at least one of the following varying conditions²¹:

- Real and reactive forecasted Load
- Expected transfers not included in the Base Case Models

¹⁸ TPL-001-4 R3

¹⁹ TPL-001-4 3.1

²⁰ TPL-001-4 3.2

²¹ TPL-001-4 2.1.4

- Expected in service dates of new or modified Transmission Facilities that may or may not have all required approvals.
- Reactive resource capability.
- Generation additions that have not yet completed a large generation interconnection agreement and/or anticipated retirement of generation not yet announced.
- Controllable Loads and Demand Side Management (modeled in selected Off-Peak).
- Duration or timing of known Transmission outages (when outages are known to occur in the Near-Term or Long Term Transmission Planning Horizon).

For the sensitivity portion, the Planning Assessment may utilize a qualified past study or a current study to meet the requirements of TPL-001-4. A qualified past study must meet the requirements of TPL-001-4 2.6. Material changes in determination of a qualified past study would include substantial changes to the System represented in the study. If a qualified past study is used, the study reports will be included in the current Planning Assessment report. The Near-Term Transmission Planning Horizon steady state analysis sensitivities described above will include P0, P1 and P3 for non-BES Elements. The Near-Term Transmission Planning Horizon steady state analysis sensitivities will include P0 through P7 and extreme events for BES Facilities. Corrective Action Plan(s) may be developed but are not required in accordance with Requirements TPL-001-4 2.1.4 and 2.4.3.²²

6.3.1.1 Study Impacts

Violations which were not identified in the Base Case Model will be documented in the sensitivity study report.

Violations which were identified in the Base Case Models in the current Planning Assessment are only documented if at least one of the following conditions are met:

- The overload on a Facility increases by 1% or more when compared to the overload identified in the Base Case Models for the same contingency(ies)
- The voltage of a Facility increases a high voltage violation by 0.5% or decreases a low voltage violation by 0.5% or more when compared to the voltage violation identified in the Base Case Models for the same contingency(ies).

6.3.2 Unavailable Long Lead Item BES Assessment

²² TPL-001-4 2.7

A list of BES Equipment with a lead time of one year or more will be identified from the appropriate LG&E/KU department. One winter On-Peak and one summer On-Peak model in the Near-Term Transmission Planning Horizon is developed that model the BES transformers out of service that do not have a spare. Example, if there are three BES transformers that do not have spares, then six additional models are developed, one for each of the three transformers out of service for winter and summer. Other equipment with long lead times and no spares will be included, if such exist. A steady state assessment is performed on these unavailable spare transformer models for TPL-001-4 Table 1 Categories P0, P1 and P2²³. The impact of this possible unavailability of certain equipment on System performance shall be studied as a portion of the Near-Term Transmission Planning Horizon Planning Assessment. The result of the analysis of potential unavailable equipment is included in the Planning Assessment report. Corrective Action Plans will be developed, if performance requirement violations are identified.

6.4 Steady State BES Assessment for Long-Term Transmission Planning Horizon

The Planning Assessment in the Long-Term Transmission Planning Horizon will include steady state analysis of the BES based on a computer simulation of contingency events²⁴. The study is performed using a computer simulation of planning and extreme events to determine whether the BES meets the performance requirements of TPL-001-4 Table 1²⁵. The contingency selection for the planning events is described in section 7 of this document. ²⁶The annual Planning Assessment for the Long-Term Transmission Planning Horizon may be supported by a current study and supplemented with a qualified past study to meet the performance requirements of TPL-001-4. At least one winter On-Peak, one Off-Peak and one summer On-Peak steady state models will be developed for the Long-Term Transmission Planning Horizon. These models are used to simulate P1 through P7 planning events and extreme events for BES Facilities using the performance requirements of TPL-001-4 Table 1²⁷. In the event that the Contingency analyzed does not meet the respective performance requirements of TPL-001-4 Table 1 P1 through P7, a Corrective Action Plan(s) will be developed to ensure that the System meets the required performance requirements. The Corrective Action Plan(s) are documented in the Planning Assessment report.

The extreme event analysis for Long-Term Transmission Planning Horizon will use the identification of System instability for conditions such as Cascading, voltage instability, or uncontrolled islanding criteria described in section 9. If the extreme event shows potential for System instability, then an evaluation of possible actions designed to reduce the likelihood or mitigate the consequences is conducted and documented in the Extreme Event report which is a portion of the Planning Assessment report.

²³ TPL-001-4 2.1.5

²⁴ TPL-001-4 R3

²⁵ TPL-001-4 3.1

²⁶ TPL-001-4 2.2

²⁷ TPL-001-4 3.2

6.5 Steady State NITS Capacity Assessment

The NITS Capacity for all units in the LG&E/KU System will be represented in at least one of the models discussed in Section 5.11. To test the NITS capacity of each plant site, generation dispatch Scenarios in which individual plant sites are maximized to their NITS capacity plus firm point to point levels will be developed. These dispatch Scenarios will be tested with the transmission system intact against normal facility ratings, and with a transmission outage (P1) against emergency facility ratings. The NITS Capacity for generation is tested in the annual Planning Assessment and will not be treated as a separate sensitivity study.

6.6 Short Circuit Analysis

The short circuit analysis portion of the Planning Assessment shall be conducted annually utilizing one model in the Near-Term Transmission Planning Horizon and one model in the Long-Term Transmission Planning Horizon²⁸. The short circuit analysis may utilize a qualified past study or a current study to meet the requirements of TPL-001-4. A qualified past study must meet the requirements of TPL-001-4 2.6. Material changes in determination of a qualified past study would include substantial changes to the System represented in the study. If a qualified past study reports is used, the study reports will be included in the current year's Planning Assessment report.

The interrupting requirements of LG&E/KU circuit breakers must remain within circuit breaker interrupting capabilities. LG&E/KU calculates circuit breaker interrupting duty utilizing a recognized industry standard software application for short circuit analysis. The software calculates the breaking currents using procedures recommended by ANSI/IEEE.

Breaker duty studies are performed with all Transmission Facilities, and all generators in service. Studies are performed on the Transmission System in its current topology at least annually, and internal ad hoc studies are performed as necessary to determine short circuit impacts of projects under consideration. For ad hoc studies, the model will be modified to simulate as accurately as possible the Transmission System configuration when the project is expected to go into service.

