South Carolina Public Service Authority
Available Transfer Capability Implementation Document (ATCID)

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Version 6.0

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Document Change History

Version	Date of Change	Description of Change
0.0	03/30/11	Original
1.0	05/01/12	Review. Minor revisions, clarified application of Counterflows to transmission reservations.
2.0	05/15/14	Review. Updated urls in *Software, Tools, & WebServices* section. Updated contacts in *AFC/ATC Methodology Contacts* section.
3.0	11/21/14	Added signature page. Clarified R3.5 of MOD-001-1a. Changed Progress Energy to Duke Energy Progress (DEP) and Duke to Duke Energy Carolinas (DEC). Made reference to Carolina Transmission Coordination Agreement.
4.0	10/30/15	Review. Clarified how mapping inconsistencies are handled in the *Model Building* section. Added utilization of "engineering judgement" in the *Daily and Monthly Horizon Criteria* section.
5.0	04/01/17	Review. Revised for MOD-030-3. Updated signatories changed ATC/AFC contact information.
6.0	07/09/18	Review. Updated Signatories and changed ATC/AFC contact information.

Available Transfer Capability Implementation Document

1. Purpose and Scope

Purpose

The purpose of Santee Cooper's Available Transfer Capability Implementation Document (ATCID) is to illustrate the methodology utilized in the calculation of Available Flowgate Capability (AFC), Available Transfer Capability (ATC), Remaining Contract Path Capability, and the coordination of ATC information between Santee Cooper and other entities. The information presented in this document is intended to facilitate the NERC MOD-001 and MOD-030 standards as approved by the Federal Energy Regulatory Commission (FERC).

The current ATCID is posted to Santee Cooper's OASIS home page making it available to any interested parties. Specifically it has been made available to Duke Energy Carolinas as the VACAR-South Reliability Coordinator Agent as well as Duke Energy Progress (DEP), Duke Energy Carolinas (DEC), South Carolina Electric & Gas (SCEG), and Southern Company as adjacent Planning Coordinators, Transmission Operators, and Transmission Service Providers. If Santee Cooper's ATCID is updated, any revisions and/or updates to this ATCID are subject to notice prior to implementation, pursuant to the North American Electric Reliability Corporation's (NERC) MOD-001 Standard Requirement 4.[1]

Santee Cooper will also make the ATCID available upon request given the request falls within confidentiality and security requirements.

Scope

South Carolina Public Service Authority (Santee Cooper) uses the NERC-approved Flowgate Methodology, as described in MOD-030, for calculating Available Flowgate Capabilities (AFCs) on Flowgates for each of its posted paths. The Flowgate Methodology is used for consistency and reliability in determining transfer capabilities for the Hourly, Daily, and Monthly horizon to support short-term and long-term system analysis and operations. The Available Transfer Capability Implementation Document (ATCID) also provides information pertaining to the Transmission Service Provider's (TSP) calculation of AFC.

2. Definitions[2]

2.1. Available Flowgate Capability (AFC)

A measure of the flow capability remaining on a Flowgate for further commercial activity over and above already committed uses. It is defined as Total Flowgate Capability (TFC) less Existing Transmission Commitments (ETC), less a Capacity Benefit Margin, less a Transmission Reliability Margin, plus Postbacks, and plus counterflows.

2.2. Available Transfer Capability (ATC)

[1] MOD-001-1a R4

[2] Most definitions obtained from the Glossary of Terms used in NERC Reliability Standards.

A measure of the transfer capability remaining in the physical transmission network for further commercial activity over and above already committed uses. It is defined as Total Transfer Capability less Existing Transmission Commitments (including retail customer service), less a Capacity Benefit Margin, less a Transmission Reliability Margin, plus Postbacks, plus counterflows.

2.3. ATC Path

Any combination of Point of Receipt and Point of Delivery for which ATC is calculated; and any Posted Path.

2.4. Block Dispatch

A set of dispatch rules such that given a specific amount of load to serve, an approximate generation dispatch can be determined. To accomplish this, the capacity of a given generator is segmented into loadable "blocks," each of which is grouped and ordered relative to other blocks (based on characteristics including, but not limited to, efficiency, run of river or fuel supply considerations, and/or "must-run" status).

2.5. Capacity Benefit Margin

The amount of firm transmission transfer capability preserved by the transmission provider for Load-Serving Entities (LSEs), whose loads are located on that Transmission Service Provider's system, to enable access by the LSEs to generation from interconnected systems to meet generation reliability requirements. Preservation of CBM for an LSE allows that entity to reduce its installed generating capacity below that which may otherwise have been necessary without interconnections to meet its generation reliability requirements. The transmission transfer capability preserved as CBM is intended to be used by the LSE only in times of emergency generation deficiencies.

2.6. Contract Path

An agreed upon electrical path for the continuous flow of electrical power between the parties of an Interchange Transaction.

2.7. Existing Transmission Commitments (ETC)

Committed uses of a Transmission Service Provider's Transmission system considered when determining ATC or AFC.

2.8. Firm Transmission Service

The highest quality (priority) service offered to customers under a filed rate schedule that anticipates no planned interruption.

2.9. Flowgate

1.) A portion of the Transmission system through which the Interchange Distribution Calculator calculates the power flow from Interchange Transactions.

2.) A mathematical construct, comprised of one or more monitored transmission Facilities and optionally one or more contingency Facilities, used to analyze the impact of power flows upon the Bulk Electric System.

2.10. Interchange Schedule

An agreed-upon Interchange Transaction size (megawatts), start and end time, beginning and ending ramp times and rate, and type required for delivery and receipt of power and energy between the Source and Sink Balancing Authorities involved in the transaction.

2.11. Interchange Transaction

An agreement to transfer energy from a seller to a buyer that crosses one or more Balancing Authority Area boundaries.

