TVA **TOPS Standard Programs and Processes**	**Available Transfer Capability Implementation Document (ATCID)**	**TOPS-SPP-30.604** **Rev. 0004** **Page 1 of 28**
		Validation Date 04-03-2017 Review Frequency 1 year Validated By Marshalia Green
		Effective Date 04-05-2017

Level of Use: Reference Use

Responsible Executive Organization: Transmission Operations & Power Supply

Approved by: Timothy E. Poseti — 4-4-2017

Tim Poseti, VP, Transmission Operations & Power Supply — Date

Revision Log			
Revision or Change Number	Effective Date	Affected Page Numbers	Description of Revision/Change
0000	03/31/2014	All	Initial issue. Supersedes TRO-TSP-SPP-30.604 R2. Organization names and title changes.
0001	03-31-2015	All	SPP Validation. Annual Review. No intent changes made.
0002	03-31-2016	All	SPP Validation. Annual Review. Added references for GOES. No intent changes made.
0003	03-31-2017	All Page 6,7	SPP Validation. Annual Review. Updated to include Remedial Action Scheme
0004	04-05-2017	Page 5	Revised language for long term horizon study.

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1.0 PURPOSE

This document describes the methodology used in the calculation of Available Transfer Capability (ATC) for TVA serving as the Transmission Operator (TOp) and the Transmission Service Provider (TSP) for the TVA Balancing Authority (BA) Area which includes the Memphis Light Gas & Water (MLGW) TOp. Smoky Mountain Transmission, while within the TVA BA Area, is a registered as both a TOp and TSP and as such maintains its own ATCID **[MOD-001 R3]**.

2.0 SCOPE

This Available Transfer Capability Implementation Document (ATCID) outlines TVA's methodology to assess ATC through the Flowgate Process. More detailed descriptions of the Transmission Reliability Margin (TRM) calculation and the Capacity Benefit Margin (CBM) calculation and usage are available in the TRM Implementation Document (TRMID) and the CBM Implementation Document (CBMID). This document satisfies the MOD-001 requirement for an ATCID and the associated MOD-030 requirements.

Review Cadence: This procedure will be reviewed annually with the review documented in the Revision Log.

3.0 PROCESS

TVA and MLGW have chosen to use the Flowgate Methodology for calculating ATC and Available Flowgate Capability (AFC) for each ATC Path for the time periods of next hour to 18 months (Short- Term Horizon). For time periods greater than 18 months (Long-Term Horizon), TVA's planning group conducts various studies to determine if sufficient transfer capability exists to grant a Transmission Service Request (TSR). 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 less simplified input assumptions. The result is more accurate studies that focus on how the power would actually flow if the TSRs were to be approved.

3.1 Roles and Responsibilities

3.1.1 Executive Owner

The VP, Transmission Operations & Power Supply, is the owner and approval authority for this procedure. Approval of this SPP is indicated by the Executive Owner's signature on the cover page. The VP is responsible for governance of this procedure.

3.1.2 Functional Lead

The Manager of Reliability Analysis has the overall responsibility for all aspects of implementation of this procedure. The manager is responsible for oversight and execution of this procedure.

3.2 Program Elements

In TVA's Flowgate Methodology, the list of Flowgates in the transfer capability calculation process is reevaluated by creating, modifying or deleting Flowgates at a minimum of once per calendar year **[MOD-030 R2.2]**.

3.2.1 Flowgate Identification Method

NOTE

TVA 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.

Flowgates are chosen to be included in the transfer capability calculation process using the following methods **[MOD-030 R1.1]**.

A. The Reliability Coordinator (RC), TOp, or Transmission Owner (TO) of the area for which transfer capability is being calculated requests that a Flowgate be added to the transfer capability calculation process, and there is a reliability related need for the Flowgate to be added.

B. An external RC or TSP requests that a Flowgate be added to the transfer capability calculation process, and it is determined that the TSP area has a 5% or greater impact on the Flowgate through generation-to-load or import/export transfers **[MOD-030 R2.1.4]**

C. The Flowgate has been identified as a Reciprocally Coordinated Flowgate by passing the coordinated Flowgate test in the Congestion Management Process (CMP). The CMP process requires immense coordination between CMP member companies. A flowgate is not considered to be officially requested until it is coordinated to be added to the CMP process and a date is set to include the flowgate in a scheduled NNL Allocation re-run.

D. Results of a first Contingency transfer analysis for ATC Paths internal to the TVA and MLGW systems, 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 at least 5% are included as Flowgates **[MOD-030 R2.1.1]**.