In service circuit breakers with fault duties in excess of interrupting capabilities will have a TEP project for breaker replacement. The project schedule will follow the rules of TEP project schedule considering lead times necessary to complete breaker replacements. When the scheduled date is beyond the need date for a breaker replacement, the first Corrective Action Plan tested will be to disable automatic reclosing. If the breaker duty still exceeds the breaker interrupting capability additional Corrective Action Plan measures will be tested. A Corrective Action Plan which mitigates all criteria violations

²⁸ TPL-001-4 2.8

will be documented in the Planning Assessment report. The Planning Assessment report will list short circuit study deficiencies and the associated actions needed to achieve the required System performance²⁹. The TEP projects identified in the short circuit analysis will include a list of breaker replacements required so as not to overload the breaker duty rating. The list of breaker replacements will be reviewed in subsequent annual Planning Assessments for continued validity and implementation status of identified System Facilities and Operating Procedures³⁰.

6.7 Near Term Transmission Planning Horizon Stability BES Assessment

Per TPL-001-4 R4, the Near-Term Transmission Planning Horizon Stability Planning Assessment will only be analyzed for BES Facility disturbances. Only BES Facilities will be monitored for the performance requirements of TPL-001-4. The Stability Planning Assessment will include TPL-001-4 P1 through P7 planning events and extreme events³¹. For the Stability portion of the Planning Assessment, the Near-Term Transmission Planning Horizon may utilize a qualified past study, five calendar years old or less, or a current study to meet the requirements of TPL-001-4. A qualified past study must meet the requirements of TPL-001-4 2.6. Material changes in determination of a qualified past study would include substantial changes to the System represented in the study. If a qualified past study is used, the study reports will be copied in the Planning Assessment report. Documentation to support the technical rationale for determining material changes will also be included in the Planning Assessment.

TPL-001-4 Table 1 P1 through P7 faults on the near-term models shall be analyzed. The respective performance requirements of P1 through P7 will be used as well as the performance requirements of section 8 in these planning guidelines. Where a fault does not pass the respective performance requirements, a Corrective Action Plan will be developed to ensure the problem is mitigated and therefore meeting the performance requirements. The Corrective Action Plan(s) are documented in the Planning Assessment.

Stability analysis will be performed on the following models:

- At least one near-term Off-Peak Load model³²
- At least one near-term On-Peak Load model

These models will represent the expected dynamic behavior of Loads that could impact the study area, considering the behavior of induction motor Loads³³. The model uses an aggregate System Load model which represents the overall dynamic behavior of the Load.

²⁹ TPL-001-4 2.8.1

³⁰ TPL-001-4 2.8.2

³¹ TPL-001-4 4.1 and 4.2

³² TPL-001-4 2.4.2

³³ TPL-001-4 2.4.1

6.7.1 BES Stability Sensitivity Studies for Near-Term Transmission Planning Horizon

The annual assessment for the Near-Term Transmission Planning Horizon portion of the Stability analysis shall be performed for at least one of the following varying conditions³⁴:

- Load level, Load forecast, or dynamic Load model assumptions
- Expected transfers not previously included in the stability models
- Expected in service dates of new or modified Transmission Facilities that may or may not have all required approvals.
- Reduced reactive resource capability.
- Generation additions that have not yet completed a large generation interconnection agreement and/or anticipated retirement of generation not yet announced.

For the sensitivity portion, the Planning Assessment may utilize a qualified past study or a current study to meet the requirements of TPL-001-4. A qualified past study must meet the requirements of TPL-001-4 2.6. Material changes in determination of a qualified past study would include substantial changes to the System represented in the study. If a qualified past study is used, the study reports will be copied in the current Planning Assessment report. The near-term Stability analysis sensitivity will include P1 through P7 and extreme events for BES Facilities only. Corrective Action Plan(s) do not need to be developed solely to meet the performance requirements for a single sensitivity study analyzed in accordance with TPL-001-4 2.1.4 and 2.4.1.³⁵ Corrective Action Plan(s) may be developed but are not required in accordance with Requirements TPL-001-4 2.1.4 and 2.4.3.³⁶

6.8 Stability BES Assessment for the Long-Term Transmission Planning Horizon

Per TPL-001-4 R4 the Long-Term Transmission Planning Horizon Stability portion of the Planning Assessment will only be analyzed for BES Facility disturbances. Only BES Facilities will be monitored for the performance requirements of TPL-001-4. If there are proposed material generation additions or changes in the Long-Term Planning Horizon timeframe, the Stability analysis portion of the Long-Term Transmission Planning

³⁴ TPL-001-4 2.4.3

³⁵ TPL-001-4 2.7

³⁶ TPL-001-4 2.7

Horizon will be analyzed on at least one model. If there are no proposed material generation additions or changes in the Long-Term Transmission Planning Horizon, a Stability assessment will not be performed in that time frame. The Stability assessment may utilize a qualified past study or a current study to meet the requirements of TPL-001-4. A qualified past study must meet the requirements of TPL-001-4 2.6. Material changes in determination of a qualified past study would include substantial changes to the System represented in the study.³⁷ The material changes may or may not include proposed generation that does not have a signed large generation interconnection agreement. The long-term model will include proposed transmission Elements and Facilities. The Stability analysis will include TPL-001-4 Table 1 P1-P7 and extreme events. Where analysis does not pass the performance requirements of TPL-001-4 Table 1 P1 through P7, a Corrective Action Plan will be developed to ensure the problem is mitigated meeting the performance requirements. Additionally, extreme event analysis will be performed using the criteria detailed in the Identification of Instability for Dynamics Simulations section below. If the extreme event shows a potential for System instability, then an evaluation of possible actions designed to reduce the likelihood or mitigate the consequences is conducted and documented in the Extreme Event Report.

6.9 Other Studies

The study Scenarios described in sections 6.3.1 (Steady State Sensitivity Studies for Near-Term Transmission Planning Horizon) and 6.7.1 (BES Stability Sensitivity Studies for Near-Term Transmission Planning Horizon) are performed on models for the Near-Term Transmission Planning Horizon only. There are other studies, described below, performed on both the Near-Term Transmission Planning Horizon and the Long-Term Transmission Planning Horizon models. Impacts will be identified in these studies through the process described in section 6.1 (Study Impacts). The studies could include, but are not limited to:

- **TSR Study:** This study ensures that confirmed firm TSRs can be served by the LG&E/KU Transmission System. Only steady state analysis for P0, P1, P2 (EHV only), P3, P4 (EHV only) category events are simulated. Corrective Action Plans will be developed for criteria violations identified on the LG&E/KU Transmission System. This will include operating guides for criteria violations associated with TSRs with a contract period of less than five years. The following criteria applies for export and import TSRs:
 - **Export Scenarios:** Confirmed firm export TSRs that were not included at the maximum level in the Base Case Models are modeled in the appropriate time frame. The TSRs must be firm and have a contract period of at least one year. Confirmed firm import point-to-point TSRs modeled in the Base Case Models will be removed in this Scenario. TSRs linked to DNR resources utilized to serve LSE load on the LG&E/KU Transmission

³⁷ TPL-001-4 2.6

system will only be re-dispatched if a single generator outage would remove the full DNR resource.

