Network Model User Guide

Revision: 01
Effective Date: May 10, 2023

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Contents

Current Revision

Revision 01 (May 10, 2023)

- Updated language to reflect installing the spring network model build in the FTR system
- Updated language to reflect the annual ARR allocation market comprising four rounds
- Updated language to reflect the network model .RAW and .SAV posted files containing the 95° day temperature limit set facility limits along with the facility limit derates based upon a historical analysis of binding constraint market flow data
- Grammar, formatting and spacing changes

Introduction

Welcome to the PJM FTR User Guide for the network model. The purpose of this document is to give an overview of the modeling in the Financial Transmission Rights (FTR) and Auction Revenue Rights (ARR) markets as well as the network model posted files found under the Model Information section on the Financial Transmission Rights page, which is available on the PJM Web Site.

Intended Audience

This user guide is for Market Participants who are already familiar with the FTR and ARR products, are interested in model information or need to use the network model posted files for FTR or ARR purposes.

Models

Operations Network Model

Operations uses the Energy Management System (EMS) network model, which is a device-breaker model. The EMS network model contains transmission system topology, substation and bus layouts, facility limits, contingency definitions and other pertinent modeling information. The EMS network model is described in detail in Manual 3A found on the Manuals page, which is available on the PJM Web Site.

Markets Network Model

The FTR and ARR markets as well as the Day-Ahead market use a network model based on a snapshot from the EMS network model. The Markets network model build process converts the EMS network model to a Markets network model, which is a device-breaker model.

LMP Bus Model

Coincident with the network model builds are updates to the Locational Marginal Pricing (LMP) Bus Model that can include the deletion of pricing nodes also known as pnodes, the renaming of pnodes, or the addition of new pnodes. The pnode changes can also include updates to aggregate, hub, interface and zone definitions. LMP Bus Model updates are on the LMP Model Information page, which is available on the PJM Web Site.

Model Build Schedule

The network model is updated four times per year with spring, summer, fall and winter network model builds performed. Network model builds are necessary to ensure adequate modeling of the Bulk Electric System (BES). Network model builds can include updates to topology and network connectivity, substation and bus layouts, line and transformer limits, tie-line changes, contingency modeling updates and other modeling changes. They can also include future changes to the transmission system or substation layouts to reflect new construction or retirements. This can result in a double model where the current and future topology are both modeled allowing either topology to be energized, as needed.

Each network model build has an implementation date when the modeling updates go into effect. The network model build schedule is found under the OASIS tool section on the System Information page, which is available on the PJM Web Site.

FTR and ARR Modeling

Network Model Build Timeline

The FTR system uses the available spring, summer, fall and winter network model builds.

The timeline for FTR auction and ARR allocation markets typically do not allow network model builds to be installed in the FTR system on the implementation date of the network model builds. Network model builds cannot be installed in the FTR system during open FTR auction and ARR allocation markets. Typically, network model builds are installed in the FTR system subsequent to the approval of the round of the FTR auction market that overlaps the implementation date of the network model build or whenever there is sufficient time between FTR auction and ARR allocation markets.

The spring network model build is installed in the FTR system after the conclusion of the annual FTR auction market and prior to the opening of the June monthly FTR auction market bidding window. The timeline for the spring network build is delayed due to its overlap with the timeline of the annual ARR allocation and annual FTR auction markets. A consistent network model is required through the annual ARR allocation and annual FTR auction markets to help ensure revenue adequacy.

Nodal Remapping

Awarded FTRs, confirmed FTR bilateral trades and allocated ARRs affected by pnode name deletion or renaming due to a LMP Bus Model update are remapped to replacement pnode names. The FTR nodal remapping process for LMP Bus Model updates is described in section 8.7 of Manual 6 found on the Manuals page, which is available on the PJM Web Site.

If the deleted pnode name is a generator pnode, it is possible for the replacement pnode name to be a load pnode. In those situations, the replacement load pnode name becomes valid for sell offer bids for periods up through the farthest awarded FTRs affected by that pnode name deletion in FTR auction markets or buy bids in only the prompt month period of monthly FTR auction markets. After all awarded FTRs affected by that pnode name deletion have expired, the replacement load pnode name returns to being a typical load pnode going forward.

There are also some pnode names that are valid only for sell offer bids for periods up through the farthest awarded FTRs sourcing or sinking at those pnode names in FTR auction markets due to them being retired interfaces, obsolete aggregates, incorrectly modeled pnodes, generators that have retired but have yet to be removed from the LMP Bus Model or other bespoke reasons. Those pnode names do not allow buy bids in any period of any FTR auction market and only allow sell offer bids to prepare them to be removed as valid pnode names once all the awarded FTRs sourcing or sinking at those pnode names have expired.

