Available Transfer Capability Implementation Document (ATCID)
PJM Effective Date: March 29, 2019

1. Purpose

The purpose of this document is to describe how PJM performs Available Transfer Capability (ATC) calculations and how PJM process meets the requirements of the NERC MOD-001-1a and MOD-030-3 standards.

2. NERC Functional roles

PJM is registered as both the Transmission Operator (TOP) and the Transmission Service Provider (TSP).

3. Description of Flowgate Methodology implementation

PJM has selected to apply the Flowgate Methodology, as described in NERC MOD-030-3, as the calculation methodology for Available Flowgate Capability (AFC) and ATC. *(MOD-001-1a R1)*

The following description provides an overview of how PJM has implemented the Flowgate methodology.

a. TARA software for AFC calculation available from PowerGEM http://www.power-gem.com
b. PAAC software for ATC calculation available from PowerGEM http://www.power-gem.com

The following are the major inputs used by TARA and PAAC:

a. Base Cases – (CEII protected) derived from MMWG series cases as modified by ERAG or IDC. Base cases cover the current through next 18 months.
b. Script files required to run the AFC and ATC calculation software.
c. Input files associated with Base Case in use
    i. Flowgate monitored/contingency and related files.
    ii. Flowgate definition parameters
    iii. Subsystem definition
    iv. Generator Dispatch
d. Static Input files associated with ATC - POR/POD and path definitions.
e. Dynamic input files associated with AFC and ATC
    i. Tag dump - includes reservations that have NERC tags and are scheduled to flow.
    ii. Reservation related files - includes PJM and external reservations.
    iii. AFC override values and allocations for flowgates subject to sharing
    iv. NERC SDX files - Includes PJM and external transmission outages, generation outages, and load forecast

The PJM ATC Determination process is a multi-step integrated process consisting of several major components. An overview of the major facets of this process is described below:

1. Seasonal base cases, NERC SDX files with transmission and generation outages, generation dispatch files, generic load profiles, and forecasted load levels are inputs into the model builder portion of the AFC/ATC Calculation. The model builder develops monthly, weekly, daily, and hourly base cases, as specified by the TARA scripts. The base case is used to calculate initial flowgate usage values, which in turn, are inputs into the AFC calculator.
2. The AFC calculator applies the impacts of transmission reservations (or schedules as appropriate) and calculates the Available Flowgate Capability by determining the capacity remaining on individual flowgates for further transmission service activity. The formula used to determine AFC is contained in the AFC algorithm provided in section Algorithms later in this document. The PJM AFC calculation utilizes the AFC values for selected coordinating entity flowgates that are calculated by the coordinating Transmission Service Provider.
3. Using transfer response or distribution factors for the specific POR/POD pairs, the AFC – ATC converter translates the flowgate AFC values into ATC values for posting the OASIS.

Values provided to the OASIS from the PJM AFC-ATC Converter are used by PJM to evaluate transmission service requests for periods less than one year. The ATC values are calculated once per hour.

4. LOAD FLOW MODEL

4.1 Base Case Model Development *(MOD-030-3, R3.1, R3.2, R3.3, R3.4, R3.5, R5.1, R5.2)*

PJM, as the TOP and TSP, develops and maintains seasonal models. The seasonal models are developed from the NERC MMWG, ERAG or IDC cases and modified during seasonal basecase preparation for any known model updates prior to going into production. The base case model includes the generation ratings, including minimum and maximum ratings, as specified by the generation owners. PJM includes additions and retirements within the scope of the industry models received from the MMWG, ERAG, or IDC model builds. These groups determine the appropriate additions and retirements of facilities in the coordinated models from which PJM derives the base case used in the AFC calculation. The model builder portion of the AFC/ATC engine modifies these seasonal base cases to reflect anticipated conditions such as forecasted load levels, outages, generation dispatch files, and base case transfers (reservations and/or schedules as appropriate) for the AFC/ATC time horizon. The base case models are refined to reflect transmission outages and generation unavailability as provided by the NERC SDX (System Data Exchange) data. Load levels are appropriately adjusted to reflect the modeled conditions using the NERC SDX data. Relevant balancing authorities external to the PJM footprint will be modeled at the appropriate load level with the generation scaled to match loads. The scope of the model used is the PJM footprint and adjacent areas covered by Entities with which PJM has coordinating agreements.

PJM uses the TARA commercial software package to create AFC cases for analyzing monthly, weekly, daily, and hourly transmission service requests. These cases serve as the base case models for the AFC calculation for a specific period. Solved base case models for monthly, weekly, daily, and hourly time frames are developed multiple times each day.

4.2 Generation and Transmission Outages *(MOD-001-1a R3.6 and MOD-030-3 R5.2)*

PJM as the TSP includes in the transmission model developed from the base case, the expected generation and Transmission outages that are in effect during the applicable period of the AFC calculation for the Transmission Service Provider's area, all adjacent Transmission Service Provider's areas where outage data is available, and any Transmission Service Provider's area with which coordination agreements have been executed and outage data is available.