2.12. Non-Firm Transmission Service

Transmission service that is reserved on an as-available basis and is subject to curtailment or interruption.

2.13. Open Access Same Time Information Service (OASIS)

An electronic posting system that the Transmission Service Provider maintains for transmission access data and that allows all transmission customers to view the data simultaneously.

2.14. Open Access Transmission Tariff (OATT)

Electronic transmission tariff accepted by the U.S. Federal Energy Regulatory Commission requiring the Transmission Service Provider to furnish to all shippers with non-discriminating service comparable to that provided by Transmission Owners to themselves.

2.15. Operating Horizon

The period of time extending from the end of the Scheduling Horizon through month 13.

2.16. Outage Transfer Distribution Factor (OTDF)

In the post-contingency configuration of a system under study, the electric Power Transfer Distribution Factor (PTDF) with one or more system Facilities removed from service (outaged).

2.17. Planning Horizon

The period of time extending from the end of the Operating Horizon through the end of the FERC required posting period. System impact studies are performed by the Transmission Planning department for Transmission Service Requests, Re-direct requests, or requests with rollover rights in the Planning Horizon.

2.18. Point of Delivery (POD)

A location that the Transmission Service Provider specifies on its transmission system where an Interchange Transaction leaves or a Load-Serving Entity receives its energy.

2.19. Point of Receipt (POR)

A location that the Transmission Service Provider specifies on its transmission system where an Interchange Transaction enters or a Generator delivers its output.

2.20. Power Transfer Distribution Factor (PTDF)

In the pre-contingency configuration of a system under study, a measure of the responsiveness or change in electrical loadings on transmission system Facilities due to a change in electric power transfer from one area to another, expressed in percent (up to 100%) of the change in power transfer.

2.21. Scheduling Horizon

If the current time is before 12:00 pm Eastern Prevailing Time, the Scheduling Horizon is through midnight of the current day. If the current time is 12:00 pm or after, the Scheduling Horizon extends through midnight of the next day.

2.22. Total Flowgate Capability (TFC)

The maximum flow capability on a Flowgate, is not to exceed its thermal rating, or in the case of a Flowgate used to represent a specific operating constraint (such as a voltage or stability limit), is not to exceed the associated System Operating Limit.

2.23. Total Transfer Capability (TTC)
The amount of electric power that can be moved or transferred reliably from one area to another area of the interconnected transmission systems by way of all transmission lines (or paths) between those areas under specified system conditions.

2.24. Transfer Distribution Factor (TDF)
The portion of an Interchange Transaction, typically expressed in per unit that flows across a transmission facility (Flowgate).

2.25. Transmission Reliability Margin (TRM)
The amount of transmission transfer capability necessary to provide reasonable assurance that the interconnected transmission network will be secure. TRM accounts for the inherent uncertainty in system conditions and the need for operating flexibility to ensure reliable system operation as system conditions change.

2.26. Transmission Service Provider (TSP)
The entity that administers the transmission tariff and provides Transmission Service to Transmission Customers under applicable transmission service agreements.

3. Available Flowgate Capability (AFC) Process Overview

Santee Cooper uses the Flowgate Methodology for calculating AFCs and the resultant ATCs for each ATC Path. The Available Transfer Capability (ATC) is computed from the calculated Available Flowgate Capability (AFC) values. The Flowgate Methodology is based on the notion that certain elements on the transmission system will reach their limits before other elements on the system; hence monitoring the more sensitive areas on the transmission system, transfer capability calculations can be simplified in regard to the number of contingencies and monitored elements examined during each study. Study results should reflect the direction in which the power would actually flow if a Transmission Service Request (TSR) were allowed.

Santee Cooper's Flowgate development is performed annually at a minimum through a coordinated Flowgate determination method. Those determined Flowgates are then rolled into Santee Cooper's two-part AFC process which consists of model building and AFC calculation as described in the Modeling Building and AFC Calculation sections of this document.

Santee Cooper exchanges data for Flowgate determination, model building, and AFC calculation, including AFC overrides, with Duke Energy Progress, Duke Energy Carolinas, South Carolina Electric & Gas, and Southern Company as adjacent Transmission Operators and adjacent Transmission Service Providers[3].

Flowgate Determination[4]

At a minimum, the list of Flowgates in the transfer capability calculation process are reviewed annually. Flowgates can also be requested for inclusion by other TSPs, and/or identified by various screening test.[5]

[3] Reference: MOD 001-1a R3.3 & R3.4
[4] Reference: MOD-030-3 R1.1
[5] Reference: MOD-030-3 R2.2 & R2.3

Santee Cooper adjusts Flowgate inclusions as required by Carolina Transmission Coordination Agreement. Available Flowgate Capability (AFC) sharing helps to manage parallel flows across specified interfaces between Santee Cooper and its adjacent Balancing Authorities: Duke Energy Carolinas, Duke Energy Progress, South Carolina Electric & Gas, and/or Southern Company.

Identification of Flowgates is based at a minimum on the results of first contingency transfer analysis from adjacent BA source and sink combinations up to the path capability where the first three limiting elements and their worst contingency combinations with a TDF of at least 5% are included.[6] The first contingency criteria is consistent with N-1 contingency analysis used in the planning of operations for the given study period.[7] Study results of the first contingency transfer analysis are filtered to include the most limiting element in a series configuration.[8] At this point, Santee Cooper has not identified any Flowgates that are kept within its limits for its associated worst contingency by operating within the limits of another Flowgate.[9]

The VACAR South Reliability Coordinator Agent provides a list of any limiting element and/or contingency combination that has been subjected to an Interconnection-wide congestion management procedure within the last 12 months for BAs and adjacent BAs. However, any limiting Element and/or Contingency combination accounted for using another ATC methodology or created to address temporary operating conditions is not included as a Flowgate.[10]

Request from another TSP to incorporate an external Flowgate in Santee Cooper's AFC process must be included in the requesting TSP's methodology, and the specified Flowgate must pass various screening tests such as:

> Any generator within Santee Cooper's TSP area has at least a 5% TDF impact on the Flowgate when delivered to the aggregate load of Santee Cooper's TSP area or a transfer from Santee Cooper's TSP area to an adjacent BA Area has at least a 5% TDF impact on a Flowgate.[11]

Internal and External area Flowgates that are not addressed by the methods previously discussed will be identified as needed by screening test. In all, Santee Cooper's Flowgate analysis is consistent with the current NERC MOD Standards.