The pnode names associated with the two sell offer bid scenarios described above are in the valid pricing nodes limited to sell offers posted file found under the Monthly FTR Auctions section on the Financial Transmission Rights page, which is available on the PJM Web Site.

LMP Bus Model Timeline

On the implementation date of the network model build, awarded FTRs and confirmed FTR bilateral trades affected by the LMP Bus Model updates are changed to reflect the replacement pnode names. An exception to that process is if the implementation date of a network model build is coincident with the second or later days of the round of an FTR auction market bidding window. The duration of the round of an FTR auction market bidding window must retain the same pnode names for awarded FTRs and confirmed FTR bilateral trades so sell offers are correctly accounted for and to have a consistent set of valid pnode names. The list of valid pnode names for an FTR auction market round and period are in the valid source/sink postings found under the appropriate auction section on the Financial Transmission Rights page, which is available on the PJM Web Site.

After the implementation date of the network model build and the closing of the round of the FTR auction market bidding window, awarded FTRs and confirmed FTR bilateral trades affected by the LMP Bus Model updates may be switched between the prior pnode names and the replacement pnode names as needed to support clearing. Immediately subsequent to the approval of the round of the FTR auction market overlapping the implementation date of the network model build, the awarded FTRs including those from the round of the recently approved FTR auction market and confirmed FTR bilateral trades affected by the LMP Bus Model updates that are in effect on the implementation date and beyond, are changed to the replacement pnode names.

If the implementation date of the network model build overlaps a round of an FTR auction market, renamed pnode names are mirrored in the FTR system to create new renamed pnode names to permit bidding or the changing of awarded FTRs and confirmed FTR bilateral trades to the new renamed pnode names as needed before the network model is installed in the FTR system. Once the network model is installed in the FTR system, those interim mirrored new renamed pnode names are overwritten with the true new renamed pnode names.

Allocated ARRs affected by the LMP Bus Model updates are also changed on the implementation date of the network model build. Allocated ARRs are modeled as injections at the source (point of receipt) and withdrawals at the sink (point of delivery) in long term FTR auctions to reserve capability hence, the sources and sinks must respect the pnode name updates in the LMP Bus Model. Allocated ARRs are not changed for the LMP Bus Model updates coincident with the spring network model build that is typically implemented during the last quarter of the effective period of the annual ARR allocation market. At the point in time that the LMP Bus Model updates for that spring network model build are typically implemented, bidding for round five of the long term FTR auction has likely already closed and it is being cleared using the winter network model build so there is no need to change ARRs.

FTRs that were not awarded, unallocated ARRs as well as awarded FTRs and confirmed FTR bilateral trades that expired before the implementation date of the network build are not changed to reflect pnode name updates in the LMP Bus Model, as there is no benefit to do so.

Baseline Network Model

Once the network model build is installed in the FTR system, the new network model is used as a baseline in the upcoming rounds of the long term FTR auction market, monthly FTR auction markets as well as monthly residual ARR allocation markets. The annual ARR allocation and annual FTR auction markets use the latest winter network model build as a baseline for the annual network model.

Market Setup

The FTR system permits the baseline network model to be overridden with changes to circuit breaker and disconnect configurations, facility outages, facility limits, generic constraints, flowgates, interfaces, loop flow and other modeling changes. These modeling overrides are mostly done in power flow cases while some require changes to the FTR system.

Base cases are setup to model every period covered by each FTR auction and ARR allocation market. Base cases allow the network model to be customized for every period of every market as needed. Bid cases are copies of the finished base cases for FTR auction markets and are executed with bids included to generate an optimized clearing solution. ARR allocation markets use base cases and do not use bid cases as ARRs are allocated and do not use an optimized clearing solution as there are no bid prices.

The following sections describe setting up the network model and base cases for FTR auction and ARR allocation markets.

Circuit Breaker and Disconnects

For the first round of the annual ARR allocation market, each round of the monthly residual ARR allocation, monthly FTR auction and long term FTR auction markets, the long term circuit breaker and disconnect configurations from a recent Day-Ahead approved case are included in the base cases. This helps to align the circuit breaker and disconnect configurations in the network model with the Day-Ahead model, to the extent possible.

Circuit breakers and disconnects may also be opened or closed as part of outage ticket IDs for modeled facility outages, to energize pnodes, bypass Phase Angle Regulators (PARs) or to model transmission system upgrades or retirements as needed. The annual ARR allocation and annual FTR auction markets use the same circuit breaker and disconnect configurations for consistency.

Contingencies

For the first round of the annual ARR allocation market, the contingencies modeled in the base cases are based on a historical analysis of contingencies binding in the Day-Ahead and Real-Time markets. The contingencies modeled for the long term in the Day-Ahead market and those required for generic constraints, flowgates and interfaces are also modeled in the base cases. Typically, the FTR system is monitoring single contingencies (N-1 contingency analysis), however there may be some modeled flowgates monitoring for double contingencies (N-2 contingency analysis).

