NERC Standard – MOD-001, MOD-030

Available Transfer Capability Implementation Document

For

Associated Electric Cooperative, Inc.

Effective Date: April 1, 2017

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Print Name

Signature

*** NOTE: When revising this procedure the AECI OPEN ACCESS TRANSMISSION TARIFF (OATT) needs to be reviewed for changes.

Revision No.	Revision History	Date Revised
0	Original Issue	3/31/2011
1	Revised AFC Final calculation frequency. Revised AFC model update frequency. Included ETC and Overrides in the ATC Diagram. Revised load flow model development section. Updated BA transfer table in Attachment A. Minor revisions to make current. Removed OASIS Coordinator Role on title page.	12/01/2014
2	Added definitions. Clarified 5.1.4(c) and 5.1.5(c). Updated section 13.0 for changes made to the TVA load flow model development process. Updated diagrams in section 16.0.	08/26/2015
3	Added clarification to section 6.0. Added clarification to sections 5.1.4 and 5.1.5. Split MISO point in MISO.N and MISO.S.	10/13/2015
4	Modified sections about PAAC to align with new webTrans ATC/AFC calculator	04/29/2016
5	Updated CMP sections as a result of joining the CMP	10/10/2016
6	Updated to align with revised RAS definition	3/15/2017

Available Transfer Capability Implementation Document (ATCID)

1.0 Purpose

This document describes the methodology used in the calculation of Available Transfer Capability (ATC) and its implementation in the Associated Electric Cooperative, Inc. (AECI) underlying Available Flowgate Capability (AFC) process with respect to AECI as the Transmission Operator (TOP) and Transmission Service Provider (TSP). **[MOD-001 R3]**

2.0 Scope

Within this ATCID is an outline of the AECI methodology to assess ATC **[MOD-001 R3].** A more detailed description of the Transmission Reliability Margin (TRM) calculation and the Capacity Benefit Margin (CBM) calculation and usage is available in the TRM Implementation Document (TRMID) and the CBM Implementation Document (CBMID).

3.0 Definitions

3.1 Available Flowgate Capability (AFC)

A measure of the flow capability remaining on a Flowgate for further commercial activity over and above already committed uses.

3.2 Available Transfer Capability (ATC) Path

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

3.3 Capacity Benefit Margin (CBM)

The amount of firm transmission transfer capability preserved by AECI for Load-Serving Entities (LSEs), whose loads are located on AECI'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 generation 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.

3.4 Contingency

The unexpected failure or outage of a system component, such as a generator, transmission line, circuit breaker, switch or other electrical element.

3.5 Contract Path

An agreed upon electrical path for the continuous flow of electrical power between the parties of an Interchange Transaction. This is usually defined as the sum of the tie line ratings or limiting series elements between the two entities.

3.6 Element

Any electrical device with terminals that may be connected to other electrical devices such as a generator, transformer, circuit breaker, bus section, or transmission line. An element may be comprised of one or more components.

3.7 Existing Transmission Commitments (ETC)

Committed uses of AECI's Transmission System considered when determining AFC.

3.8 Flowgate

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.

3.9 Limiting Element

The element that is 1.)Either operating at its appropriate rating, or 2,) Would be following the limiting contingency. Thus, the Limiting Element establishes a system limit.

3.10 Outage Transfer Distribution Factor (OTDF)

The percentage of a power transfer that flows through the monitored element of a Flowgate for a particular transfer when the contingency element of the Flowgate is out of service.

3.11 Power Transfer Distribution Factor (PTDF)

The percentage of power transfer that flows through a Flowgate for a particular transfer when there are no contingencies.

3.12 Remedial Action Scheme[1]

A scheme designed to detect predetermined System conditions and automatically take corrective actions that may include, but are not limited to, adjusting or tripping generation (MW and Mvar), tripping load, or reconfiguring a System(s). RAS accomplish objectives such as:

[1] Definition per the NERC Glossary of Terms
http://www.nerc.com/pa/Stand/Glossary%20of%20Terms/Glossary_of_Terms.pdf

- Meet requirements identified in the NERC Reliability Standards;
- Maintain Bulk Electric System (BES) stability;
- Maintain acceptable BES voltages;
- Maintain acceptable BES power flows;
- Limit the impact of Cascading or extreme events.

The following do not individually constitute a RAS:

a. Protection Systems installed for the purpose of detecting Faults on BES Elements and isolating the faulted Elements
b. Schemes for automatic underfrequency load shedding (UFLS) and automatic undervoltage load shedding (UVLS) comprised of only distributed relays
c. Out-of-step tripping and power swing blocking
d. Automatic reclosing schemes
e. Schemes applied on an Element for non-Fault conditions, such as, but not limited to, generator loss-of-field, transformer top-oil temperature, overvoltage, or overload to protect the Element against damage by removing it from service
f. Controllers that switch or regulate one or more of the following: series or shunt reactive devices, flexible alternating current transmission system (FACTS) devices, phase-shifting transformers, variable-frequency transformers, or tap-changing transformers; and, that are located at and monitor quantities solely at the same station as the Element being switched or regulated
g. FACTS controllers that remotely switch static shunt reactive devices located at other stations to regulate the output of a single FACTS device
h. Schemes or controllers that remotely switch shunt reactors and shunt capacitors for voltage regulation that would otherwise be manually switched
i. Schemes that automatically de-energize a line for a non-Fault operation when one end of the line is open
j. Schemes that provide anti-islanding protection (e.g., protect load from effects of being isolated with generation that may not be capable of maintaining acceptable frequency and voltage)
k. Automatic sequences that proceed when manually initiated solely by a System Operator
l. Modulation of HVdc or FACTS via supplementary controls, such as angle damping or frequency damping applied to damp local or inter-area oscillations
m. Sub-synchronous resonance (SSR) protection schemes that directly detect sub-synchronous quantities (e.g., currents or torsional oscillations)
n. Generator controls such as, but not limited to, automatic generation control (AGC), generation excitation [e.g. automatic voltage regulation (AVR) and power system stabilizers (PSS)], fast valving, and speed governing

Scheme.

3.13 Transfer Distribution Factor (TDF)

TDF is a general term, which may refer to either PTDF or OTDF. The TDF is the percentage of power transferred from source to sink that flows through a Flowgate.

3.14 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 conditions change.

3.15 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.

4.0 Overview

AECI has chosen to use the Flowgate Methodology for calculating ATC and AFC for each ATC Path for the time horizons of next hour to 18 months (Short-Term Horizon). For time periods greater than 18 months (Long-Term Horizon), AECI will conduct a full N-1 load flow analysis for the request. The rest of this document pertains to the calculations of ATC for the Short-Term Horizon **[MOD-001 R1]**.