<u>AFC Coordination</u>

AFC values for external Flowgates are calculated and provided by the appropriate TSP or Flowgate owner. The AFC Calculator will utilize the "override" value when made available by the other TSP.[12]

[6] Reference: MOD-030-3 R2.1.2
[7] Reference: MOD-030-3 R2.1.2.1
[8] Reference: MOD-030-3 R2.1.2.2
[9] Reference: MOD-030-3 R2.1.2.3
[10] Reference: MOD-030-3 R2.1.3
[11] Reference: MOD-030-3 R2.1.4
[12] Reference: MOD-030-3 R5.3

Transfer or Flowgate Allocation Process[13]
Santee Cooper does not allocate transfer or Flowgate capability among multiple lines or sub-paths or multiple owners or users within a larger ATC Path or Flowgate, or between Transmission Service Providers to address issues such as forward looking congestion management and seams coordination.

Model Building
Santee Cooper participates in the SERC Long Term Study Group (LTSG) Power Flow Data Bank and contributes to preparing steady-state modeling data representing the SERC Region through these LTSG activities. These power flow models are then incorporated into the annual Eastern Reliability Assessment Group – Multiregional Modeling Working Group (ERAG-MMWG) library of power flow models.

Santee Cooper utilizes a starting point case from the given seasonal OASIS base case derived during the SERC Near Term Study Group (NTSG) OASIS Support Study process. These cases contain modeling data and system topology for VACAR South RC area and adjacent RCs.[14] Expected additions and retirements are included in the cases. If any additional information is provided, those updates will be incorporated into the models.[15]

The raw data for the power flow along with the monthly interchange schedules determined in the NTSG process are utilized to create multiple power flow snapshot models for each specified AFC horizon. The SERC NTSG OASIS Support Studies utilize the ERAG-MMWG library of power flow models and updates to the models are incorporated quarterly as system conditions change.

The detailed internal power flow model is developed in accordance with ERAG-MMWG Working Group modeling standards.

a) Transmission & Generation – Santee Cooper's model includes electrical characteristics, facility ratings based on summer or winter peak ambient conditions as well as critical facility thermal ratings, future facilities when warranted, and status of existing system elements (open switches, reconfigurations, etc). Generation facility ratings are based on summer or winter peak maximum and minimum output levels.[16]
b) System Load – Santee Cooper's area load is indicative of conditions for the given study period. Ambient-based system load will be adjusted to reflect summer and winter peak load conditions as well as monthly and daily peak load conditions. Santee Cooper's base load data is calculated based on historical and forecast load data.
c) Generation Dispatch – Generation in Santee Cooper's area is indicative of conditions for the given study period. Base case generation is based on economic dispatch with

[13] Reference: MOD-001-1a R3.5
[14] Reference: MOD-030-3 R3.4 & R3.5
[15] Reference: MOD-030-3 R5.2
[16] Reference: MOD-030-3 R3.1

base load units, hydro conditions, and peaking units given proper consideration for modeled conditions.

d) Interchange – Santee Cooper's interchange in the power flow model is adjusted to match the current NTSG OASIS Interchange schedule.
e) Phase Shifters – Santee Cooper does not employ phase shifters on its transmission system.
f) Remedial Action Scheme (RAS) – Santee Cooper does not own any Remedial Action Schemes.
g) Series Compensation – Santee Cooper does not utilize series compensation in its transmission facilities.
h) Grandfathered Agreements – Base transfers included in the NTSG OASIS Studies that are grandfathered or network do not have an associated OASIS reservation.[17]

The detailed external power flow model is enhanced with data from the NERC System Data Exchange (SDX) given data mapping is consistent. If the mapping is not consistent between the SDX and the given powerflow model due to various reasons such as name mismatches and/or topology changes, then Santee Cooper will use a manual outage file that defines the topology that matches the given powerflow model, in addition to the NERC SDX files. The manual outage file is shared among members of the VACAR AFC Working Group for use in their studies. Generation and transmission outages that cannot be mapped to the powerflow model will be reviewed periodically and passed on to the appropriate modeling group for consideration during the next model build.[18.]

Santee Cooper also utilizes load forecast data from the SDX when available to update the loads in the adjacent areas in the powerflow model. Given the load forecast, generation in the powerflow model is dispatched to meet the updated load and interchange requirements based on block dispatch provided by adjacent TSP.[19]

The external powerflow model is further enhanced through a coordinated effort and shared data files such as: block generation dispatch, pre-determined Flowgate definition, point of receipt (POR) and point of delivery (POD) generation and load subsystems including distribution factors as well as scheduled reservations made available through the NERC net's Tag Data Dump files are also incorporated with the model.

The block economic dispatch file depicts various subsystems which groups and dispatches generation units based on Santee Cooper's typical unit commitment. Generators within a group participate proportionally with respect to its unit rating.[20] The economic dispatch may be modified to reflect probable outages due to maintenance and/or system conditions. At a minimum, Santee Cooper develops a Block Economic Dispatch file for its Balancing Authority Area which is updated annually. However, Santee Cooper does not utilize direct dispatching for Santee Cooper's internal area model. If a direct dispatch file is utilized by an adjacent neighbor, then that information will be incorporated as needed.