PJM incorporates generation and transmission outages in the models used to calculate AFC values. PJM accesses the outage data from NERC SDX and utilizes a Scrubber to filter the outage data to include representative control areas that may impact PJM ATC calculations. PJM models representative generation and transmission outages as defined below:

1. PJM footprint generation outage data comes from the same pjm_outages.csv file used by external entities provided from PJM's eDart database or NERC using the SDX (System Data Exchange). PJM as the TSP considers all PJM footprint generation outages for generators with an installed capacity of 20 MW or greater and are within the scope of the implemented MMWG, ERAG, IDC, or similar model used for PJM's AFC process.
2. PJM footprint transmission outage data comes from the same pjm_outages.csv file used by external entities provided from PJM's eDart database or NERC using the SDX (System Data Exchange). PJM as TSP considers all PJM footprint transmission outages 161kV and above within the scope of the implemented MMWG, ERAG, IDC, or similar model used in the AFC Flowgate capability calculations per the additional criteria below.
3. External entity generation outage data considered comes from the NERC SDX (System Data Exchange). PJM as TSP considers all external entity generation outages, as provided in the SDX files, that map to the current base case, have an installed capacity of 20 MW or greater and are within the scope of the implemented MMWG, ERAG, IDC or similar model used in the AFC Flowgate capability calculations per the additional criteria below.
4. External entity transmission outage data considered comes from the NERC SDX (System Data Exchange). PJM as TSP considers all external entity transmission outages, as provided in the SDX files, that map to the current base case, are 161 kV and above, and are within the scope of the implemented MMWG, ERAG, IDC or similar model used in the AFC Flowgate capability calculations per the additional criteria below.

In Addition to the above, PJM applies the following criteria when applying outages:

1. The name of the bus(es) in the NERC SDX file matches the name of the bus(es) in the model used in the applicable model horizon.
2. Valid PJM and external outages are included when the following conditions apply for the given time horizon.
   - Hourly – Outages in effect for the given hour are considered for that hour.
   - Daily – *(MOD-001-1a R3.6.1)* Outages in effect for at least 50% of the time between the hours of 7AM and 11PM (8hrs of the 16 hrs. in the peak window) on the specific day being calculated (Monday through Sunday) are considered outaged for the entire day or as specified in the amb_common_option.dir script file. The Daily AFC calculation has a cutoff that applies to ignore constraints if contingency flow doesn't change from the base case more than 5 MW.

- Weekly - Outages for any day are included as outaged for the entire week if they are in effect (outaged) for at least 50% of the time between the hours of 7AM and 11PM (8hrs of the 16 hrs. in the peak window) on the representative day (Wednesday) of the week being calculated or as specified in the amb_common_option.dir script. The Weekly AFC calculation has a cutoff that applies to ignore constraints if contingency flow doesn't change from the base case more than 5 MW.
- Monthly *(MOD-001-1a R3.6.2)* - Outages for any day are included as outaged for the entire month if they are in effect (outaged) for at least 50% of the time between the hours of 7AM and 11PM (8hrs of the 16 hrs. in the peak window) on the representative day (the third Wednesday) of the month being calculated or as specified in the amb_common_option.dir script. The Monthly AFC calculation has a cutoff that applies to ignore constraints if contingency flow doesn't change from the base case more than 5 MW.

Outages impacting Merchant path ATC are treated differently because their default ATC is determined based on transmission withdrawal and transmission injection rights. For outages impacting Merchant path ATCs, PJM considers operational study results/procedures and the outage rules above to adjust Merchant ATC only for the impacted operating period.

4.3 Consideration of outages that cannot be mapped *(MOD-001-1a R3.6.3)*

Outages from other Transmission Service Providers that meet criteria under above that cannot be mapped to the transmission model are not used to calculate AFC or Flowgate capability until possibly the next model build, which is currently twice a year in coordination with the MMWG, ERAG, or IDC model builds. An external entity is responsible to include appropriate facilities in the coordinated models from which PJM derives the base case used in the AFC calculation. PJM monitors and updates invalid mappings of PJM outaged facilities as appropriate to ensure representative ATC results. At times, PJM may include or exclude outages if PJM deems it appropriate to provide AFC results more consistent with operations, to provide a better quality solution, or to provide a more representative AFC result.

4.4 Load Forecasts *(MOD-001-1a R9)*

PJM includes load forecast data for PJM Balancing Authority (BA), first tier neighbors and entities for which PJM has coordination agreements. The load forecast data is obtained via an internal application, PJM eDART that sends/retrieves load data from OATI webSDX, a NERC approved System Data Exchange site. The data is exchanged between PJM and NERC SDX 4 times per hour and updated in the AFC model 3 times per day.

PJM load forecast data for the PJM BA is obtained from the annual PJM Load Forecast Report. Where external load data is not provided for a given time horizon, PJM will use the most current load data for a given time horizon.