The Flowgate Methodology is based on the assumption that certain elements on the Transmission System will begin to reach their limits before the other elements on the system. Therefore by 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. This allows for a greater number of studies to be conducted with more simplified input assumptions. The result is more accurate studies that focus on how the power would actually flow if the Transmission Service Requests (TSRs) were to be approved.

5.0 Flowgate Methodology

At a minimum the list of Flowgates in the transfer capability calculation process is reevaluated by creating, modifying or deleting Flowgates at least once a year. **[MOD-030 R2.2]**

5.1 Flowgate Identification Criteria [MOD-030 R1.1]

Flowgates are chosen to be included in the transfer capability calculation process by using one or more of the following methods.

1. The Flowgate is requested to be added to the transfer capability calculation process by the Reliability Coordinator, Transmission Operator, or Transmission Owner of the area for which transfer capability is being calculated and there is a reliability related need for the Flowgate to be added.
2. The Flowgate is requested to be added to the transfer capability calculation process by an external Transmission Service Provider (TSP) where the coordination of the Limiting Element/Contingency combination is not already addressed through a different methodology and:
    a. It is determined that any generator within the TSP's area has at least a 5% Power Transfer Distribution Factor (PTDF) or Outage Transfer Distribution Factor (OTDF) impact on the Flowgate when delivered to the aggregate load of its own area.
    b. A transfer from any Balancing Area within the TSP's area to an adjacent Balancing Area has at least a 5% PTDF or OTDF impact on the Flowgate.

Flowgates meeting these criteria shall be included in the requested TSP's (AECI's) methodology if the Limiting Element/Contingency combination is included in the requesting TSPs methodology (external). **[MOD-030 R2.1.4.1, R2.1.4.2]**

3. The Flowgate has been identified as a Reciprocally Coordinated Flowgate by passing the coordinated Flowgate test in the Congestion Management Process (CMP).
4. Results of a first Contingency transfer analysis for ATC Paths internal to the AECI system up to the path capability such that at a minimum the first three Limiting Elements and their worst associated Contingency combinations with an OTDF of 3% or higher and within the AECI system are included as Flowgates. **[MOD-030 R2.1.1]**
    a. The same contingency file used in the planning of operations will be used in the Flowgate test, which is to include Remedial Action Schemes. **[MOD-030 R2.1.1.1]**
    b. Where obvious, only the most limiting element in a series configuration is included as a Flowgate. **[MOD-030 R2.1.1.2]**
    c. Where obvious and for the same path and Limiting Element, the Flowgate associated with the worst Contingency is included. **[MOD-030-2 R2.1.1.3]**
    d. Any monitored element not exceeding its limit for its associated worst contingency and deemed non-critical will be removed as long as operation is kept within the limits of another flowgate. **[MOD-030-2 R2.1.1.3]**
    e. At this time, AECI does not identify any ATC Paths internal to the AECI transmission system. This section 4 will be implemented if internal ATC paths are identified.

5. Results of a first Contingency transfer analysis to/from all adjacent Balancing Authority source and sink combinations up to the path capability such that at a minimum the first three Limiting Elements and their worst associated Contingency combinations with an Outage Transfer Distribution Factor (OTDF) of 3% or higher and within the AECI system are included as Flowgates. The assumptions used for modeling Balancing Authority sources and sinks are located in Attachment A. **[MOD-030 R2.1.2]**
    a. The same contingency file used in the planning of operations will be used in the Flowgate test, which is to include Remedial Action Schemes relevant to impact analysis on/by the AECI system. **[MOD-030 R2.1.2.1]**
    b. Where obvious, only the most limiting element in a series configuration is included as a Flowgate. **[MOD-030 R2.1.2.2]**
    c. Where obvious and for the same path and Limiting Element, the Flowgate associated with the worst Contingency is included. **[MOD-030-2 R2.1.2.3]**
    d. Any monitored element not exceeding its limit for its associated worst contingency and deemed non-critical will be removed as long as operation is kept within the limits of another flowgate. **[MOD-030-2 R2.1.2.3]**

6. Subject to review, any Limiting Element/Contingency combination at least within its Reliability Coordinator's Area that has been subjected to a Transmission Loading Relief (TLR) procedure within the last 12 months, unless the Limiting Element/Contingency combination was created to address temporary operating conditions. **[MOD-030 R2.1.3]**
7. Any AECI Flowgate that is requested by AECI to be included in a neighboring TSP's methodology.

AECI does not differentiate between permanent and temporary Flowgates in the Transfer Capability Calculation process. Every Flowgate added to the Transfer Capability Calculation

process is considered permanent until it is determined that there is no longer a reliability need to keep the Flowgate in the process.

5.2 Flowgate Requests

Requests for Flowgates to be modified, added, or deleted from our process should be directed to the email address atc_contact@aeci.org with the subject “Flowgate Request”. Flowgate requests received from this address will be processed and Flowgate list amended if required as part of the Flowgate identification methodology within 30 days of receiving the request. **[MOD-030 R2.3]**

6.0 Available Transfer Capability Calculation Equations

The assumptions used in calculating ATC 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. Outage approvals requiring emergency or temperature dependent ratings are conditionally approved in order to determine if real time operating conditions would allow for the outage to occur **[MOD-001 R7]**.

Consideration is given to Tie Facilities such that no request for Firm Transmission Service on an ATC Path that serves as an interface with another BA is granted if the service exceeds the amount the Transmission Service Providers mutually agree they have the right to use between the two BAs. Additionally, the Interchange Schedule (both Firm and non-Firm) of the reservations on an ATC Path that serves as an interface with another BA is limited so as to not exceed the Facility Ratings of Tie Facilities.

6.1 Firm Available Flowgate Capability Calculations

In accordance with NERC’s MOD-030-2 R8 reliability standard, the following equation is used when calculating Firm AFC for a Flowgate for a specified period:

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

Where:

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

TFC is the Total Flowgate Capability of the Flowgate

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

$Counterflows_{Fi}$ are adjustments to firm AFC due to power flows in the opposite direction of the Flowgate

6.2 Non-Firm Available Flowgate Capability Calculations

In accordance with NERC's MOD-030-2 R9 reliability standard, the following equation is used in calculating Non-Firm AFC:

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

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

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

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

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

TRM_{Ui} is the impact of the unreleased Transmission Reliability Margin on the Flowgate during that period

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

$Counterflows_{NFi}$ are adjustments to non-firm AFC due to power flows in the opposite direction of the Flowgate

6.3 AFC Initial Values

AECI uses an intermediate step when calculating AFC called AFC initial (AFC_{Init}). This step does not mathematically change the equations, only the order in which they are calculated. This allows for the exchange of AFC_{Init} values with other AFC calculators that share the task of calculating transfer capability and also allows the use of two engines in the process, the Transmission and Reliability Analysis (TARA) Automated Model Builder (AMB) engine (performed by TVA with results downloaded by AECI) and the OATI webTrans engine (performed by AECI, beginning with TVA AMB results). The current process calculates AFCs the following way:

$$TFC - ETC_{AMB} = AFC_{Init}$$

Transmission Impacts = ETC_{ATC} + CBM - Postbacks - Counterflow

AFC_{Init} - Transmission Impacts - TRM = AFC_{Final}

To prove the equations are the same, substitution can be used and the equations can be written as:

$AFC_{Final} = AFC_{init}$ - Transmission Impacts - TRM

AFC_{Final} = (TFC - ETC_{AMB}) - (ETC_{ATC} + CBM - Postbacks - Counterflow) - TRM

AFC_{Final} = TFC - (ETC_{AMB} + ETC_{ATC}) - CBM + Postbacks + Counterflow - TRM

AFC_{Final} = TFC - ETC - CBM - TRM + Postbacks + Counterflows

6.4 Total Flowgate Capability (TFC)

The TFC of each Flowgate is equal to the System Operating Limit (SOL) or Interconnection Reliability Operating Limit (IROL) of that Flowgate if the SOL or IROL is based on a thermal limit. For a voltage or stability limit the TFC is equal to the flow limit that will respect the SOL or IROL. **[MOD-030 R2.4]**

There are four different TFCs for each Flowgate, (one used for each season). The TFC used in the ATC calculation must match the seasonal capacity being calculated.

In instances where there is a difference in derived limits, such as a tie line, the most limiting parameter is used as TFC.

TFCs will be updated at least once per calendar year. **[MOD-030 R2.5]** If notified of a change in the facility rating by the Transmission Owner that would affect the TFC of a Flowgate used in the AFC process, the TFC will be updated within seven calendar days of the notification. **[MOD-030 R2.5.1]** The TSP will be notified within seven calendar days of the rating establishment. **[MOD-30 R2.6]**

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. Outage approvals requiring emergency or temperature dependent ratings are conditionally approved in order to determine if real time operating conditions would allow for the outage to occur **[MOD-001 R6]**.

6.5 Existing Transmission Commitments (ETC)

All of the calculated forward flow impacts are considered in the AFC calculations as ETC. Some partial path reservations are included in the calculation of ETC.

6.5.1 ETC_{Fi}

ETC_{Fi} contains two major components, ETC_{AMB} and ETC_{ATC}. ETC_{AMB} is the existing transmission commitments that are accounted for in the AMB process (performed at TVA) and

ETC_{ATC} is the existing transmission commitments accounted for in the ATC process. Transmission commitments accounted for in the ETC_{AMB} (performed at TVA) should not be double counted in the ETC_{ATC} (performed at AECI) and transmission commitments accounted for in the ETC_{ATC} should not be double counted in the ETC_{AMB}.

6.5.1.1 Scheduling Horizon

If current time is 12:00 - 24:00 CPT, the scheduling horizon is from next hour until midnight the next day. If current time is from 24:00 - 12:00, then the scheduling horizon is until midnight the current day. In the scheduling horizon, tags (schedules) are used to account for transmission service impacts, because in the scheduling horizon the tags are the transactions that are expected to be scheduled. In accordance with **MOD-030 R6**, transmission service that is expected to be scheduled is accounted for in AECI's calculation of ETC.

In the scheduling horizon ETC components are calculated as follows:

AECI's ETC_{AMB} is calculated (at TVA) using the following:

1. The impacts of Network Integration Transmission Service (gen to load) for the TSP's area **[MOD-030 R6.1]**. These values are calculated from:
   a. Load forecast for the time period being calculated including Native Load and Network Service load, and
   b. Unit commitment and generation block dispatch, including all Designated Network Resources and other resources that have a legal obligation to run.
2. The impact of Network Integration Transmission Service (gen to load) for other TSP areas covered by an executed coordination agreement or adjacent TSPs **[MOD-030 R6.2]**. These values are calculated from:
   a. Load forecast for the time period being calculated including Native Load and Network Service load, and
   b. Unit commitment and generation block dispatch, including all Designated Network Resources and other resources that have a legal obligation to run.
3. The impact of generation to load for all other TSP areas. These values are calculated from the seasonal peak load forecast included in the Multiregional Modeling Working Group (MMWG) or Near-Term Study Group (NTSG) models. **[MOD-030 R6.2]**
4. The impact of confirmed Point-to-Point Transmission Service that are modeled in the starting case for all Balancing Authority Areas in the transmission model.
5. The impact of any grandfathered obligations for the TSP's area **[MOD-030 R6.5]**.
6. The impact of any grandfathered obligations for adjacent TSP's or TSP areas covered by an executed coordination agreement **[MOD-030 R6.6]**.
7. The impact of tags included in the NERC Tag Dump file for the area of the TSP. These tags include firm point-to-point and network service reservations that are expected to be scheduled **[MOD-030 R6.3]**.
8. The impact of tags included in the NERC Tag Dump file for adjacent TSPs or TSP areas covered by an executed coordination agreement. These tags include point-to-point and network service reservations that are expected to be scheduled. Impact of adjacent TSP-to-TSP is accounted in AECI's TRM due to uncertainty of SPP and MISO Market influence. **[MOD-030 R6.4]**.
9. The impact of any other firm transmission service from other TSPs that have been deemed to have a significant impact on the transfer capability calculations. At present,

AECI is unaware of any such arrangements that are not within the basecase model. **[MOD-030 R6.7].**

ETC_{ATC} is zero in the scheduling horizon.

6.5.1.2 Reservation Horizon

The reservation horizon is any time between the scheduling horizon and 18 months from the current month.

In the reservation horizon ETC components are calculated as follows:

ETC_{AMB} is calculated using the following:

1. The impacts of Network Integration Transmission Service (gen to load) for the TSP's area **[MOD-030 R6.1]**. These values are calculated from:
   a. Load forecast for the time period being calculated including Native Load and Network Service Load, and
   b. Unit commitment and generation block dispatch, including all Designated Network Resources and other resources that have a legal obligation to run.
2. The impact of Network Integration Transmission Service (gen to load) for other TSP areas covered by an executed coordination agreement or adjacent TSPs **[MOD-030 R6.2]**. These values are calculated from:
   a. Load forecast for the time period being calculated, and
   b. Unit commitment and generation block dispatch, including all Designated Network Resources and other resources that have a legal obligation to run.
3. The impact of generation to load for all other TSP areas. These values are calculated from the seasonal peak load forecast included in the Multiregional Modeling Working Group (MMWG) or Near-Term Study Group (NTSG) models.
4. The impact of confirmed Point-to-Point Transmission Service that are modeled in the starting case for all Balancing Authority Areas in the transmission model **[MOD-030 R6.3, R6.4]**.
5. The impact of any grandfathered obligations that are modeled in the starting case for all Balancing Authority Areas in the transmission model **[MOD-030 R6.5, R6.6]**.
6. The impact of any other firm transmission service from other TSPs that have been deemed to have a significant impact on the transfer capability calculations **[MOD-030 R6.7]**.

