# Appendix A

# ATC/AFC Coordination and Calculation

NERC LTATF

## 1.0 Introduction:

The purpose of this paper is to provide an overview of the process of calculating and coordinating transfer capability (AFC/ATC). The paper outlines existing coordination processes in the Eastern Interconnection (EI) and the WECC. The paper also defines a proposed method of exchanging ATC/AFC data between entities. The last section is a summary of minimum requirements for flowgate exchange and modeling techniques to facilitate proper calculation and coordination of transfer capability (AFC/ATC).

## 2.0 Coordination:

The objective of ATC/AFC coordination is to ensure that neighboring entities exchange relevant information to facilitate:

a) a reasonable representation of external entities in the model for calculating AFC/ATC
b) the ability for each Calculator to honor flowgates in third party systems
c) the ability for each Calculator to translate data from neighboring entities and make meaningful use of the data in their respective calculations

The NERC SDX is a platform for data exchange between the various NERC regions. Several entities have developed alternate platforms to exchange data as a supplement to data exchange via SDX. Each NERC region has its own document outlining the coordination and calculation of transfer capability by its members.

Following is a summary of the coordination processes in place in major regions in NERC:

<u>Eastern Interconnection:</u>

In the EI, several entities have signed operating agreements to facilitate the coordination process. The following agreements are currently in effect or have been filed with the FERC:

a) MISO – PJM[1]
b) MISO – MAPP[2]
c) SPP - MISO[3]

SERC and FRCC members consist predominantly of ATC calculators. Coordination standards for SERC members are outlined in the SERC supplement[4] to the NERC planning standards.

<u>Western Interconnection:</u>

WECC members coordinate transfer capability through seasonal studies[5].

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[1] http://www.pjm.com/documents/downloads/agreements/joa-complete.pdf
[2] http://www.midwestiso.org/initiatives/joa_seams/mapp_seams/docs/Final_SOA_modified_01142005.pdf
[3] http://www.midwestiso.org/initiatives/documents/12-02-04%20FERC_Filing_SPP-MISO-JOA.pdf
[4] http://www.serc1.org/Pages/DocumentDisplay.aspx?FN=SERC%20Supplements/Planning/IE1%20SERC%20Supplement%203-8-02.PDF
[5] http://www.wecc.biz/documents/library/procedures/ATC-apprdec01.pdf

## 2.1 Exchange of data between and AFC and ATC calculator:

This section outlines an option to enable entities to exchange useful information on flowgates for use in their calculations.

2.1.1 AFC calculator reading data from ATC calculator:

- ATC calculator determines CE/LE (contingent element/limiting element/monitoring element) pairs that are limiting to transfers
- List is sorted to identify CE/LE pairs that are in the list of monitored flowgates for the AFC calculator
- For these CE/LE pairs, an equivalent AFC value is transmitted to the AFC calculator.

2.1.2 ATC calculator reading data from AFC calculator:

- AFC calculator supplies list of flowgate AFC values to the ATC calculator
- ATC calculator translates the AFC value into the model by adjusting the rating of the LE such that under contingency or non-contingency (as appropriate for the specified flowgate), the adjusted rating - flow (LE) equals the AFC value supplied by the AFC calculator

## 2.2 Flowgate data exchange and modeling requirements:

This section outlines the list of flowgates that should be considered for the coordination process. The section also defines modeling requirements for entities performing the transfer capability calculations.

2.2.1 Each TSP will consider in its TTC and ATC/AFC determination process all third party flowgates:

(i) that are significantly impacted by its transactions, or

(ii) as mutually agreed between the parties, subject to the following:

- A TSP's transactions are deemed to significantly impact another TSP's flowgates if they have a response factor equal to or greater than the response factor cutoff (threshold) used by the owning TSP.
- The parties, in their AFC determination and transmission service processing efforts, shall use the response factor cut-off that the owning/operating TSP uses for its flowgates.
- The TSPs shall coordinate their counterflow assumptions on affected flowgates.
- At a minimum, coordination should occur on flowgates in transmission systems that comprise the first tier with respect to the TSP.
- To the extent a TSP is coordinating AFC on a requested flowgate, the TSP needs to ensure that modeling around the flowgate is sufficient to produce reasonable response factors. As an alternative, the TSP can use response factors provided by the requesting TSP.

2.2.2 All entities should meet the following minimum modeling requirements:

- Transmission providers should use reasonably accurate response factors
- Model should include the TSP's control area as well as control areas within the footprint of the adjacent TSP's tariff
- Equivalent model representations for beyond first-tier transmission providers / control areas are acceptable as long as they enable calculation of accurate response factors
- Use of an MMWG base case, modified by appropriate NERC SDX system conditions, would be considered a reasonable alternative
- If an area is too small or its model too limiting, it should delegate its calculations to an entity that has the capability to perform the calculations with appropriate modeling capabilities

2.2.3 In the absence of a mutual agreement, or for a waiver from this requirement, NERC or its designate shall define for the TSPs those external system modeling requirements to be used for TTC/ATC/AFC calculations.

