ATTACHMENT C

METHODOLOGY TO ASSESS AVAILABLE TRANSFER CAPABILITY

Preamble:

This Attachment C sets forth the methodology to assess Total Transfer Capability ("TTC") and Available Transfer Capability ("ATC") through coordination between Louisville Gas and Electric Company and Kentucky Utilities Company ("LG&E/KU"), the Independent Transmission ~~Operator~~Organization ("ITO"), and the Reliability Coordinator ("RC"). Nothing in this Attachment C is intended to alter or conflict with the relationships between and amongst LG&E/KU, the ITO, and the RC as provided for in the ITO Agreement and the RC Agreement and Attachment P to the Open Access Transmission Tariff ("OATT"). LG&E/KU, the RC, and the ITO shall utilize the method described in this Attachment C in the calculation of ATC.

ATC is calculated using a Flowgate Methodology, described below, that considers Available Flowgate Capacity ("AFC"). As explained in more detail below, this methodology will be applied consistent with the methodology for determining Flowgates under all currently effective reliability coordination agreements that pertain to LG&E/KU's transmission system, such as the Congestion Management Process ("CMP"), and all currently effective reserve sharing agreements, such as the Contingency Reserve Sharing Group ("CRSG") currently in effect between LG&E/KU and TVA.

I. ~~I.~~ Overview

LG&E/KU 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~~beyond 18 months ("Long-Term Horizon"), ~~LG&E/KU~~requests for transmission service will ~~conduct a full N-1 power flow analysis~~be evaluated based on the ~~request. The rest of this document~~TSR Study Criteria posted on OASIS. This Attachment C pertains to the calculations of ATC for the Short-Term Horizon.

The Flowgate Methodology is based on the assumption that certain elements on the transmission system will begin to reach their limits before 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 methodology results in more accurate studies that focus on how the power would actually flow if the Transmission Service Requests ("TSRs") were to be approved.

Various components of LG&E/KU's AFC/ATC methodology ~~is~~are performed by TVA~~, acting as the RC, and TranServ International ("TSI"), acting as~~ and the ITO, in the following coordinated two-stage process:

A. ~~A.~~ **Stage 1**

TVA calculates base flow values, initial AFC values ("AFC_{Init}") and the associated Transfer Distribution Factors ("TDFs"). TVA's AFC_{Init} values account for only a subset of the Existing Transmission Commitment ("ETC") (see Section V) values that are long-term firm transactions in the base study models used by the TVA Automat~~ic~~ed Model Builder ("AMB") engine as ETC_{AMB}. TVA's AFC_{Init} and TDF values are made available to LG&E/KU's ITO.

B. ~~B.~~ **Stage 2**

The ITO calculates final AFC values using the algorithms described herein (Sections VII and VIII), which account for ETC values ("ETC_{webT}") not accounted for in the TVA calculation. The ITO converts the final AFCs to ATC final values calculated by the OATI webTrans software ("ATC_{AFC}"). The ATC_{AFC} values are then ~~tested against~~comparedagainst the contract path ATC and any limiting Available Share of Total Flowgate Capability ("ASTFC") to select final effective ATCs ("ATC_{Eff}"), which are based on the minimum of those calculations. The ATC_{Eff} are the commercially available ATC values and are posted on LG&E/KU's Open Access Same-Time Information System ("OASIS", available at https://www.oasis.oati.com/LGEE) for each "transfer path." A "transfer path" consists of a defined Point of Receipt ("POR") ~~-~~ Point of Delivery ("POD") pair.

II. ~~II. Operating, Planning and Study~~ATC Time Horizons, Algorithms & Frequency of Calculations:

A. ~~A.~~ **Firm ATC**

1. ~~1. Planning and Study~~Time Horizons

For Firm ATC calculations, the following periods are defined:

Daily ~~Planning~~ Horizon: The period beginning with the ~~current day and ending at the~~ end of hourly planning horizon and ending at the ~~31st~~end of the next calendar ~~day~~month following the current day.

Monthly Study Horizon: The period beginning at the ~~start~~end of ~~the upcoming calendar month~~daily horizon and ending at the end of the 18th calendar month following the current month.

2. ~~2.~~ Algorithms Used to Calculate Firm ATC

Firm ATC is calculated over the ~~Planning~~Daily Horizon and Monthly Study Horizon~~s~~ using the algorithms described in Sections IX and XI. The mathematical algorithm for the calculation of Firm ATC is available at: ~~<http://www.oasis.oati.com/LGEE>~~http://www.oasis.oati.com/LGEE under the ATC Information link.

3. ~~3.~~ Frequency of Calculation

Firm Daily ATC values are calculated four times a day ~~for~~till the ~~31~~end of next calendar ~~days~~month following the ~~current day~~end of hourly planning horizon.

Firm Monthly ATC values are calculated ~~once~~four times per day for the 18 calendar months following ~~the current month~~end of daily horizon.

Firm Seasonal ATC values are calculated if planning and specific requested studies have been done. Firm seasonal capability shall be posted, if applicable, for the year following the current year and for each year following to the end of the study horizon, but not to exceed 10 years.

4. ~~4.~~ Path-Specific ATC Values

The ATC process calculates the TDF related to each Flowgate. Each calculated TDF represents the relationship between the increased power flow on a specific Flowgate for a transaction across a specific transmission path.

The Firm ATC values for each transmission path are derived from the applicable TDF, ETC_{webT}, and AFC_{Init} for the most limiting Flowgate for the path.

B. ~~B.~~ **Non-Firm ATC**

1. ~~1. Operating, Planning and Study~~Time Horizons

For Non-Firm ATC calculations, the following periods are defined:

Hourly Operating Horizon: The period of the Hourly Operating Horizon differs for hours starting before noon and hours starting after noon. For hours starting before noon, the period includes the current hour through midnight, Eastern Standard Time ("EST") of the current day. For hours starting after 12 noon EST, the period includes the then current hour through midnight EST of the following day. For example, the Hourly Operating Horizon for the hour of 10:00 a.m. EST January 1 includes the current hour and extends until ~~the following~~ midnight EST (*i.e.*, from 10:00 a.m. EST to midnight EST for a total of 14 hours). However, the Hourly Operating Horizon for 1:00 p.m. of January 1 extends until midnight EST of the next day (*i.e.*, from 1:00 p.m. EST January 1 to midnight the following day for a total of ~~36~~35 hours).

Hourly Planning Horizon: The period beginning at the end of the Hourly Operating Horizon and ending at the end of the 7th calendar day following the current day.

Daily~~ Planning~~ Horizon: The period beginning at the end of the Hourly Planning Horizon and ending at the end of the ~~31st~~next calendar ~~day following the current day~~month.

Monthly Study Horizon: The period beginning at the ~~start~~end of ~~the upcoming calendar month~~daily horizon and ending at the end of the 18th calendar month following the current month.

Non-Firm ATC is calculated over the operating, planning, and study horizons using the algorithms described in Sections IX and XI.

2. ~~2.~~ Algorithms Used to Calculate Non-Firm ATC

Non-Firm ATC is calculated in hourly, daily, and monthly increments. The mathematical algorithm for the calculation of Non-Firm ATC is available at:
~~http://www.oasis.oati.com/LGEEunder~~http://www.oasis.oati.com/LGEE under the ATC Information link.

3. ~~3.~~ Frequency of Calculation

Hourly Non-Firm ATC values are calculated each hour for 192 hours. The Hourly values span the period beginning with the current clock hour and extending through the next 7 days. ~~At 12:00 noon EST each day, the calculation of the hourly values for the next day changes to include unscheduled Firm capacity.~~

Non-Firm Daily ATC values are calculated four times a day ~~for~~till the ~~31~~end of the next calendar ~~days~~month following the ~~current day~~end of hourly horizon.

Non-Firm Monthly ATC values are calculated once per day for the 18 calendar months following the ~~current month~~end of daily horizon.

Non-Firm Seasonal ATC values are calculated if planning and specific requested studies have been done. Non-firm seasonal capability shall be posted, if applicable, for the year following the current year and for each year following to the end of the study horizon, but not to exceed 10 years.

4. ~~4.~~ Path-Specific ATC Values

The ATC process calculates the TDF related to each Flowgate. Each calculated TDF represents the relationship between the increased power flow on a specific Flowgate and the corresponding ability to schedule a transaction across a specific transmission path.

The Non-Firm ATC values for each transmission path are derived from the applicable TDF, ETC_{webT}, and AFC_{Init} for the most limiting Flowgate for the path.

III. ~~III.~~ Process Flow Diagram

A process flow diagram of the ATC/AFC calculation process is included as Appendix 1 of this Attachment C.