4.5 Generation Dispatch *(MOD-030-3 R6.1 and R6.2, MOD-001-1a R9)*

PJM as TSP includes, within its generation dispatch, all PJM unit commitment and order of dispatch, all designated network resources and other resources that are committed or have a legal obligation to run, or as they are expected to run. PJM commits generation using a block dispatch methodology.

5. FLOWGATE METHODOLOGY

5.1 Flowgate Criteria *(MOD-030-3 R1.1, R2.1.2)*

The criteria used by PJM as the Transmission Operator (TOP) to identify sets of Transmission Facilities as Flowgates that are to be considered in AFC calculations are included in PJM's Tariff (OATT), Attachment C, "Methodology To Assess Available Transfer Capability". The OATT is located on the PJM public website at the following link: http://www.pjm.com/library.aspx. An excerpt of the referenced section is included below:

PJM models some flowgates without contingencies and some with contingencies. The flowgates modeled without contingencies are the Power Transfer Distribution Factor (PTDF) flowgates, which are flowgates where a single facility or multiple transmission facilities are monitored for a limiting condition. The limiting condition can be due to thermal loading above 100% of the normal rating or due to a thermal rating above 100% of the surrogate rating representing an equivalent voltage or stability limit.

The flowgates modeled with contingencies are the Outage Transfer Distribution Factor (OTDF) flowgates, which are flowgates where a single facility or multiple transmission facilities are monitored for a limiting condition after a contingency event has been simulated to have occurred (one or multiple facilities for the loss of another facility or facilities). The limiting condition monitored can be due to thermal loading above 100% of the four hour emergency rating.

For flowgates owned by other parties, the Transmission Provider uses the limit provided by that party, subject to the terms of the AFC Coordination and Congestion Management Process sections of the applicable agreements between Transmission Provider and the other parties.

PJM implements provisions of Joint Operating Agreements with its neighbors specifying the identification of flowgates and includes flowgates with an OTDF or PTDF of 5% and are within the PJM control area. PJM's agreements are posted at: http://www.pjm.com/library.aspx

PJM uses the same power flow contingency file used in the planning of operations for identification of flowgates for the ATC process. PJM considers the impacts of Remedial Action Scheme (RAS) which are modeled in the Transmission Owner provided contingency files. PJM does not postulate regarding the most limiting flowgate in a series path. The AFC software evaluates all flowgates as part of the process. The most limiting flowgate is identified by the analysis. PJM shall include, at a minimum, the top three limiting elements with an outage transfer distribution factor (OTDF) of at least 3%, as flowgates based on the BA to BA transfer analysis. Ratings are used from the MMWG case assembled with information from the transmission owners or if more updated ratings are provided by the transmission owner via PJM's eDART application as described under Flowgate Ratings section. *(MOD-030-3 R2.1.2.1, R2.1.2.2, R2.1.2.3)*

PJM only calculates ATCs on paths that are inter-BA and has no internal ATC paths. The entire PJM transmission system is treated as a single control area. *(MOD-030-3 R 2.1.1)*

PJM implements Eastern Interconnection TLR (Transmission Loading Relief) procedures. Flowgates which have experienced a TLR within the last 12 months are included in the AFC process. PJM updates the AFC flowgates at least once every 12 months, but more often when appropriate with those flowgates that have been subject to TLR procedures. *(MOD-030-3 R 2.1.3)*

5.2 Flowgate Analysis Timing

PJM performs a flowgate analysis at least once every 12 months, but more often if needed to reflect significant changes, such as integration of a new area. *(MOD-030-3 R2.2)*

5.3 Flowgate Requests by other Transmission Service Providers

PJM includes external entity flowgates with a 5% distribution factor in the AFC process. PTDF or OTDF is applied as appropriate to the flowgate as defined by the requesting TSP. PJM performs a BA to BA transfer analysis to determine flowgates that meet the cutoff based on the distribution factor of a single generator or the aggregate transfer impact. Where agreements are in effect between PJM and another BA, coordination studies with other BAs are performed as prescribed in the applicable operating agreements. PJM performs analysis of neighboring entity flowgates when requested and adds to PJM's process within 30 days of the request. *(MOD-030-3 R2.1.4 and R2.3)*

5.4 Flowgate Ratings

Total Flowgate Capability (TFC) is the rating assigned to a flowgate. For PJM flowgates, PJM applies the normal (continuous) rating to the flowgate if it has no associated contingency (PTDF), and the long term emergency rating to the flowgate if it is defined with a contingency. Flowgates which are limited by voltage or stability are assigned a thermal surrogate rating which is calculated based on a transfer limit analysis. For external flowgates, PJM applies the ratings provided by the owning entity and consistent with applicable joint operating agreements; otherwise the rating from the power flow model is applied. *(MOD-030-3 R2.4)*

For PJM flowgates, PJM applies the facility rating(s) as provided by the PJM transmission owners. PJM uses an automated flowgate file creator to update the flowgate ratings when new ratings are provided from Transmission Owners to PJM via the eDART application. When new ratings are detected for a flowgate with a valid mapping, an updated flowgate file is generated and then sent to the transmission service engineers. PJM applies the updated ratings, within the scope of the model, to the AFC process within 7 days. *(MOD-030-3 R2.5, and R2.6)*