ETC_{ATC} is calculated using the following impacts that are not already included in ETC_{AMB}:

1. The impact of NITS for the areas of the TSP, adjacent TSPs, and any other TSP covered by an executed coordination agreement in which reservations are exchanged **[MOD-030 R6.1, R6.2]**.
2. The impact of confirmed Point-to-Point Transmission Service expected to be scheduled for the areas of the TSP, adjacent TSPs, and any TSP covered by an executed coordination agreement in which reservations are exchanged. Impact of adjacent TSP-to-TSP is accounted in AECI's TRM due to uncertainty of SPP and MISO Market influence. **[MOD-030 R6.3, R6.4]**.

3. The impact of any grandfathered obligations expected to be scheduled or expected to flow for the areas of the TSP, adjacent TSPs, and any TSP covered by an executed coordination agreement in which reservations are exchanged **[MOD-030 R6.5, R6.6]**.
4. The impact of any other firm transmission service from other TSPs that have been deemed to have a significant impact on the transfer capability calculations. At present, AECI is unaware of any such arrangements that are not within the basecase model. **[MOD-030 R6.7]**.

6.5.2 ETC_{NFi}

ETC_{NFi} is calculated using the following:

1. The impact of non-firm NITS (secondary service) for the areas of the TSP, adjacent TSPs, and any other TSP covered by an executed coordination agreement in which reservations are exchanged. Each transaction should be filtered to reduce or eliminate duplicate impacts from multiple TSP's. **[MOD-030 R7.5, R7.6]**
2. The impact of confirmed non-firm Point-to-Point Transmission Service expected to be scheduled for the areas of the TSP, adjacent TSPs, and any other TSP covered by an executed coordination agreement in which reservations are exchanged. Each transaction should be filtered to reduce or eliminate duplicate impacts from multiple TSP's. **[MOD-030 R7.1, R7.2]**
3. The impact of any grandfathered non-firm obligations expected to be scheduled or expected to flow for the areas of the TSP, adjacent TSPs, and any other TSP covered by an executed coordination agreement in which reservations are exchanged **[MOD-030 R7.3, R7.4]**.
4. The impact of any other non-firm transmission service from the TSP that have been deemed to have a significant impact on the transfer capability calculations **[MOD-030 R7.7]**.

6.5.3 Transmission Service Request Rollover Rights Impact

TSRs that have met the requirements for rolling over service are considered an impact in the ETC_{ATC} calculations for the time periods when the rollover would occur.

7.0 Source and Sink Definitions [MOD-030 R1.2]

7.1 Reservation Impacts

The Source/Sink definitions as used in the determination of reservation impacts are as follows:

7.1.1 Source Definitions

If the reservation is sourced in a BA area (BAA), then the sources used in calculating the impacts of the reservation are obtained from the source field in the reservation as long as the BAA is found in the current system model. If the BAA is not in the current system model, then the Point of Receipt (POR) field is used as the source in calculating the impacts of the reservation.

If the reservation is sourced in an Independent Power Producer (IPP) within AECI's BA area, then the source used in calculating the impacts of the reservation are obtained from the source field of the TSR as long as the source field in the reservation matches the source name in the AMB process. If the source field does not match, the IPP source name in the AMB process, then the POR field is used as the source in calculating the impacts of the reservation.

If the reservation is sourced in an IPP outside AECI's BA area, the source used in calculating the impacts of the reservation are obtained from either the source field or the POR field of the reservation. Some tier 1 area IPPs are included as specific source definitions, if the IPP has been included in the process and the source field matches the name in the AMB process then the source field is used as the source to calculate reservation impacts, otherwise the POR field is used as the source field to calculate reservation impacts.

7.1.2 Sink Definitions

If the reservation is sunk in a BA area, then the sinks used in calculating the impacts of the reservation are obtained from the sink field in the reservation as long as the BAA is found in the current system model. If the BAA is not in the current system model, then the Point of Delivery (POD) field is used as the sink in calculating the impacts of the reservation.

If the reservation is sunk at a discreet load, the sink used in calculating the impacts of the reservation is obtained from either the sink field or the POD field of the reservation. Some discreet loads may be included as specific sink definitions, if the discreet load has been included in the process and the sink field matches the name in the AMB process then the sink field is used as the sink to calculate reservation impacts, otherwise the POD field is used as the sink field to calculate reservation impacts.

7.2 Schedules Impacts

The Source/Sink definitions as used in the modeling of schedules are as follows:

7.2.1 Source Definitions

If the schedule is sourced in a BA area, then the sources used in modeling the schedule are obtained from the source field in the schedule as long as the BAA is found in the current system model. If the BAA is not in the current system model, then the POR field is used as the source in modeling the schedule.

If the schedule is sourced in an IPP within AECI's BA area, then the source used in modeling the schedule are obtained from the source field of the TSR as long as the source field in the schedule matches the source name in the AMB process. If the source field does not match, the IPP source name in the AMB process, then the POR field is used as the source in modeling the schedule.

If the schedule is sourced in an IPP outside AECI's BA area, the source used in modeling the schedule are obtained from either the source field or the POR field of the schedule. Some tier 1 area IPPs are included as specific source definitions, if the IPP has been

included in the process and the source field matches the name in the AMB process then the source field is used as the source to calculate schedule impacts, otherwise the POR field is used as the source field to calculate schedule impacts.

7.2.2 Sink Definitions

If the schedule is sunk in a BA area, then the sinks used in modeling the schedule are obtained from the sink field in the schedule as long as the BAA is found in the current system model. If the BAA is not in the current system model, then the POD field is used as the sink in modeling the schedule.

If the schedule is sunk at a discreet load, the sink used in modeling the schedule is obtained from either the sink field or the POD field of the schedule. Some discreet loads may be included as specific sink definitions, if the discreet load has been included in the process and the sink field matches the name in the AMB process then the sink field is used as the sink to calculate schedule impacts, otherwise the POD field is used as the sink field to calculate schedule impacts.

7.3 TSR Evaluation

The Source/Sink definitions as used in the evaluation of Transmission Service Requests are as follows:

7.3.1 Source Definitions

If the TSR is sourced in an area, then the source used in evaluating the TSR is obtained from the POR field in the TSR.

If the TSR is sourced in an IPP within AECI's BA area, then the source used in evaluating the TSR is obtained from the source field of the TSR as long as the source field matches the source name in the reservation screener process, otherwise the source used in evaluating the TSR is obtained from the POR field of the TSR.

If the TSR is sourced in an IPP outside AECI's BA area, the source used in evaluating the TSR is obtained from the POR field of the TSR.