- Import Scenarios: Confirmed firm import TSRs that were not included at the maximum level in the Base Case Models are modeled in the appropriate time frame. The TSRs must be firm and have a contract period of at least one year. Confirmed firm export point-to-point TSRs modeled in the Base Case Models will be removed in this Scenario.

7 Contingencies

The contingencies of TPL-001-4 Table 1 P1 through P7 and extreme events simulated for the assessment will only include those that are expected to produce more severe System impacts on the LG&E/KU portion of the BES³⁸. The list of Contingencies being simulated is included in appropriate Planning Assessment report.

Category P1-5, P3-5, P6-4, and P7-2 refer to HVDC outages. There are no HVDC lines within or near the LG&E/KU BA that affect the LG&E/KU System. The Planning Assessment does not evaluate HVDC contingencies and no P1-5, P3-5, P6-4, or P7-2 contingencies are simulated in either the steady state or Stability analyses.

7.1 Contingency List Coordination

Per TPL-001-4 3.4.1 and 4.4.1, LG&E/KU TP will coordinate with adjacent PCs and TPs to ensure that Contingencies on adjacent Systems which may impact the LG&E/KU System are included in the Contingency list. The LG&E/KU BES Contingency list will be shared with the LG&E/KU neighbor TP with a request for the neighbor TP to recommend contingencies in its System that should also be evaluated in the LG&E/KU Planning Assessment. All contingencies recommended by neighboring TPs and/or PCs will be assessed for inclusion in the LG&E/KU Contingency list for evaluation in the LG&E/KU annual Planning Assessment.

7.2 Generation Replacement Scenarios

To maintain the capability to serve native load after loss of a generator, for an LG&E/KU generator owner outage greater than 50 MW, replacement generation shall be simulated from the most restrictive combination of internal resources, Tennessee Valley Authority (TVA), Midcontinent Independent System Operator (MISO) or PJM. Generator contingencies are selected that produce the most severe System impacts on the BES and may be used to limit the number of generator outage and replacement generation Scenarios, such as the largest unit per plant, or BES voltage connection point.

³⁸ TPL-001-4 3.4

For non LG&E/KU owned generator unit outages greater than 50 MW connected to the LG&E/KU transmission system, replacement generation to cover non LG&E/KU load will be simulated from TVA, MISO or PJM whichever is the most restrictive. Generator contingencies are selected that produce the most severe System impacts on the BES and may be used to limit the number of generator outages, such as the largest unit per plant, or BES voltage connection.

For non-affiliate generator units, posted as DNRs on OASIS, and not connected to the LG&E/KU transmission system, replacement generation to cover non LG&E/KU load served from the LG&E/KU system will be simulated from other associated DNRs as available, and replacement generation to cover non LG&E/KU load will be simulated from TVA, MISO or PJM whichever is the most restrictive unless customer discussions indicate that some of these Scenarios are not needed. If replacement generation is not available in a specific model, the dispatches will not be simulated.

For generator outages greater than 50 MW and not connected to the LG&E/KU transmission system replacement generation will be simulated from an area on the opposite side of the generating unit area from the LG&E/KU system. Generator contingencies are selected that produce the most severe System impacts on the BES and may be used to limit the number of generator outages, such as the largest unit per plant, per BES voltage connection.

In addition to LG&E/KU generator unit outages with replacement power as described above, analysis will consider certain dispatch Scenarios with replacement from plants simulating maximum output level at the replacement site. Valid Scenarios will be outages of single units greater than 200 MW, with replacement power sourced by maximizing the output at either Trimble County or Brown. In some off-peak models (e.g. light load), plant sites that include higher cost peaking units may not be maximized since, by definition, peaking units typically only run during peak load Scenarios. However, maximization Scenarios required to test that NITS capacity rights are deliverable will be included. If the site chosen for replacement power has inadequate available resources (i.e. less than the outaged unit), that particular Scenario is not valid. Any excess created by maximizing plant output, after netting with the outaged unit, will be offset by proportionally reducing all other LG&E/KU units not directly involved. Generator contingencies are selected that produce the most severe System impacts on the BES and may be used to limit the number of generator outages, such as the largest unit per plant per BES voltage connection.

7.3 Automatic Control Inclusion

³⁹The simulated contingencies must remove all elements that the Protection System and other automatic controls are expected to disconnect for each Contingency without operator intervention.

³⁹ TPL-001-4 3.3.1 & 4.3.1

The LG&E/KU System does not currently have any Special Protection Systems. Simulations of Protection System responses during a fault or Contingency are analyzed with that Contingency. The LG&E/KU BA does not have any generation tripping or run back scheme other than what would be tripped as a result of clearing a fault. If generation is tripped as a result of fault clearing, then that tripping scheme will be studied as part of the Contingency analyzed.

Per TPL-001-4 3.3.1.1, LG&E/KU will build a project to ensure that generators do not trip due to low voltage on the generator bus after a P1 or P3 planning event. The minimum generator steady state or ride through voltage limit is 0.95 pu at the generator bus. Tripping of generators will be included in the simulation by running the simulation manually if the screen result indicates the generator bus voltage falls below 0.95 pu for a P2, P4 through P7 and extreme events.

7.3.1 Steady State Automatic Control Inclusion

If the results of the steady state analysis show an overload of Facility (ies), prior to loss of load if allowed by TPL-001-4 Table 1, a verification of the relay loadability values is completed. Verification is done via the CASCADE database or through communication with the Protection department. If the MVA flow on a BES Facility exceeds the relay loadability setting, the steady state simulation will include the outage of that Facility that exceeds the relay loadability setting.

The LG&E/KU transmission System does not contain any phase-shifting transformers. There are switched capacitors on the LG&E/KU transmission System and those facilities are modeled with the voltage levels at which they are switched on and off⁴⁰. Transmission capacitor status (on/off) are simulated consistent with automatic voltage control (on/off) settings and operating practice during normal transmission System conditions. Therefore, when the solution of the power flow analysis has capacitor bank switching enabled, the automatic switching of capacitor banks are simulated. .

7.3.2 Stability Assessment Protection System Inclusion

Per TPL-001-4 4.3.1.1 the Stability simulation will include successful high speed (less than one second) reclosing and unsuccessful high speed reclosing into a Fault where high speed reclosing is utilized.

Per TPL-001-4 4.3.1.2 the Stability simulations will include the tripping of generators where simulations show generator bus voltages or high side of the GSU voltages are less than known or assumed generator low voltage ride through capability. If assumptions are made they will be included in the Planning Assessment report.