For each round of the annual ARR allocation market, it is possible for additional contingencies to be modeled as needed along with new contingencies binding in the Day-Ahead and Real-Time markets otherwise; the same contingencies are modeled in all four rounds. This helps to ensure that the latest contingencies are modeled, to the extent possible. The contingencies modeled in the annual ARR allocation market are used as a baseline for each round of the FTR auction and ARR allocation markets subsequently conducted effective for that corresponding planning period and beyond. As rounds of the FTR auction and ARR allocation markets are conducted, additional contingencies may be modeled in the base cases as appropriate. The contingencies modeled posted files for FTR auction and ARR allocation markets are found under the appropriate auction or allocation section on the Financial Transmission Rights page, which is available on the PJM Web Site.

Upgrades

For the annual ARR allocation and annual FTR auction markets, transmission system upgrades with a potential impact to congestion that are scheduled to be in-service by June 30th of the corresponding planning period are included in the base cases. The upgrades modeled are the highlighted upgrades in the key system upgrades scheduled posted file found under the Annual Auction Revenue Rights (ARR) Allocation section in the corresponding planning period's dropdown on the Financial Transmission Rights page, which is available on the PJM Web Site.

For each round of the long term FTR auction market, transmission system upgrades that individually or together, have a 10% or more impact on the transmission congestion on an individual constraint or constraints with congestion of $5 million or more affecting a common congestion path and that are scheduled to be in-service by June 30th of the first planning period covering the market are included in the base cases. The upgrades modeled are presented annually to the Market Implementation Committee (MIC), typically in February. Meeting materials can be found on the Market Implementation Committee page, which is available on the PJM Web Site. For each round of the long term FTR auction market, the in-service dates of the upgrades are checked under the Planning section on the Project Status & Cost Allocation page, which is available on the PJM Web Site. Upgrades with in-service dates that slip to beyond June 30th of the first planning period covering the market are not modeled in the base cases for that round.

Outages

Facility outages are modeled in the base cases based on reasonable assumptions about the transmission system configuration and capability for the periods covering the FTR auction and ARR allocation markets. For the annual ARR allocation and annual FTR auction markets, and for each round of the long term FTR auction markets, facility outages of sixty days or more, down to as low as fourteen days or more if there is an expected impact to revenue adequacy or congestion are considered. For monthly FTR auction markets, facility outages of five days or more, down to as low as three days for 500 kV and 765 kV facility outages are considered.

Internal and external facility outages are grouped into electrically connected clusters and selected based on an algorithm taking into account many factors such as outage length and voltage to select the most impactful set of facility outages. There may be circuit breaker and disconnect configuration changes included with modeled facility outage ticket IDs which are also modeled in the base cases. Facility outages may be re-serviced due to problems with de-energized pnodes, islanding or Phase Angle Regulator (PAR) solving.

For monthly residual ARR allocation markets, facility outages of one day or more that match the facility outages modeled in the corresponding annual ARR allocation market are modeled. The annual ARR allocation and annual FTR auction markets model the same facility outages for consistency.

The outages modeled posted files for FTR auction and ARR allocation markets are found under the appropriate auction or allocation section on the Financial Transmission Rights page, which is available on the PJM Web Site.

Limits

Facilities that are designated with a monitored priority of 1 (MP1) for reliability and markets are monitored using the 95° day temperature limit set in the base cases for all FTR auction and ARR allocation markets. The temperature limit set used helps to ensure that there are sufficient revenues from Day-Ahead transmission congestion charges to satisfy all FTR obligations for the auction periods under expected conditions and to ensure that there are sufficient revenues from the annual FTR auction market to satisfy all ARR obligations. Facility limits equal to 9999 or higher are not monitored in the FTR system.

Facility limits using the 95° day temperature limit set are available in the network model .RAW and .SAV posted files found on the FTR Model Critical Energy Infrastructure (CEII) page, which is available on the PJM Web Site. Additional access is required to view the FTR Critical Energy Infrastructure Information site. Facility limits are also available for all temperature limit sets in the ratings text posted file found under the OASIS tool section on the Ratings Information page, which is available on the PJM Web Site.