   1. The same contingency file used in the planning of operations will be used in the Flowgate test, which includes any identified Special Protection Systems/Remedial Action Schemes considered in the short-term planning of operations **[MOD-030 R2.1.1.1]**.

   2. Only the most limiting element in a series configuration needs to be included as a Flowgate **[MOD-030 R2.1.1.2]**.

3.2.1 Flowgate Identification Method (continued)

E. Results of a first Contingency transfer analysis from all adjacent BA source and sink (as defined in this document) combinations 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 at least 5% and within the TVA or MLGW systems are included as Flowgates **[MOD-030 R2.1.2]**.

1. The same contingency file used in the planning of operations will be used in the Flowgate test, which includes any identified Special Protection Systems/Remedial Action Schemes used in the short-term planning of operations **[MOD-030 R2.1.2.1]**.

2. Only the most limiting element in a series configuration needs to be included as a Flowgate **[MOD-030 R2.1.2.2]**.

F. Any limiting element/contingency combination within the TVA RC 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]**.

G. Any TVA or MLGW Flowgate that is requested by TVA to be included in a neighboring TSP's methodology

3.2.2 Flowgate Requests

Requests for Flowgates to be added to the TVA transfer capability calculation process should be directed to the email address: transmissionspecialist@tva.gov with the subject "Flowgate Request." Flowgate requests received at this address will be processed within 30 calendar days of receiving the request and will be added to the Flowgate list, if meeting the above criteria **[MOD-030 R2.3]**.

3.3 Available Transfer Capability Calculation Equations

3.3.1 Firm Available Flowgate Capability Calculations [MOD-030 R8]

In accordance with NERC's MOD-030-2 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.

3.3.1 Firm Available Flowgate Capability Calculations [MOD-030 R8] (continued)

$Postbacks_{Fi}$ 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.

3.3.2 Non-Firm Available flowgate Capability Calculations [MOD-20 R9]

In accordance with NERC's MOD-030-2 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.

3.3.3 AFC Initial Values Defined

TVA 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 and the PowerGem AFC/ATC Calculator (PAAC) engine. The current process calculates AFC_{final} values the following way:

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

$$AFC_{Init} - \text{Transmission Impacts} - TRM = AFC_{Final}$$

3.3.3 AFC Initial Values Defined (continued)

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

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

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

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

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

3.3.4 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][IRO-005-3a R11]**.

There are four different TFCs for each Flowgate, (one used for each season). The TFC used in the ATC calculation must match the four seasonal ratings defined in the CTR Portal and used in the planning of operations.

In instances where there is a difference in derived limits, such as a tie line, the most limiting parameter is used as TFC **[IRO-005-3a R10]**.

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 TO 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]**.

3.3.5 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.

3.3.5 Existing Transmission Commitments (ETC) (continued)

A. **ETC_{Fi} -** ETC_{Fi} is the sum of two major components, ETC_{AMB} and ETC_{ATC}. ETC_{AMB} is the existing transmission commitments that are accounted for in the AMB process and ETC_{ATC} is the existing transmission commitments accounted for in the ATC process. Transmission commitments accounted for in the ETC_{AMB} should not be double counted in the ETC_{ATC} and transmission commitments accounted for in the ETC_{ATC} should not be double counted in the ETC_{AMB}.

B. **Scheduling Horizon -** If current time is 06:00 - 24:00 CPT, the scheduling horizon is from next hour until midnight the next day. If current time is from 24:00 - 06:00, 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 TVA's calculation of ETC. All tag priorities are included in the ETC_{Fi} calculation.

1. ETC_{AMB} is calculated using the following:

   a. The impact of Network Integration Transmission Service (NITS) (generation to load) for the TSP's area **[MOD-030 R6.1]**. These values are calculated from:

      (1) Load forecast for the time period being calculated, and

      (2) Unit commitment and generation block dispatch, including all Designated Network Resources and other resources that have a legal obligation to run.

   b. The impact of NITS (generation to load) for adjacent TSPs or other TSP areas covered by an executed coordination agreement **[MOD-030 R6.2]**. These values are calculated from:

      (1) Load forecast for the time period being calculated, and

      (2) Unit commitment and generation block dispatch, including all Designated Network Resources and other resources that have a legal obligation to run.

   c. The impact of generation to load for all other TSP areas. These values are calculated from the seasonal peak load forecast included in the NERC Multiregional Modeling Working Group (MMWG) or SERC Near-Term Study Group (NTSG) models.

   d. The impact of confirmed Point-to-Point Transmission Service that is modeled in the starting case for all BA Areas in the transmission model **[MOD-030 R6.3, R6.4]**.

   e. The impact of any Grandfathered obligations for the TSP's area **[MOD-030 R6.5]**.