6. Source and Sink Definitions *(MOD-030-3 R1.2.1, R1.2.2, R1.2.3, R1.2.4, R4)*

6.1 Reservation Impacts and source/sink definition

PJM defines that the source used for AFC and ATC calculations is obtained from the Point of Receipt (POR) field of the transmission reservation. *(MOD-030-3 R1.2.1)*

PJM defines that the sink used for AFC and ATC calculations is obtained from the Point of Delivery (POD) field of the transmission reservation. *(MOD-030-3 R1.2.2)*

Transmission service reservations from the PJM and non-PJM OASIS sites are utilized for AFC and ATC calculations. The Point of Receipt (POR) is used as the source for all of these reservations, as appropriate. The Point of Delivery (POD) is used as the sink for all of these reservations, as appropriate. PJM does not use a discrete point for a source, like a specific generator, to calculate AFCs. Any valid POR or POD that is to be used, but cannot be mapped is assigned an alias name and mapped to a valid POR/POD that is representative of the flow for mapping purposes. *(MOD-030-3 R1.2.3, R4)*

PJM's POR/POD identification and mapping to the model are included at the following location:

http://www.pjm.com/markets-and-operations/etools/oasis/atc-information.aspx

6.2 Generation Dispatch and Source/Sink Definition *(MOD-030-3 R1.2.4)*

PJM's POR/POD definitions in the AFC calculation process use a grouping of generators or 'subsystems'. PJM's grouping of generators is included in ATC_POR_POD & Dispatch file at the following location:
http://www.pjm.com/markets-and-operations/etools/oasis/atc-information.aspx

Each POR/POD represents a geographic area with generation located in the area represented by the POR/POD grouped for dispatch to source/sink the transfer for the model. PJM, when identified as the POR or POD, groups generation by a sub-area geographically closest to the transaction path. For example, generation in AEP is grouped and scaled to source a transaction to TVA. Generator participation factor within these groups is determined as follows:

POR: Online units are eligible to participate, and are scaled pro rata with respect to their available generation. In other words, the participation factor is equal to $P_{max} - P_{gen}$.

POD: Online units are eligible to participate, and are scaled pro rata with respect to their generation available to be reduced. In other words, the participation factor is equal to $P_{gen} - P_{min}$.

7. Allocation Processes *(MOD-001-1a R3.5)*

PJM as the TSP has processes that are part of the FERC approved Congestion Management Process (CMP) that are used to allocate transfer or flowgate capabilities between Transmission Service Providers to address issues such as forward looking congestion management and seams coordination. PJM implements the Congestion Management Process that allocates flowgate capabilities between participating transmission service providers including MISO and TVA. The Congestion Management Process appears in the CMP Master document located in the PJM-MISO JOA, Attachment 2:
http://www.pjm.com/directory/merged-tariffs/miso-joa.pdf

The CMP Master Document section 6, "Reciprocal Operations", thoroughly describes the application of Available Share of Total Flowgate Capability (ASTFC) to the transmission service process. The methodology is described in several sub-sections in the application of impact determination, allocations amongst the entities and determination of what remains available for sale of service (ASTFC). Section 6.6, "Forward Coordination Processes" contains an example of an ASTFC calculation, and further describes how service is limited by either AFC or ASTFC as appropriate. AFC is calculated for all flowgates even if the sale of transmission service is limited by ASTFC.

Specific Coordinating Agreements between Entities are located at the following location:
http://www.pjm.com/library.aspx

PJM does not currently have agreements with Duke Energy Carolinas, NYISO, or Progress Energy that require implementation of an allocation process.

8. AFC

PJM's AFC/ATC calculation implements the following principles for firm and non-firm ATC calculations: (1) for firm ATC calculations, PJM accounts only for firm commitments; (2) for non-firm

ATC calculations, PJM accounts for both firm and non-firm commitments. Reservations from the PJM and non-PJM OASIS sites are utilized. Flow based analysis is used to determine and update flowgate loadings for reservations not modeled in the base case and to determine response factors on each flowgate. Flowgate loadings and response factors are used to determine the individual path ATC values.

- PJM recognizes physical network limitations (i.e., flowgates) on PJM and appropriate non-PJM systems in the determination of the path ATC values.

- AFC values received from coordination entities are calculated by those entities according to their AFC methodology. *(MOD-030-3 R5.3)*

PJM calculates initial AFC values for flowgates on the following frequencies for the following horizons *(MOD-030-3 R10.1, 10.2, 10.3)*:

- Hourly (hours 1 to 168) – three times per day
- Daily (days 1 to 35) – three times per day
- Weekly (week 1 to 5) – three times per day
- Monthly (month 1 to 18) – three times per day

In calculating AFCs, PJM applies assumptions that are no more limiting than that used in the planning of operations. *(MOD-001-1a R6/R7)* NERC Category P1 criteria are used for planning of operations whereas in AFC screening, only a subset of the flowgates is monitored. Further, PJM applies updated load forecasts for calculation of AFC, whereas the peak load forecast is used in planning of operations. As stated in PJM's Tariff, PJM calculates TTC as required by NAESB but TTC is not an input to the calculation of ATC.