Some facility limits are derated based upon a historical analysis of binding constraint market flow data and are modeled in the base cases. The facility limit derates modeled in the annual ARR allocation market are modeled in the base cases for each round of the FTR auction and ARR allocation markets subsequently conducted effective for that corresponding planning period and beyond. The facility limit derates are listed in the uncompensated flow modeled historically congestion facilities posted file found under the Annual Auction Revenue Rights (ARR) Allocation section in the corresponding planning period's dropdown on the Financial Transmission Rights page, which is available on the PJM Web Site. The facility limit derates are also available in the network model .RAW and .SAV posted files found on the FTR Model Critical Energy Infrastructure page, which is available on the PJM Web Site. Additional access is required to view the FTR Critical Energy Infrastructure Information site.

If there are infeasible facilities in Stage 1A of the annual ARR allocation market then facility limits are increased in the base cases to resolve those limit violations. The increased facility limits are modeled in Stage 1B and Stage 2 of the annual ARR allocation market and for each round of the FTR auction and ARR allocation markets subsequently conducted effective for that corresponding planning period and beyond. Normal facility limits may be used instead of the increased Stage 1A facility limits in FTR auctions if ARR funding is not impacted, requested self-scheduled FTRs are fully awarded and net FTR auction revenue is positive.

For FTR auction markets, facility limits may be increased to achieve feasible base cases for all effective periods. A feasible base case does not have any limit violations based upon the modeled topology and the approved rights effective for the period of the base case. It is important to have feasible base cases before creating the bid cases. If a base case has limit violations and is therefore infeasible then the bid case attempts to resolve the limit violations by clearing counter flow FTRs, which decreases FTR auction revenue.

Flowgates

Flowgates are modeled along with their limits in the base cases based upon a historical analysis of Firm Flow Entitlements (FFE) and binding flowgates. The flowgates modeled in the annual ARR allocation market are modeled for each round of the FTR auction and ARR allocation markets subsequently conducted effective for that corresponding planning period and beyond.

The modeled flowgates, their definitions, direction and limits are in the MISO Market-to-Market firm flow entitlements utilized for the planning period posted file found under the Annual Auction Revenue Rights (ARR) Allocation section in the corresponding planning period's dropdown on the Financial Transmission Rights page, which is available on the PJM Web Site.

Interfaces

Interfaces are modeled along with their limits in the base cases based upon a historical analysis of interface flows and limits in the Day-Ahead and Real-Time markets. For monthly FTR auction markets, interface limits may be decreased in the base cases if there are facility outages modeled that comprise the interface definition.

The modeled interfaces, their definitions and limits are in the PJM interface definitions limits posted files found under the Model Information section in the annual and long-term & monthly dropdowns on the Financial Transmission Rights page, which is available on the PJM Web Site. Monthly FTR auction interfaces and their limits by period are in the interface ratings posted files found under the Monthly FTR Auctions section in the outage & interface modeling dropdown on the Financial Transmission Rights page, which is available on the PJM Web Site.

Loop Flow

Loop flow is also known as uncompensated power flow circulating in the network model. Loop flow is modeled in the base cases based upon a historical analysis of schedule and actual interchange data along with a power flow study to determine the set of external pnodes and MW injections/withdrawals that represent it.   Some historical grandfathered transmission rights are also modeled as loop flow.

The modeled loop flow, their definitions and MW injection/withdrawal are in the uncompensated parallel flow posted files found under the Model Information section in the annual and long-term & monthly dropdowns on the Financial Transmission Rights page, which is available on the PJM Web Site.

Phase Angle Regulators

Phase Angle Regulators (PARs) are modeled with a lower and upper MW limit range for ARR allocation markets and while setting up base cases for FTR auction markets. PARs that are de-energized due to facility outages are not modeled in the base cases for FTR auction and ARR allocation markets. In FTR auction markets, base cases are modeled on a fixed phase angle range before being duplicated to create the bid cases, which are also executed on a fixed phase angle range. PAR lower and upper MW limits as well as lower and upper phase angle limits may be adjusted as required in the cases for FTR auction and ARR allocation markets. Some external PARs and PARs near tie lines are modeled as facility outages while circuit breakers and disconnects are configured to energize a bypass path if available, to help with software performance.

The list of modeled PARs, their definitions and lower and upper limits are in the par data posted files found under the Model Information section in the annual and long-term & monthly dropdowns on the Financial Transmission Rights page, which is available on the PJM Web Site.

Approved Rights

Previously awarded FTRs and allocated ARRs that are effective during the periods of a market are modeled as injections at the source (point of receipt) and withdrawals at the sink (point of delivery) in the cases. These approved rights serve to reserve capability in the network model. For FTR auction markets, the approved rights along with confirmed FTR bilateral trades serve as the basis for sell offer bids.

Incremental Auction Revenue Rights (IARRs) for Regional Transmission Expansion Plan (RTEP) upgrades that met a certain set of criteria are in a separate annual RTEP IARR market, which uses the same network model as the annual ARR allocation market. RTEP IARRs are automatically allocated to Responsible Customers unless they are declined in the FTR Center system during the Stage 1A ARR nomination period. The annual RTEP IARR market is approved prior to the clearing of Stage 1A of the annual ARR allocation market.

