INTEGRATED MARKETPLACE

TCR Market Modeling Processes

Updated: January 14, 2016

SPP Southwest Power Pool

Table of Contents

REVISION HISTORY CHART **2**
Overview **3**
Purpose 3
TCR Modeling Practices **4**
Network Topology 4
Contingencies 4
Monitored Branch Constraints 4
Monitored Flowgate Constraints 5
Parallel Flow Assumptions 5
Parallel Flow Forecast (Alstom) 5
External Parallel Flow (Nexant) 6
Scheduled Outages 6
Future Transmission Facility Upgrades 7
Quality Assurance **7**

REVISION HISTORY CHART

Version	Revised By	Description of Modifications	Revision Date
1.0	Congestion Hedging	Document Published	8/16/2013
2.0	Congestion Hedging	Outages, External Flow, and Engineering judgment	11/11/2014
2.1	Congestion Hedging	General review and edits and the addition of the use of proposed outages in model outage selection	1/14/2016

Overview

Purpose

This document is intended for Southwest Power Pool Market Participants and provides information regarding the modeling approaches and assumptions for various elements of the SPP TCR model used in the Simultaneous Feasibility Analysis for ARR Allocations and TCR Auctions. These approaches and assumptions where applicable apply to the Long-term Congestion Rights (LTCR), Annual, and Monthly process.

TCR Modeling Practices

Network Topology

ARR/TCR analysis utilizes a bus-branch network model that is derived from a node-breaker model maintained in the EMS environment. HEDGE™ software used in the ARR/TCR analysis can read the bus-branch model in the PTI PSS/E v.31 format.

The EMS model is utilized in Southwest Power Pool's Reliability Coordination applications such as State Estimator and Contingency Analysis. This model is continuously reviewed and updated with the help of Southwest Power Pool's Transmission Owning members. A significant portion of the U.S. Eastern Interconnection electricity grid is represented in this model. Generation, load, flow, breaker status, etc. are obtained and applied on the model for purposes of providing TCRXFER a starting value for obtaining a valid powerflow solution.

The Southwest Power Pool EMS system is based on Alstom's Habitat/WebFG environment. The ARR/TCR model is created through the following steps:

1. The network model savecase from the Centralized Modeling Tool (CMT) is consumed by the TCRXFER tool
2. The circuit breakers are positioned at their nominal status
3. Powerflow is executed to ensure relevant facilities are energized
4. The bus numbers are mapped to those in the IDC case where available
5. The model is exported to the PTI PSS/E v.31 bus-branch format with an additional field to indicate the EMS equipment names

Contingencies

The SPP operations modeling approaches apply.
(From SPP RC Reliability Plan*)
"SPP has defined all branches and transformers with low side voltages of 138 kV and higher (with some 115kV) within the SPP RC Area and all branches and transformers with low side voltages of 230 kV and higher within the first-tier Balancing Authority Areas as contingencies in RTCA."

Monitored Branch Constraints

The SPP operations modeling approaches apply.
(From SPP RC Reliability Plan*)
"SPP monitors the post-contingency flow on all SPP branches and transformers with low side voltages of 115kV and higher. Alarms are triggered if that flow exceeds the emergency rating of the branch or transformer. Additionally, SPP monitors post-contingency flow on all branches and transformers with low side voltages of 230 kV and higher within neighboring systems as well as selected lower voltage facilities within neighboring systems that are known to be impacted by an SPP contingency."

Monitored Flowgate Constraints

The SPP operations modeling approaches apply.
(From SPP Criteria 12.3)
"***12.3 System Operating Limits (SOLs)***
The value (such as MW, MVar, Amperes, Frequency or Volts) that satisfies the most limiting of the prescribed operating criteria for a specified system configuration to ensure operation of the Bulk Electric System (BES) within acceptable reliability criteria. System Operating Limits are based upon certain operating criteria. These include, but are not limited to: Facility Ratings (Applicable pre- and post-Contingency equipment or facility ratings), Transient Stability Ratings (Applicable pre- and post-Contingency Stability Limits), Voltage Stability Ratings (Applicable pre- and post-Contingency Voltage Stability), and System Voltage Limits (Applicable pre- and Southwest Power Pool Criteria post-Contingency Voltage Limits). SPP monitors and controls the BES using Flowgates and the NERC TLR process.

SPP also monitors numerous other BES facilities within its footprint and creates temporary flowgates when operating conditions reveal any additional limiting system configurations. Since SPP is utilizing these flowgates to ensure the system is operating within acceptable reliability criteria, these flowgate limits serve as the SPP System Operating Limits."