3.3.5 Existing Transmission Commitments (ETC) (continued)

f. The impact of any Grandfathered obligations for adjacent TSP's or TSP areas covered by an executed coordination agreement **[MOD-030 R6.6]**.

g. The impact of tags included in the NERC Tag Dump file for the area of the TSP. These tags include Point-to-Point and NITS reservations that are expected to be scheduled **[MOD-030 R6.3]**.

h. 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 NITS reservations that are expected to be scheduled **[MOD-030 R6.4]**.

i. The impact of any other firm Transmission Service from other TSPs that has been deemed to have a significant impact on the transfer capability calculations **[MOD-030 R6.7]**.

2. ETC_{ATC} is zero in the scheduling horizon.

C. **Reservation Horizon** - is any time between the scheduling horizon and 18 months from the current month.

1. ETC_{AMB} is calculated using the following:

a. The impact of NITS (generation to load) for the TSP's area **[MOD-030 R6.1]**. These values are calculated from:

(1) Load forecast for the time period being calculated, and

(2) Unit commitment and generation block dispatch, including all Designated Network Resources and other resources that have a legal obligation to run.

b. The impact of NITS (generation to load) for adjacent TSPs or other TSP areas covered by an executed coordination agreement **[MOD-030 R6.2]**. These values are calculated from:

(1) Load forecast for the time period being calculated, and

(2) Unit commitment and generation block dispatch, including all Designated Network Resources and other resources that have a legal obligation to run.

c. The impact of generation to load for all other TSP areas. These values are calculated from the seasonal peak load forecast included in the NERC Multiregional Modeling Working Group (MMWG) or SERC Near-Term Study Group (NTSG) models.

d. The impact of confirmed Point-to-Point Transmission Service that is modeled in the starting case for all BA Areas in the transmission model **[MOD-030 R6.3, R6.4]**.

3.3.5 Existing Transmission Commitments (ETC) (continued)

e. The impact of any Grandfathered obligations that are modeled in the starting case for all BA Areas in the transmission model **[MOD-030 R6.5, R6.6]**.

f. The impact of any other firm Transmission Service from other TSPs that has been deemed to have a significant impact on the transfer capability calculations **[MOD-030 R6.7]**.

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

a. 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]**.

b. 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 **[MOD-030 R6.3, R6.4]**.

c. 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]**.

d. The impact of any other firm Transmission Service from other TSPs that has been deemed to have a significant impact on the transfer capability calculations **[MOD-030 R6.7]**.

3. **ETC_{NFi} -** is calculated using the following:

a. 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 **[MOD-030 R7.5, R7.6]**.

b. 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 **[MOD-030 R7.1, R7.2]**.

c. 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]**.

d. The impact of any other non-firm Transmission Service from other TSPs that has been deemed to have a significant impact on the transfer capability calculations **[MOD-030 R7.7]**.

4. **Transmission Service Request Rollover Rights Impact** - TSRs that have met the requirements for rolling over service are considered as impact in the ETC_{ATC} calculations for the time periods when the rollover would occur.

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

3.4.1 Reservation Impacts

The source/sink definitions as used in the determination of reservation impacts are as follows:

A. Source Definitions **[MOD-030 1.2.1]**

If the reservation is sourced in a BA Area, then the sources used in calculating the impacts of the reservation is obtained from the source field in the reservation, provided the BA Area is found in the current system model. If the BA Area 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 from a specific generator within TVA's BA Area, then the source used in calculating the impacts of the reservation is obtained from the source field of the TSR, provided the source field in the reservation matches the source name in the AMB process. If the source field does not match, the generator 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 from a specific generator outside TVA's BA Area, the source used in calculating the impacts of the reservation is obtained from either the source field or the POR field of the reservation. Some tier 1 area generators are included as specific source definitions. If the generator 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 to calculate reservation impacts.

B. Sink Definitions **[MOD-030 1.2.2]**

If the reservation sinks in a BA Area, then the sinks used in calculating the impacts of the reservation is obtained from the sink field in the reservation, provided the BA Area is found in the current system model. If the BA Area 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 sinks at a discrete 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 discrete loads may be included as specific sink definitions. If the discrete 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 to calculate reservation impacts.

3.4.2 Schedule Impacts

The source/sink definitions as used in the modeling of schedules are as follows:

A. Source Definitions

3.4.2 Schedule Impacts (continued)

If the schedule is sourced in a BA Area, then the source used in modeling the schedule is obtained from the “source ca” field in the tag, provided the BA Area is found in the current system model and the tag source/sink definition file. If the BA Area is not in the current system model and the tag source/sink definition file, then the tag is not used.