Interconnection Customers with merchant and generation interconnection IARRs have the choice to request or decline the IARRs in the annual ARR allocation market. Requested merchant and generation interconnection IARRs are allocated in Stage 1A of the annual ARR allocation market.

Allocated RTEP IARRs are included as approved rights in all four rounds of the corresponding annual ARR allocation market. Requested merchant and generation interconnection IARRs are included as approved rights in Stage 1B and Stage 2 of the corresponding annual ARR allocation market. As each of the four rounds of the annual ARR allocation market are conducted, the prior awarded ARRs from previous rounds are included as approved rights.

Allocated RTEP IARRs, merchant and generation interconnection IARRs, firm point-to-point and network service ARRs effective for the planning period covering the monthly residual ARR allocation market are included as approved rights.

Long term FTRs previously awarded effective for the planning periods covering the long term FTR auction are included as approved rights. Additionally, allocated RTEP IARRs, merchant and generation interconnection IARRs, firm point-to-point and network service ARRs effective for the planning period during which the long term FTR auction is conducted are included as approved rights. Lastly, additional ARRs resulting from increased capability that becomes available through an offline annual ARR allocation market without the modeling of facility outages and residual annual ARRs that become available through incremental capability created by future transmission system upgrades are included as approved rights. As each of the five rounds of the long term FTR auction market are conducted, the prior awarded FTRs from previous rounds are included as approved rights.

Long term FTRs previously awarded effective for the planning period covering the annual FTR auction market are included as approved rights. As each of the four rounds of the annual FTR auction market are conducted, the prior awarded FTRs from previous rounds are included as approved rights. Self-scheduled bids are guaranteed to clear and their path capability is reserved and accounted for when setting up the base cases prior to executing the bid cases.

Long term, annual and monthly FTRs previously awarded effective for the periods covering the monthly FTR auction market are included as approved rights.

ARR market approved rights along with the offline annual ARR allocation market approved rights for long term FTR auction markets are listed in the bids posted file found under the Annual Auction Revenue Rights (ARR) Allocation section in the corresponding planning period's dropdown on the Financial Transmission Rights page, which is available on the PJM Web Site. FTR market approved rights are available in FTR Center or in the FTR auction results posted files found under the appropriate auction section on the Financial Transmission Rights page, which is available on the PJM Web Site.

ARR Requests and FTR Bids

ARR requests are included in the final base cases for rounds of the ARR allocation markets to generate a clearing solution. FTR auction bids are included in the bid cases for rounds of the FTR auction markets to generate an optimized clearing solution.

ARR requests are listed in the bids posted file found under the Annual Auction Revenue Rights (ARR) Allocation section in the corresponding planning period's dropdown on the Financial Transmission Rights page, which is available on the PJM Web Site. FTR auction bids are available through Data Miner 2 under the FTR Auction Bids section on the Financial Transmission Rights page, which is available on the PJM Web Site.

Clearing Engine

The FTR system converts the Markets network model, which is a device-breaker model to a bus-branch model during the Pre-processing Function of case execution. The FTR Optimization (FTRO) engine formulates the Linear Programming problem taking into account pre and post-contingency facility limits, generic constraints, flowgates, interfaces and modeled contingencies to generate the highest bid-based value of awarded FTRs. The Simultaneous Feasibility Test (SFT) performs DC power flow based contingency analysis to ensure that the solution generated by FTRO is feasible under normal system conditions. The SFT models paths as injections at the source (point of receipt) and withdrawals at the sink (point of delivery) and takes into account FTR auction bids or ARR requests as well as existing approved FTRs or ARRs for the period, outages, interface limits and loop flow. The SFT is not a system reliability test and is not intended to model actual system operating conditions.

Model Information Section Posted Files

There are three sections under the Model Information section found on the Financial Transmission Rights page, which is available on the PJM Web Site.

Annual FTR Auction & Annual ARR Allocation Model Mapping CSV Files

The posted files apply to the rounds of the annual FTR auction and annual FTR allocation markets for the planning period shown in the dropdown title. These mapping files correlate to the posted files found under the Annual section on the FTR Model Critical Energy Infrastructure Information page, which is available on the PJM Web Site. Additional access is required to view the FTR Critical Energy Infrastructure Information site.

Annual 500kV Mapping

Lists the Extra High Voltage (EHV) aggregate pnode name mappings.

Valid Source/Sink List: EHV aggregate pnode name

B1-B2-B3: station name

Type: EHV pnode type

Bus #: PSSE bus number

Annual Aggregate Definitions

Lists the aggregate and interface definition pnode name mappings. Each aggregate and interface is comprised of one or more bus pnode names. The sum of the factors for each bus pnode name comprising an aggregate or interface definition add up to approximately one.