9. Existing Transmission Commitments (ETC)

9.1 Firm ETC

PJM accounts for the impact of Firm Existing Transmission Commitments (ETC_{Fi}) as follows.

- PJM includes Firm reservations of Network Integration Transmission Service (NITS) in the AFC/ATC calculations and the resources specified in the source of the reservation are included in the PJM unit commitment and Dispatch Order, as described above under Load Flow Model. PJM includes the impact of all firm NITS and does not apply a distribution factor cut-off. *(MOD-030-3 R6.1, R6.2)*

- PJM includes in its process Firm reservations that exist on PJM's OASIS in the MW amount listed. PJM incorporates reservations from neighbors but does not include the neighbors' reservations for transactions that are already accounted for on PJM's OASIS. Roll-over rights are included for reservations that exist on the PJM OASIS and exist for an interval of at least 5 years. All Transmission Service reservations are included with no distribution factor cut-off applied. *(MOD-030-3 R6.3, R6.4)*

- The Grandfathered reservations that are expected to be scheduled are embedded in the base case. The Grandfathered reservations that are not expected to be scheduled are not embedded into the case but added during the Scheduling Horizon as appropriate. PJM does not limit the Grandfathered Firm obligations used in the case by a distribution factor cut-off. *(MOD-030-3 R6.5, R6.6)*

9.2 Non-firm ETC

PJM accounts for the impact of Non-Firm Existing Transmission Commitments (ETC_{NFi}) as follows.

- PJM includes in its process Non-Firm reservations that exist on PJM's OASIS in the MW amount listed. PJM incorporates reservations from neighbors but does not include the neighbors' reservations for transactions that are already accounted for on PJM's OASIS. All Transmission Service reservations are included with no distribution factor cut-off applied. *(MOD-030-3 R7.1, R7.2)*
- The Grandfathered reservations that are expected to be scheduled are embedded in the base case. The Grandfathered reservations that are not expected to be scheduled are not embedded into the case but added during the Scheduling Horizon as appropriate. PJM does not limit the Grandfathered Firm obligations used in the case by a distribution factor cut-off. *(MOD-030-3 R7.3, R7.4)*
- PJM includes Non-Firm reservations of Network Integration Transmission Service (NITS) in the AFC/ATC calculations and the resources specified in the source of the reservation are included in the PJM unit commitment and Dispatch Order, as described above under Load Flow Model. PJM includes the impact of all Non-Firm NITS and does not apply a distribution factor cut-off. *(MOD-030-3 R7.5, R7.6)*

9.3 Scheduling Horizon

The Scheduling Horizon is a near-term ATC calculation window. Within the Scheduling Horizon, the ETC impacts of all firm (ETC_{Fi}) and non-firm (ETC_{NFi}) transactions are determined by the scheduled MW amount of corresponding eTags, as opposed to the transmission reservation MW amount. The Scheduling Horizon impacts the calculation of Hourly Non-Firm ATC for same-day service, and extends to day-ahead service intervals beginning with the 9am (EPT) hourly OASIS posting. *(MOD-030-3 R6, R7)*

10. Capacity Benefit Margin (CBM)

PJM applies CBM in calculation of AFC used in evaluation of transmission service requests. PJM methodology for calculation and application of CBM is described in PJM's CBMID document, which is posted on PJM's OASIS website at:

ftp://ftp.pjm.com/oasis/CBMID.pdf

11. Transmission Reliability Margin (TRM)

PJM applies TRM in calculation of AFC used in evaluation of transmission service requests. PJM methodology for calculation and application of TRM is described in PJM's TRMID document, which is posted on PJM's website at the following location:

ftp://ftp.pjm.com/oasis/TRMID.pdf

12. Postback Methodology

PJM implements a postback methodology as described in PJM's Postback Methodology posted on PJM's website at the following location:

ftp://ftp.pjm.com/oasis/Postback-Methodology.pdf

13. Counter Flows

The manner in which PJM as the TSP will account for counterflows on a Flowgate is by including a percentage of each reservation in confirmed or accepted status in the opposite direction. *(MOD-001-1a R3.2)*

The description of how confirmed and accepted transmission reservations, expected interchange and internal counterflow are addressed in firm and non-firm ATC or AFC calculations is provided below.

Transmission reservation positive and counterflow rules are *(MOD-001-1a R3.2.1)*:

1. Firm reservations impact firm reservations in the positive and opposite direction at the percentages assigned in the flowgate definitions file. The default percentages in the positive and counterflow directions are 100% and 30% respectively.
2. Firm reservations impact on non-firm reservations in the positive and opposite direction at the percentages assigned in the flowgate definitions file. The default percentages in the positive and counterflow directions are 100% and 50% respectively.
3. Non-firm reservations impact on non-firm reservations in the positive and opposite direction at the percentages assigned in the flowgate definitions file. The default percentages in the positive and counterflow directions are 100% and 50% respectively.