If the schedule is sourced from a specific generator, then the source used in modeling the schedule is obtained from the “source ca” of the TSR, provided the generator is found in the current system model and the tag source/sink definition file. If the generator is not in the current system model and the tag source/sink definition file, then the tag is not used.

B. Sink Definitions

If the schedule sinks in a BA Area, then the sinks used in modeling the schedule is obtained from the ”sink ca” field in the tag, provided the BA Area is found in the current system model and the tag source/sink definition file. If the BA Area is not in the current system model and the tag source/sink definition file, then the tag is not used.

If the schedule sinks at a discrete load, the sink used in modeling the schedule is obtained from the “sink ca” field of the tag, provided the discrete load is found in the current system model and the tag source/sink definition file. If the discrete load in not in the current system model and the tag source/sink definition file, then the tag is not used.

3.4.3 TSR Evaluation

The source/sink definitions as used in the evaluation of TSRs are as follows:

A. Source Definitions

If the TSR is sourced in a BA Area, then the source used in evaluating the TSR is obtained from the POR field of the TSR.

If the TSR is sourced from a generator within TVA’s BA Area, then the source used in evaluating the TSR is obtained from the source field of the TSR, provided 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 from a generator outside TVA’s BA Area, then the source used in evaluating the TSR can be obtained from either the source field or the POR field. Evaluating the request using the source field is the preferred method, but identifying all possible sources in the process is not possible. Therefore, the process defaults to using the POR field, but if the transmission customer requests that it’s TSR be evaluated from the specific source, and there is time to add the source to the process (at least two business days), then the TSR evaluation will be performed using the source field.

B. Sink Definitions

If the TSR sinks in a BA Area, then the sink used in evaluating the TSR is obtained from the POD field of the TSR.

3.4.3 TSR Evaluation (continued)

If the TSR sinks at a discrete load, then the sink used in evaluating the TSR is obtained from either the sink field or the POD field of the TSR. Evaluating the request using the sink field is the preferred method, but identifying all possible sinks in the process is not possible. Therefore, the process defaults to using the POD field, but if the transmission customer requests that its TSR be evaluated from the discrete load, and there is time to add the discrete load to the process (at least two business days), then the TSR evaluation will be performed using the sink field.

3.4.4 Model Mapping [MOD-030 R4, MOD-030 R1.2.3, R1.2.4]

If the source (as specified in sections 3.4.1, 3.4.2 and 3.4.3) has been discretely modeled in the transmission model, the discretely modeled point is used as the source. If the source cannot be mapped to the discretely modeled point, then it is mapped to an equivalent or aggregate representation. If the source cannot be mapped to an equivalent or aggregate representation, it is mapped to the adjacent BA Area associated with the TSP from which the power is to be received. When a group of generators or a BA Area is used as the source, it is mapped to the online generators within the area, such that all online generation is dispatched based on distribution factors calculated as: (PMax - PGen) / ∑(PMax - PGen). In some cases, generation that does not normally participate in transfers, such as large fossil and nuclear is excluded from the calculation. Also, in some cases, offline generation is included in the calculation for BA Areas with little online generation.

If the sink (as specified in sections 3.4.1, 3.4.2 and 3.4.3) has been discretely modeled in the transmission model, the discretely modeled point is used as the sink. If the sink cannot be mapped to the discretely modeled point, then it is mapped to an equivalent or aggregate representation. If the sink cannot be mapped to an equivalent or aggregate representation, it is mapped to the adjacent BA Area associated with the TSP to which the power is to be delivered. When a group of generators or a BA Area 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). In some cases, generation that does not normally participate in transfers, such as large fossil and nuclear, is excluded from the calculation. Also, in some cases, generator must be dispatched below PMin for BA Areas with little online generation.

3.5 Calculation Number and Frequency

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

3.5.1 Transmission Models and AFC Initial Values

Under normal conditions, transmission models and AFC initial values are calculated at the following frequency:

Hourly	Hours 1 - 48	Hourly
	Hours 48 - 192	Four times a day
Daily	Days 1 - 35	Eight times a day
Monthly	Months 1 - 18	Daily

3.5.1 Transmission Models and AFC Initial Values (continued)

Under unusual conditions (e.g. system maintenance or a solution issue), the calculations may be performed less often. At a minimum, the AFC initial values will be calculated at the following frequency:

Hourly	Hours 1 - 48	Once per day
	Hours 48 - 168	Once per day
Daily	Days 1 - 31	Once per day
Monthly	Months 1 - 18	Once per month

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

Under normal conditions, reservation impacts are used to calculate AFC final values and converted to ATCs at the following intervals:

Hourly	Hours 1 - 48	Every 15 minutes
	Hours 48 - 192	Every 15 minutes
Daily	Days 1 - 35	Every 15 minutes
Monthly	Months 1 - 18	Every 15 minutes

Under unusual conditions (e.g. system maintenance or calculation issues), the calculations may be performed less often. At a minimum the AFC final values will be calculated and converted to ATCs at the following intervals:

Hourly	Hours 1 - 48	Once per hour
	Hours 48 - 168	Once per hour
Daily	Days 1 - 31	Once per day
Monthly	Months 1 - 18	Once per week

3.6 Counterflows [MOD-001 R3.2]

3.6.1 Confirmed Transmission Reservations

Confirmed reservations that are received from the TVA OASIS or a neighboring TSP's OASIS are first filtered to prevent double-counting. This filtering process removes 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 the flow on a Flowgate, counterflow assumptions are used. The following are the default counterflow assumptions used in the calculation of AFC:

Reservation Type	Counterflow Impact Used
Firm Reservations for Firm Calculations	30%
Firm Reservations for Non-Firm Calculations	50%
Non-Firm Reservations for Non-Firm Calculations	50%

3.6.1 Confirmed Transmission Reservations (continued)

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.

3.6.2 Expected Interchange

For transactions that are expected to flow and are built into the starting base cases (such as off-system load modeled in a neighboring system), the transaction is left in the base case 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.

3.6.3 Internal Counterflow

As a starting point the base cases assume each BA Area's generation is serving its own load. These generation-to-load transactions are considered internal counterflows and, since they are modeled in the base case, 100% counterflow is used. The reason 100% counterflow is used for internal counterflow is the fact that the cases must include some base level assumptions in order to correctly solve.

3.7 Postbacks

TVA does not currently use the postback component of the AFC equation when calculating ATC. Since the ETC_{ATC} and ATC values are recalculated every 15 minutes, changes in reservation statuses are incorporated in the ATC values when the ETC and ATC components are recalculated, removing the need to use postbacks.

3.8 Total Transfer Capability (TTC)

TVA 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.

TVA calculates TTC as:

$TTC_{path} = ATC_{path} + TRM_{LimitFG} / TDF_{LimitFG}$ + Reservation Impacts

If there is no limiting Flowgate then the TTC is set to the path limit for the Flowgate. 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.

3.9 Converting AFCs to ATC [MOD-030 R11]

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

3.9 Converting AFCs to ATC [MOD-030 R11] (continued)

$ATC = Min [AFC_{Flowgate\ n} / TDF_{Flowgate\ n}]$

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 Power Transfer Distribution Factor (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 on that path.

3.10 Load Flow Model Development

The Automated Model Builder (AMB) generates transmission models that simulate anticipated system conditions for the different horizons needed to adequately calculate transmission transfer capability. These models are derived from the NERC MMWG models, the SERC Long-Term Study Group (LTSG) models and the SERC NTSG models. The starting models are chosen based on the most recently updated case available. All TOps within the TVA BA Area contribute modeling data to NERC and SERC models and also submit changes to the starting models used in the AMB process. The models are combined into a set of seven starting models **[MOD-030 R5.1]**.

The transmission models contain the system topology and generation data for the Eastern Interconnection which includes modeling data and system topology for the TVA RC Area 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 3.10.3 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 also included, since they are considered in the transmission planning process.

The transmission models used to calculate AFC and ATC are the same models employed in the planning of operations. At times, more up to date input data is used in order to reflect the different time horizon being studied. TVA's planning of operations is conducted through the outage analysis process **[MOD-001 R7]**.

3.10.1 Generation Dispatch

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

3.10.2 Load Forecasts

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

A. The name of the BA Area in System Data eXchange (SDX) matches the name of the area defined in the transfer capability calculation process

B. The data for that horizon is supplied in SDX

C. 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 Days 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

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

Location
TVA BA Area
RC Area
TVA's tier 1 neighbors

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

Generation and transmission outages 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 Screener where TVA's outage evaluation rules are applied. The Screener outputs the files to the AMB process to be used in the transmission models. Transmission and generation outages are included in the models when the following criteria are met:

A. The name of the bus(es) in the SDX file matches the name of the bus(es) in the model used for that horizon.

B. The outage is included in the following time period assumptions:

3.10.3 Generation and Transmission Outages [MOD-001 R3.6, MOD-030 R5.2] (continued)

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 Days 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.

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

Location	kV Level
TVA BA Area	100 kV and above
RC Area	100 kV and above
TVA tier 1	100 kV and above
Coordination Agreement Signed with TVA	300 kV and above

D. The generation outage is included in the following location and MW level:

Location	kV Level
TVA BA Area	All
RC Area	All
TVA tier 1	50 MW and greater
Coordination Agreement Signed with TVA	50 MW and greater

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.

