Transmission Reliability Margin Implementation Document

(TRMID)

Effective Date: November 10, 2015

Approved by:

Delyn Kilpack, Manager - Transmission Strategy & Planning — Date: 11/4/15

Chris Balmer, Director – Transmission Strategy & Planning — Date: 11/4/15

Tom Jessee, VP – Transmission — Date: 11/4/2015

Revision History

Date	Description
October 31, 2007	Initial LGEE draft of TRM methodology submitted for Customer review.
February 18, 2009	Removed "DRAFT", no customer comments; Added signatures to cover page; Added Revision History
April 1, 2009	Corrected references to MISO CRS and expanded "Use of TRM in ATC Calculations" section
January 18, 2011	Major revision to comply with NERC Standard MOD-008-1, which is to be effective 4/1/2011.
September 9, 2011	Refinement of section 8.0 regarding R3 of standard; Miss type of revision History year; Update signature line
June 1, 2013	Periodic review; Update signature line; Remove references to EKPC due to transition to PJM
April 24, 2015	Revised the Rate A table in Section 6.0 to include CRSG and Generation Dispatch component.
November 10, 2015	Revisions to implement new calculation methodology

Table of Contents

1.0 Purpose (R1)

This implementation document, TRMID, describes the methodology used in the calculation of Transmission Reliability Margin (TRM) and the application of TRM in the calculation of Available Flowgate Capability (AFC) used in the process of approving Transmission Service Requests (TSR).

2.0 Overview

Louisville Gas and Electric Company/Kentucky Utilities Company (collectively "LG&E/KU") uses an AFC methodology for calculation of Available Transfer Capability (ATC), which is documented in the Available Transfer Capability Implementation Document (ATCID). AFC values include decrements for TRM to provide operating flexibility and ensure secure operation of the interconnected network and accommodate reasonable uncertainties in system conditions. TRM is reserved to preserve transmission capacity on each identified Flowgate in the operating and planning horizons to model uncertainty in system conditions and for delivery of energy as required under generator Contingency Reserve Sharing (CRS) Agreements. The TRM process defined within this methodology is referenced in Attachment C of the Open Access Transmission Tariff (OATT).

3.0 Definitions

Definitions can be found in the NERC Glossary for italicized terms.

Available Flowgate Capability (AFC)

Available Transfer Capability (ATC)

Balancing Authority (BA)

Bulk Electric System (BES)

Capacity Benefit Margin (CBM)

Contingency Reserve

Contingency Reserve Sharing: (CRS) – Sharing between two or more Balancing Authorities that collectively maintain, allocate, and supply operating reserves required for each Balancing Authority's use in recovering from contingencies by the provision of capacity deployed by the Balancing Authority to meet the Disturbance Control Standard (DCS) and other NERC and Regional Reliability Organization contingency requirements.

Contract Path

Emergency Rating

Flowgate

Normal Rating

Operating Horizon – The period of the Hourly Operating Horizon differs for hours starting before noon and hours starting after noon. For hours starting before noon, the period includes the current hour through midnight, Eastern Standard Time ("EST") of the current day. For hours starting after 12 noon EDT, the period includes the then current hour through midnight EST of the following day. For example, the Hourly Operating Horizon for the hour of 10:00 a.m. EST January 1 includes the current hour and extends until the following midnight EST (*i.e.*, from 10:00 a.m. EST to midnight EST for a total of 14 hours). However, the Hourly Operating Horizon for 1:00 p.m. of January 1 extends until midnight EST of the next day (*i.e.*, from 1:00 p.m. EST January 1 to midnight the following day for a total of 36 hours).

Outage Transfer Distribution Factor (OTDF)

Planning Horizon – The period beginning at the end of the Hourly Operating Horizon and ending at the end of the 31st calendar day following the current day.

Power Transfer Distribution Factor (PTDF)

Study Horizon – The period beginning at the end of the Planning Horizon and ending at the end of the 18th calendar month following the current month.

Reliability Coordinator (RC)

Total Transfer Capability (TTC)

Transfer Distribution Factor (TDF)

Transmission Operator (TO)

Transmission Reliability Margin (TRM)

4.0 TRM Components (R1.1, R1.2)

LG&E/KU, as the Transmission Operator (TOP), considers the TRM components of LG&E/KU transmission system uncertainty described in this section in the TRM calculations. TRM component values will be set to zero, if they are not applicable.

Because the AFC methodology is used for the LG&E/KU Flowgates, the impact of power transfers on a transmission network is not path specific. Instead, TRM is applied against the Total Flowgate Capability ratings and is implemented as a MW reduction of those ratings. This allows the application of TRM on every Flowgate in LG&E/KU as necessary.