IV. ~~IV.~~ Total Transfer Capability ("TTC")

A. ~~A.~~ TTC Definition

TTC is the maximum amount of power that is allowed to reliably flow across an interface before transmission impacts such as ETC, Transmission Reliability Margin ("TRM"), Capacity Benefit Margin ("CBM"), postbacks, and counterflows are considered. TTC is therefore normally the contract path amount for the interface. For an interface that has a very large Contract Path, such that the Contract Path is above the reliable transfer limit, the TTC is set to a more appropriate transfer limit based on reasoned engineering analysis.

B. ~~B.~~ TTC Methodology

LG&E/KU calculates TTC as the sum of the seasonal normal facility ratings of the tie lines between itself and other interconnected transmission providers.

C. ~~C.~~ Databases Utilized in TTC Assessment

The databases used in TTC assessments are maintained by LG&E/KU. Other interconnected transmission providers calculate the seasonal normal ~~and emergency~~ facility ratings for their tie lines in internal spreadsheets and provide them to LG&E/KU.

D. ~~D.~~ Assumptions Utilized in TTC Assessment

The assumptions utilized in TTC assessments regarding load levels, generation dispatch, and modeling of planned and contingency outages are listed in the Available Transfer Capability Implementation Document ("ATCID"). These assumptions shall be no more limiting than those used in the planning of operations for the corresponding time period studied, provided that such planning of operations has been performed for that time period.

V. ~~V.~~ Existing Transmission Commitments ("ETC")

A. ~~A.~~ ETC Definition

ETC encompasses committed use of the transmission system, including: (1) Native Load commitments (including Network Integration Transmission Service ("NITS")), (2) grandfathered transmission rights, (3) appropriate Point-to-Point

("PTP") Transmission Service reservations, and (4) rollover rights associated with long-term firm service of five or more years.

B. ~~B.~~ **ETC Calculation Methodology**

When calculating firm ETC ("ETC_{Fi}") the following impacts shall be summed for all periods (which are thoroughly described in the ATCID to fully comply with MOD-030-~~2~~3, R6):

1. ~~1.~~ For LG&E/KU's Transmission Service Provider ("TSP") area, the impacts of firm NITS, including the impacts of generation-to-load;
2. ~~2.~~ For all adjacent TSP areas and other TSP areas which are covered by an executed coordination agreement, the impacts of any firm NITS, including the impacts of generation-to-load having a distribution factor (calculated using power flow models) equal to or greater than the percentage used to curtail in the Interconnection-wide congestion management procedure used by LG&E/KU.
3. ~~3.~~ The impacts of all confirmed firm PTP Transmission Service expected to be scheduled;
4. ~~4.~~ The impacts of any grandfathered firm obligations expected to be scheduled or to flow into LG&E/KU's area; and
5. ~~5.~~ The impacts of other firm services, as determined by the ITO, which are explained in the ATCID.

~~Load Served by Others ("LSBO") is a grouping of the wholesale load on the Transmission Provider's transmission system that is the responsibility of another party. LSBO shall not constitute a new component for ETC. All LSBO shall be identified in the transmission service categories provided above as grandfathered service, PTP, or NITS.~~

C. ~~C.~~ **Components of ETC Firm Commitments**

ETC_{Fi} contains two major components, ETC_{AMB} and ETC_{webT}.

ETC_{AMB} is the existing transmission commitments that are accounted for in the TVA AMB process (*e.g.*, longer-term transactions in the planning model). ETC_{webT} is the existing transmission commitments accounted for in the ITO ATC process (OASIS reservations not included in ETC_{AMB}). Transmission commitments accounted for in the ETC_{AMB} should not be double counted in the ETC_{webT}.

1. ~~1.~~ **ETC_{AMB} is calculated with the model reflecting the following:**
   a) ~~a)~~ **The impacts of generation-to-load for the LG&E/KU Transmission Service area. These values are calculated from (and reflected in the power flow models of):**

(i) ~~*(i)*~~ *load forecast for the time period being calculated, including Native Load and NITS load, and*

(ii) ~~*(ii)*~~ *unit commitment and Dispatch Order, to include all designated network resources and other resources that are committed or have the legal obligation to run as specified in the ATCID.*

b) ~~**b)**~~ **The impact of generation-to-load for other TSP areas covered by an executed coordination agreement or where the impact is deemed significant. These values are calculated from (and reflected in the power flow models of):**

(i) ~~*(i)*~~ *load forecast for the time period being calculated, and*

(ii) ~~*(ii)*~~ *unit commitment and block generation dispatch.*

c) ~~**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 Multiregional Modeling Working Group ("MMWG") or Near-Term Study Group ("NTSG") models.**

d) ~~2.~~ **The impact of confirmed PTP Transmission Service expected to be scheduled and modeled as expected interchange in the base models for the LG&E/KU TSP area and any other TSP areas covered by an executed coordination agreement.**

e) **The impact of any grandfathered obligations expected to be scheduled or expected to flow and modeled as expected interchange in the base models for the LG&E/KU TSP area and any other TSP area covered by an executed coordination agreement.**

2. **ETC_{webT} is calculated taking into account the following:**

a) ~~**a)**~~ **The impact of NITS for the LG&E/KU TSP area and any other TSP area covered by an executed coordination agreement.**

b) ~~**b)**~~ **The impact of confirmed PTP Transmission Service** ~~**expected to be scheduled**~~ **for the LG&E/KU TSP area and any other TSP area covered by an executed coordination agreement.**

~~**2. c) The impact of any grandfathered obligations expected to be scheduled or expected to flow for the LG&E/KU TSP area and any other TSP area covered by an executed coordination agreement.**~~

D. ~~D.~~ **Calculating the Impact of ETC for Non-Firm Commitments**

When calculating the impact of ETC for non-firm commitments ("ETC_{NFi}") the following impacts shall be summed (which are thoroughly described in the ATCID to fully comply with MOD-030-~~2~~3, R7):

1. ~~1.~~ **The impact of all confirmed non-firm PTP Transmission Service expected to be scheduled for the LG&E/KU TSP area and any other TSP area covered by an executed coordination agreement.**
2. ~~2.~~ **The impact of any grandfathered non-firm obligations expected to be scheduled or expected to flow for the LG&E/KU TSP area and any other TSP area covered by an executed coordination agreement.**
3. ~~3.~~ **The impact of non-firm NITS (secondary service) for the LG&E/KU TSP area and any other TSP area covered by an executed coordination agreement.**
4. ~~4.~~ **The impacts of other non-firm services, as determined by the ITO, which are explained in the ATCID.**

E. ~~E.~~ *Counterflow Impact*

When applying transmission reservation impacts in the opposite direction of flow on a Flowgate in the AFC calculations, ~~the following~~LG&E/KU uses a set of default counterflow assumptions ~~are used~~ listed in the ATCID for LG&E/KU Flowgates~~:~~

~~**Reservation Type**~~	~~**Counterflow Impact Used**~~
~~Firm Reservations for Firm Calculations~~	~~0%~~
~~Firm Reservations for Non-Firm Calculations~~	~~0%~~
~~Non-Firm Reservations for Non-Firm Calculations~~	~~0%~~

~~**Note**: These~~ . The default counterflow assumptions are based on ~~operator experience and~~ reasonable engineering judgment~~.~~ and closely align with the counterflow assumptions used by TVA. Future revisions to the default assumptions will be reflected in the ATCID. Historically, LG&E/KU have observed some flowgates located on its Transmission System experience more congestion in the real-time operating environment than other Flowgates. LG&E/KU, in coordination with the ITO, will revise the counterflow assumption for specific Flowgates in order to calculate a more accurate AFC for the Flowgate; these revisions will be posted on OASIS. LG&E/KU reviews and updates these default and flowgate specific counterflow adjustment factors annually (or more often if needed).

LG&E/KU honors Flowgate assumptions it receives through TVA on non-LG&E/KU Flowgates.

F. ~~F.~~ **Positive Flow Impacts**

For transactions that are expected to flow and are built into the base models (such as Network Resources serving Network Loads and off-System load modeled in a neighboring System), the transaction is modeled in the base model and therefore 100% positive impact is used in these circumstances. Since these transactions can be expected to flow, the 100% assumption creates a more accurate transfer capability calculation.

The default positive impact assumptions for reservations not modeled as expected interchange in base model is also 100% but can be modified on a flowgate basis based on industry practice and engineering experience. An example of these type reservations would be where a yearly reservation is scheduled during various seasons with a smaller MW amount than the original reservation MW amount or situations where an hourly or daily reservation could be not scheduled. To facilitate the calculation of more accurate AFC values, LG&E/KU, in coordination with the ITO, may revise the default 100% positive impact assumption for specific Flowgates in order to calculate a more accurate AFC for the Flowgate. These revised assumptions will be posted on OASIS. LG&E/KU reviews periodically and updates these positive impact adjustment factors as needed.