3.11 Allocation Processes [MOD-001 R3.5]

3.11.1 Congestion Management Process (CMP)

The CMP process allocates Flowgate capabilities among member entities to address issues such as forward-looking congestion management and seams coordination.

The CMP process facilitates better coordination between non-market and market entities, largely through honoring the available allocation, called Available Share of Total Flowgate Capability (ASTFC), on certain Flowgates.

3.11.1 Congestion Management Process (CMP) (continued)

The allocation on a Flowgate is based on the TFC of that Flowgate, with the allocation split between the reciprocal entities on that Flowgate, based on its historical impacts.

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

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

3.11.2 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 the 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, then the TDF is equal to 15/100 = 0.15 = 15%. The AFC_{init} value is calculated by summing the flows on each monitored element.

3.11.3 Allocation of Flowgate Capability or Transfer Capability among Multiple Owners

TVA designates the owner of the most limiting element of the monitored element of a flowgate as the owner. This provides all flowgates in the process a single designated owner therefore TVA does not allocate flowgate capability or transfer capability among multiple owners.

3.12 Coordination Process

3.12.1 Coordination with Other TSPs

The following data is coordinated with the following TSPs and TOps **[MOD-001 R3.3, R3.4]**:

Data	Provides To	Receives From
AFC Overrides	MISO, PJM, SPP, LGEKU, Duke, Progress, AECI	MISO, PJM, LGEKU, Duke, Progress, SPP
Transmission Reservations*	AECI, EEI, LGEKU, MISO, PJM, SPP, Duke, Progress, Southern	AECI, EEI*, LGEKU, MISO, PJM, SPP, Duke, Progress, Southern
ASTFC**	MISO, PJM, SPP, LGEKU, MAPP	MISO, PJM, LGEKU
AAL File (allocation borrowing)**	MISO, PJM, SPP, LGEKU, MAPP	MISO, PJM, LGEKU
Allocation Overrides**	MISO, PJM, SPP, LGEKU, MAPP	MISO, PJM, LGEKU

3.12.1 Coordination with Other TSPs (continued)

NOTE

* Tier 1 entities that have not provided access to reservation files, coordination of reservations is through the base case interchange in the NTSG and LTSG models.
**Some coordination between TVA and LGEE automatically occurs because the processes are at times combined into one process such as parts of the CMP process.

A. Schedules are received via the NERC tag dump file and contain schedules from the whole eastern interconnect. The following data is coordinated through SDX and is available to anyone having access to SDX:

   1. Load forecast

   2. Transmission outages

   3. Generation outages and de-rates

B. When provided, AFC override values are used for external Flowgates **[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.

C. Externally-owned Flowgates that have been added to the Flowgate process 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.

   3. The Flowgate owner does not honor the Flowgate in its own transfer capability calculation process.

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

A. Upon request TSPs, Planning Coordinators, RCs and TOps (subject to the conditions of MOD-001-1 R9.1 and 9.2) shall be given access within 30 days:

   1. Expected generation and transmission additions and retirements

   2. Expected generation and transmission outages

   3. Load forecasts

   4. Block dispatch files

3.12.2 Sharing of AFC/ATC Calculation Data [MOD-001 R9] (continued)

5. Aggregated firm capacity set-aside for Network Integration Transmission Service and aggregate non-firm capacity set aside for Network Integration Transmission Service

6. Firm and non-firm reservations

7. Aggregate capacity set-aside for Grandfathered obligations

8. Firm roll over rights

9. Firm and non-firm adjustments applied by the TSP to reflect parallel path impacts

10. Power flow models and underlying assumptions

11. Contingencies definitions

12. Facility Ratings (TFCs)

13. Any services impacting ETCs

14. CBM and TRM values for all paths or Flowgates

15. TFC and AFC values for Flowgates

16. Source and sink identification

B. 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 on the schedule specified by the requestor (no greater than once per hour) **[MOD-001 R9.2]**. Requests will be made to the email address transmissionspecialist@tva.gov with the subject, "AFC Calculation Data Request."

3.12.3 Notification of New/Revised ATCID

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

A. Planning Coordinators in TVA RC Area

B. TVA RC

C. TOps in TVA RC Area

D. Adjacent RCs

E. Adjacent Planning Coordinators

F. Adjacent TSPs

3.12.4 ATCID posting

TVA shall make the current ATCID available to all the above entities by posting the current document on TVA's OASIS **[MOD-001 R5]**.

3.12.5 Process Flow Diagrams

Process Flow Diagrams are shown in Attachment 1.