[17] Reference: MOD-030-3 R6.5, R6.6, R7.3, & R7.4; NAESB Stds 001-19
[18] Reference: MOD-001-1a R3.6.3
[19] Reference: MOD-030-3 R6.2
[20] Reference: MOD-030-3 R1.2.4

The raw power flow data file and the additional system model updates are passed to an Automated Model Builder (AMB). The Automated Model Builder creates power flow snapshot models based on the available data inputs.[21] If no Block Economic Dispatch files are provided by external entities or if the provided file does not map to the powerflow model, is corrupted or otherwise cannot be used, the model builder will dispatch available generation based on its programmed design.

Source and sink for scheduled tags (from the NERC Tag Data Dump) are accounted for in Santee Cooper's AFC calculation process when scheduled tags are utilized in accordance to the model builder subsystem files. If the source/sink has been identified in the reservation and it is discretely modeled in the Transmission Service Provider's transmission model, Santee Cooper uses the discretely modeled point as the source/sink. If the source/sink has been identified in the reservation and the point can be mapped to an "equivalence" or "aggregate" representation in the Transmission Service Provider's transmission model, Santee Cooper uses the modeled equivalence or aggregate as the source/sink. If the source/sink has been identified in the reservation and the point cannot be mapped to a discretely modeled point or an "equivalence" representation in the Transmission Service Provider's transmission model, Santee Cooper uses the immediately adjacent Balancing Authority associated with the Transmission Service Provider from which the power is to be received as the source/sink. If the source/sink has not been identified in the reservation, Santee Cooper uses the immediately adjacent Balancing Authority associated with the Transmission Service Provider from which the power is to be received as the source/sink.[22]

From the initial system model the AMB engine will then provide Transfer Distribution Factors (TDFs) by flow gate for each POR/POD including load and generation.

- Intra-day, Next day, and days two through 30 are created once per day.
- Month two through 13 are calculated once per month.

AFC/ATC Calculation

OATi's webTrans application then determines the impacts of the Transmission Service Request on the flowgates, calculates AFCs and ATCs, evaluates new Transmission Service Requests, applies business rules (for netting flows and counter flows), and post ATCs to OASIS in compliance with the NERC Reliability MOD Standards.

The AFC Calculator will perform TSR validation checks, ATC evaluations and calculations, account for reservations and netting rules in the AFC calculation, post ATC values to OASIS, and recalculate ATC postings as TSP "business" occurs based on reservation status changes. This AFC process will cycle continually within the AFC Calculator until data is re-synced with new data inputs.

[21] Reference: MOD-030-3 R5.1
[22] Reference: MOD-030-3 R4

AFC Time Horizons

Santee Cooper calculates AFC for the following time horizons:

- Hourly Operating – Prior to 12 noon (or other preset time), current hour through midnight of current day; After 12 noon, current hour through midnight of the next day; Only horizon which incorporates tags from NERC Tag Dump
- Hourly Planning – From end of Hourly Operating horizon through midnight 6 days beyond current day
- Daily Planning – From end of the Hourly Planning horizon through midnight 31 days beyond the current day
- Daily Study – From the end of the Daily Planning horizon to last day of the month in which the end of the Daily Planning horizon exists
- Monthly Study – From end of the Daily Study Horizon through the end of the month 12 calendar months from the current month

The AFC values for the Hourly, Daily, and Monthly Horizons are calculated and posted, at a minimum, as follows[23]:

Horizon Type	AFC Value	Time Period	Calculation Frequency[24]
Hourly Operating	Intra-Day & Next Day (Hourly)	Current Hour – Hour 48	Once per hour
Hourly Planning	Extended Hourly	End of Hourly Operating horizon – midnight of the day 6 days beyond the current day	Once per day
Daily Planning	Daily	End of Hourly Planning horizon – midnight of the day 31 days beyond the current day	Once per day
Daily Study	Daily	End of Daily Planning horizon – last day of the month in which the end of the Daily Planning horizon exists	Once per day
Monthly Study	Monthly	Months 2 through 13	Once per week

All studies can be calculated "on-demand" as needed through an automated resync operation which correlates to a new model build

During the horizon in which schedules (tags) are being utilized, generation in the powerflow snapshot model is dispatched first by schedules (tags) then if more generation is needed to meet the forecasted load and net interchange requirements, Santee Cooper utilizes Block Economic Dispatch files and may use Direct Dispatch files to dispatch the remaining generation. When utilizing schedules (tags), the model builder applies the capacity in the energy profile of the schedule (tag). During horizons in which schedules (tags) are not utilized, generation in the powerflow snapshot model is simply dispatched utilizing the Economic Dispatch files and may use Direct Dispatch files to meet the forecasted load and net interchange requirements.

[23] Reference: MOD-001-1a R2 & MOD-030-2 R10
[24] Reference: MOD-001-1a R8

Hourly Horizon Criteria[25]

Generator outages of facilities and transmission outages of facilities 100 kV and above internal to the Santee Cooper transmission system and adjacent neighbors (DEC, DEP, SCEG) and 200 kV and above for TVA and Southern, active for the specified time of the day or during the peak hours of the day being calculated, that map to the seasonal case are included in the powerflow snapshot model.[26]

Hourly Operating Horizon – Non-Firm [27]

Transmission service expected to be scheduled will be considered to be the tags associated with confirmed reservations. The AFC Calculator will also include any newly queued non-firm TSRs that have not otherwise already been included as impacts, as transmission service expected to be scheduled for a limited time or until it is tagged.