TRM will account for the following components of LG&E/KU transmission system uncertainty:

- Network Uncertainty
  - Allowances for simultaneous path interactions
  - Forecast uncertainty in transmission system topology
  - Allowances for parallel path (loop flow) impacts
  - Aggregate load forecast uncertainty
  - Load distribution uncertainty
  - Inertial response and frequency bias
  - Short-term System Operator response
- Contingency Reserve Sharing (CRS) Uncertainty
- Generation Dispatch Uncertainty

4.1 Network Uncertainty

Modeling assumptions utilized to calculate AFC values can contribute to uncertainties. While LG&E/KU does not explicitly utilize all FERC allowed uncertainty components to establish TRM values for Flowgates, the flow uncertainties due to the following potential modeling inaccuracies are addressed by a TRM component for each Flowgate equal to 2% of the Flowgate rating.

- Allowances for simultaneous path interaction
- Forecast uncertainty in transmission system topology
- Allowance for parallel path (loop flow) impacts
- Aggregate load forecast uncertainty
- Load distribution uncertainty
- Inertial response and frequency bias
- Short-term system operator response

4.2 CRS Uncertainty

LG&E/KU and TVA have established a Contingency Reserve Sharing Group (TEE CRSG). As such, entities with reserve sharing obligations under the TEE CRSG, must set aside transmission capability to export these reserves. Similarly, transmission capability must also be set aside for importing CRS assistance from other TEE CRSG member systems. The CRS uncertainty component of TRM is a minimum value that each TO must reserve on the Flowgate and should not be sold at any time.

When applicable, this component must be considered for both CRS needs of the Transmission Provider's own transmission system, as well as, the CRS needs of neighboring systems. Care is taken not to over-state the CRS component of TRM when adjoining systems' TRM values sufficiently encompass the through-flow requirements. LG&E/KU simulates the outage of certain generators of neighboring TEE CRSG participants.

The calculation process to quantify this component of TRM is to modify the base generation dispatch normally provided in the power flow models to simulate the generator outage and the TEE CRSG redispatch. The Flowgates are simulated on the base case and the CRS dispatch case. The difference between the flows for each Flowgate in the two cases (normal and CRS dispatch) constitutes the TRM MW value for the CRS impact on each Flowgate. Only the maximum MW value difference (normal and CRS) when looking at all the CRS contingencies in included for evaluation in the TRM MW value for the CRS impact component.

4.3 Generation Dispatch Uncertainty

Generation dispatch uncertainty or the location and output of generation that is assumed in the Planning/Study Horizon might be vastly different from actual conditions in the Operating Horizon. The dispatch profile of generation can vary which can cause flows on the Flowgate to vary. Variations occur because of unit availability and changes in dispatch order due to operating cost changes. Variations in generating patterns can significantly affect transfer capability, especially when specific generators or combination of generators significantly impacts a particular Flowgate. These generation dispatch changes can be internal or external to the LG&E/KU Balancing Area.

The calculation process to quantify this value of the TRM component consists of modifying the generation dispatch normally provided in the power flow base case to simulate an outage of one generator with internal redispatch. The Flowgates are simulated on the base case and the redispatch case. The difference between the flows for each Flowgate in the two cases (normal and redispatch) constitutes the value for the generation dispatch impact on each Flowgate. Only the maximum MW value difference (normal and redispatch) when looking at all the generation outage models is included for evaluation in the TRM for the generation dispatch uncertainty component.

5.0 No Double Counting between TRM and CBM (R2)

Double counting between TRM and CBM is removed during CBM calculations, as required by FERC Order 890, NERC standard MOD-004-1, and MOD-008-1. The CBM Implementation Document has details.

6.0 TRM on Temporary Flowgates

Temporary Flowgates created by TVA as the RC will be assigned a TRM equal to 3% of the Flowgate rating.

7.0 Use of TRM in ATC Calculations (R1.3)

LG&E/KU uses an AFC methodology (NERC MOD-030-02) for calculation of ATC for each posted path. Firm and Non-Firm AFC values include a decrement for TRM of Network Uncertainty (2% of Flowgate rating), plus the maximum of the applicable CRS and Generation Dispatch Uncertainties in all horizons.

7.1 Excessive Congestion

Flowgates that experience an excessive level of congestion may be subjected to additional TRM to reduce future congestion. LG&E/KU will review these situations and will make a determination whether to increase the uncertainty component of TRM under these circumstances.

8.0 Frequency of Calculations (R4, R5)

TRM updates are typically performed quarterly but will be performed every 13 months at a minimum. LG&E/KU shall provide the TRM values to its Transmission Service

Provider(s) and Transmission Planners(s) no more than seven calendar days after a TRM value is initially established or subsequently changed.

9.0 Document Control (R3,R5)

LG&E/KU and/or the ITO posts and will maintain on OASIS its TRMID, for Transmission Service Providers, Reliability Coordinators, Planning Coordinators, Transmission Planner, and Transmission Operators, to review at any time.

- TRM value updates will be sent to the LG&E/KU Transmission Service Provider(s) and Transmission Planners(s) within seven calendar days from the time the values are updated and reviewed by the ITO.
- This TRMID, and if requested, underlying documentation (if any) used in determining TRM, in the format of the Transmission Operator, shall be made available within 30 calendar days following a written request being received. Requests for such information should be made to Ashley Moore the Manager, Policy & Tariffs at Ashley.Moore@lge-ku.com with a subject line of "TRM Documentation Request".