## ***Glossary***

| | |
|---|---|
| ***TTC*** | *Total Transfer Capability* |
| ***ATC*** | *Available Transfer Capability* |
| ***AFC*** | *Available Flowgate Capability* |
| ***SDX*** | *System Data Exchange: NERC tool to facilitate electronic data exchange* |
| ***MMWG*** | *Multi-regional model working group (NERC working group responsible for power flow model development)* |
| ***TSP*** | *Transmission Service Provider* |
| ***CE/LE*** | *Contingent Element/Limiting Element; typically used to identify facilities that define a flowgate* |
| ***OTDF*** | *Outage Transfer Distribution Factor* |
| ***PTDF*** | *Power Transfer Distribution Factor* |
| ***LODF*** | *Line Outage Distribution Factor* |

## 1. ATC/AFC Equations

Basic transmission service is sold to customers in the form of " Transfer Capability " (TC). Available Transfer Capability (ATC) is the amount of transfer capability still available for sale after all existing uses are accounted for. Transfer Capability (TC) is measured along a path from source to sink. Transfer Capability is limited by the capacity of either equipment (such as transformer, circuits) or interfaces (collection of circuits). An example of an interface limit would be a voltage or stability limit that can be measured as a maximum flow on an interface or a thermal contract path limit.

A "flowgate" is the name given to the transmission element(s) and associated contingency if any, that may limit ATC. Available Flowgate Capability (AFC) is a measure of the capability remaining on a flowgate for future uses, after considering the impact of prior sales. AFC is measured as a "flow" limit on a flowgate, while ATC is measured as a "transaction" limit from a source to sink. There are typically several flowgates between source and sink that can limit the transaction. Transactions distribute amongst these flowgates based on the transmission configuration. The percent distribution of a transaction on a flowgate is determined via power flow analysis and is called a distribution factor (DF) (this term is interchangeable with "response factor") whereby:

$$AFC(f) = DF(t,f) * ATC(t,f)$$

t = defined path from source to sink
f = flowgate "f"
ATC(t,f) = The maximum transaction for path t available as limited by flowgate "f"
AFC(f) = AFC for flowgate "f"
DF(t,f) = percentage of transaction on path that flows on flowgate "f"

Typically, AFCs are determined for all flowgates and ATC is then determined from AFC. For this reason, the equation is more frequently used in the format:

$$ATC(t,f) = AFC(f)/DF(t,f)$$

The overall "ATC" is the "minimum" ATC calculated from the above equation for all flowgates. Posted ATCs must therefore have an associated "most limiting" flowgate. Each flowgate has an associated AFC for the time frame being studied, which can be used to calculate an ATC for any potential path.

Other Relationships:

Total Flowgate Capacity (TFC) is generally equal to the *rating* of the flowgate. A typical flowgate might consist of a limiting circuit, or "monitored" circuit, along with the outage that limits the monitored circuit. An "interface" flowgate's AFC is typically set to a flow value above which a stability or voltage limit will be exceeded.

Basic Equations:

AFC = TFC – Base Network Flows(Native & Network load model) – Margins (such as CBM/TRM) – Effect on the flowgates of existing transmission reservations

**Margins:**

Capacity Benefit Margin (CBM)[1] or Transmission Reserve Margin (TRM)[1] are margins used in ATC or AFC calculations to account for uncertainties or contingencies that are not explicitly modeled in the calculations due to time constraints. The criteria used to determine these values must be consistent with the TO's planning and operating criteria. A more detailed description of these margins can be found in the NERC white paper titled "Transmission Capability Margins and Their Use In ATC Determination" dated June 17, 1999.

## 2. Translation of ATC/AFC for Data Exchange Between Entities

Sharing of ATC/AFC quantities between entities, which sell transmission service, requires translating the data from ATC to AFC (& vice versa) if one of the entities uses ATC and the other uses AFC as a basis. The basic AFC/ATC equations discussed earlier can be used to "translate" shared data:

$$ATC(t,f) = AFC(f)/DF(t,f)$$

Where:

(t) is a defined source to sink transaction
(f) is any flowgate
DF is the distribution factor on the flowgate of the defined source to sink transaction.

Defined source to sink transactions are those qualifying for transmission service. For example, if two RTOs are coordinating data and the transaction is from a source in one to a sink in the other the direct path is usually not available. The transaction would be from the source in RTO number 1 to a border interface with RTO number 2. The transaction in RTO number 2 would be from the border interface to the sink in RTO number 2. Each RTO would be responsible for its portion of the transactions. Even if the transmission purchaser is oblivious to the intervening interface, the RTOs share their own piece of the calculation. This situation has the inherent problem that the true source to true sink is ignored when a "border" is introduced. It is a similar problem to "hubbed" transactions where transactions are ultimately split from the source to the "hub" and then from the "hub" to the sink.

1 "Transmission Capability Margins and Their Use in ATC Determination - White Paper" NERC ATCWG document dated 9/28/99. Available from the following URL: http://www.nerc.com/~filez/atcwg.html