Daily and Monthly Horizon Criteria[28]

Daily Study

Generator outages of facilities and transmission outages of facilities 100 kV and above internal to the Santee Cooper transmission system and adjacent neighbors (DEC, DEP, SCEG) and 200 kV and above for TVA and Southern, active at a minimum of 50% of the "Daily Peak Period" of the day being calculated, that map to the seasonal case are included in the powerflow snapshot model.[29]

The "Daily Peak Period" is defined based on the time horizon being studied. Since Santee Cooper has 2 distinct peaks, a summer peak and a winter peak, the "Daily Peak Period" is defined as 0600-1000 in the winter periods and 1400-1800 during the summer periods. Based on system conditions and engineering judgement, the "Daily Peak Period" could change to get the best representative "Daily Peak Period".

Monthly Study

Generator outages of facilities and transmission outages of facilities 100 kV and above internal to the Santee Cooper transmission system and adjacent neighbors (DEC, DEP, SCEG) and 200 kV and above for TVA and Southern, active at a minimum of 50% of the "Daily Peak Period" of the representative day in the month being calculated, that map to the seasonal case are included in the powerflow model. [30]

The representative day is defined as the third week of the month on the third day of that week. Based on system conditions and engineering judgement, the representative day may be modified to get the best representative day for the given conditions.

[25] Reference: MOD-030-3 R5.2
[26] Reference: MOD-001-1a R3.6
[27] Reference: MOD-030-3 R6.4
[28] Reference: MOD-030-3 R5.2
[29] Reference: MOD-001-1a R3.6.1
[30] Reference: MOD-001-1a R3.6.2

All Other Horizons – Firm & Non-Firm[31]

Transmission service expected to be scheduled will be considered to be firm and non-firm Transmission Service Requests (TSRs) that have not otherwise already been included as impacts or filtered to remove duplicates, etc. For internal network transmission service, TSRs will be substituted and "transmission service expected to be scheduled" is considered to be the initial flow impacts of the Gen-to-Load balance in the powerflow snapshot model.

4. Available Flowgate Capability (AFC) Calculations[32]

Base flows for each Flowgate and Transfer Distribution Factors are determined in the initial model build process using the AMB software as previously described. These initial values are then passed to the Open Access Technology International, Inc. (OATI) webTrans application known as the AFC Calculator. The AFC Calculator then applies this information in addition to other inputs to calculate each component of the AFC algorithm.

Firm[33]

$$\mathbf{AFC_F = TFC - ETC_{Fi} - CBM_i - TRM_i + Postbacks_{Fi} + counterflows_{Fi}}$$

Where:

AFC_F – firm Available Flowgate Capability for the AFC Path for that period
TFC – Total Flowgate Capability of the Flowgate
ETC_{Fi} – sum of existing firm Transmission commitments for the AFC Path during that period
CBM_i – Capacity Benefit Margin for the AFC Path during that period
TRM_i – Transmission Reliability Margin for the AFC Path during that period
$Postbacks_{Fi}$ – changes to firm AFC due to a change in the use of Transmission Service for that period, as defined in Business Practices
$Counterflows_{Fi}$ – adjustments to firm AFC as determined by the Transmission Service Provider and specified in the ATCID

Non-Firm[34]

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

Where:

AFC_{NF} – non-firm Available Flowgate Capability for the AFC Path for that period
TFC – Total Flowgate Capability of the Flowgate
ETC_{Fi} – sum of existing firm Transmission commitments for the AFC Path during that period
ETC_{NFi} – sum of existing non-firm Transmission commitments for the AFC Path during that period
CBM_{Si} – Capacity Benefit Margin for the AFC Path during that period
TRM_{Ui} – Transmission Reliability Margin for the AFC Path during that period
$Postbacks_{NFi}$ – changes to firm AFC due to a change in the use of Transmission Service for that period, as defined in Business Practices
$Counterflows_{NFi}$ – adjustments to firm AFC as determined by the Transmission Service Provider and specified in the ATCID.

[31] Reference: MOD-030-3 R6.4
[32] Reference: MOD-001-1a R3.1
[33] Reference: MOD-030-3 R8
[34] Reference: MOD-030-3 R9

The assumptions used in calculating AFC are no more limiting than those used in the planning of operations for the corresponding time period studied. The planning of operations in the short term horizon is conducted through the outage analysis process. The outage analysis process uses the normal seasonal ratings for the approval of outages.[35]

Calculation of TFC:
Total Flowgate Capability (TFC) is the maximum flow capability on a Flowgate which should not exceed its thermal rating, or in the case of a Flowgate used to represent a specific operating constraint (such as a voltage or stability limit), should not exceed the associated System Operating Limit. The TFC of each Flowgate is equal to the seasonal thermal rating of the facilities associated with that Flowgate. For a voltage or stability limit the TFC is equal to the flow limit that will respect the System Operating Limit (SOL) or Interconnection Reliability Operating Limit (IROL).[36] TFC values will be established at a minimum of once per calendar year. If Santee Cooper is notified of a change in a rating by the Transmission Owner that might impact the TFC of a Flowgate used in the AFC process, then the TFC will be updated within seven calendar days of notification.[37] Santee Cooper will provide the TSP with TFC values within seven calendar days of establishing said TFC.[38]

The assumptions used in calculating TFC are no more limiting than those used in the planning of operations for the corresponding time period studied. The planning of operations in the short term horizon is conducted through the outage analysis process. The outage analysis process uses the normal seasonal ratings for the approval of outages.[39]

Calculation of ETC:
Existing Transmission Commitments (ETC) are committed uses of a Transmission Service Provider's transmission system considered when determining AFC. Santee Cooper sets aside transmission capacity for native load (including network load) and non-OATT (Open Access Transmission Tariff) customers by explicitly modeling their forecasted loads.[40] The designated network resources in the power flow base case are economically dispatched to meet the forecasted loads.[41] ETC is determined by the AFC Calculator which accounts for Flowgate base flows and TDFs. Any new reservation will be allocated as needed once the status has been confirmed.