⁴⁰ TPL-001-4 3.3.2

7.4 Load Restoration and Switching Procedure.

During breaker to breaker outages, some Consequential Load loss is possible. The simulation of the load restoration and switching procedure is performed as part of the Planning Assessment. Post-fault conditions and conditions after load restoration, switching, or transmission reconfiguration should be evaluated. Post-Contingency operator-initiated actions to restore load service are simulated. Post-contingency operator-initiated actions including switching may be simulated to reduce the flow through transformers or increase voltages but not to reduce line flows. Load that is off-line as a result of the Contingency (consequential load loss) being evaluated may be switched to alternate sources during the restoration assessment, but load is not taken off-line to perform switching.

7.5 Steady State Planning Events

The steady state Planning Assessment studies are performed based on a Contingency list created to meet requirements of TPL-001-4 R3. The Contingency list includes those planning events in TPL-001-4 Table 1 that are expected to produce more severe System impacts on its portion of the BES. Since the Contingency list that produces the most severe events may vary year to year of the planning assessment, the Contingency list will be documented in the Planning Assessment. This section of the Planning Guidelines will document the methodology used to develop the Contingency list which will produce the most severe System impacts.

The Extreme Event Report will also list those contingencies analyzed and expected to produce more severe System impacts. The extreme event analysis may utilize a qualified past study or a current study to meet the requirements of TPL-001-4. A qualified past study must meet the requirements of TPL-001-4 2.6. Material changes in determination of a qualified past study would include substantial changes to the System represented in the study.

7.5.1 TPL-001-4 Table 1 Category P1 Contingency Selection

TPL-001-4 Table 1 Category P1 is single contingencies including loss of generator, transmission circuit, transformer, or shunt device. The LG&E/KU Planning Assessment includes all single transmission circuits and transformers that are operated at 69 kV (secondary voltage) and above. In order to achieve the removal of all elements that the Protection System and other automatic controls are expected to disconnect for each Contingency without operator intervention all breaker to breaker contingencies for transmission circuits and transformers are simulated for Category P1 events⁴¹.

The single generator Contingency (ies), includes single generator units connected to the LG&E/KU System and simulates an outage of the largest generator at each transmission bus. The largest generator at a bus is considered to produce more severe System impacts

⁴¹ TPL-001-4 3.3.1

than smaller units connected to the same bus. Similarly, single generator contingencies not connected to the LG&E/KU System, but that are in close proximity are also simulated by taking the outage of only the largest unit at a plant site.

7.5.2 TPL-001-4 Table 1 Category P2 Contingency Selection

- Opening a line section without a fault: All line section outages of BES Facilities will be simulated to ensure the performance requirements of TPL-001-4 Table 1.
- Bus Section Fault: Many LGE&E/KU BES substations are designed with a breaker and a half or ring bus design. A bus section fault for a ring bus results in the same Contingency as P1, while a bus section fault of a breaker and a half design results in no transmission circuit outage or a P1 outage depending on the location of the bus. Therefore, the only Bus Section Faults analyzed for Category P2 are the BES buses that have a straight bus design. All BES Facilities in a straight bus configuration are simulated for Category P2-2.
- Internal Breaker Fault (non-Bus-tie Breaker): An internal breaker fault means a breaker failing internally, thus creating a System fault which must be cleared by protection on both sides of the breaker. An internal breaker fault on a ring bus design is a double Contingency of the two Facilities that share a breaker in the ring. An internal breaker fault on a breaker in a breaker and a half design, results in a double Contingency of the two Facilities that share a breaker in the same bay. Therefore the internal fault contingencies simulated are those double contingencies for BES Facilities that share a breaker for either a ring bus or breaker and a half design. An internal breaker fault for a breaker on a straight bus will be simulated when the fault causes more than just a disconnected bus, like an internal breaker fault where the breaker protects a three terminal line.
- Internal Breaker Fault (Bus-Tie Breaker): An internal breaker fault means a breaker failing internally, thus creating a System fault which must be cleared by protection on both sides of the breaker. This contingency results in opening all breakers connected to both buses connected by the bus-tie breaker. All of the internal breaker faults for bus-tie breakers are simulated.

7.5.3 TPL-001-4 Table 1 Category P3 Contingency Selection

Category P3 includes the loss of a single generator unit, as described in section 7.5.1, followed by system adjustments. After system adjustments, all P1 contingencies are simulated. This includes generator, transmission circuit, transformer, and shunt device contingencies. For P3 events, LG&E/KU runs all single contingencies of 69 kV and above combined with a Generator Replacement Scenarios described in section 7.2. LG&E/KU also runs combinations of two generator outages.

7.5.4 TPL-001-4 Table 1 Category P4 Contingency Selection

Category P4 contingencies in steady state are multiple contingencies caused by a stuck breaker or relay failure where backup clearing is required to clear a fault.

7.5.5 TPL-001-4 Table 1 Category P5 Contingency Selection

The contingencies for TPL-001-4 Table 1 Category P5 are simulated using Stability results from the previous year's Planning Assessment. The Stability analysis identifies which breakers will open for a category P5 event. The contingency selection is determined by the Stability analysis described in Section 7.7.2 for P5 events. If the Stability results for the current year's Planning Assessment identifies additional breakers to open for a specific P5 event then the steady state analysis will be reviewed to determine if there are additional results to analyze.

7.5.6 TPL-001-4 Table 1 Category P6 Contingency Selection

The following are criteria for contingencies selected of Category P6 that produce more severe System results or impacts. All tested BES contingencies are analyzed to determine impacts on BES Facilities remaining in-service. When a BES Contingency shows an impact on any BES Facility remaining in-service, that Contingency will be paired with any other BES Contingency that impacts the same in-service BES Facility. Category P6 contingencies include transmission circuit, transformer, and shunt devices. LG&E/KU does not currently have any shunt devices on the BES, but if/when any are installed, they will be added to the contingency list.

The contingencies selected that produce the most severe results in steady state are not always the same as those selected for Stability analysis. LG&E/KU's Contingency Selection Criteria describes the rationale for Contingency selection that is consistent with TPL-001-4 R3 and is considered to produce more severe System results or impacts.

7.5.7 TPL-001-4 Table 1 Category P7 Contingency Selection

LG&E/KU maintains a list of adjacent circuits greater than one mile in length that reside on a common structure. Loss of all BES double circuit Facilities that reside on a common structure are simulated for Category P7.