~~F.~~G. **Point-to-Point Transmission Service Requests Incorporated in ETC**

The impact of confirmed PTP Transmission Service expected to be scheduled for the area of LG&E/KU TSP area and any other TSP area covered by an executed coordination agreement.

~~G.~~H. ~~G.~~ **Accounting for Rollover Rights in ETC**

Transmission Service Requests ("TSRs") that have met the requirements for rollover service, and that have been determined to have a likelihood of rolling over, are considered in the ETC calculations for the periods when the rollover would occur.

~~H.~~I. ~~H.~~ **Release of Non-Firm Capacity**

Non-firm AFC for the Hourly Scheduling and Planning Horizon is calculated considering known energy schedules for all reservations except hourly non-firm reservations. For hourly non-firm reservations, the reservation amount is used ~~if no schedule has been submitted.~~until the next initialization. If a NERC e-Tag has been submitted for hourly non-firm service, the amount on the e-Tag is used in the calculation.

VI. ~~VI.~~ Addition or Elimination of Flowgates

A. ~~A.~~ Transmission Owner Adding or Eliminating Flowgates

LG&E/KU performs transfer and single contingency analysis on the four quarterly models used in the ATC process. Flowgates that monitor LG&E/KU facilities, which exceed a Power Transfer Distribution Factor ("PTDF") of 4% and an Outage Transfer Distribution Factor ("OTDF") of 2%, both of which are 1% less than the curtailment threshold, are tested for limitations to transfer. The three most restrictive Flowgates that limit transfers below 150% of LG&E/KU interconnected capability between the two control areas will be included in the LG&E/KU ATC process. Transfers between the Midwest ISO, PJM, and TVA will be tested ~~at the 10,000 MW level~~up to the 10,000 MW level. Other paths that are not OASIS posted paths may be included in the transfer file if it is deemed that they are needed to ensure a complete set of potentially impacted flowgates are identified. This will typically be for paths to/from nearby entities that are part of MISO or PJM.

Existing Flowgates on the LG&E/KU Transmission System that do not meet any of the above criteria, have not been identified in the ATC process as a transfer limit in the past ~~two years~~twelve months, and have not been identified as an operation limit in the past ~~two years~~twelve months, will be recommended to the RC for removal. ~~Once the models are complete and fully updated to reflect the appropriate AFC values, the RC will generate the base system AFC values and Flowgate response factors for all transmission Flowgates monitored by LG&E/KU.~~

LG&E/KU recommends the addition or elimination of Flowgates to ~~the RC. The RC~~TVA. TVA coordinates the addition or elimination of Flowgates with ~~NERC and~~ the ~~other TSPs~~CMP entities.

B. ~~B. RC~~ Adding or Eliminating Flowgates

~~The RC, an Operating Entity, participates in the process and provides the list of coordinated Flowgates to LG&E/KU. All impacted Flowgates identified in the CRSG process are included in the LG&E/KU ATC process.~~

~~The RC~~TVA may request LG&E/KU to add a Flowgate (permanent or temporary) to the ATC process. If LG&E/KU receives a request from or through ~~the RC to~~TVAto add an external Flowgate to its ATC process, then LG&E/KU will do so if the Flowgate exceeds a ~~3~~5% threshold~~ in any of the coordinated~~. The same 5% threshold may apply to a Flowgate ~~tests. LG&E/KU will also add any internal Flowgate that TVA has identified as an operational limit.~~request from non-CMP entities.

VII. ~~VII.~~ Available Flowgate Capability ("AFC")

A. ~~A.~~ AFC Definition

AFC is a flow-based approach to the measure of the transfer capability remaining on a Flowgate for further commercial activity over and above already committed uses. It is defined as Total Flowgate Capacity ("TFC"), less ETC (including retail customer service), less a CBM, less a TRM, plus Postbacks, and plus Counterflows.

The NERC Glossary of Terms defines Flowgate as 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 ("BES").

A Flowgate is a selected power transmission element or group of elements that act as a proxy for the power transmission system capability and are used to evaluate potential thermal, voltage, stability, and/or contractual system limits to power transfer.

B. ~~B.~~ *Types of Flowgates*

There are two types of Flowgates:

Outage Transfer Distribution Factor ("OTDF") Flowgate: Composed of usually two power transmission elements in which the loss of one (contingency element) significantly increases the loading on the other transmission element (monitored element).

Power Transfer Distribution Factor ("PTDF") Flowgate: Composed of one or more power transmission elements in which the total pre-contingency flow over the Flowgate cannot exceed a predetermined limit.

C. ~~C.~~ *Total Flowgate Capability ("TFC")*

Once limiting elements have been identified as potential transfer constraints, they can be grouped with their related contingencies and identified as unique Flowgates. The rating of the Flowgate is called the TFC of the Flowgate and is monitored and used for evaluation of all viable transfers for commerce. The TFC values used in the AFC process are consistent with those used for planning purposes.

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.

1. ~~1.~~ Types of TFCs

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.

D. ~~D.~~ *Limiting Parameters and Assumptions*

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

The assumptions utilized in calculating TFC shall be no more limiting than those used in the planning of operations for the corresponding time period studied, providing such planning of operations has been performed for that time period.

E. ~~E.~~ *Updating TFC*

TFCs will be reviewed and~~ (~~, if needed~~)~~, updated at least once per calendar year. 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 should be updated within seven calendar days of the notification as required by MOD-030-~~002~~3, R2.5 and 2.6 and documented in the ATCID.

VIII. ~~VIII.~~ AFC Calculation Methodology

A. ~~A.~~ *Mathematical Algorithms and Posting of Results*

The mathematical algorithms stated below are used to calculate firm and non-firm AFC. The results are available on LG&E/KU's OASIS.

B. ~~B.~~ *Flowgate Methodology for Calculating ATC*

LG&E/KU has selected the Flowgate Methodology for calculating ATC for each path identified for the LG&E/KU Transmission Operating area.

C. ~~C.~~ *Criteria for Including Flowgates in AFC Process*

The LG&E/KU Transmission Operator includes Flowgates used in the AFC process, at a minimum, based on the following criteria. These criteria are thoroughly described in the ATCID to fully comply with MOD-030-~~2~~3, R2. The LG&E/KU Transmission Operator includes the following Flowgates:

1. ~~1.~~ **those that appear in the results of a first Contingency transfer analysis for ATC Paths;**
2. ~~2.~~ **any limiting Element/Contingency combination within TVA's RC Area; and**
3. ~~3.~~ **any limiting Element/Contingency combination within the Transmission model that has been requested to be included by any other TSP using the Flowgate Methodology.**

Additionally, the LG&E/KU Transmission Operator maintains its list of Flowgates used in the AFC process by:

1. ~~1.~~ **At a minimum, establishing a list of Flowgates by creating, modifying, or deleting Flowgate definitions at least once per calendar year.**
2. ~~2.~~ **At a minimum, establishing a list of Flowgates by creating, modifying, or deleting Flowgates that have been requested within thirty calendar days from the request.**
3. ~~3.~~ **Establishing the TFC of each of the defined Flowgates as equal to:**
   - **a)** ~~a)~~ **For thermal limits, the SOL of the Flowgate.**
   - **b)** ~~b)~~ **For voltage or stability limits, the flow that will respect the SOL of the Flowgate.**
4. ~~4.~~ **At a minimum, establishing the TFC once per calendar year.**
   - **a)** ~~a)~~ **If notified of a change in the Rating by the Transmission Owner that would affect the TFC of a Flowgate used in the AFC process, the TFC should be updated within seven calendar days of the notification.**
5. ~~5.~~ **Providing the TSP with the TFCs within seven calendar days of their establishment.**
6. ~~6.~~ **When calculating AFCs, the TSP shall represent the impact of Transmission Service, as required by MOD-030-2, R4 and detailed in the ATCID.**

The ITO uses NTSG models provided by the LG&E/KU Transmission Operator. These models include expected generation and transmission outages (as specified in the ATCID), and the AFC values provided by the respective external TSPs for external Flowgates identified.

D. ~~**D.**~~ *Firm Available Flowgate Capability Calculations ("Firm AFC Flowgate Algorithm")*

The following algorithm (subject to allocation processes described in the ATCID) 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 commitments for the Flowgate during that period.

CBM_i is the impact of the Capacity Benefit Margin on the Flowgate during that period (as further described in the CBMID).