4.0 RECORDS

4.1 QA Records

None

4.2 Non-QA Records

None

5.0 DEFINITIONS

Definitions of terms not defined in this document can be assumed to correspond to the NERC Glossary definition.

Available Flowgate Capability (AFC) - A measure of the flow capability remaining on a Flowgate for further commercial activity over and above already committed uses.

ATC - 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.

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

Capacity Benefit Margin (CBM) - The amount of firm transmission transfer capability preserved by TVA for Load-Serving Entities (LSEs), whose loads are located on TVA'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.

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.

Existing Transmission Commitments (ETC) - Committed uses of TVA's Transmission System considered when determining AFC.

5.0 DEFINITIONS (continued)

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.

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.

Power Transfer Distribution Factor (PTDF) - The percentage of power transfer that flows through a Flowgate for a particular transfer when there are no contingencies.

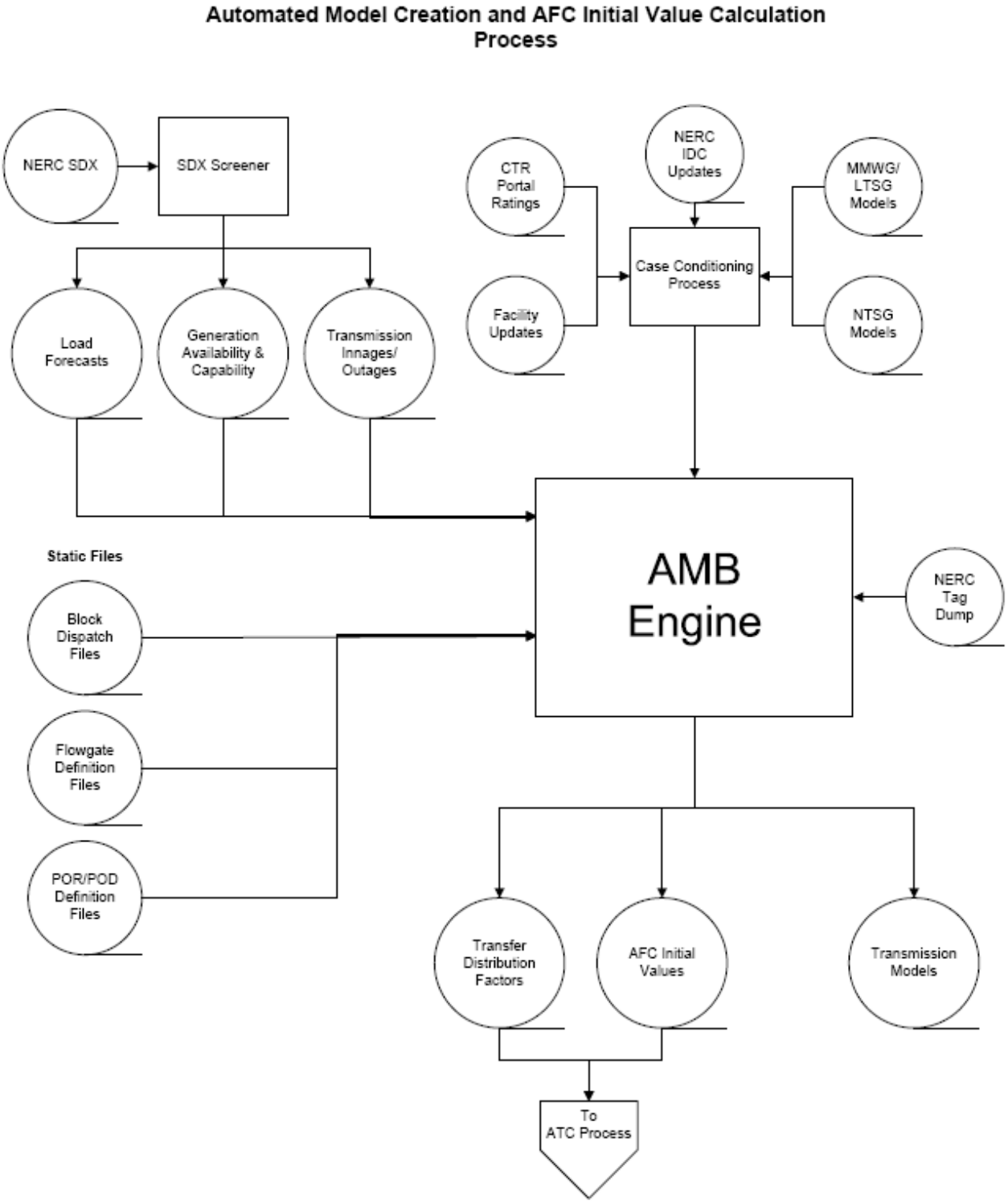
Transfer Distribution Factor (TDF) - TDF is a general term, which may refer to either PTDF or OTDF. The TDF is the percentage of power transferred from source to sink that flows through a Flowgate.