The flowgate definition file used in ATC calculations contains the specific percentages of positive impact and counterflow impact assigned for a Flowgate. The specific percentage used on an internal PJM Flowgate is included in the flowgate definitions file located at: ftp://ftp.pjm.com/oasis/fgates-definitions-posting.csv

The expected interchange and internal counterflows are addressed in the AFC calculations used in both the firm and non-firm ATC calculations as follows:

1. Positive impact and Counterflow impact from expected Interchange in the base case in the positive and opposite direction, respectively, are included at 100%.
2. The impact of transactions and internal dispatch creating internal counterflows is included in the base case at 100%.

PJM as TSP uses the following rationale for the accounting to set the specific percentages on PJM Flowgates *(MOD-001-1a R3.2.2)*:

1. Counterflow impacts are set less than 100% to avoid the potential for off-setting reservations indicating zero system impact but where actual energy scheduling does not match these

reservation pairs. Positive and counterflow impacts which are different than these default values are set based on coordination with neighboring TSPs.

2. Positive impact and counterflow impact from expected interchange and the impact of transactions creating internal counterflows are 100% due to the nature of including these in the model used in AFC. This treatment results in every transaction being included at its full value.

14. Algorithms for AFC calculations

14.1 Firm AFC Calculation *(MOD-030-3 R8)*

When calculating Firm AFC for a Flowgate for a specified period, PJM uses the following algorithm:

$$AFC_F = TFC - ETC_{Fi} - CBM_i - TRM_i + Postbacks_{Fi} + Counterflows_{Fi}$$

Where,

AFC_F is the firm Available Flowgate Capability for the Flowgate for that period.

TFC is the Total Flowgate Capability of the Flowgate for that period and is equivalent to Total Transfer Capability (TTC).

ETC_{Fi} is the sum of the impacts of existing firm Transmission commitments on the Flowgate during that period.

CBM_i is the impact of the Capacity Benefit Margin on the Flowgate during that period.

TRM_i is the impact of the Transmission Reliability Margin on the Flowgate during that period.

$Postbacks_{Fi}$ are changes to firm AFC due to a change in the use of firm Transmission Service for that period.

$Counterflows_{Fi}$ are adjustments to firm AFC as determined by the Transmission Service Provider and specified in this document.

14.2 Non-Firm AFC Calculation *(MOD-030-3 R9)*

When calculating non-firm AFC for a Flowgate for a specified period, PJM uses the following algorithm:

$$AFC_{NF} = TFC - ETC_{Fi} - ETC_{NFi} - CBM_{Si} - TRM_{Ui} + Postbacks_{NFi} + Counterflows_{NFi}$$

Where:

AFC_{NF} is the non-firm Available Flowgate Capability for the Flowgate for that period.

TFC is the Total Flowgate Capability of the Flowgate for that period and is equivalent to Total Transfer Capability (TTC).

ETC_{Fi} is the sum of the impacts of existing firm Transmission commitments for the flowgate during that period.

ETC_{NFi} is the sum of the impacts of existing non-firm Transmission commitments for the flowgate during that period.

CBM_{Si} is the impact on the Flowgate of any schedules using Capacity Benefit Margin during that period.

TRM_{Ui} is the impact on the Flowgate of the Transmission Reliability Margin that has not been released (unreleased) for sale as non-firm capacity by the Transmission Service Provider during that period.

$Postbacks_{NFi}$ are changes to non-firm AFC due to a change in the use of non-firm Transmission Service for that period.

$Counterflows_{NFi}$ are adjustments to non-firm AFC as determined by the Transmission Service Provider and specified in this document.

PJM includes the impact of all firm generation or Network Integration Transmission Service in the AFC calculation.

15. ATC

15.1 AFC to ATC Conversion *(MOD-030-3 R11)*

When converting Flowgate AFCs to ATCs (and TFCs to TTCs) for ATC Paths, PJM uses the following algorithm:

$$TC = \min(P)$$

$$P = \{PTC1, PTC2, \ldots PTCn\}$$

$$PTC_n = \frac{FC_n}{DF_{np}}$$

Where,

TC is the Transfer Capability (either 'Available' or 'Total').

P is the set of partial Transfer Capabilities (either available or total) for all "impacted" flowgates honored by the Transmission Service Provider. A flowgate is considered "impacted" by a path if (a) the Distribution Factor for that path is greater than 3% on an OTDF Flowgate or PTDF Flowgate or (b) is at least 5%, consistent with the MOD-030 R2 standard.

PTC_n is the partial Transfer Capability (either 'Available' or 'Total') for a path relative to a flowgate n.

FC_n is the Flowgate Capability ('Available' or 'Total') of a flowgate n.