TRM_i is the impact of the Transmission Reliability Margin on the Flowgate during that Period (as further described in the TRMID).

$Postbacks_{Fi}$

LG&E/KU does not currently use the postback component of the AFC equation when calculating ATC. Since ETC_{webT} and ATC values are recalculated multiple times per day, changes in reservation statuses are incorporated in the ATC values when the ETC_{webT} and ATC components are recalculated, removing the need to use Postbacks.

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

E. ~~E.~~ *Non-Firm Available Flowgate Capability Calculations*

The following algorithms (subject to allocation processes described in the ATCID) are 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 commitments for the Flowgate during that period.

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

CBM_{Si} is the impact of any Capacity Benefit Margin schedules on the Flowgate during that period (as further described in the CBMID).

TRM_{Ui} is the impact of the unreleased Transmission Reliability Margin on the Flowgate during that period (as further described in the TRMID).

$Postbacks_{NFi}$

LG&E/KU does not currently use the postback component of the AFC equation when calculating ATC. Since ETC_{webT} and ATC values are recalculated multiple times per day, changes in reservation statuses are incorporated in the ATC values when the ETC_{webT} and ATC components are recalculated, removing the need to use Postbacks.

$Counterflows_{NFi}$ for Hourly Operating Horizons are adjustments from the impact of tags included in the NERC tag dump file to firm and non-firm AFC due to power flows in the opposite direction of the Flowgate in the hourly operating horizon.

$Counterflows_{NFi}$ for Planning and Study Horizons are adjustments to firm AFC due to power flows in the opposite direction of the Flowgate; and adjustments to non-firm AFC in the planning and study horizons.

F. ~~F.~~ *Initial and Final AFC Calculation*

Each day at 12:00 noon EST, the Non-Firm Hourly ATC calculation for the Hourly Operating Horizon is modified so that unscheduled Firm capacity is available to transmission customers as Non-Firm service. The modification to the algorithm is achieved by replacing the impact of the Reservations with the impact of the Transmission Schedules.

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. As previously mentioned, Postbacks and Counterflows are included in the AFC_{Init} that TVA calculates for the LG&E/KU Base Case, posted on OASIS. This allows the ITO to utilize the AFC_{Init} values calculated and supplied. TVA utilizes the Transmission Adequacy and Reliability Assessment ("TARA") AMB engine for calculating AFC_{Init} values. LG&E/KU uses the OASIS webTrans engine for calculating final AFC ("AFC_{Final}") and ATC values. The current process calculates AFCs the following way:

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

Where:

$$\text{Transmission Impacts} = ETC_{webT} - Postbacks_{NFi} - Counterflows_{NFi}$$

$$AFC_{Final} = AFC_{Init} - \text{Transmission Impacts} - CBM_{Si} - TRM_{Ui}$$

Where, ETC_{webT} = reservation impacts not included in AFC_{Init}

1. ~~1.~~ **AFC Initial**

Under normal circumstances TVA will calculate AFC_{Init} values as follows:

AFC_{Init} Horizon	**Calculation Frequency**
Hourly, Hours 1-48	Every hour
Hourly, Hours 46-192	Four times per day
Daily, Days 1-35	~~Four~~Eight times per day
Monthly, Months 1-18	Once per day

The above frequencies reflect the expected intervals for AFC_{Init} calculations. In the event of system maintenance or solution issues, TVA may calculate AFC_{Init} values on a less frequent basis, but no less~~s~~ once per day for hourly and daily AFC_{Init} values, and once per month for monthly AFC_{Init} values.

2. ~~2.~~ **AFC Final**

The ITO will calculate AFC_{Final} values as follows:

AFC_{Final} Horizon	**Calculation Frequency (Minimum)**
Hourly Operating~~,~~ - Prior to 12 noon EST, current hour through midnight EST of the current day; After 12 noon EST, current hour through midnight EST of the next day	Every hour
Hourly Planning ~~-~~ From end of Hourly Operating horizon through midnight EST 7 days beyond the current day	Every hour
Daily Planning ~~-~~and Study – From end of the Hourly Planning horizon through midnight 31 days beyond the current day	Four times per day
Monthly Study ~~-~~ From the start of the upcoming calendar month through the end of the month 18 calendar months from the current month	~~Once~~Four times per day

IX. ~~**IX.**~~ Conversion of AFC Values to ATCs

When converting Flowgate AFCs to ATCs for evaluated transfer paths, the following algorithm is used:

$$ATC = \min(P)$$
$$P = \{PATC_1, PATC_2, \ldots PATC_n\}$$
$$PATC_{AFC_n} = AFC_n / DF_{np}$$

Where:

ATC is the Available Transfer Capability.

P is the set of Partial Available Transfer Capabilities for all "impacted" Flowgates honored by the ITO; a Flowgate is considered "impacted" by a path if the Distribution Factor for that path is greater than the percentage used to curtail in the Interconnection-wide congestion management procedure used by the ITO on an OTDF Flowgate or PTDF Flowgate.

$\mathbf{PATC_{AFC_n}}$ is the Partial Available Transfer Capability for a path relative to a Flowgate *n*.

$\mathbf{AFC_n}$ is the Available Flowgate Capability of a Flowgate *n*.

$\mathbf{DF_{np}}$ is the Distribution Factor for Flowgate *n* relative to path *p*.

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.

X. ~~X.~~ ASTFC Process and Allocation by ~~CRSG~~CMP

The ~~CRSG~~CMP facilitates coordination between the non-market and 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 it has sufficient ASTFC on that Flowgate. If it does not have sufficient ASTFC, it can either borrow or transfer it in order to grant the transmission service. If no ASTFC is available from any entity, then the service shall be denied.

The ITO calculates final ASTFC values for each Flowgate in accordance with the ~~Congestion Management Process ("CMP") between PJM & TVA, and the Midwest ISO & PJM~~CMP.

XI. ~~XI.~~ ATC Contract Path Calculations

Contract Path ATC is calculated for path segments that are bound to the commercially reservable paths established on the LG&E/KU OASIS. ATC contract path calculations are the result of subtracting the existing reservations from TTC. Contract Path ATC values are calculated and posted by the ITO with the same frequencies as the AFC_{Final}.

A. ~~A.~~ *Effective ATC Calculation ("ATC_{Eff}")*

The ITO calculates a final AFC value using the algorithms described herein, which accounts for ETC values not accounted for in the TVA calculation, ETC_{webT}. The ITO converts the final AFC to a final ATC_{AFC} value using the ITO's OATI webTrans software. The final ATC_{AFC} value is then tested against the contract path ATC and any limiting ASTFC to select a final ATC_{Eff}, which is based on the minimum of those calculations. The ATC_{Eff} is the commercially available ATC value and is posted on the OASIS for each "transfer path." A "transfer path" consists of a defined POR-POD pair.

ATC_{Eff} values are calculated and posted to OASIS using the same frequencies as AFC_{Final}, which meet or exceed the minimum ATC calculation intervals identified in NERC's MOD-001-01, R8 reliability standard.

XII. ~~XII.~~ Transmission Service Request Evaluation

A. ~~A.~~ *Transmission Service Requests ("TSRs") Intervals*

TSRs are evaluated, respecting queue order, based on their impact on all Flowgates in the AFC process, such that the impact is greater than the cutoff of 3% for OTDF Flowgates and 5% for PTDF Flowgates. The affected Flowgates are also determined by On/Off path rules outlined in the CMP to determine transmission constraints and affected Flowgates. The requests are also checked against the amount of allocation available on the impacted Flowgates according to the Congestion Management Process ("CMP").

B. ~~B.~~ *Criteria for Granting TSRs*

For a TSR to be granted, it must pass the three following checks:

1. ~~1.~~ **Is there enough AFC available on the affected Flowgate?**
2. ~~2.~~ **Is there sufficient ASTFC, including the borrowing of ASTFC, on the Reciprocal Coordinated Flowgates in accordance with the ~~CRSG~~CMP?**
3. ~~3.~~ **Is there enough capacity available on the Contract Path to grant the request?**

If the request fails one of the three checks, it is then evaluated for bumping opportunities. If bumping is not available, the request is marked failed, and the TSR shall be denied.

XIII. ~~XIII.~~ Databases Utilized in AFC Calculation

The following databases are utilized in AFC calculation: (i) the NERC System Data Exchange ("SDX"), which is a compilation of reported loads and transmission and generation outages in the Eastern Interconnection; and (ii) the Interchange Distribution Calculator ("IDC"), or power flow model.

XIV. ~~XIV.~~ Assumptions Utilized in ATC and AFC Assessments

The assumptions used in AFC and ATC assessments regarding load levels, generation dispatch, and modeling of planned and contingency outages are listed in the calculation methodology documented in the ATCID. These assumptions shall be no more limiting than those used in the planning of operations for the corresponding time period studied, provided that such planning of operations has been performed for that time period.