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.

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.

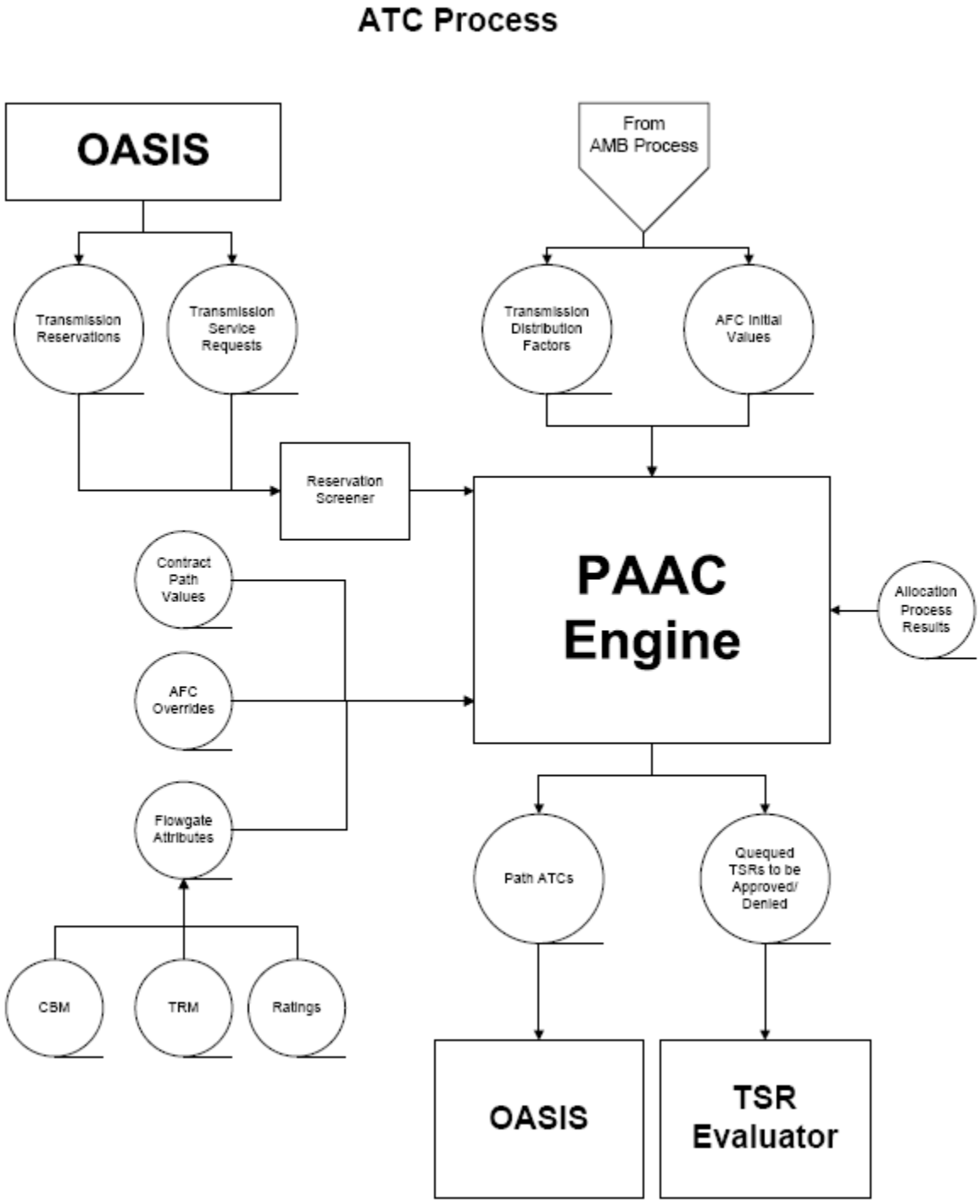
Attachment 1
(Page 1 of 2)

PROCESS FLOW DIAGRAM



Attachment 1
(Page 2 of 2)

PROCESS FLOW DIAGRAM



Source Notes
(Page 1 of 1)

Requirements Statement	Source Document	Implementing Statement
Scope: This document is to be compliant with applicable standards, specifically **MOD-001 and MOD-030**	**MOD-030 & MOD-001**	2.0
In instances where there is a difference in derived limits, the Total Flowgate Capability honors the most limiting parameter.	**IRO-005-3a R10 & R11**	3.3.4