In the planning horizon, ETC may include (1) firm capacity set aside to serve peak Native Load forecast commitments including losses and load growth (2) firm capacity reserved for Network Integration Transmission serving Load including losses and load growth (3) firm capacity set aside for grandfathered Transmission Service[42] (4) firm capacity reserved for confirmed point-To-Point Transmission Service (5) firm capacity reserved for Roll-over

[35] Reference: MOD-001-1a R7
[36] Reference: MOD-030-3 R2.4
[37] Reference: MOD-030-3 R2.5
[38] Reference: MOD-030-3 R2.6
[39] Reference: MOD-001-1a R6
[40] Reference: MOD-030-3 R6.1.1
[41] Reference: MOD-030-3 R6.1.2
[42] Reference: MOD-030-3 R6.6

rights associated with long-term firm service, and (6) other firm capacity reserved for any other services, contracts, or agreements using Firm Transmission Service.

Santee Cooper will account for higher priority firm point-to-point transmission reservations and firm long-term point-to-point transmission capacity in its ETC. Firm point-to-point TSRs may be modeled as coordinated interchange (base transfer) in the power flow base case utilizing the designated source and sink from the transmission service reservations. Other confirmed point-to-point TSRs are accounted for by the AFC Calculator.[43]

Calculation of CBM:
Capacity Benefit Margin (CBM) is the amount of firm transmission transfer capability preserved by the Transmission Provider for Load-Serving Entities (LSEs), whose loads are located on that Transmission Service Provider's system, to enable access by the LSEs to generation from interconnected systems to meet generation reliability requirements. Santee Cooper has not defined a need for CBM on any of its importing interfaces; therefore the CBM value is set to zero in the AFC calculations. More detail on this calculation can be found in Santee Cooper's CBM Implementation Document (CBMID).

Calculation of TRM:
Transmission Reliability Margin (TRM) is the amount of transmission transfer capability necessary to provide reasonable assurance that the interconnected transmission network will be secure. More detail on this calculation can be found in Santee Cooper's TRM Implementation Document (TRMID).

Calculation of Postbacks:
Postbacks are positive adjustments to AFC based on a change in status of a Transmission Service Reservation or unscheduled firm transmission service. Santee Cooper incorporates Postbacks in the calculation of firm and non-firm AFC for any transmission capacity made available due to (1) an annulment of a transmission service reservation (2) redirect of a transmission service on a firm basis (3) recall of transmission capacity reservation or (4) unscheduled firm capacity.

Calculation of Counterflows[44]:
Counterflows are adjustments made to firm and non-firm AFC due to flows in the opposite direction of the Flowgate. Appropriate long-term firm transmission reservations are included in the starting point models. The model builder incorporates 100% counter flow for 100% netting in the base case when calculating TDFs and initial base flows.

When applying transmission reservation impacts not included in the starting point models, counterflow assumptions are used in the AFC calculations. Counterflow impact percentages may be defined for each Flowgate to address:

- Firm reservation Counterflow impact on firm AFC calculations
- Firm reservation Counterflow impact on non-firm AFC calculations
- Non-firm reservation Counterflow impact on non-firm AFC calculations

[43] Reference: MOD-030-3 R6.3 & R6.4
[44] Reference: MOD-001-1a R3.2, R3.2.1 & R3.2.2

Counterflow impact percentages are based on engineering judgment and coordination with neighboring TOPs and TSPs that use the Flowgate methodology and are specified in the flowgate definitions file.

Source/Sink Accounting

Santee Cooper defines the source used in the calculation of AFC as the Point of Receipt (POR) field of the transmission reservation. Santee Cooper defines the sink used in the calculation of AFC as the Point of Delivery (POD) field of the transmission reservation.[45]

Transmission Service Requests (TSRs)

In the AFC Calculator, TSRs are mapped based on POR and POD for AFC calculations. These PORs and PODs are mapped to the appropriate TDFs in order to calculate their TDF impacts on each Flowgate. TSRs are mapped in the AFC Calculator based on the import/export paths for remaining contract path capability calculations.[46]

TSR Impacts and Coordination

To determine transmission service reservation impacts, the AFC Calculator determines transaction TDF values by subtracting the POR TDF from the POD TDF. TSRs which are used in the AFC Calculator are mapped to the powerflow model via the POR/POD ultimate file. This file maps the POR/PODs of TSRs to the corresponding subsystems in the model used to calculate distribution factors by the model builder. The AFC Calculator also utilizes impacts of rollover rights in the AFC calculation process depending on the horizon.

Impacts of TSRs sold under the Santee Cooper OATT including rollover rights may be excluded from the AFC Calculator process to reduce or eliminate duplicate impacts of transmission service in the AFC calculation process. A manual override to include or exclude TSRs sold under the Santee Cooper OATT may be used to further eliminate duplicate impacts of transmission service in the AFC process if needed.

For firm Transmission Service Request and Network Service Request beyond the operational planning horizon, studies will be performed that address specific long-term firm reservation and network service requests following the execution of the appropriate service agreement. The effect of each transmission service reservation on every path's TFC is calculated, based on given source and sink. Sources and Sinks are grouped on a Balancing Authority Area basis.

For firm and non-firm reservations where Santee Cooper is a part of the transaction path, the appropriate AFC values are decremented on a contract path basis. TFC values are not changed. Reservations outside where Santee Cooper is not part of the transaction path do not change the AFC and TFC postings.