DF_{np} is the distribution factor for Flowgate n relative to path p.

15.2 Frequency of ATC calculations *(MOD-001-1a, 2.1, 2.2, 2.3, 8.1, 8.2, 8.3)*

PJM recalculates ATC once per hour for all valid paths posted on the PJM OASIS.

- Hourly (hours 1 to 168)
- Daily (days 1 to 35)
- Weekly (weeks 1 to 5)
- Monthly (months 1 to 18)

15.3 Merchant Controllable Facilities

The ATC of Merchant Transmission Facilities is determined based on the transmission injection and withdrawal rights of the facilities' primary rights holders. These values are static within the ATC engine. However, in accordance with the PJM Tariff and curtailment procedures, PJM may adjust Merchant path ATC based on operational analysis. Operational studies showing the need to restrict Merchant Transmission service to ensure reliability may result in ATC override values to adjust ATC appropriately. Additional information for merchant facilities is provided in the regional Business Practices found on the PJM OASIS Merchant Facilities page:

http://www.pjm.com/markets-and-operations/etools/oasis/merch-trans-facilities.aspx

15.4 Path Cap Limit

For paths that are not limited by a transmission facility, a Flowgate, or other limit, including software simulation limitations, PJM applies the path cap limit as the default rating and then subtracts out existing commitments on the contract path to arrive at the remaining Path ATC.

15.5 Operations Conditions

PJM ATC calculations are intended to represent the range of system conditions that are within the bounds of reliable operating criteria. Pursuant to Attachment C, paragraph 3 of the PJM Tariff, PJM determines transfer capability by employing both offline and real-time EMS analyses. In the event of unusual system conditions such as multiple overlapping outages, multiple generation outages, and conditions identified by PJM Operations as impacting ATC, PJM may limit ATC on a path, as directed by PJM Operations, to support the reliable operation of the transmission system.

16. Data Exchange

PJM receives data from and provides data to the Transmission Service Providers and Transmission Operators as noted below. *(MOD-001-1a R3.3, R3.4)* PJM receives and/or provides most of the data through an indirect means by having access to FTP sites created by the Coordinating Entities with which PJM has coordination agreements for exchange of this specific information and data. These agreements include the details of data exchanges between the Entities in Article IV, Exchange of Information and Data, and are located at:

http://www.pjm.com/library.aspx

PJM also accesses data from the NERC System Data Exchange (SDX), which is one of the methods of data exchange in coordination agreements used by TSPs and TOPs to exchange load forecast and outage data. Reliability Coordinators providing data to or retrieving data from the NERC SDX, for their own use or the use of their members include but are not limited to: MISO, NYISO, SOCO, SWPP, VACS and TVA.

PJM also receives base case modeling data from various groups associated with development of transmission load flow models which may be used to derive the base case model used in PJM's AFC calculation. These groups include, but are not limited to, MMWG, ERAG, and IDC.

PJM also provides base case modeling data to various groups associated with development of transmission load flow models which may be used to derive the base case model used in PJM's AFC calculation. These groups include, but are not limited to, MMWG, ERAG, and IDC.

Progress Energy Corporation, in addition to other data exchanges, receives telemetered PJM data to obtain real-time flows for their AFC/ATC calculation process.

Entity	Functional Role
Associated Electric Cooperative Inc.	Transmission Service Provider, Transmission Operator
Duke Energy Carolinas	Transmission Service Provider, Transmission Operator
Duke Energy Progress	Transmission Service Provider, Transmission Operator
Louisville Gas and Electric	Transmission Service Provider, Transmission Operator
Midcontinent Independent System Operator	Transmission Service Provider, Transmission Operator
New York Independent System Operator	Transmission Service Provider, Transmission Operator
Southern Company	Transmission Service Provider, Transmission Operator
Southwest Power Pool	Transmission Service Provider
Tennessee Valley Authority	Transmission Service Provider, Transmission Operator

Table 1: Entity Data - from which PJM receives data and to which PJM provides data

17. Administrative

17.1 Document Control

PJM's Available Transfer Capability Implementation Document (ATCID) is reviewed at least annually and is posted on PJM's public website at the link below. *(MOD-001-1a R5)*

ftp://ftp.pjm.com/oasis/ATCID.pdf

PJM notifies all adjacent Planning Coordinators, Reliability Coordinators and Transmission Service Providers before implementing a new or revised ATCID. PJM is the Planning Coordinator, Reliability Coordinator and Transmission Operator for PJM transmission area. *(MOD-001-1a R4)*

17.2 Data Requests *(MOD-001-1a R9.1, R9.2)*

PJM will make available data as required by MOD-001-1a R9.1 and R9.2, subject to applicable confidentiality agreements and CEII requirements. Data requests may include the following:

- Expected generation and transmission additions and retirements
- Expected generation and transmission outages
- Load Forecasts
- Block dispatch files
- Aggregated firm capacity set-aside for Network Integration Transmission Service and aggregated non-firm capacity set aside for Network Integration Transmission Service (i.e. Secondary Service).
- Firm and non-firm Transmission reservations.
- Aggregated capacity set-aside for Grandfathered obligations
- Firm roll-over rights.
- Any firm and non-firm adjustments applied by the Transmission Service Provider to reflect parallel path impacts.
- Power flow models and underlying assumptions.
- Contingencies files
- Facility Ratings
- Any services that impact Existing Transmission Commitments (ETCs).
- Values of Capacity Benefit Margin (CBM) and Transmission Reliability Margin (TRM) for all paths or flowgates.
- Values of Total Flowgate Capability (TFC) and AFC for any Flowgates
- Source and sink identification

17.3 Automated Application Maintenance *(MOD-030-3 R5.2)*

PJM commits to maintain a robust and representative ATC process that makes available unused transmission capacity while maintaining a reliable transmission system. In order to provide calculations with the most current information, PJM automated processes run as frequently as hourly. While these processes typically run without incident and require minimal downtime for maintenance, software applications do not always perform as designed. Application issues or limited downtime events may include invalid data inputs, file transfer failures, server problems, application failures or periodic maintenance downtime. PJM also recognizes the potential for application failures, both internal and external, and commits to handle application performance issues associated with the ATC process in the following manner:

1. PJM monitors all internal ATC applications continuously. This monitoring includes error messaging to both IT and business staff. PJM will use best efforts to identify the causes of the system failure and promptly restore the application. In this scenario, PJM will make reasonable efforts to continue calculating ATC using the best available data until the issue has been resolved. PJM will take appropriate actions to minimize any impact on reliability, such as the oversubscription of FIRM transmission service.

2. For external system failures such as the NERC Tag application or FTP site failures, PJM will continue to calculate ATC using the best available data. PJM will notify the external entity experiencing the failure to effect a resolution of the system problem and restore the processes to normal operations in a timely manner after such resolution is implemented and communicated.

17.4 Data storage and archiving

PJM archives AFC and ATC input data files and ATC output files for all AFC and ATC calculations. PJM retains the data for a period of 5 years.

17.5 Questions

Questions regarding any information contained in this document may be directed to PJMATCMethodologyContact@pjm.com.

Revision History

Reviewed January 20, 2021

- No change required.

Reviewed January 10, 2020

- No change required.

Revised March 27, 2019

- Administrative updates.

Revised September 5, 2018

- Updated remaining MOD-001-1 references to MOD-001-1a.

Revised February 3, 2018

- Updated Table 1 in Section 16.

Revised June 13, 2017

- Updated links
- Administrative Cleanup

Revised April 1, 2017

- Updated page headers.
- Section 5.1: Replaced references to “Special Protection System” with “Remedial Action Scheme” consistent with MOD-030-2 update to MOD-030-3
- Replaced all references to MOD-030-2 with MOD-030-3 in the document.

Revised January 20, 2017

- Added page headers.

Revised March 4, 2016

- Added detail to section 9.3 to specify the impact window of the Scheduling Horizon.

Revised February 16, 2016

- Administrative update to external entities identified in Section 16.
- Outdated language removed from Section 3.

Revised February 4, 2016

- Renamed the title of sections 9, 9.1 and 9.2 for clarity.
- Added section 9.3 to explain the Scheduling Horizon concept.
- Administrative update to references of MOD Standards.

Revised September 25, 2015

- Section 4.4: Minor wording change for clarity purposes.
- Section 16: Administrative cleanup of data exchange entities.

Revised September 01, 2015

- Section 15.1: Clarified to provide additional flexibility consistent with MOD-030, R2 flowgate analysis (including sub-requirements)

Revised February 26, 2015

- Minor changes to clarify language, add consistency and correct formatting issues.

Revised July 29, 2014

- Modified wording in section 4.1 for clarity. Also specified that the 'TARA' commercial software package is used to create PJM's AFC cases.
- Clarified wording in section 4.2. Also added language specifying PJM's process for incorporating outages into ATC calculations for Merchant Transmission paths.
- Section 4.5: specified that generation commitments applied to the AFC cases is done using the block dispatch methodology.
- Section 5.1: clarified that PJM uses a 3% cut-off threshold when performing the MOD-030, R2 flowgate analysis.
- Section 5.3: added language clarifying how the DFAX cut-off percentage is applied to neighboring TSP flowgate requests.
- Section 5.4: added language regarding how PJM establishes TFC limits for flowgates limited by voltage/stability.
- Section 6.2: provided details regarding generator participation in PJM's source/sink modeling.
- Section 15.3: Modified language to better explain PJM's process for Merchant Transmission path ATC calculations.

Revised December 6, 2013

- Modified wording from 'annually' to 'at least once every 12 months' in sections 5.1 and 5.2
- Updated Section 16 to exclude EKPC and include individual entities within MISO

Revised May 17, 2013

- Modified format to describe how PJM complies with requirements not previously addressed in earlier version for both MOD-001-1a and MOD-030-2
- Added revision history