7.6 Steady State Extreme Events

LG&E/KU simulates the System performance for extreme events in TPL-001-4 Table 1 extreme events. The extreme events are selected that are expected to produce more severe System impacts. When LG&E/KU evaluates in steady state the performance of Category P6, there are no System adjustments after the first Contingency. Therefore, the

P6 planning event is the same as the extreme event steady state part 1. The extreme events that are simulating in the TPL performance assessment include:

- Loss of a tower line that has three or more BES circuits when the common structure lines are more than one mile in length.
- Loss of all BES transmission lines on a common Right-of-Way when the common right of way is longer than one mile in length.
- Loss of a substation (one BES voltage level plus transformers) which are analyzed in the Planning Assessment process. A list of substations selected for this extreme event using will be included in the Planning Assessment report.
- Loss of all generating units at a station which is analyzed in the Planning Assessment process includes only the largest generation sites greater than 500 MW total generation capability in the LG&E/KU System.
- Loss of a large load or major load center which is analyzed in the Planning Assessment process includes tripping the load from the LG&E/KU largest single customers. This also includes large municipal loads.
- Loss of all gas-fired generation (two plants) served by a common large gas pipeline.
- Loss of two large generating stations in close proximity due to severe weather (e.g. tornado)

7.7 Stability Planning Events

The Stability portion of the Planning Assessment shall be performed for planning events to meet performance requirements in TPL-001-4 Table 1. The Stability portion of the Planning Assessment will only do analysis of disturbances on BES Facilities. The Stability analysis shall use a current or qualified past study per TPL-001-4 2.6.

7.7.1 Category P1 Stability Disturbances Analyzed

Category P1 disturbances are selected to comply with NERC reliability standards including faults on generators, Transmission Circuits, and Transformers. Three phase faults with normal clearing (assumed six cycles) are initially analyzed for breaker to breaker BES Facilities in the stability model. A clearing time of six cycles is a worst case assumed clearing time. In the event that a Category P1 disturbance does not meet the performance requirements of TPL-001-4 Table 1, the Protection group is contacted to acquire the actual clearing time. The disturbance is re-simulated with the actual clearing time.

7.7.2 Categories P2 through P7 Stability Disturbances Analyzed

TPL-001-4 Table 1 Categories P2 through P7 disturbances are selected such that only the disturbances that produce the more severe System results or impacts are analyzed.⁴²

Categories P4-P7 Stability disturbances may not be analyzed annually. A past study can be used per TPL-001-4 2.6 if there has not been a material change. Material changes in determination of a qualified past study would include substantial changes to the System represented in the study. When a past study is used, a new study would be required a minimum once every five years.

Opening a line section, generator, transformer or shunt device without a fault: These disturbances are less severe to the BES compared to simulating a fault and then opening the line section, generator, transformer or shunt device in order to clear a fault (P1). The FAC-010 standard requires these contingencies. P1 faults that fail to meet the criteria set forth in these Planning Guidelines will be tested per the FAC-010 standard.

Bus Fault Contingency Selection: Bus faults are selected on buses which are generation points of interconnection except those that are interconnected in a breaker and a half design or ring bus design. The breaker and a half and ring bus schemes are designed for more reliable operation of a bus section disturbance. So faults on a breaker and a half scheme and ring bus are considered less severe. Disturbances are analyzed for straight bus designs.

Internal breaker faults: Internal breaker three phase faults are analyzed instead of the less severe single line to ground fault. These are analyzed on breakers considered to be more critical as documented in the Planning Assessment report. The breaker and a half and ring bus schemes are designed for more reliable operation of a bus section disturbance. So faults on a breaker and a half scheme and ring bus are considered less severe. Therefore, internal breaker faults are analyzed for straight bus designs. Three phase faults are initially analyzed and if performance requirements are not met, then the less severe single line to ground fault is studied. Breakers are selected for internal fault or breaker failure, relay failure disturbances for Categories P2, P4 and P5 which are considered to produce the most severe results or impacts to the reliable operation of the BES.

Category P3 starts with loss of a generator followed by “manual System adjustments” or replacement of the generation by another available source. Then a selected list of worst case BES Category P1 disturbances including breaker to breaker contingencies are analyzed on the generator outage model. The list includes faults one bus away from high side of the BES generators.

Category P4 and P5 Contingency Selection: For Category P4 and P5 three phase faults with a delayed clearing of 20 cycles, or worst case assumption, are analyzed on specific breakers. A more severe three phase fault is initially analyzed. If the three phase fault does not meet the performance requirements for P4 and P5, then the less severe single line to ground fault is analyzed. The stuck breakers selected are those that are expected

⁴² TPL-001-4 4.4

to produce the most severe System results or impacts. In the event that a three phase fault with delayed clearing fails the performance requirements of TPL-001-4 Table 1, the Protection group is contacted to acquire the actual clearing times. The event is then re-simulated with the actual clearing times and using a single line to ground fault instead of a three phase fault. This analysis satisfies the requirements of P4, P5 and when required, extreme events. For P5 on a fault plus relay failure to operate, contingencies are selected based on selection criteria from FERC Order 754.

Category P6 Contingency Selection: The n-2 BES contingencies are selected which produce the more severe System impacts of the BES. The rationale used to determine the more severe n-2 contingencies will be documented in the Planning Assessment report. The simulation uses a prior outage model followed by manual adjustments. Those manual adjustments can include generation re-dispatch, loss of firm transmission service and non-consequential load loss. Then after these adjustments, three phase faults are analyzed using the same faults as selected for P1 contingencies. The list of prior outages used as the initial condition is documented in the Planning Assessment report.

Category P7 Contingency Selection: LG&E/KU maintains a list of BES transmission lines that are on common towers of greater than one mile in distance. Category P7 disturbances are analyzed by introducing a three phase fault on both lines of the common tower line at the same time with the appropriate clearing time for each line. The normal clearing and reclosing time (if high speed reclosed in less than one second) is simulated. For the common tower P7 disturbance, there are no manual System adjustments after one Contingency. The analysis is performed using two faults occurring at the same time in the Stability analysis.

7.8 Stability Extreme Event Assessment

The Stability portion of the Planning Assessment will perform studies to assess the impact of the extreme events of TPL-001-4 Table 1⁴³. The events selected for evaluation are those that are expected to produce more severe System impacts. This section describes the rationale for the Contingencies selected for Stability extreme events. If the Stability portion of the Planning Assessment for extreme events concludes there is instability (see section 9) caused by the occurrence of extreme events, an evaluation of possible action designed to reduce the likelihood or mitigate the consequences of the event will be conducted. This evaluation will be documented in the Extreme Event Report.

Protection Systems, including planned backup or redundant Systems, are accounted for in the analysis of breaker failure, internal fault of a breaker with delayed clearing contingencies. Redundant protection Systems may be a mitigating project when delayed clearing contingencies do not meet the performance requirements of the reliability standards.