7.3.2 Sink Definitions

If the TSR is sunk in an area, then the sink used in evaluating the TSR is obtained from the POD field in the TSR.

If the TSR is sunk at a discreet load, the sink used in evaluating the TSR is obtained from the POD field of the TSR.

7.4 Model Mapping [MOD-030 R4]

If the Source, as specified in the Source definition section 7.1, 7.2, and 7.3 has been discreetly modeled in the Transmission model, the discreetly modeled point is used as the source. If the source, as specified in the Source definition section 7.1, 7.2, and 7.3 cannot be mapped to the discreetly modeled point then it is mapped to an equivalent or aggregate representation.

If the source, as specified in the Source definition section 7.1,7.2 and 7.3 cannot be modeled to an equivalent or aggregate representation, it is mapped to the adjacent Balancing Authority associated with the TSP from which the power is to be received. Therefore when the source field is used as the source, it is mapped to the units of the generator. When the POR field is used as the source, it is mapped to the online generators within the area, such that all online generation is dispatched based on distributions factors calculated as: (PMax - PGen) / ∑(PMax - PGen)

If the Sink, as specified in the Sink definition section 7.1, 7.2 and 7.3 has been discreetly modeled in the Transmission model, the discreetly modeled point is used as the sink. If the sink, as specified in the Sink definition section 7.1, 7.2 and 7.3, cannot be mapped to the discreetly modeled point then it is mapped to an equivalent or aggregate representation. If the sink, as specified in the Sink definition section 7.1, 7.2 and 7.3 cannot be modeled to an equivalent or aggregate representation, it is mapped to the adjacent Balancing Authority associated with the TSP from which the power is to be delivered. Therefore when the POD field is used as the sink, it is mapped to the online generators within the area, such that all online generation is dispatched based on distribution factors calculated as: (PGen - PMin) / ∑(PGen - PMin)

8.0 Calculation Number and Frequency

AECI's AFC/ATC calculation frequency meets or exceeds requirements outlined in the NERC Standards **[MOD-001 R2, MOD-030 R3.2, R3.3]**.

8.1 Transmission models and AFC Initial Values

The number of transmission models and AFC initial values and their calculation frequency (update frequency) is the following:

Hourly	Hour 1 - 48	Hourly
Hourly (48-168)	Hour 48 - 168	Four times a day
Daily (1-31)	Day 1 - 31	Five times a day
Monthly (1-18)	Month 1 - 18	Daily

The above frequencies reflect the normal frequency for calculations. If there is system maintenance or a solution issue, the frequency may be less. The AFC initial values are updated at least according to the following:

Hourly	Hour 1 - 48	Once per day
Hourly (48-168)	Hour 48 - 168	Once per day
Daily (1-31)	Day 1 - 31	Once per day
Monthly (1-18)	Month 1 - 18	Once per month

8.2 AFC Final Values and AFC/ATC Conversion [MOD-001 R8, MOD-030 R10]

For AECI, reservation impacts are used to calculate AFC final values and converted to ATCs on the following intervals:

Hourly	Hour 1 - 48	Once per hour

Hourly (48-168)	Hour 48 - 168	Once per hour
Daily (1-31)	Day 1 - 31	Once per day
Monthly (1-18)	Month 1 - 18	Once per week

9.0 Counterflows [MOD-001 R3.2]

9.1 Confirmed Transmission Reservations

Confirmed reservations that are received from the AECI OASIS or neighboring entities OASIS are first filtered to remove double counting. This filtering process filters out some partial path reservations. Some reservations that are built into the base cases are also filtered out. When applying transmission reservation impacts in the opposite direction of flow on a Flowgate in the AFC calculations counterflow assumptions are used. The following are the default counterflow assumptions used in the calculation of AFC:

Reservation Type	Positive/Counterflow Impacts Used
Firm Reservations for Firm Calculations	100%/30%
Firm Reservations for Non-Firm Calculations	100%/50%
Non-Firm Reservations for Non-Firm Calculations	50%/50%

These default counterflow assumptions are based on operator and engineering experience of normal Flowgate flows. At times, a Flowgate may experience higher or lower than normal counterflows. If real-time or expected operating conditions change such that higher or lower than normal counterflows are expected, the counterflow assumptions for the Flowgate can be changed from the default to reflect the new conditions. These changes will be reflected in the Flowgate definition database.

9.2 Expected Interchange

For transactions that are expected to flow and that are built into the starting basecases, such as off system load modeled in a neighboring system, the transaction is left in the basecase and therefore 100% counterflow is used in these circumstances. Since these transactions can be expected to flow the 100% counterflow assumption creates a more accurate transfer capability calculation.

9.3 Internal Counterflow

As a starting point the basecases have each Balancing Authority Area's generation serving its load (gen to load). These gen to load transactions in these cases naturally include internal 100% counterflow.

10.0 Postbacks

AECI does not currently use the postback component of the AFC equation when calculating ATC. Since the ETC_{ATC} and ATC values are recalculated every hour, and then in response to TSR transitions, changes in reservation status' are incorporated in the ATC values when the ETC and ATC components are recalculated, removing the need to use postbacks.

11.0 Total Transfer Capability (TTC)

AECI considers TTC the maximum amount of power that is allowed to reliably flow across an interface in the base case model before transmission impacts such as ETC_{ATC}, TRM, CBM, postbacks and counterflows are considered.

AECI calculates TTC as:

$$TTC = Min\left[\frac{AFC_{init\,Flowgate\,n}}{TDF_{Flowgate\,n}}\right]$$

If there is no limiting Flowgate then the TTC is set to the path limit. The path limit is set to the minimum of the Contract Path or the stability limit for that interface.

The AFC_{init} and TDF values are the same data (database) used in the calculation of AFC/ATC. The load levels, generation dispatch, and modeling assumptions are the same assumptions used in the AFC/ATC calculations.

12.0 Converting AFCs to ATC [MOD-030 R11]

When converting Flowgate AFCs to ATCs on an ATC Path, the following equation is used:

$$ATC = Min\left[\frac{AFC_{Flowgate\,n}}{TDF_{Flowgate\,n}}\right]$$

Where:

$AFC_{Flowgate\,n}$= AFC for limiting Flowgate n
$TDF_{Flowgate\,n}$= TDF for limiting Flowgate n

The TDF used in the calculation must be greater than the cut-off. The current cut-off used for calculating transfer capability is 3% for OTDF Flowgates and 5% for PTDF Flowgates. An impact of less than the cut-off is considered no impact when calculating ATC.

The posted ATC is the minimum of the calculated ATC and the Contract Path minus the reservations sold across that path.