[45] Reference: MOD-030-3 R1.2.1 & R1.2.2
[46] Reference: MOD-030-3 R1.2.3

Santee Cooper requires all requests for transmission service to include at a minimum path name, POR and POD. Requests for firm service must also include the ultimate source and sink. This allows for study evaluation. Reservations that do not include this information are marked as an invalid request and must be resubmitted for approval.

Remaining Contract Path Capability (RCPC)

Generation outages are not considered in the RCPC calculation. The only transmission outages that are included in the RCPC calculation are facilities that interface between Santee Cooper's transmission system and that of adjacent Transmission Provider's system (tie lines) and are at least an hour in duration. The start and stop times of these outages may be modified to begin and/or end on the hour. Impacts of these outages are reflected in the RCPC as a change in the Contract Path Limit.

The AFC Calculator calculates the Remaining Contract Path Capability (RCPC) for each import/export path. Contract Path Limits are imported to the AFC Calculator. For wheel-through paths, Contract Path Limit and RCPC is the minimum of the import/export paths that comprise the wheel-through path (e.g. for CPLE-SOCO the Contract Path Limits and RCPC are the minimum of CPLE-SC and SC-SOCO Contract Path Limits and RCPC respectively).

In the Hourly Planning, Daily Planning, Daily Study, and Monthly Study horizon the equation for RCPC is as follows:

Firm RCPC = Contract Path Limit – TRM – CBM - Confirmed Firm TSRs
Non-Firm RCPC = Contract Path Limit – TRM – CBM – Confirmed Firm TSRs – Confirmed Non-Firm TSRs

In the Hourly Operating horizon the equation for RCPC is as follows:

Firm RCPC = Contract Path Limit – TRM – CBM - Confirmed Firm TSRs
Non-Firm RCPC = Contract Path Limit – TRM – CBM – Scheduled Firm – Confirmed Non-Firm TSRs

When calculating the scheduled firm component of the Hourly Operating horizon non-firm RCPC equation, the AFC Calculator utilizes the capacity in the transmission profile of the schedules (tags) referencing firm TSRs. The source used in the calculation of the scheduled firm component of RCPC is obtained from the POR field of the transmission profile of the Tag. The sink used in the calculation of the scheduled firm component of RCPC is obtained from the POD field of the transmission profile of the Tag.

Counterflows do not impact the RCPC process in the Hourly Operating, Hourly Planning, Daily Planning, Daily Study, and Monthly Study horizons.

Calculation of AFC and ATC

When the AFC Calculator determines the ATC for Posted Paths, it uses the minimum of the remaining contract path capability or ATC derived from the AFC calculation.

To calculate AFC, the AFC Calculator uses the previously discussed AFC Firm and AFC Non-Firm algorithms. Using these calculated AFC values, the AFC Calculator evaluates new Transmission Service Requests, applies business practices, and posts ATCs to OASIS.

Available Transfer Capability (ATC) is a measure of the transfer capability remaining in the physical transmission network for further commercial activity over and above already committed uses. When converting AFC to ATC, the AFC Calculator uses the following equations[47]:

$$ATC_{AFC} = minP$$

$$P = \{PATC_1, PATC_2, \ldots PATC_n\}$$

$$PATC_n = \frac{AFC_n}{DF_{np}}$$

Where:

ATC_{AFC} = the ATC derived from the AFC process

P = is the set of partial ATCs for all impacted Flowgates honored by Santee Cooper

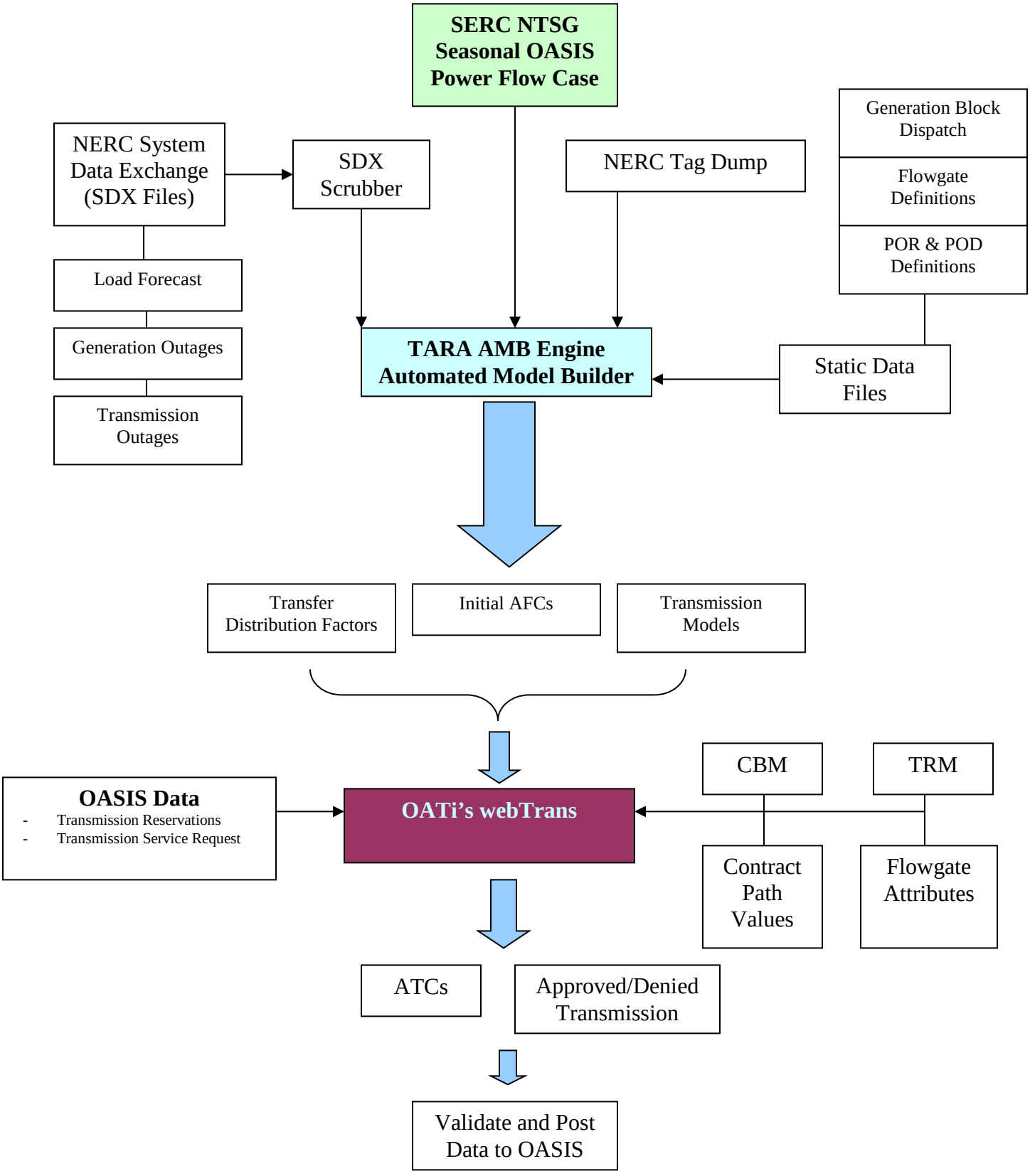
$PATC_n$ = the partial ATC for a path relative to a Flowgate *n*