(From SPP Criteria 4.2.10)
"***4.2.10 Monitored Facilities***
During the Flowgate determination process those facilities monitored for pre-defined limiting conditions. Mandatory Monitored Facilities, for use in these calculations, are all facilities operated at 100 kV and above and all interconnections between Transmission Providers. Other facilities operated at lower voltage levels may be added to the Monitored Facilities list at the discretion of the Transmission Providers or Transmission Owners. In defining Flowgates, the Monitored Facilities are those components of a Flowgate that remain in service following the defined contingency."

Parallel Flow Assumptions

Parallel Flow, (also known as loop flow), is defined as transmission use (flow of energy) by entities external to the SPP Footprint, including tagged and untagged transactions impacting flowgates. External entities are also known as "third-party" entities. Error in forecasting third-party use affects the physical operation of the power system and the financial operation of the SPP Marketplace. Third-party use physically impacts the capability of SPP Marketplace users to transmit energy across the system. The physical impact is modeled in SPP's reliability and financial processes to allow for monitoring and controlling transmission constraints across flowgates throughout the Marketplace timeline, (from the TCR Market through the Real-Time Balancing Market). The financial impact is a result of binding constraints and the congestion costs reflected in the Auction Clearing Prices, constraint shadow prices, and market flow on the flowgates.

Parallel Flow Forecast (Alstom)

Accurate modeling of third-party use is needed to mitigate physical and financial impact. This requires SPP to utilize forward-looking analysis based on historical real-time data, which the Parallel Flow Forecasting process supports. Parallel Flow Forecasting utilizes historical constrained flowgate data collected at real-time to produce a Parallel Flow Forecast per flowgate on an hourly basis for each TCR monthly or seasonal product (On-Peak and Off-peak). The results of the forecast are a de-rate amount per flowgate that is consumed and represented as *Fixed Option Flowgate Rights* by the TCR system. SPP may also utilize engineering judgment to modify the calculated flowgate rights that will be applied to the SPP transmission system topology in order to better represent the flows that SPP expects to occur. The Parallel Flow forecast is used to determine third-party injections and withdrawals to represent a reasonable power flow across flowgates for use in the Simultaneous Feasibility Test (SFT).

External Parallel Flow (Nexant)

The intent of External Parallel Flow is to take the forecasted flowgate parallel flows (modeled as *Fixed Option Flowgate Rights*) created by Alstom's Parallel Flow Forecast and use Interface Settlement Locations to calculate the injections and withdraws that will represent these forecasted flowgate parallel flows. SPP may also utilize engineering judgment to modify the calculated parallel flows that will be applied to the SPP transmission system topology in order to better represent the flows that SPP expects to occur. These new external injections and withdraws will be represented as *External Fixed Option PTP TCRs* and replace the original *Fixed Option Flowgate Rights*. Any leftover MW amount needed to procure the original forecasted amount of parallel flow on a given flowgate will be represented as *Fixed Obligation Flowgate Rights*. In summary, these new external injections/withdraws will represent the forecasted flows on the flowgates as well as place the necessary parallel flows on all other branches which are not flowgates.

Scheduled Outages

Scheduled transmission outages from the SPP CROW system and NERC System Data Exchange (SDX) are considered for use in the models used for the congestion hedging processes. The scheduled CROW outages considered are all Proposed[1], Approved, Pre-Approved, and Implemented scheduled transmission outages according to the duration thresholds listed below, unless the outage causes a Settlement Location to island. A Settlement Location is islanded if an outage causes all of the buses within a Settlement Location to become electrically disconnected from the rest of the system, for continuity that outage will be dismissed from the list of scheduled outages.

Outage duration thresholds are as follows:
In General, outages greater than 120 hours in duration will be included in the model, and outages less than or equal to 120 hours in duration will not be included in the model. If SPP determines that the inclusion or exclusion of an outage has significant detrimental impact to flow and/or overall funding, it may be excluded or included regardless of its duration.

[1] In the SPP Markets, Proposed transmission outages are only used in the TCR Markets for modeling purposes.

Future Transmission Facility Upgrades

Future transmission system upgrades are not modeled in the TCR Market. Only equipment that is in-service at the time the TCR Market is built will be incorporated into the TCR Model.

Quality Assurance

The modeling practices and assumptions described in this document will be reevaluated regularly to ensure the most accurate and reasonable representation of the SPP system. As an increased amount of Integrated Marketplace data becomes available, forecasts and assumptions can be updated to more closely align with the Day-Ahead and Real-time markets.