⁴³ TPL-001-4 4.5

Extreme Event Contingency Selection: Extreme events that are expected to produce more severe System impacts will be identified. These extreme events are a three phase fault on large generators, transmission circuits above 300 kV, transformers with high side above 300 kV, straight line bus sections followed by a stuck breaker, or relay failure resulting in delayed clearing. These disturbances are analyzed during the analysis for Categories P5 and P6 planning events. If the results of the P5 and P6 analysis do not meet the performance requirements P5 and P6 of TPL-001-4 Table 1, then the less severe single line to ground fault is analyzed. The performance of the three phase fault is then checked for potential instability (see section 9.2). The stuck breaker list for P5 and P6 contingencies are breakers that are located at BES buses that are also generator points of interconnection at sites with more than 500 MW of total generation capacity. Additionally, other non-generation point interconnection BES buses are included in the stuck breaker selection for Category P5 and P6 disturbances using the stuck breaker contingencies that will produce the more severe System impacts on the BES.

The selection of buses for analysis of the extreme event for a three phase fault on a bus with a stuck breaker analyzes those buses which are a generation point of interconnection except those that are interconnected in a breaker and a half scheme. The breaker and a half scheme is designed for more reliable operation of a bus section disturbance. So faults on a breaker and a half scheme are considered less severe.

The extreme event or three phase internal fault on a breaker is analyzed for the Category P2 less severe planning event using performance requirement for P2 of TPL-001-4 Table 1. If the performance requirements for the planning event are met, no additional work is required, since both the planning and extreme event pass the performance requirements of the planning event. If the extreme event does not pass the performance requirements of the planning event, the less severe single line to ground fault is simulated. The extreme event is then checked for potential instability (see section 9). Breakers are selected for internal fault and breaker failure disturbances, Category P2 which are considered to produce the most severe results or impacts to the reliable operation of the BES. The breakers selected for P2 contingencies are located at BES buses that are also generator points of interconnection at sites with more than 500 MW of total generation capacity. Additionally, other non-generation point of interconnection BES buses are included in the breaker selection for P2 disturbances using bus contingencies that will produce the more severe System impacts on the BES.

8 Performance Requirements

This section documents acceptable System steady state voltage limits, thermal limits, and the transient Stability performance requirements for the LG&E/KU System⁴⁴. Additionally performance requirements for P0 through P7 and extreme events described in TPL-001-4 Table 1 are included in the Planning Assessment report.

⁴⁴ TPL-001-4 R5

Specific criteria for P1 planning events will be tested for TPL-001-4 4.1.1; P2 through P7 performance requirements in 4.1.2 and P1 through P7 performance requirements in 4.1.3.

8.1 Special Protection System

The LG&E/KU does not currently own or operate any Special Protection System (SPS) or Remedial Action Scheme in order to comply with the TPL Standards or these Planning Guidelines. Neither SPSs nor remedial action schemes should be considered when developing the Corrective Action Plan(s).

8.2 Steady State Voltage Performance Criteria

Per TPL-001-4 R5, the following is the steady state voltage criteria: A steady state System voltage violation will occur when the percent nominal voltage, rounded to one decimal place, is outside the applicable performance requirements.

The following are detailed voltage criteria for each of the TPL-001-4 Table 1 Categories.

1. Category P0 with all Elements and Facilities in service, the LG&E/KU Elements and Facilities of 69 kV and above shall perform within the following:
 - The minimum acceptable voltage criteria for Facilities of 69 kV (load serving buses) and above are .94 pu of their nominal value. The maximum voltage criteria of any 500 kV System bus should not exceed 1.10 pu of the nominal value. All other transmission Elements and Facilities 69 kV to 345 kV should not exceed 105 percent of the nominal value.
2. Category P1 and P3 voltage criteria:
 - The minimum acceptable voltage criteria for Elements 69 kV (load serving buses) and above are 0.90 pu of their nominal value. The maximum voltage criteria of any 500 kV System bus should not exceed 1.10 pu of the nominal value. All other transmission Elements and Facilities 69 kV to 345 kV should not exceed 1.05 pu of the nominal value.
 - The minimum generator steady state or ride through voltage limit is 0.95 pu at the generator bus after a P1 or P3 planning event⁴⁵.
 - Load shed using TPL-001-4 footnote 12 is not used as a mitigation for P1 and P3 planning events.

3. Category P2, P4 through P7: Additional criteria for P2, P4 through P7 events which limit how much Non-Consequential Load Loss can be shed in order to meet the performance requirements of TPL-001-4 Table 1.
 - Where Non-Consequential Load Loss is allowed in TPL-001-4 Table 1, maximum load shed of ten percent of the LG&E/KU Balancing Area load as modeled for P2, and P7 planning events; maximum load shed of five percent for P4, P5 and P6
 - Interruption of Firm Transmission Service when permitted by TPL-001-4 HV.
 - After allowed Non-Consequential Load Loss and interruption of Firm Transmission Service, the minimum acceptable voltage criteria for BES Facilities is 0.9 pu of their nominal value. The maximum voltage criteria of any 500 kV System bus should not exceed 1.10 pu of the nominal value. All other BES Facilities below 500 kV should not exceed 105 percent of the nominal value.
 - Load shed using TPL-001-4 footnote 12 is not used as a mitigation for P2, P4 through P7 planning events.
4. Steady state extreme events: Extreme events are only checked against the criteria in section 9.1 of these planning guidelines.

8.2.1 Steady State Thermal Facilities Limits

The applicable Facility Rating for TPL-001-4 Table 1 Category P0 is the seasonal normal Facility Rating. The applicable Facility Rating for TPL-001-4 Table 1 Categories P1 through P7 is the seasonal emergency rating. The recorded circuit flow will be the maximum MVA flow of either end. The recorded transformer flow on two-winding transformers will be the “design output” flow where step-down transformers will be measured at the low-voltage side and System tie transformers will be measured on the side where the MW flow exits the transformer. The loading of GSU transformers and all other equipment attached to and associated with generators are the responsibility of the generator owner; therefore they will not be monitored as part of the transmission planning assessment.

8.3 Transient Stability Performance Requirements

Transient Stability studies shall be performed to meet TPL-001-4 Table 1 performance requirements. The System must remain stable per identification of System instability per Section 9 for TPL-001-4 Table 1 Categories P1 through P7 events. It is important to note that this criterion is applied when using an Inductive Motor Load model.

8.3.1 Angular Stability

The angular Stability criteria for a generator are defined as: a generator rotor angle must remain less than 180 degrees with respect to the relative angle. LG&E/KU chooses the TVA's Brown Ferry, a nuclear unit, as the relative machine.

8.3.2 Damping Criteria

For TPL-001-4 Table 1 Categories P1-P7 Power Oscillations shall exhibit acceptable damping as established by the PC and TP⁴⁶. This damping criteria is: The angular variation of a machine must be tested showing visual damping for a five second run. If the angular variation is not visually damped after the five second run, a 20 second run will be completed. If after the 20 second simulation, the angular variation is still not visually damped, then the System will be determined to be unstable. LG&E/KU examines the Stability plots as part of the Stability analysis.