13.0 Load Flow Model Development

AMB (exercised at TVA) generates transmission models that simulate anticipated system conditions for the different horizons needed to adequately calculate transmission service capability. These models are derived from the industry-wide IDC (Interchange Distribution Calculator) model, which is updated monthly by the Reliability Coordinators within the Eastern Interconnection, for the current season. The ERAG MMWG, SERC LTSG and SERC NTSG models are used as reference models to make updates to the monthly IDC model. Beyond the current season, the NTSG, LTSG, and/or MMWG models are used in the AMB process to create 18 monthly models. The starting point reference models are chosen based on the most recently updated case available. The TOPs within the AECI BA Area actively participate in the annual

ERAG and SERC model building processes, as well as review the IDC model used for the AMB process. They submit changes to the IDC model as needed to ensure accuracy. The result is a set of 6-8 transmission models provided by the Transmission Operators within AECI BA Area that is used to adequately calculate transmission service capability **[MOD-030 R5.1]**.

The transmission models contain the system topology and generation data for the Eastern Interconnection. Included with this is modeling data and system topology for the AECI TSP and BA areas and immediately adjacent RC areas and beyond. Within the model, there is some equivalent representation of radial lines and facilities below 100 kV **[MOD-030 R3.4, R3.5]**. The generation Facility Ratings, i.e. generation maximum and minimum output levels, are also included in the transmission models **[MOD-030 R3.1]**.

The AMB modifies the starting cases to reflect anticipated system conditions such as load forecasts, transmission and generation outages, derates, additions, retirements and (in some horizons) approved tags. The Generation and Outage section defines the criteria that must be met for an outage to be included in the models. The conforming loads within the TSP area, including interruptible loads, will be scaled based on the projected load forecast for that area. Interruptible loads are included since they are considered in the transmission planning process.

Generators that are identified as Designated Network Resources in the TSP's area are modeled in the basecase and are dispatched based on block generation. In some horizons, when the data is available, a direct dispatch based on projected individual generation dispatches is used.

The transmission models that are used to calculate AFC and ATC are the same models used in the planning of operations. AECI's planning of operations is conducted through the outage analysis process **[MOD-030 R7]**.

13.1 Generation Dispatch

Generators that are identified as Designated Network Resources in the TSP's area are modeled in the basecase and are dispatched based on block generation. In some horizons, when the data is available, a direct dispatch based on projected individual generation dispatches is used.

Generators in some external areas are dispatched using a block dispatch. If a block dispatch is not used, then the generation dispatch in the starting base case is used and scaled to balance the load, interchange and losses.

13.2 Load Forecasts

Load forecast are included in the transmission models when the following criteria are met:

1. The name of the Balancing Authority Area in System Data eXchange (SDX) matches the name of the area defined in the transfer capability calculation process
2. The data for that horizon is supplied in SDX
3. The load forecast is included in the following time period assumptions:

Model Horizon	Assumptions

Monthly Firm and Non-Firm Months 1-18	Load forecast for the given month from SDX
Daily Firm and Non-Firm Day 1-35	Load forecast for the given day or the monthly load forecast for that time period from SDX
Hourly Non-Firm Hours 1-192	Load forecast for the given hour or the daily or monthly load forecast for that time period from SDX

4. The load forecast data is included in the following location:

Location
AECI BAA
RC Partner
AECI's tier 1 neighbors

13.3 Generation and Transmission Outages [MOD-001 R3.6, MOD-030 R5.2]

Generation and transmission outages, additions, and retirements are included in the models used to evaluate TSRs and to calculate transfer capability. Generation and transmission outages are received from the NERC SDX and are processed in the SDX scrubber where AECI's outage evaluation rules are applied. The scrubber exports the files to the AMB process to be used in the transmission models. Transmission outages are included in the transmission models when the following criteria are met:

1. The name of the bus(es) in the SDX file matches the name of the bus(es) in the model used for that horizon.
2. The outage is included in the following time period assumptions:

Model Horizon	Assumptions
Monthly Firm and Non-Firm Months 1-18	Outages based on a representative day (3rd Wednesday) will be included.
Daily Firm and Non-Firm Day 1-35	Outages for the given day will be included.
Hourly Non-Firm Hours 1-192	Outages for the given hour from SDX will be included.

3. The transmission outage is included in the following location and kV level:

Location	kV Level
AECI BAA	100 kV and above
RC Partner	100 kV and above
AECI Tier 1	100 kV and above
Coordination Agreement Signed with TVA and Tier 2 or greater	300 kV and above

Outages that are in effect for part of the day are assumed to last the whole day when considering a daily outage in the AMB **[MOD-001 R3.6.1]**. Outages that are in effect for part of a month are only considered if they occur on the representative day of the month. This representative day is the third Wednesday of the month being built **[MOD-001 R3.6.2]**.

Outages from other TSPs that cannot be mapped to the transmission model are not built into the cases by the AMB and are not considered in the AFC/ATC calculations **[MOD-001 R3.6.3]**.

The above is the minimum criteria for outages to be included. At times outages outside these criteria can be included if needed.

14.0 Allocation Processes [MOD-001 R3.5]

14.1 Congestion Management Process

The Congestion Management Process (CMP) allocates Flowgate capabilities between member entities to address issues such as forward looking congestion management and seam coordination.

The CMP facilitates better coordination between the non-market and the market entities. A large part of this process involves honoring the available allocation called Available Share of Total Flowgate Capability (ASTFC) on certain Flowgates.

The amount of allocation on a Flowgate is based on the TFC of that Flowgate. The allocation is then split up between the reciprocal entities on that Flowgate, based on its historical impact on the Flowgate.

Each entity can grant Transmission Service, as long as they have sufficient ASTFC on that Flowgate. If they do not have sufficient ASTFC, they can either borrow or transfer it in order to grant the Transmission Service. If no ASTFC is available from any entity, then the service must be denied.

For more detailed information on the CMP process see the CMP Process document.

14.2 Allocation of Flowgate capability among multiple lines within a larger flowgate

Flowgates can contain multiple monitored elements. For these Flowgates the TFC value is set to the SOL for that Flowgate. The TDF of the Flowgates is calculated using sum of the impacts on the Flowgates. For example, if a transfer of 100 MW has a 10 MW impact on one monitored element of a Flowgate and a 5 MW impact on the other monitored element of a Flowgate then the TDF is equal to 15/100 = .15 = 15%. The AFCinit value is calculated by summing the flows on each monitored element.

14.3 Allocation of Flowgate capability or transfer capability among multiple owners

AECI does not currently have a process to allocate Flowgate capability or transfer capability among multiple owners.

