# Transmission Reliability Margin (TRM) Methodology

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## Purpose

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

## Overview

E.ON U.S. (EON) uses an AFC methodology for calculation of Available Transfer Capability (ATC). AFC values are decremented by CBM and TRM to accommodate reasonable uncertainties in system conditions and provide operating flexibility to ensure secure operation of the interconnected network. TRM is used to reserve transmission flowgate capacity in the operating horizon and in the planning horizon for uncertainty in system conditions modeled in the AFC calculation and for automatic reserve sharing (ARS). CBM is used to reserve transmission flowgate capacity in the operating horizon (beyond 1 hr) and in the planning horizon to enable access to generation from interconnected systems in times of emergency generation deficiencies. Discrete CBM and TRM values in MWs or percent are determined for each flowgate.

## NERC Definitions

Capacity Benefit Margin (CBM) - The amount of firm transmission transfer capability preserved for Load Serving Entities (LSEs) on the host transmission system where their load is located, to enable access to generation from interconnected systems to meet generation reliability requirements. Preservation of CBM for a LSE allows that entity to reduce its installed generating capacity below what may otherwise have been necessary without interconnections to meet its generation reliability requirements. The transmission capacity preserved as CBM is intended to be used by the LSE only in times of emergency generation deficiencies.

Transmission Reliability Margin (TRM) - The amount of transmission transfer capability necessary to provide a reasonable level of assurance that the interconnected transmission network will be secure. TRM accounts for the inherent uncertainty in system conditions and its associated effects on ATC calculations, and the need for operating flexibility to ensure reliable system operation as system conditions change. All transmission system users benefit from the preservation of TRM by Transmission Service Providers.

## TRM Components

Transmission Service Providers must consider the ATC margin components described in this section in their TRM calculations. Some, or all, of the TRM component values may be set to zero. The TRM components descriptions include R.1.3.X for reference to the requirements in NERC MOD-008-0 and SERC Supplement – Transmission Reliability Margin (TRM) Methodology.

### R1.3.3 Balancing of generation within a Balancing Authority Area

System load is a dynamic quantity. Generation increases and decreases in response to these load variations. The generation dispatch will vary for reasons such as the number of units having load following capability, generation availability, generation conditions within the generating plant, and economics. Inclusion of CRS Uncertainty and Dispatch Uncertainty provides adequate TRM margin for this component.

### R1.3.6 Allowances for simultaneous path interactions

Transmission paths may interact and not be capable of operation at each path's full transfer capability. The variability in capability of a flowgate may be dictated by temperature, load level, available reactive support, and other factors. NERC provides for the establishment of "proxy or interface" flowgates to reduce this uncertainty.

The TRM value for 'proxy or interface" flowgates will account for the difference between the firm capability and the maximum capability of the facilities plus an adjustment for Network Uncertainty (described below).

EON's has categorized the remaining components as Network Uncertainty, Dispatch Uncertainty, CRS Uncertainty, Load Forecast Uncertainty and Load Distribution Uncertainty. A TRM value is calculated for each category of Uncertainty.

Network Uncertainty – The flow uncertainties due to the following potential modeling inaccuracies are addressed by a TRM value for each flowgate equal to 2% of the facility rating.

<u>R1.3.4 Forecast uncertainty in transmission system topology</u>
ATC calculations performed for the planning horizon are based upon the most critical single contingency and does not account for the base system condition including some level of additional facility outages. TRM provides an allowance for the impact of the myriad outages that may occur day-to-day. Settings of Phase Angle Regulators (PARs), status of series capacitors, timing of transmission system enhancements, outages beyond the first contingency, transmission facility maintenance outages and the status of operating procedures are a few of the additional uncertainties that Transmission Service Providers cannot accurately predict when calculating the ATC values.

<u>R1.3.5 Allowances for parallel path (loop flow) Impacts</u>
Real-time facility loading can be higher than predicted due to unaccounted for parallel path flows resulting from schedule transfers by other entities. These parallel path flows are the result of transmission service transactions that are not explicitly scheduled on the transmission system of a particular transmission provider or accounted for in their ATC process. The RC utilizes the NERC tag dump for calculation of AFC for hours 1 through 48 and the ITO utilizes transmission reservation information from BREC, EKPC, LGEE, MISO, OVEC, PJM, SPP and TVA to reduce the magnitude of unaccounted for parallel path flows.

<u>CRS Uncertainty - R1.3.8 Short-term System Operator response</u>
Participation in MISO's Contingency Reserve Sharing (CRS) System allows EON access to the operating reserves of other participants in the event of a generation outage. As such, entities with reserve sharing obligations under MISO's CRS System must set aside transmission capability to export these reserves. Similarly, transmission capability must also be set aside for importing CRS assistance from other systems. This component of TRM is the minimum value that each Transmission Provider 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. EON simulates the outage of certain generators of neighboring MISO CRS 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 CRS redispatch. Transmission contingencies are simulated on the base case and the CRS dispatch case. The difference between the flows for each contingency in the two cases (normal and CRS dispatch) constitutes the

TRM MW value for each flowgate for each CRS dispatch. The maximum MW value for all the CRS contingencies will determine the TRM MW value for the flowgate.