Name: aggregate or interface pnode name

Type: aggregate or interface pnode type

B1: station name of the bus pnode name comprising the aggregate or interface definition

B2: voltage level of the bus pnode name comprising the aggregate or interface definition

B3: equipment name of the bus pnode name comprising the aggregate or interface definition

Bus #: PSSE bus number of the bus pnode name comprising the aggregate or interface definition

Factor: percentage factor of the bus pnode name comprising the aggregate or interface definition

Annual B1 - B2 - B3 Power System Simulator for Engineering (PSSE) Mapping File
Lists the B1, B2 and B3 bus pnode name mappings.

B1: station name

B2: voltage level

B3: equipment name

PSSE Bus#: PSSE bus number

Annual Load Apportionment Zones Hubs
Lists the zone and hub definition pnode name mappings. Each zone and hub is comprised of one or more bus pnode names. The sum of the factors for each bus pnode name comprising a zone or hub definition add up to approximately one.

Name: zone or hub pnode name

Type: zone or hub pnode type

B1: station name of the bus pnode name comprising the zone or hub definition

B2: voltage level of the bus pnode name comprising the zone or hub definition

B3: equipment name of the bus pnode name comprising the zone or hub definition

Bus #: PSSE bus number of the bus pnode name comprising the zone or hub definition

Factor: percentage factor of the bus pnode name comprising the zone or hub definition

Annual Phase Angle Regulator (PAR) Data
Lists the PAR mappings.

First column: station name

Second column: voltage level

Third column: equipment name

From Bus #: from PSSE bus number

To Bus #: to PSSE bus number

Deg: upper degree limit

Deg: lower degree limit

MW: upper MW limit

MW: lower MW limit

Annual PJM Interface Definitions Limits

Lists the interface definition branch mappings, direction and limits. Each interface is comprised of one or more branches.

First column: interface name

Second column: station name of the branch comprising the interface definition

Third column: voltage level of the branch comprising the interface definition

Fourth column: equipment name of the branch comprising the interface definition

From Bus #: from PSSE bus number

To Bus #: to PSSE bus number

Direction: 1 is monitoring in the direction of the From Bus # column to the To Bus # column while -1 is monitoring in the direction of the To Bus # column to the From Bus # column

Eighth column: interface name, names ending in Contingency monitor for contingency conditions

Limit (MW): MW limit

Annual Power System Simulator for Engineering (PSSE) Branch Mapping File

Lists the branch or line and transformer mappings. These mappings can be used to help determine the direction for binding constraint data available in FTR Center or posted files found under the appropriate annual FTR auction or annual ARR allocation section on the Financial Transmission Rights page, which is available on the PJM Web Site. The From Bus # column to the To Bus # column maps to binding constraints ending with _I while the To Bus # column to the From Bus # column maps to binding constraints ending with _Z.

First column: station name

Second column: voltage level

Third column: equipment name

From Bus #: from PSSE bus number

To Bus #: to PSSE bus number

Circuit ID: circuit ID

Annual Uncompensated Parallel Flow

Lists the uncompensated parallel flow or loop flow mappings.

Interface: station name for bus pnode names, aggregate or interface pnode name

Second column: voltage level for bus pnode names

Bus #: PSSE bus number for bus pnode names

Injection/Withdrawal: positive indicates a MW injection while negative indicates a MW withdrawal

Long-Term & Monthly FTR Auction Model Mapping CSV Files

The posted files apply to the rounds of the long term FTR auction and monthly FTR auction markets that open after the date the files are posted. These mapping files correlate to the posted files found under the Long-Term & Monthly section on the FTR Model Critical Energy Infrastructure Information page, which is available on the PJM Web Site. Additional access is required to view the FTR Critical Energy Infrastructure Information site.

There are separate aggregate definitions and load apportionment zones hubs posted files that apply to round five of the long term FTR auction market that is open after the date the files are posted. The timeline of round five of the long term FTR auction market typically overlaps with the timeline of the annual ARR allocation market. The FTR system is configured to use the latest aggregate, interface, zone and hub definitions for the annual ARR allocation market thus round five of the long term FTR auction market also uses those definitions.

500kV Mapping

Lists the Extra High Voltage (EHV) aggregate pnode name mappings.

Valid Source/Sink List: EHV aggregate pnode name

B1-B2-B3: station name

Type: EHV pnode type

Bus #: PSSE bus number

Aggregate Definitions

Lists the aggregate and interface definition pnode name mappings. Each aggregate and interface is comprised of one or more bus pnode names. The sum of the factors for each bus pnode name comprising an aggregate or interface definition add up to approximately one.