Within thirty calendar days of receiving a request from any entity described in MOD-01-1a, R9, LG&E/KU will begin to make the requested data available to the requestor, subject to the conditions specified in R9.

XV. ~~XV.~~ Available Transfer Capability Implementation Document ("ATCID")

In accordance with NERC Standards, LG&E/KU has posted on its OASIS an ATCID at http://www.oasis.oati.com/LGEE, under the ATC Information link. This document provides detail of the process for calculating ATC by the ITO using a Flowgate Methodology. The ATCID includes details that satisfy NERC's Standard MOD-030 requirements.

If a revised or new ATCID is implemented, LG&E/KU will notify the following entities of such implementation: each Planning Coordinator, RC, and Transmission Operator associated with the TSP's area and each Planning Coordinator, RC, and TSP adjacent to the TSP's area. At all times, LG&E/KU will ensure that the currently effective ATCID is available to the same entities.

XVI. ~~XVI.~~ Postback Requirements

In accordance with the current NAESB OASIS Standards~~, Version 1.5 - WEQ-001~~, the ITO incorporates Postbacks (standard 01-18) in the ATC posted on OASIS due to a change in status of transmission reservations or unscheduled firm transmission service, including providing for the release of unscheduled firm capacity in its calculation of non-firm ATC or AFC, as appropriate. Also in accordance with current NAESB OASIS Standards~~, Version 1.5 - WEQ-001~~, LG&E/KU has posted on its OASIS a Postback Methodology at http://www.oasis.oati.com/LGEE, under the ATC Information link.

XVII. ~~XVII.~~ Transmission Reliability Margin ("TRM")

A. ~~A.~~ TRM Definition

Transmission Reliability Margin ("TRM") **is the amount of transmission transfer capability necessary to provide a reasonable level of assurance that the interconnected transmission network will be secure.** TRM accounts for the inherent uncertainty in system conditions and its associated effects on ATC calculations, and the need for operating flexibility to ensure reliable system operation as system conditions change. All transmission system users benefit from the preservation of TRM by TSPs. The assumptions and components of LG&E/KU's TRM calculation are described in detail below.

B. ~~B.~~ *TRM Calculation Methodology and Implementation Document ("TRMID")*

LG&E/KU, as the TSP, considers the ATC margin components described in this section in its TRM calculations. Some, or all, of the TRM component values may be set to zero. The TRM components descriptions include the requirements in NERC Standard MOD-008 and SERC Supplement ~~-~~ Transmission Reliability Margin Implementation Document.

LG&E/KU has posted on OASIS its TRMID at http://www.oasis.oati.com/LGEE, under the ATC Information link for TSPs, RCs, Planning Coordinators, Transmission Planners, and Transmission Operators to review. The TRMID details the components used in establishing TRM by the LG&E/KU Transmission Operator and the process used to do so.

On each of its respective ATC Paths or Flowgates, the TRMID provides identification of each of the following components of uncertainty if used in establishing TRM and a description of how that component is used to establish a TRM value. TRM will be considered for the following components of LG&E/KU transmission system uncertainty:

- ~~•~~ Aggregate Load forecast
- ~~•~~ Load distribution uncertainty
- ~~•~~ Forecast uncertainty in Transmission system topology (including, but not limited to, forced or unplanned outages and maintenance outages) (included in network uncertainty)
- ~~•~~ Allowances for parallel path (loop flow) impacts (included in network uncertainty)
- ~~•~~ Allowances for simultaneous path interactions (included in network uncertainty)

- Variations in generation dispatch (including, but not limited to, forced or unplanned outages, maintenance outages and location of future generation)
- Short-term System Operator response (Operating Reserve actions)
- Reserve sharing requirements
- Inertial response and frequency bias

The TRMID includes a description of the method used to allocate TRM across ATC Paths or Flowgates.

LG&E/KU will use only those components of uncertainty listed in the TRMID and will not include any of the components of CBM.

If requested, LG&E/KU shall make available to any TSP, RC, Planning Coordinator, Transmission Planner, or Transmission Operator the underlying documentation used to calculate TRM (if any) no more than 30 days after receiving a request for such information from any such entity.

LG&E/KU will establish TRM values in accordance with the TRMID at least every 13 months.

Within seven days after establishing or changing a TRM value, LG&E/KU will provide the established or changed value to the TSP and its Transmission Planner.

C. ~~**C.**~~ Use of TRM in ATC Calculations

LG&E/KU uses an AFC methodology (NERC MOD-030-~~02~~3) for calculation of ATC for each posted Flowgate. Firm and Non-Firm AFC values include a decrement for TRM of Network Uncertainty (2%), plus the maximum of the applicable Contingency Reserve Sharing ("CRS") and generation dispatch in all horizons.

D. ~~**D.**~~ *Databases Utilized in TRM Calculations*

LG&E/KU does not use any databases to calculate TRM.

E. ~~**E.**~~ *Transmission Provider's Use of TRM*

TRM is utilized for all firm and non-firm Flowgate AFC calculations. 100% of the TRM value is utilized for firm and non-firm Flowgate AFC calculations.

XVIII. ~~XVIII.~~ Capacity Benefit Margin ("CBM")

A. ~~A.~~ *LG&E/KU's practice regarding CBM*

LG&E/KU does not reserve CBM on its own behalf or for other transmission customers without a specific request for CBM.

B. ~~B.~~ *Capacity Benefit Margin Implementation Document ("CBMID")*

In accordance with NERC Standard MOD-004-1, LG&E/KU has posted on its OASIS a CBMID at http://www.oasis.oa~~s~~t~~is~~.com/LGEE, under the ATC Information link for TSPs, RCs, Load-Serving Entities ("LSEs"), Planning Coordinators, Transmission Planners, and Transmission Operators to review. This document provides procedures for an LSE or Resource Planner to request transmission capacity set aside as CBM, including a description of the studies that must be performed. The CBMID further describes the operational criteria for administration of CBM once a set aside has been established.

C. ~~C.~~ *Transmission Provider's Definition of CBM*

CBM is the amount of firm transmission transfer capability preserved for LSEs on the host transmission system where their LSE load is located, to enable access to generation from interconnected systems to meet generation reliability requirements. Preservation of CBM for a LSE allows that entity to reduce its installed generating capacity below what may otherwise have been necessary without interconnections to meet its generation reliability requirements. The transmission capacity preserved as CBM is intended to be used by the LSE only in times of emergency generation deficiencies.

D. ~~D.~~ *CBM Procedures during Emergencies*

LSEs on the LG&E/KU system requesting to import energy over firm Transfer Capability set aside as CBM must be experiencing a declared NERC Energy Emergency Alert ("EEA") Level 2 or higher and must complete the steps as described in the CBMID.

~~E.~~ When reviewing an Arranged Interchange using CBM, LG&E/KU will waive, within the bounds of reliable operation, any Real-time timing and ramping requirements. LG&E/KU will approve, within the bounds of reliable operation, any Arranged Interchange using CBM that is submitted by an "energy deficient entity" under an EEA 2 if:

- the CBM is available,
- an EEA 2 has been declared, and
- the load of the "energy deficient entity" is located within LG&E/KU's TSP area.

E. *Accounting for CBM Values in Subsequent Years*

LG&E/KU and the ITO will account for any CBM values in future year evaluations pursuant to the CBMID.

1. ~~1.~~ **ATC and AFC Calculations**

At least every 13 months, the ITO, as the TSP, when maintaining any CBM, as applicable, shall establish a CBM value for each ATC Path or Flowgate to be used for ATC or AFC calculations during the 13 full calendar months (months 2-14) following the current month (the month in which the ITO is establishing the CBM values). This value shall reflect the provisions of Section XVIII.E.3.

2. ~~2.~~ **CBM use in Transmission Planning**

At least every 13 months, LG&E/KU as the Transmission Planner, when CBM is applied, shall establish a CBM value for each ATC Path or Flowgate to be used in planning during each of the full calendar years two through ten following the current year (the year in which the Transmission Planner is establishing the CBM values). This value shall reflect the provisions of Section XVIII.E.3.

No later than 31 calendar days after the establishment of CBM, the TSP that maintains CBM shall notify all LSEs and Resource Planners that determined they had a need for CBM on the TSP's system of the amount of CBM set aside.