Dispatch Uncertainty - R1.3.7 Variations in generation dispatch

The location and output of generation that is assumed in the planning horizon might be vastly different from actual conditions at the time of operation. Variations occur as a result of unit availability and the changing cost. Variations in generating patterns can significantly affect transfer capability, especially when specific generators or combinations of generators have a substantial influence on flows over flowgates. These generators can be internal or external to the control area.

TRM calculations should consider the outage of generating units at or near the limiting transmission interface, if not already considered in the determination of the TTC/ATC of that interface. Generation variations and transactions that take place by neighboring companies are not part of this component. EON simulates outages of internal designated network resources with redispatch to other internal resources.

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. Transmission contingencies are simulated on the base case and the redispatch case. The difference between the flows for each contingency in the two cases (normal and redispatch) constitutes the TRM MW value for each flowgate for each redispatch. The maximum TRM MW value for each flowgate will constitute the TRM MW value for the component.

Load Forecast Uncertainty - R1.3.1 Aggregate Load Forecast error

The load forecast is subject to error, as is any forecast. Sufficient TRM should be maintained on the network to allow for wide-area deviations from forecast load (both real and reactive) caused by severe or extreme weather and long term divergence from the economic load forecast. These deviations in real and reactive power from forecasted levels can occur due to hotter or cooler temperatures, stronger or weaker economic conditions, unforeseen (new business) or unanticipated (load growth) additions or reductions in system load, and other reasons.

The E.ON load forecast is sensitive to extreme weather and long-term economic conditions. An evaluation of the 2006 Forecast indicates that the 2007 summer load could increase by 7.3% due to extreme weather and that the 2016 load levels could increase by 4.7% with “High” economic conditions.

This TRM component will be evaluated utilizing an extreme weather adjustment of 7% of MW load. The load power factor without distribution capacitor correction is typically 80-85%. Distribution capacitors are installed to correct load power factor to specified levels with normal weather. The MVAR load adjustment will be equal in magnitude to the MW adjustment assuming no additional distribution capacitor correction and to account for additional distribution transformer and distribution line losses.

The calculation process to quantify this value of the TRM component consists of modifying the load level normally provided in the power flow base case to simulate an extreme weather event for the E.ON control area. Transmission contingencies are simulated on the base case and the extreme weather case. The difference between the flows for each contingency in the two cases (normal and extreme weather) constitutes the TRM MW value for each flowgate. The maximum TRM MW value for each flowgate will constitute the TRM MW value for the component.

Load Distribution Uncertainty - R1.3.2 Load distribution error

Similar to an "error" in the aggregate load forecast, the distribution of the load will also vary the loading of system facilities. The Operating Companies (LG&E/KU) of EON have service territory that encompasses most of the state of Kentucky and five counties in Virginia and have significantly different seasonal peak characteristics due to the availability of natural gas.

The load balance between KU and LG&E is fairly consistent during the months of April through October (summer months) and during the months of November through March (winter months). The LG&E load is approximately 42% of the E.ON load during the summer months with a Standard Deviation of +/- 67 MW. The LG&E load is approximately 27% of the E.ON load during the winter months with a Standard Deviation of +/- 51 MW.

This TRM component for load distribution error will utilize a load adjustment of 100 MW (approximately +/- 2 standard deviations). The load power factor will be held constant.

The calculation process to quantify this value of the TRM component consists of modifying the load level normally provided in the power flow base case to a load shift between the two Operating Companies in the E.ON control area. Transmission contingencies are simulated on the base case and each load shift case. The difference between the flows for each contingency in the two cases (normal and load shift) constitutes the TRM MW value for each component of load shift. The maximum TRM MW value for all the components will constitute the TRM MW value for the flowgate.

EON does not have a high concentration of load in one industry and the largest single customer is less than 150 MW. Therefore, EON does not consider industry specific load changes.

**Use of TRM in ATC Calculations**

E.ON U.S. (EON) uses an AFC methodology for calculation of Available Transfer Capability (ATC). All Firm AFC and Non-Firm AFC values include a decrement for TRM. The TRM value will include Network Uncertainty (2%), when applicable, plus the maximum of the applicable ARS, Dispatch, Load Distribution, and the Load Forecast Uncertainties as indicated in the following table:

| **Component** | **Long-Term Firm** | **Short Term Firm** | **Long-Term Non-Firm** | **Short-Term Non-Firm** |
|---|---|---|---|---|
| Network Uncertainty | X | X | X | |
| CRS Uncertainty | X | X | X | X |
| Dispatch Uncertainty | X | X | | |
| Load Distribution Uncertainty | X | X | | |
| Load Forecast Uncertainty | X | | | |

**Frequency of Calculation**

TRM is reviewed and recalculated quarterly and will be revised, if necessary.