Name: aggregate or interface pnode name

Type: aggregate or interface pnode type

B1: station name of the bus pnode name comprising the aggregate or interface definition

B2: voltage level of the bus pnode name comprising the aggregate or interface definition

B3: equipment name of the bus pnode name comprising the aggregate or interface definition

Bus #: PSSE bus number of the bus pnode name comprising the aggregate or interface definition

Factor: percentage factor of the bus pnode name comprising the aggregate or interface definition

Aggregate Definitions - Long-Term Round 5

Lists the aggregate and interface definition pnode name mappings that apply to round five of the long term FTR auction market that is open after the date the files are posted. Each aggregate and interface is comprised of one or more bus pnode names. The sum of the factors for each bus pnode name comprising an aggregate or interface definition add up to approximately one.

Name: aggregate or interface pnode name

Type: aggregate or interface pnode type

B1: station name of the bus pnode name comprising the aggregate or interface definition

B2: voltage level of the bus pnode name comprising the aggregate or interface definition

B3: equipment name of the bus pnode name comprising the aggregate or interface definition

Bus #: PSSE bus number of the bus pnode name comprising the aggregate or interface definition

Factor: percentage factor of the bus pnode name comprising the aggregate or interface definition

B1 - B2 - B3 Power System Simulator for Engineering (PSSE) Mapping File

Lists the B1, B2 and B3 bus pnode name mappings.

B1: station name

B2: voltage level

B3: equipment name

PSSE Bus#: PSSE bus number

Load Apportionment Zones Hubs

Lists the zone and hub definition pnode name mappings. Each zone and hub is comprised of one or more bus pnode names. The sum of the factors for each bus pnode name comprising a zone or hub definition add up to approximately one.

Name: zone or hub pnode name

Type: zone or hub pnode type

B1: station name of the bus pnode name comprising the zone or hub definition

B2: voltage level of the bus pnode name comprising the zone or hub definition

B3: equipment name of the bus pnode name comprising the zone or hub definition

Bus #: PSSE bus number of the bus pnode name comprising the zone or hub definition

Factor: percentage factor of the bus pnode name comprising the zone or hub definition

Load Apportionment Zones Hubs - Long-Term Round 5

Lists the zone and hub definition pnode name mappings that apply to round five of the long term FTR auction market that is open after the date the files are posted. Each zone and hub is comprised of one or more bus pnode names. The sum of the factors for each bus pnode name comprising a zone or hub's definition add up to approximately one.

Name: zone or hub pnode name

Type: zone or hub pnode type

B1: station name of the bus pnode name comprising the zone or hub definition

B2: voltage level of the bus pnode name comprising the zone or hub definition

B3: equipment name of the bus pnode name comprising the zone or hub definition

Bus #: PSSE bus number of the bus pnode name comprising the zone or hub definition

Factor: percentage factor of the bus pnode name comprising the zone or hub definition

Phase Angle Regulator (PAR) Data

Lists the PAR mappings.

First column: station name

Second column: voltage level

Third column: equipment name

From Bus #: from PSSE bus number

To Bus #: to PSSE bus number

Deg: upper degree limit

Deg: lower degree limit

MW: upper MW limit

MW: lower MW limit

PJM Interface Definitions Limits

Lists the interface definition branch mappings, direction and limits. Each interface is comprised of one or more branches.

First column: interface name

Second column: station name of the branch comprising the interface definition

Third column: voltage level of the branch comprising the interface definition

Fourth column: equipment name of the branch comprising the interface definition

From Bus #: from PSSE bus number

To Bus #: to PSSE bus number

Direction: 1 is monitoring in the direction of the From Bus # column to the To Bus # column while -1 is monitoring in the direction of the To Bus # column to the From Bus # column

Eighth column: interface name, names ending in Contingency monitor for contingency conditions

Limit (MW): MW limit

Power System Simulator for Engineering (PSSE) Branch Mapping File

Lists the branch or line and transformer mappings. These mappings can be used to help determine the direction for binding constraint data available in FTR Center or posted files found under the appropriate auction or allocation section on the Financial Transmission Rights page, which is available on the PJM Web Site. The From Bus # column to the To Bus # column maps to binding constraints ending with _I while the To Bus # column to the From Bus # column maps to binding constraints ending with _Z.

First column: station name

Second column: voltage level

Third column: equipment name

From Bus #: from PSSE bus number

To Bus #: to PSSE bus number

Circuit ID: circuit ID

Uncompensated Parallel Flow
Lists the uncompensated parallel flow or loop flow mappings.