15.0 Coordination with other TOPs & TSPs

The following data is coordinated with TSPs that are parties to a coordination agreement **[MOD-001 R3.3, R3.4]**:

Data	Provides To	Receives From

AFC Overrides	MISO, SPP, TVA, LGE	MISO, SPP, TVA
Transmission Reservations	Publically posted on AECI OASIS	Publically posted on AECI OASIS
Available Share of Total Flowgate Capability (ASTFC)	*MISO, SWPP, TVA*	*MISO, SWPP, TVA*
AAL File (allocation borrowing)	*MISO, SWPP, TVA*	*MISO, SWPP, TVA*
Allocation Overrides (BMS files)	*MISO, SWPP, TVA*	*MISO, SWPP, TVA*

The following data is coordinated through SDX and is available to anyone having access to SDX:

1. Load forecast,
2. Transmission outages, and
3. Generation outages/derates

The AFC override values are used for external Flowgates when they are provided **[MOD-030 R5.3]**. If no AFC override value is provided, then the calculated AFC value is used for the external Flowgates. For other input data, if a file is not received, the last file received will be used when possible.

Flowgates that are owned by external entities that have been added to the Flowgate process through the Flowgate identification methodology will be honored in the AFC process for all TSR evaluations, except under the following circumstances:

1. The Flowgate's OTDF or PTDF is below the coordinated distribution factor cut-off.
2. The Flowgate owner is included as the source, sink, POR, or POD of the TSR. This exception is included with the understanding that the Flowgate owner will have the opportunity to evaluate and approve the TSR on its own system.

15.1 Sharing of AFC/ATC Calculation Data [MOD-001 R9]

AECI posts the following data on a secure AECI ftp site and upon request Transmission Service Providers, Planning Coordinators, Reliability Coordinators and Transmission Operators subject to the conditions of MOD-001-1 R9.1 and 9.2 shall be given access within 30 days:

- 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 aggregate non-firm capacity set aside for Network Integration Transmission Service
- Firm and Non-firm reservations
- Aggregate capacity set-aside for Grandfathered obligations
- Firm Roll Over Rights
- Firm and non-firm adjustments applied by the TSP to reflect parallel path impacts
- Power flow models and underlying assumptions
- Contingencies as a list of Flowgates
- Facility Ratings (TFCs)

- Any services impacting ETCs
- CBM and TRM values for all paths or Flowgates
- TFC and AFC values for Flowgates
- Source and Sink identification and mapping to the model

This data will be made available for 13 months into the future (subject to confidentiality and security requirements) in accordance with MOD-001-1 R9.1. AECI makes this data available hourly but may be polled more often **[MOD-001 R9.2]**.

15.2 Notification of new/revised ATCID

AECI shall notify the following entities electronically before implementing a new or revised ATCID **[MOD-001 R4]**:

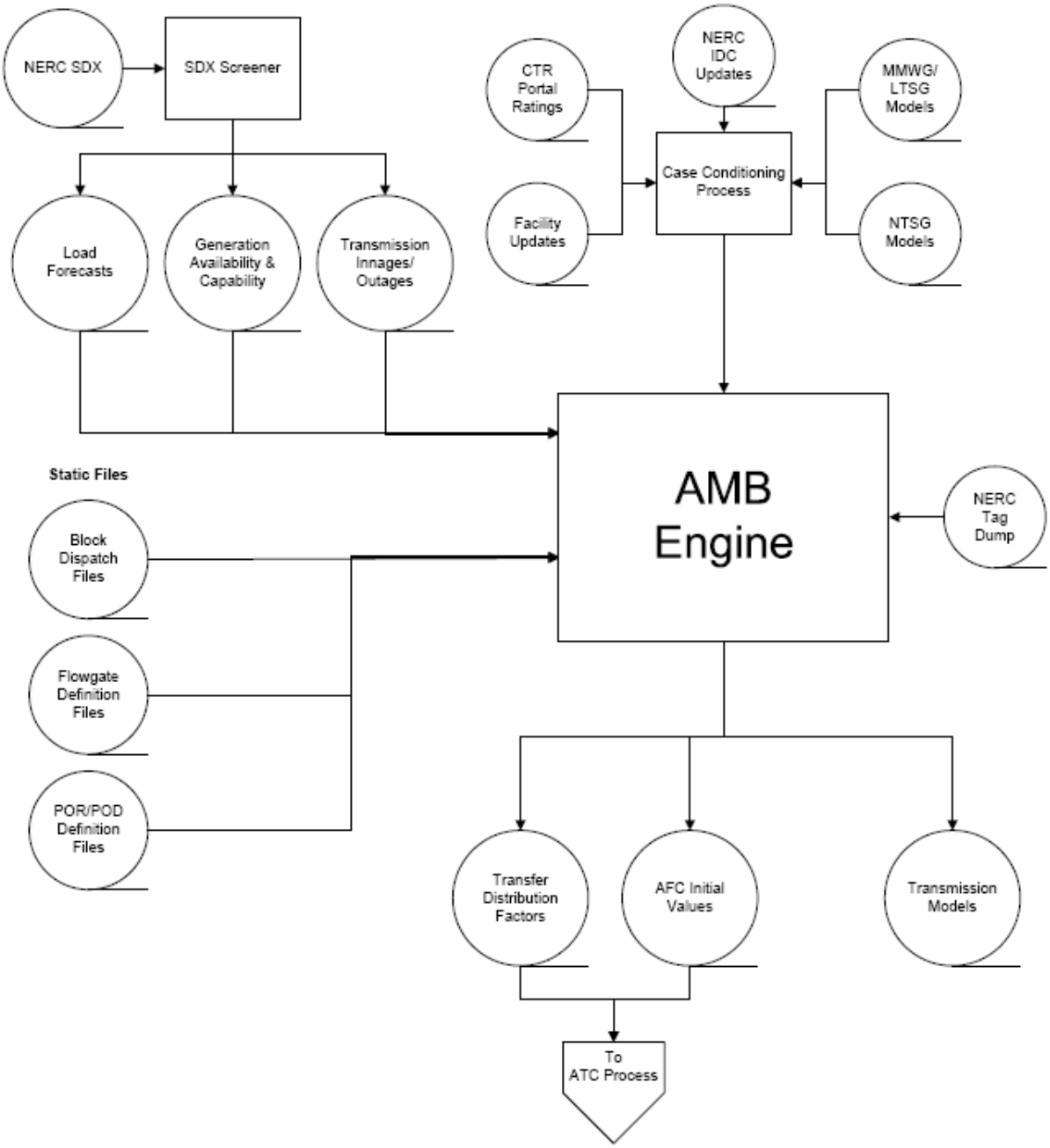
- Planning Coordinators associated with the AECI TSP area
- Reliability Coordinator associated with the AECI TSP area
- Transmission Operators associated with the AECI TSP area
- Reliability Coordinators adjacent to the AECI TSP area
- Planning Coordinators adjacent to the AECI TSP area
- Transmission Service Providers adjacent to the AECI TSP area