~~When reviewing an Arranged Interchange using CBM, LG&E/KU will waive, within the bounds of reliable operation, any Real-time timing, and ramping requirements.~~ LG&E/KU~~LG&E/KU will approve, within the bounds of reliable operation, any Arranged Interchange using CBM that is submitted by an "energy deficient entity" under an EEA 2 if:~~

- ~~the CBM is available,~~
- ~~the EEA 2 is declared within the Balancing Authority Area of the "energy deficient entity," and~~
- ~~the load of the "energy deficient entity" is located within LG&E/KU's TSP area.~~

~~LG&E/KU and the ITO~~ shall also provide (subject to confidentiality and security requirements) copies of the applicable supporting data, including models, used in determining CBM or allocating CBM over each ATC Path or Flowgate to:

- ~~•~~ each of the associated Transmission Operators within 30 calendar days of their making a request for data; and
- ~~•~~ any TSP, RC, Transmission Planner, Resource Planner, or Planning Coordinator within 30 calendar days of their making a request for data.

3. ~~3.~~ **Accounting for CBM Values that are Continuing**

a) ~~**a)**~~ **The CBM value for each ATC Path or Flowgate to be used for ATC or AFC calculations must reflect consideration of each of the following if available:**

(i) ~~*(i)*~~ *any studies performed by LSEs for loads within the TSP's area or Transmission Planner's area, as applicable;*

(ii) ~~*(ii)*~~ *any studies performed by Resource Planners for loads within the TSP's area or the Transmission Planner's area, as applicable; and*

(iii) ~~*(iii)*~~ *any reserve margin or resource adequacy requirements for loads within the TSP's area established by other entities, such as municipalities, state commissions, regional transmission organizations, independent system operators, Regional Reliability Organizations, or regional entities.*

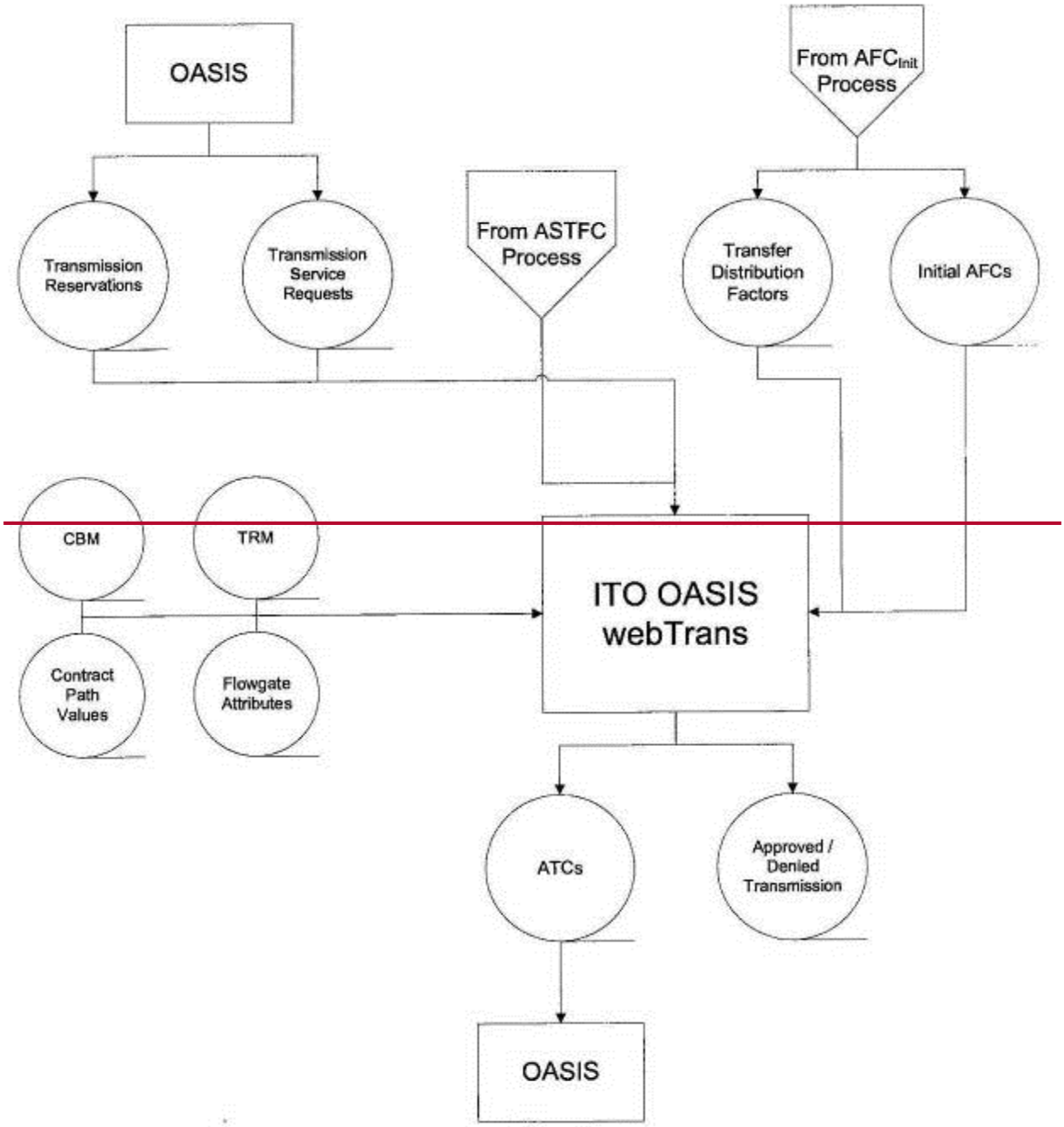
b) ~~**b)**~~ **The CBM value for each ATC Path or Flowgate to be used for ATC or AFC calculations must be allocated as follows:**

(i) ~~*(i)*~~ *for ATC Paths, based on the expected import paths or source regions provided by LSEs or Resource Planners; and*

(ii) ~~*(ii)*~~ *for Flowgates, based on the expected import paths or source regions provided by LSEs or Resource Planners and the distribution factors associated with those paths or regions, as determined by the TSP or Transmission Planner, as applicable.*