Interface: station name for bus pnode names, aggregate or interface pnode name

Second column: voltage level for bus pnode names

Bus #: PSSE bus number for bus pnode names

Injection/Withdrawal: positive indicates a MW injection while negative indicates a MW withdrawal

FTRs Affected by LMP Bus Model Updates CSV Files

The posted files list the replacement pnode names for deleted and renamed bus and aggregate pnode names if applicable due to a LMP Bus Model update. Some posted files are specific to other events such as interface retirements, interface consolidations, zone integrations or other unique situations that list the replacement pnode names for deleted and renamed bus, aggregate and interface pnode names if applicable.

The posted files are not a comprehensive list of all pnode name changes in the LMP Bus Model update, as replacement pnode names are listed for sources or sinks that have awarded FTRs in effect on the implementation date of the update and beyond. The posted files are named in the format of the month, day and year that the updates are implemented. For additional information on timing for the updates, refer to the LMP Bus Model Timeline section above. The posted files list the reason and implementation date for the update in the top row along with the relevant pnode information for the deleted or renamed pnode name and the replacement pnode name. The files for LMP Bus Model updates are typically posted approximately a week before the implementation date of the network model build while files for other events are posted on an as needed basis.

FTR Model Critical Energy Infrastructure Information Section Posted Files

There are two sections under the FTR Model Critical Energy Infrastructure Information section found on the FTR Model Critical Energy Infrastructure Information page, which is available on the PJM Web Site. Additional access is required to view the FTR Critical Energy Infrastructure Information site.

The FTR and ARR markets use the same network model as Day-Ahead. A Day-Ahead case is setup without modeling facility outages though the circuit breaker and disconnect configurations may cause some facilities to be out-of-service. The Day-Ahead case is configured to use the 95° day temperature limit set for all hours and zones along with the facility limit derates based upon a historical analysis of binding constraint market flow data. Facility limits of 9999 or 99999 are not monitored.

The Day-Ahead case is executed, and a one-hour snapshot is exported as a bus-branch model to create the network model .RAW and .SAV posted files as well as the contingency list PSSE compatible text posted file. The contingency flowgate list posted file is derived from the device-breaker model. Typically, the network model .RAW and .SAV files are posted in a solved state, which sometimes requires altering parameters such as modifying the gen and load values. These modeling files are posted for topology purposes specific to the FTR and ARR markets and are not intended to be used for other purposes.

Long-Term & Monthly Model Files

The posted files apply to the rounds of the long term FTR auction and monthly FTR auction markets that open after the date the files are posted. These posted files correlate to the mapping files found under the Model Information section in the long-term and monthly dropdown on the Financial Transmission Rights page, which is available on the PJM Web Site.

Network Model

The network model topology is posted in the PSSE .RAW file format for the bus-branch model. It is a raw power flow data file, which is a text file that can be opened and edited in text editor programs. It can also be opened in PSSE software programs.

Network Model Saved Case

The network model topology is posted in the PSSE .SAV file format for the bus-branch model. It is a binary file that can be opened in PSSE software programs.

Contingency & Flowgate List

Lists the contingency definitions by ID, contingency name and equipment status for the device-breaker model. A key for the action taken values (CL, CP, L, LD, OP, P, S, U, X, etc.) for the equipment status can be found on the LMP Model Information page, which is available on the PJM Web Site.

Contingency List PSSE Compatible

Lists the contingency definitions by ID, contingency name and equipment status for the bus-branch model. It is a text file that can be used in PSSE software programs.

Annual Model Files

The posted files apply to the rounds of the annual FTR auction and annual ARR allocation markets that open after the date the files are posted. These posted files correlate to the mapping files found under the Model Information section in the annual dropdown on the Financial Transmission Rights page, which is available on the PJM Web Site.

The annual network model .RAW and .SAV files include the highlighted upgrades in the key system upgrades scheduled posted file found under the Annual Auction Revenue Rights (ARR) Allocation section in the corresponding planning period's dropdown on the Financial Transmission Rights page, which is available on the PJM Web Site.

Network Model

The network model topology is posted in the PSSE .RAW file format for the bus-branch model. It is a raw power flow data file, which is a text file that can be opened and edited in text editor programs. It can also be opened in PSSE software programs.

Network Model Saved Case

The network model topology is posted in the PSSE .SAV file format for the bus-branch model. It is a binary file that can be opened in PSSE software programs.

Contingency & Flowgate List

Lists the contingency definitions by ID, contingency name and equipment status for the device-breaker model. A key for the action taken values (CL, CP, L, LD, OP, P, S, U, X, etc.) for the equipment status can be found on the LMP Model Information page, which is available on the PJM Web Site.

Contingency List PSSE Compatible

Lists the contingency definitions by ID, contingency name and equipment status for the bus-branch model. It is a text file that can be used in PSSE software programs.

Revision History

Revision 00 (December 17, 2021)

- Network Model User Guide created