8.3.3 Voltage Ride Through Criteria

Tripping of a generator will be simulated when the generator bus voltages or high side of the GSU voltages are less than known or assumed generator low voltage ride through capability. The acceptable limit of LG&E/KU BA generator tripping is 3500 MW.

8.3.4 TPL-001-4 Table 1 Categories P1 Generator Synchronism

For TPL-001-4 Table 1 Category P1: No generating unit shall pull out of synchronism. A generator being disconnected from the System by fault clearing action or by a Special Protection System (SPS) is not considered to be pulling out of synchronism⁴⁷. LG&E/KU does not currently have an SPS.

8.3.5 TPL-001-4 Table 1 Categories P2-P7 Generator Synchronism

For TPL-001-4 Table 1 Category P2 through P7: Tripping of generating units will be simulated when the analysis indicates that a unit(s) is pulling out of synchronism. The acceptable limit for total (consequential and non-consequential) generation loss is 3500 MW.

8.3.6 TPL-001-4 Table 1 Categories P1 and P3 Transient Voltage Stability Performance Requirements:

Per TPL-001-4 R5, the following is the transient voltage Stability criteria for P1 and P3 events: LG&E/KU's transmission System voltage must recover to 0.8 p.u. within 4 seconds after the fault is cleared. Generation that trips as a result of low voltage at the auxiliary load bus described in Section 8.3.3 is not a violation of these criteria unless the

⁴⁶ TPL-001-4 4.1.3

⁴⁷ TPL-001-4 4.1.1

criteria in Section 8.3.3 is violated. TPL-001-4 Table 1 Categories P1 and P3 Stability faults must also pass the angular and damping Stability performance requirements described in this section.

8.3.7 TPL-001-4 Table 1 Categories P2, and P4-P7 Transient Voltage Stability Performance Requirements:

Per TPL-001-4 R5, the following is the Stability voltage criteria for P2 and P4-P7 events: These disturbances are less probable and may involve loss of some non-consequential load (when allowed by TPL-001-4) and/or generation tripping within the LG&E/KU control area. Generation that trips as a result of the low voltage at the auxiliary load bus as described in Section 8.3.3 is not a violation of these criteria unless the criteria in Section 8.3.3 is violated. These disturbances must pass the angular and damping Stability performance requirements described in this section. Within 4 seconds after a fault is cleared, there cannot be more than 6 BES substations with voltages less than 0.80 pu.

8.4 Extreme Events Stability Performance Requirements:

Stability disturbances for TPL-001-4 Table 1 extreme events are analyzed for those contingencies that would produce more severe System results or impacts⁴⁸. If the analysis concludes there is potential instability per Section 9.2, caused by the occurrence of the extreme events, an evaluation of the possible actions designed to reduce the likelihood of or mitigate the consequences and adverse impacts of the event(s) will be conducted.

9 System Instability Criteria Methodology

As required by TPL-001-4 R6 this section defines and documents the criteria or methodology used in the analysis to identify System instability for conditions such as Cascading, voltage instability, or uncontrolled islanding. It is the intent of the Planning Assessment to identify potential System instability before that instability actually occurs giving some margin in the assessment. The identification of potential instability in the power System simulation is different between the steady state study and the stability study.

9.1 Identification of Instability for Steady State Simulations

LG&E/KU has considered Cascading, voltage instability and uncontrolled islanding in the steady state power flow analysis, instability could result after one or more of the following occurs:

- Load Loss: Loss of 10% of the LGEE (area 363) load in the appropriate model.

⁴⁸ TPL-001-4 3.5, 4.5

9.2 Identification of Instability for Dynamics Simulations

For purposes of these planning guidelines, LG&E/KU has considered dynamic instability, Cascading, voltage instability, or uncontrolled islanding. For dynamics analysis, instability could result after one or more of the following occurs:

- The event is considered to be uncontrolled if, for a grid event on the LGEE BA, the total non-consequential generation loss is more than one plant located external to the LGEE BA, or if the total (consequential and non-consequential) loss of LGEE BA generation is greater than 3500 MW.
- 4 seconds after a fault is cleared, there exists more than six BES Facilities whose voltages are below 0.8 p.u.
- Violation of damping criteria per Damping Criteria section.

10 Corrective Action Plan(s)

For planning events shown in TPL-001-4 Table 1, when the analysis indicates an inability of the System to meet the performance requirements in TPL-001-4 Table 1, the Planning Assessment shall include Corrective Action Plan(s) addressing how the performance requirements will be met⁴⁹. Revisions to the Corrective Action Plan(s) are allowed in subsequent Planning Assessments but the planned System shall continue to meet the performance requirements of TPL-001-4 Table 1.

Corrective Action Plan(s) may be developed but are not required in accordance with TPL-001-4 2.1.4 and 2.4.3⁵⁰. The Corrective Action Plan(s) is documented in the Planning Assessment report. ⁵¹The Planning Assessment report lists the System deficiencies and the associated actions needed to achieve the required System performance.

Operating Guides may be an acceptable Corrective Action Plan in order to meet the performance requirements if the violation only occurs in the Near-Term Planning Horizon and not in the Long-Term Planning Horizon. Operating guides may include; but not limited to, generation re-dispatch, transmission reconfiguration, Non-Consequential Load Loss, and loss of firm transmission service in accordance with TPL-001-4.

The LG&E/KU Planning Assessment will NOT use Non-Consequential Load Loss when allowed per TPL-001-4 footnote 12 to satisfy the performance requirements of TPL-001-4.

The LG&E/KU BA does not have any automatic generation tripping or run back scheme other than what would be tripped as a result of clearing a fault. If generation is tripped as

⁴⁹ TPL-001-4 2.7

⁵¹ TPL-001-4 2.7.1

a result of the fault clearing, then that tripping will be studied as part of the Contingency analyzed. Automatic generator tripping or automatic generator run-back other than fault clearing should not be considered in the Corrective Action Plan(s).

The LG&E/KU System does have DSM programs, the load forecast supplied by the LSE's contain reductions in load as a result of the DSM programs. Therefore, DSM programs are not utilized in the Corrective Action Plan(s).

The previous years Planning Assessment Corrective Action Plans are reviewed in subsequent annual Planning Assessments for continued validity and implementation status of identified of Systems Facilities or improvements to existing Systems Facilities⁵².