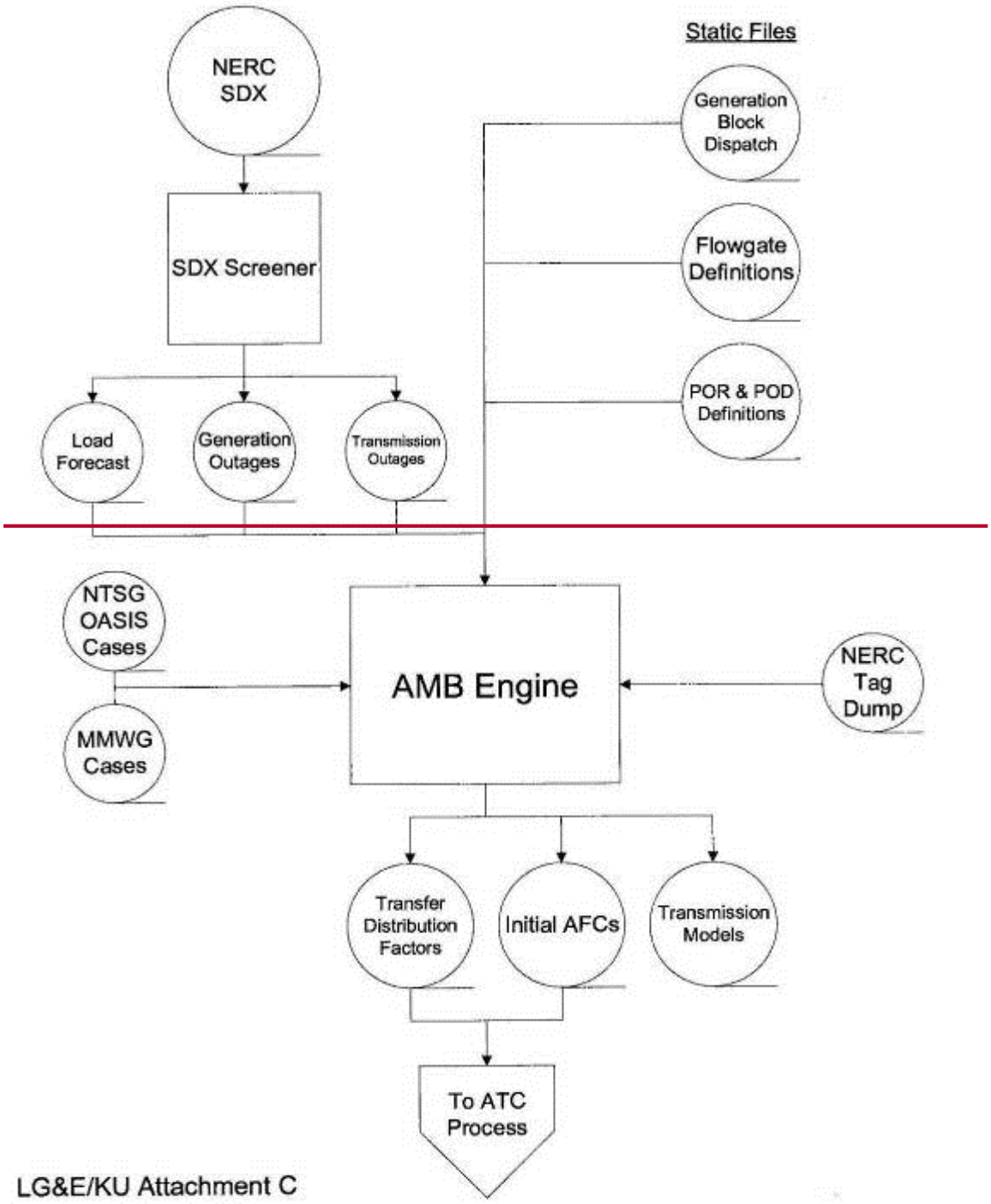
Appendix 1

ATC Process



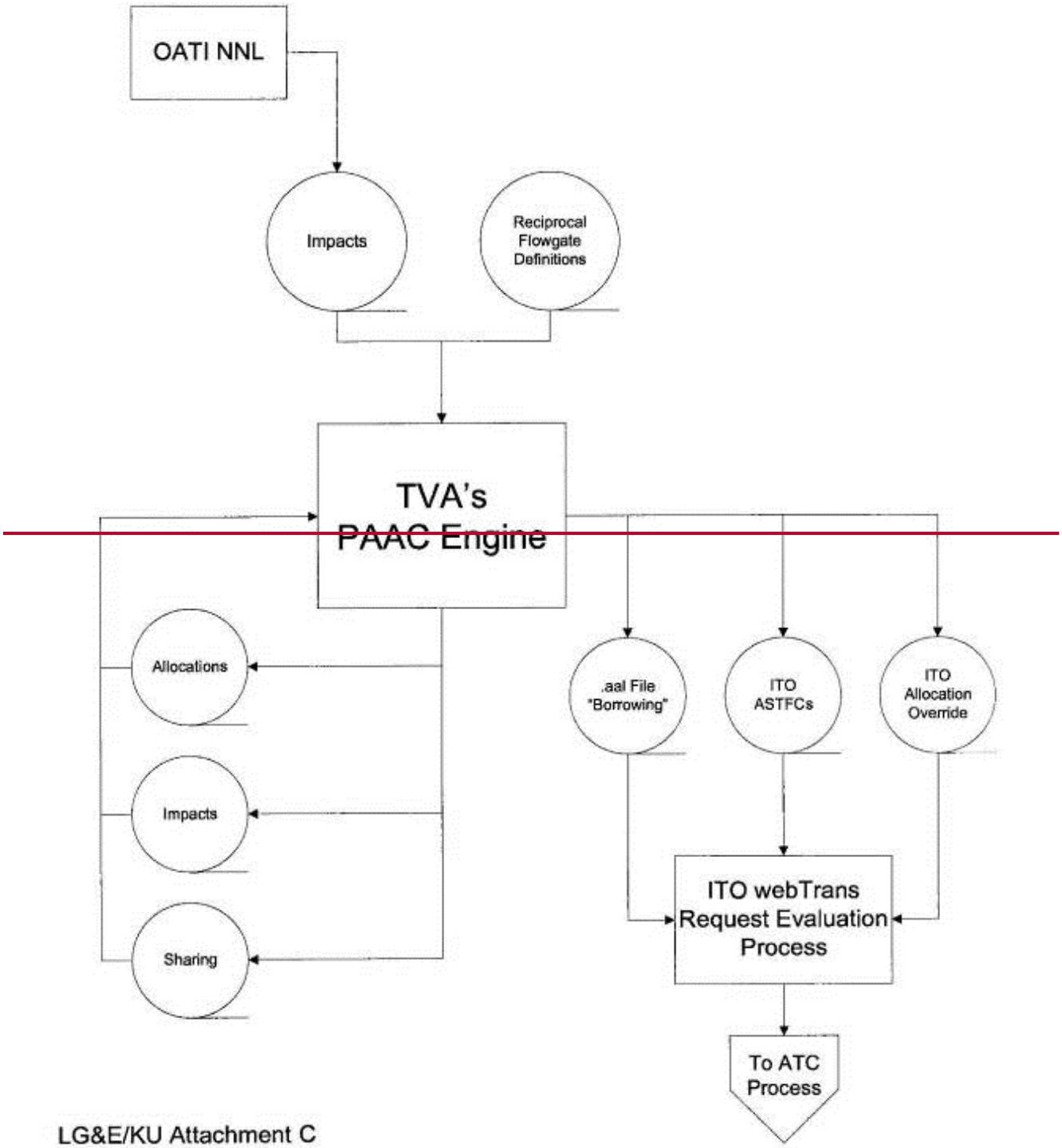
Appendix 1

Model Building & AFC_{Init} Creation Process



Appendix 1

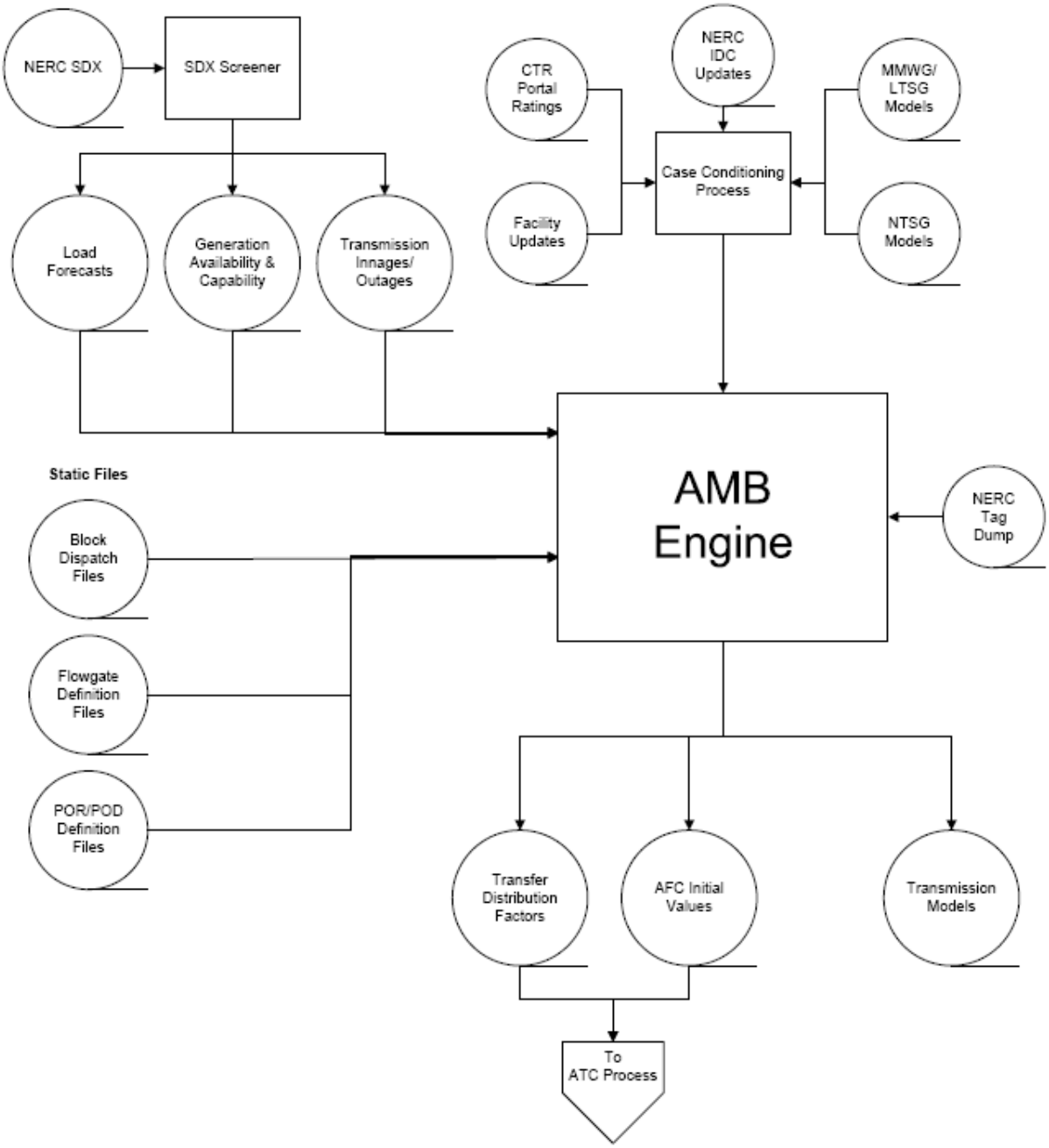
ASTFC Process



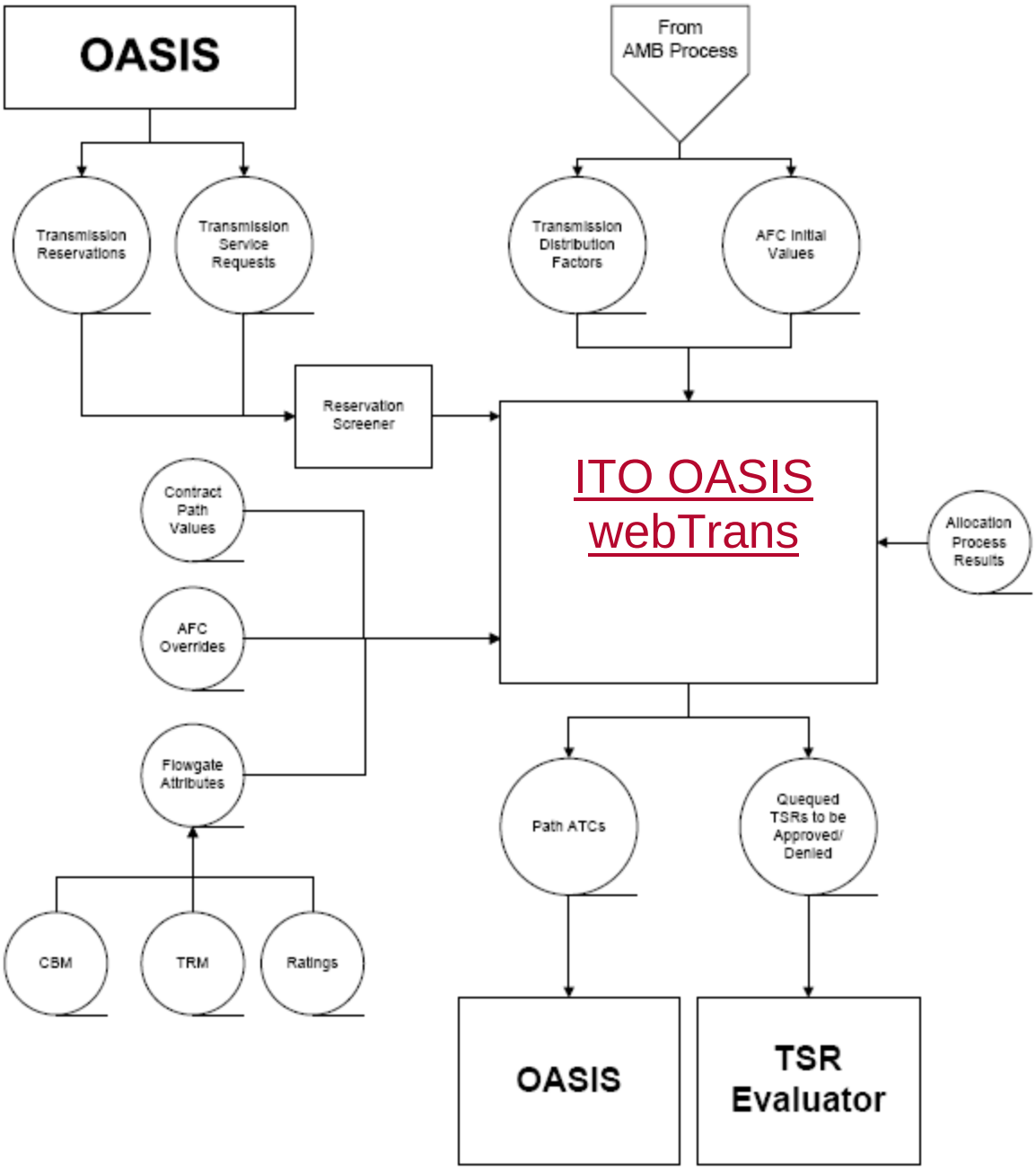
LG&E/KU Attachment C

Apppendix 1

Automated Model Creation and AFC Initial Value Calculation Process

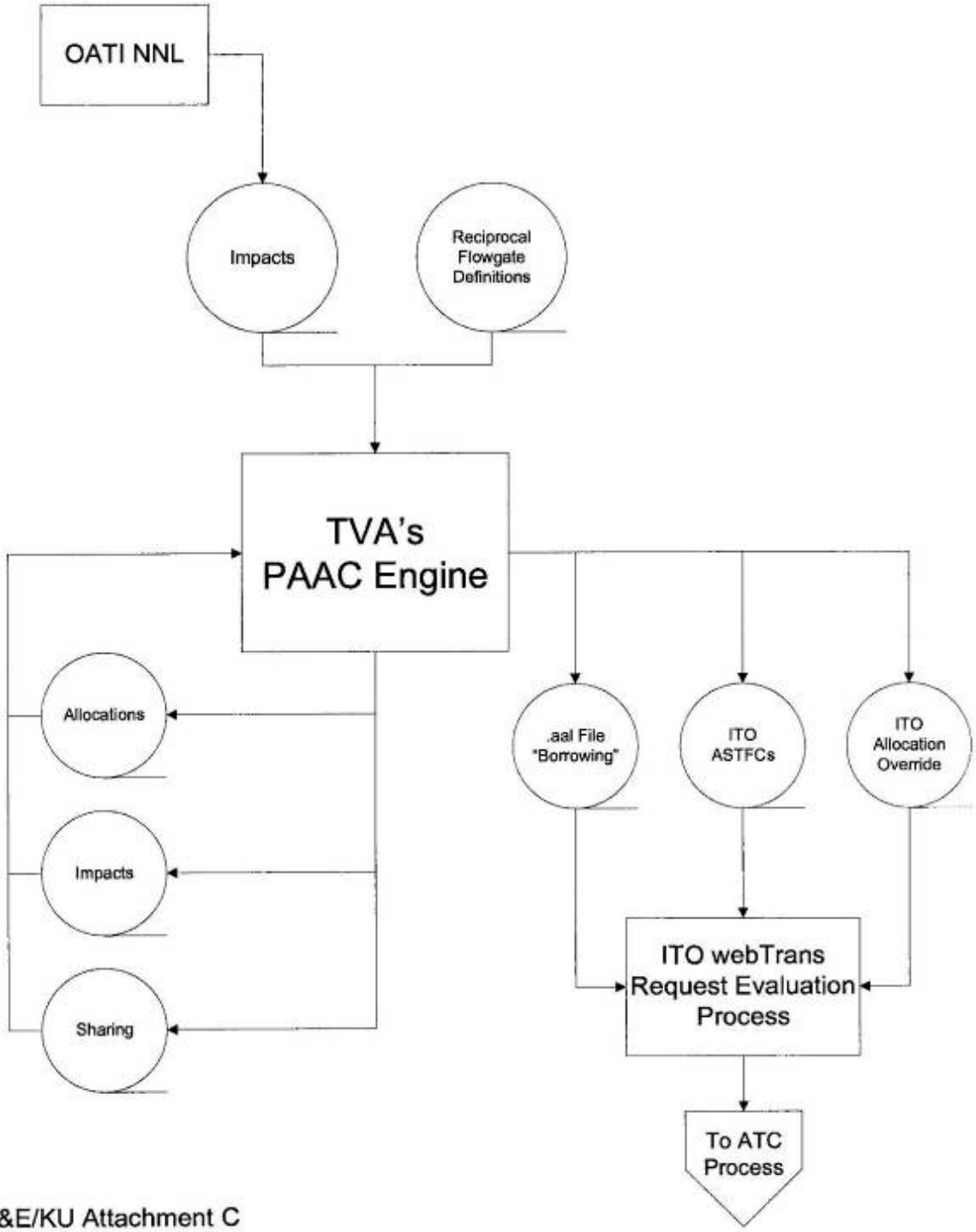


ATC Process


OASIS
From AMB Process
Transmission Reservations
Transmission Service Requests
Transmission Distribution Factors
AFC Initial Values
Reservation Screener
ITO OASIS webTrans
Contract Path Values
AFC Overrides
Flowgate Attributes
Allocation Process Results
CBM
TRM
Ratings
Path ATCs
Queued TSRs to be Approved/ Denied
OASIS
TSR Evaluator

Appendix 1

ASTFC Process



LG&E/KU Attachment C