AFC_n = the AFC for Flowgate *n*

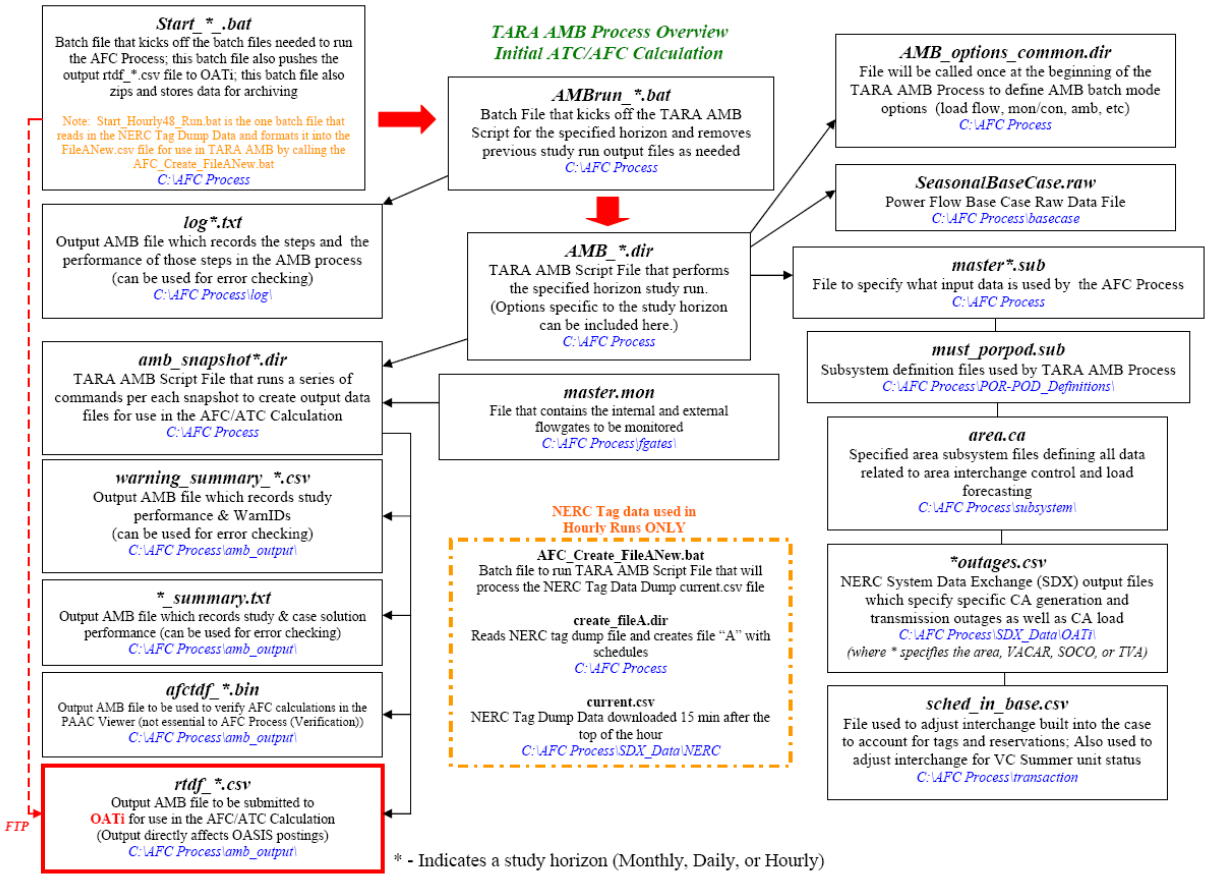
DF_{np} = the distribution factor for Flowgate *n* relative to path *p*

[47] Reference: MOD-030-3 R11

5. Overall Process Flow Diagram



6. Model Build Diagram



7. Software, Tools, & WebServices

Santee Cooper utilizes the following products when determining AFCs:

Power GEM – Automated Model Builder (AMB) & PowerGEM ATC/AFC Calculator (PAAC)

OATi – webTrans & webTrans (AFC Solution) (https://www.vacar.oati.com)

NERC System Data Exchange (SDX) (https://www.sdx.oati.com/)

NERC Tagging System (https://www.nerc.net/tags)

AFC/ATC Methodology Contacts

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