10.1.1 Corrective Action Plan(s) for P0

The Corrective Action Plans for TPL-001-4 Table 1 Category P0 may include:

- Building new transmission Elements and Facilities
- Upgrading existing transmission Elements and Facilities

10.1.2 Corrective Action Plan(s) for P1 and P3

For events of TPL-001-4 Table 1 Categories P1 and P3 which require a Corrective Action Plan in order to meet the performance requirements of Table 1, the Corrective Action Plans may include:

- Building new transmission Elements and Facilities
- Upgrading existing transmission Elements and Facilities
- Switching procedures
- Transmission re-configuration

10.1.3 Corrective Action Plan(s) P2, P4 through P7

For events of TPL-001-4 Table 1 Categories P2, P4 through P7 which require a Corrective Action Plan in order to meet the performance requirements of Table 1, the Corrective Action Plans may include:

- Building new transmission Elements and Facilities
- Upgrading existing transmission Elements and Facilities
- Load Restoration and Switching Procedures (see Section 7.4)
- Generation re-dispatch
- Transmission re-configuration

⁵² TPL-001-4 2.7.4

- Non-Consequential Load Loss where specifically allowed in TPL-001-4 Table 1. However non-consequential load loss allowed per footnote 12 will not be used in the Corrective Action Plan.

10.2 Project Timing

If situations arise that are beyond the control of the TP or PC that prevent the implementation of a Corrective Action Plan in the required timeframe, then the TP or PC is permitted to utilize Non-Consequential Load Loss and curtailment of Firm Transmission Service to correct the situation that would normally not be permitted in TPL-001-4 Table 1, provided that the TP or PC documents that they are taking actions to resolve the situation.⁵³ The TP or PC shall document the situation causing the problem, alternatives evaluated and the use of Non-Consequential Load Loss and curtailment of Firm Transmission Service.

Operating guides are used to document the mitigation steps when a construction project with a need date in the first year of the Planning Horizon (first year of models) is not expected to be completed on time per TPL-001-4 2.7.3. When necessary, an operating guide could include the use of Non-Consequential Load Loss and curtailment of Firm Transmission Service in accordance with TPL-001-4.

The goal of timing projects is to ensure that the project is completed before the loading reaches 100% of the emergency seasonal rating. Due to varying conditions, this may not be possible. Therefore, utilization of TPL-001-4 2.7.3 may be used in the form of an operating guide when studies indicate there is an overload of 100% or more of the seasonal rating.

All existing projects that are not determined to be under construction are reviewed annually to determine if the current timing should be changed.

For P0, P1 and P3 thermal overload of a Facility, the following criteria will be used to determine the needed timing for the Corrective Active Plan to address the issue:

1. The flow on the Facility must be equal to or exceed 100% of the applicable thermal rating of the Facility at the end of the Long-Term Transmission Planning Horizon without the Corrective Action Plan. An issue that does not equal or exceed 100% of the thermal rating of the Facility in the Long-Term Transmission Planning Horizon is not required to have a Corrective Action Plan with one exception. A facility that is overloaded within the Planning Horizon (Near-Term or Long-Term), but not at the end of the Long-Term Planning Horizon is required to have a Corrective Action Plan in the form of a planning level operating guide. This is applicable to Facilities with flows that decrease through time.
2. Corrective Action Plans for new issues will be timed to the year and season when the flow is equal to or exceeds 98% of the applicable thermal rating of the

⁵³ TPL-001-4 2.7.3

Facility. The timing of new projects (construction) will not be any earlier than the first model year of the Planning Assessment. However, the Corrective Action Plan will contain potential actions, if needed, which can be taken to mitigate the identified constraint in the Planning Horizon prior to the expected completion of construction.

3. Existing Corrective Action Plans that had a timing in the previous Planning Assessment will be retimed by the following:
 - a. If the flow on the Facility is less than to 96% of the applicable thermal rating for the timing year and season in the previous Planning Assessment, the Corrective Action Plan will be retimed to the year and season when the flow is equal to or exceeds 98% of the applicable thermal rating of the Facility.
 - b. If the flow on the Facility is equal to or greater than 100% of the applicable thermal rating prior to the timing year and season in the previous Planning Assessment, the Corrective Action Plan will be retimed to the year and season when the flow is equal to or exceeds 98% of the applicable thermal rating of the Facility. The timing of new projects (construction) will not be any earlier than the first model year of the Planning Assessment. However, the Corrective Action Plan will contain potential actions, if needed, which can be taken to mitigate the identified constraint in the Planning Horizon prior to the expected completion of construction.
 - c. If the flow on the Facility is equal to or greater than 96% and less than 100% of the applicable thermal rating for the timing year and season in the previous Planning Assessment, the timing of the Corrective Action Plan will remain the same as the previous Planning Assessment. Facilities that do not exceed the applicable thermal rating in the Long-Term Planning Horizon will have their Corrective Action Plan delayed beyond the Long-Term Planning Horizon.

Voltage performance driven projects will be timed with a need date based on the performance criteria of section 8. There will not be a timing date associated with these projects.

Until January 1, 2021, Corrective Action Plans applying to the following Categories of Contingencies and events identified in the TPL-001-4, Table 1 are allowed to include Non-Consequential Load Loss and curtailment of Firm Transmission Service (in accordance with Requirement R2, Part 2.7.3) that would not otherwise be permitted by the requirement of TPL-001-4:.

- P1-2 (for controlled interruption of electric supply to local network customers connected to or supplied by the Faulted element)
- P1-3 (for controlled interruption of electric supply to local network customers connected to or supplied by the Faulted element)
- P2-1
- P2-2 (above 300 kV)

- P2-3 (above 300 kV)
- P3-1 through P3-5
- P4-1 through P4-5 (above 300 kV)
- P5 (above 300 kV)

11 Responsibility Coordination TPL-001-4 R7

Each PC, in conjunction with the TP, shall determine and identify each entity's individual and joint responsibilities for performing the required studies for the Planning Assessment. LG&E/KU is registered as a PC and TP. LG&E/KU is not a member of a Reliability Transmission Organization (RTO). The LG&E/KU PC area consists only of the LG&E/KU Transmission Owned Facilities. All responsibilities for the studies required by TPL-001-4 and the Planning Assessment are the sole responsibility of the LG&E/KU Transmission Planning.

The required studies are performed in two parts. Part 1, the Planning Assessment uses the study results for planning events (TPL-001-4 Table 1 P0 through P7) and corresponding Corrective Action Plan(s) to demonstrate compliance with TPL-001-4 planning events. The annual Planning Assessment may utilize a qualified past study when allowed by TPL-001-4 and requirements of TPL-001-4 2.6, are met.

Part 2 is the extreme event report which documents the results of the study for extreme events of TPL-001-4 Table 1. The extreme event report may not be performed annually, and may use a qualified past study as long as the past study for the extreme event analysis is less than five years old and there have been no material changes since the previous past study as discussed in Section 7.5.