15.3 ATCID posting

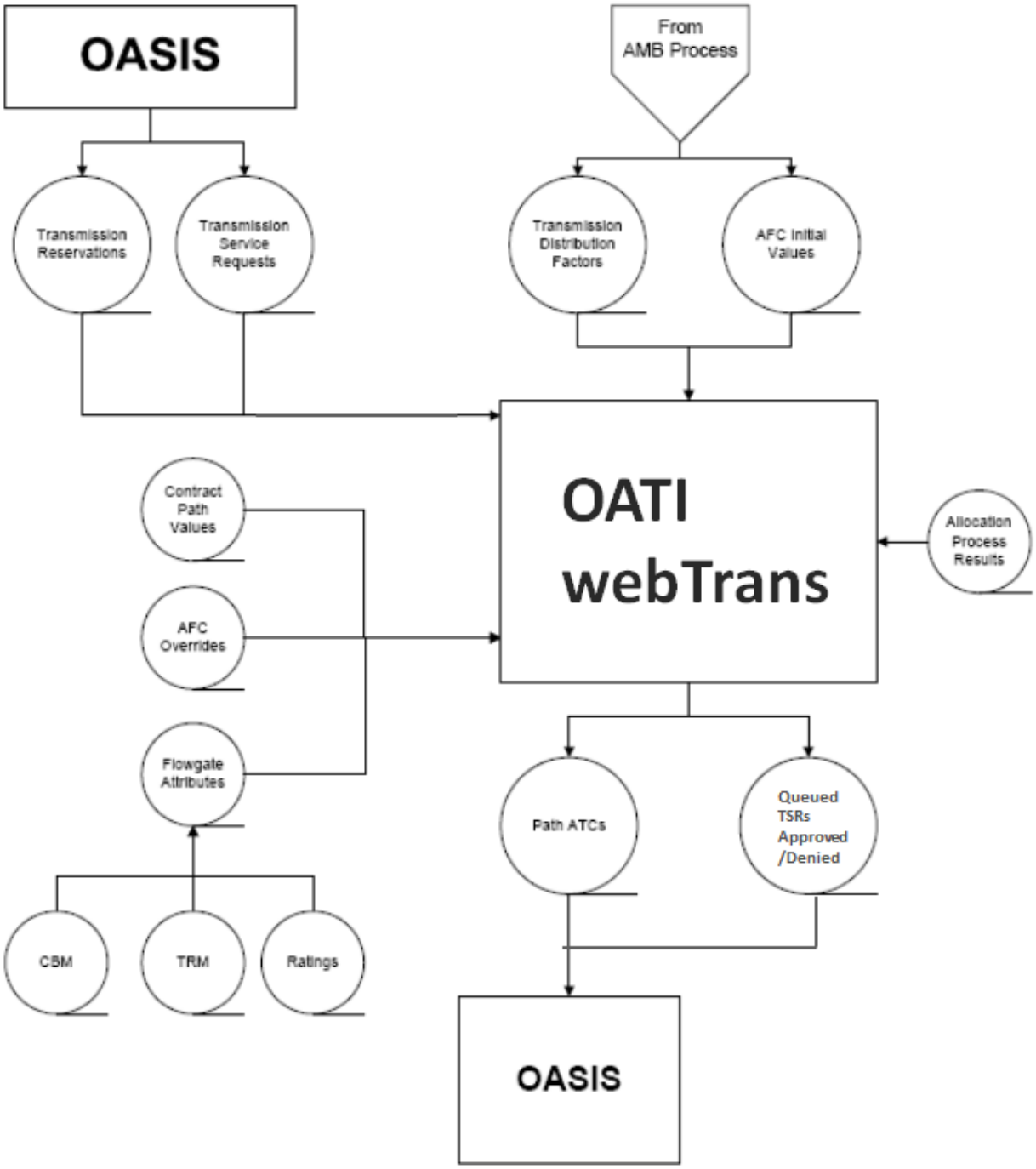
AECI shall make the current ATCID available to all the above entities by posting the current document to the OASIS website **[MOD-001 R5]**.

16.0 Process Flow Diagrams

Automated Model Creation and AFC Initial Value Calculation Process



ATC Process


OASIS
From AMB Process
Transmission Reservations
Transmission Service Requests
Transmission Distribution Factors
AFC Initial Values
OATI webTrans
Contract Path Values
AFC Overrides
Flowgate Attributes
Allocation Process Results
CBM
TRM
Ratings
Path ATCs
Queued TSRs Approved /Denied
OASIS

ATTACHMENT A
Sources and Sinks used in Flowgate identification

Background:

Surrounding the AECI transmission system, there are 2 large RTO's and a single non-market system. To the north, south and east, MISO operates a large transmission network which is operated as a single BA. To the north, west and southwest, the SPP system functions as a single BA. To the southeast, TVA operates as a BA and transmission service provider with sources and sinks that identify with specific BA boundary.

Source and Sink Definition used by AECI:

In an effort to more accurately determine AECI Flowgates which result from a first contingency transfer analysis, AECI has modeled the neighboring states of Kansas, Oklahoma, Arkansas, Tennessee, Illinois, Iowa, Kentucky, and Nebraska. Also, to further test the impact on Flowgates, AECI conducts north, south, east, and west transfers. Combinations of the above list will be used in the determination of the first three Limiting Elements as specified in Section 5.1, paragraph 5 in the AECI ATCID **MOD-030-2 [R2.1.2].** This modeling is done in an attempt to remove the uncertainty of how BA's are defined in the surrounding area, and instead, utilize nearby generation as sources or sinks which will more accurately identify transfer impacts to the AECI transmission system and the critical Flowgates needed for the processing of transmission service requests. See Table 1 below for a list of BA's modeled in each of the transfers studied.

Table 1: Regional Flowgate analysis and BA areas modeled

State/Area	*BA's modeled*
North	ALTW, MPW, MEC, NPPD, LES, OPPD
South	TVA, EES, SWPA, AEPW, OKGE, WFEC, OKGE
East	LGEE, BREC, EKPC, TVA, AMIL, CWLP, SIPC, EEI, AMMO
West	NPPD, LES, OPPD, MIDW, SUNC, WERE, MKEC, AEPW, OKGE, WFEC, KCPL
Arkansas	EES, SWPA, WESTMEMP, CONWAY, BUBA, PUPP
Kansas	MIDW, SUNC, WERE, MKEC
Tennessee	TVA
Oklahoma	AEPW, OKGE, WFEC
Iowa	ALTW, MPW, MEC
Nebraska	NPPD, LES, OPPD
Illinois	AMIL, CWLP, SIPC, EEI
MISO Market	South – Midwest and Midwest – South
OASIS Paths	*BA's modeled*
SWPP	All SWPP LBAs
SPA	SPA
TVA	TVA
MISO South	All MISO South LBAs
MISO North	All MISO Midwest LBAs

Confidentiality:

AECI performs a separate study to identify the Flowgates used in the AFC process. This study may contain non-public transmission information and is not included in AECI's posted ATCID.