Available Transfer Capability Implementation Document (ATCID)

FOR COMPLIANCE WITH:
NERC MOD-001-1a & MOD-030-2 Reliability Standards

Date: February 1st, 2017
VERSION: 8.0

Cube Hydro Carolinas
INTERNAL USE ONLY
# DOCUMENT HISTORY

Entries in the revision table for this document below provide a record of the name of the authorized Reviewer, date of the review, required action, or verification and a summary notation of any material change to policy, procedure, program, access list, or modification to systems or security control as a result of this document review and maintenance activity.

## Procedure Issued by

- **Khalid Osman**
- **Khalid Osman, Power System Engineer**

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<tr>
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<th>Rev. No.</th>
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<th>Author</th>
<th>Review by</th>
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<tbody>
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<td>D. Todd</td>
<td>Sonny Patel</td>
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• Added Document Owner, Roles and Responsibility sections  
• Added PowerGEM diagram to explain the process on Page 29  
• Explained the PowerGEM process on Page 29  
• Added the software and OASIS links on Page 6 and Page 25  
• Added the static and dynamic inputs on Page 25  
• Changed document formatting to Arial 10 | Khalid Osman | Sonny Patel | Khalid Osman, Power System Engineer |
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• Modified TO’s and TSP’s list on page 7 and page 8  
• Modified daily and monthly outages representation in the AMB process on Page 9  
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• Modified TO’s and TSP’s list on page 7 | Khalid Osman | Amy Kohntopp | Khalid Osman Compliance Engineer |

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<table>
<thead>
<tr>
<th>Date</th>
<th>Page</th>
<th>Description</th>
<th>Author</th>
<th>Reviewer</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/14/2015</td>
<td>6</td>
<td>Annual Review</td>
<td>Khalid Osman</td>
<td>Susan Shanahan</td>
<td>Khalid Osman Power System Engineer</td>
</tr>
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<td>7</td>
<td>Annual Review</td>
<td>Khalid Osman</td>
<td>Susan Shanahan</td>
<td>Khalid Osman Power System Engineer</td>
</tr>
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<td>Susan Shanahan</td>
<td>Khalid Osman Power System Engineer</td>
</tr>
</tbody>
</table>
Contents

1.1 Roles and Responsibility ................................................................. 6
1.2 Document Owner(s) ........................................................................ 6
1.3 Flowgate Identification Method ..................................................... 6
1.4 AFC/ATC calculations Frequency ................................................. 6
1.5 ATCID Availability and Implementation: ...................................... 7
1.6 Flowgates Methodology Descriptions: .......................................... 8
1.7 Counterflows: .............................................................................. 8
1.8 Counterflow Rational: ................................................................. 8
1.9 Identities of TO’s and TSPs from Which Cube Hydro Carolinas receives data: ......................................................... 8
1.9.1 Duke Energy .................................................................... 8
1.9.2 Progress Energy ................................................................ 8
1.9.3 Any other entity which is deemed appropriate ......................... 9
1.10 Identities of TO’s and TSP’s, which Cube Hydro Carolinas send data to: .......................................................... 9
1.10.1 Duke Energy .................................................................. 9
1.10.2 Progress Energy ............................................................ 9
1.10.3 Any other entity which is deemed appropriate ....................... 9
1.11 Allocation Process ...................................................................... 9
1.11.1 Multiple Lines Allocation .................................................... 9
1.11.2 Multiple Owners Allocation ................................................. 9
1.11.3 Congestion Management ..................................................... 9
1.11.4 Generations and Transmission Outages .................................. 9
1.11.4.1 Daily Outage .................................................................. 10
1.11.4.2 Monthly Outage .......................................................... 10
1.11.4.3 Unmapped Outages ....................................................... 10
1.11.5 ATCID Revision Notification ............................................... 10
1.11.6 ATCID Availability to entities in R4 ....................................... 10
1.11.7 Total Transfer Calculation (TTC) Assumptions ....................... 10
1.11.8 ATC/AFC Assumptions: ..................................................... 11
1.11.9 ATC Recalculation Frequency ............................................ 11
1.11.10 ATC/AFC Data Request: .................................................. 11
1.11.11 TSP Future Data Availability: ........................................ 12
1.11.12 TSP Future Data Request Schedule: ................................... 12
1.11.13 Flowgates Selection Criteria: ............................................ 12
1.11.14 Flowgates Identified as Part of Coordination ........................ 12
1.11.15 Source and Sink Definition ............................................. 13
1.11.16 Source and Sink Mapping ................................................ 13
1.11.17 Generator Grouping ......................................................... 13
1.11.18 Flowgates used in the AFC Process-R2: .................................. 13
1.11.19 First Contingency Criteria: ............................................... 13
1.11.20 Contingency Limiting Elements ........................................ 14
1.11.21 First Contingency Result Transfer ....................................... 14
1.11.22 Flowgates Subject to Interconnection-Wide Congestion ........... 14
1.11.23 Flowgates Requested For Inclusion by another TSP: ............... 14
1.11.24 Flowgates List ................................................................ 15
1.11.25 TFC Establishment .......................................................... 15
1.11.26 TFC Update ................................................................... 15
1.11.27 Transmission Model ........................................................ 16
1.11.28 Transmission Model Requirements-R3 ................................. 17
1.11.29 Transmission Service Impact-R4 ......................................... 17
1.11.30 AFC Calculation-R5 ....................................................... 18
1.11.31 ETC Firm Commitment Calculation-R6 ............................. 18
ETC model – All Horizons ................................................................. 18

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<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.11.32</td>
<td>ETC Non-Firm (ETCAF-NCi) Commitment Calculation -R7</td>
<td>20</td>
</tr>
<tr>
<td>1.11.33</td>
<td>Firm AFC Calculations [MOD-030 R8]</td>
<td>21</td>
</tr>
<tr>
<td>1.11.34</td>
<td>Non-Firm AFC Calculations [MOD-030 R9]</td>
<td>21</td>
</tr>
<tr>
<td>1.11.35</td>
<td>AFC Calculation Horizons and Frequency</td>
<td>22</td>
</tr>
<tr>
<td>1.11.36</td>
<td>Converting AFC to ATC</td>
<td>23</td>
</tr>
<tr>
<td>1.11.38</td>
<td>Data Inputs</td>
<td>24</td>
</tr>
<tr>
<td>1.11.39</td>
<td>Contract Path Limit</td>
<td>25</td>
</tr>
<tr>
<td>1.11.40</td>
<td>ATC on Posted Paths</td>
<td>25</td>
</tr>
<tr>
<td>1.11.41</td>
<td>TRM</td>
<td>26</td>
</tr>
<tr>
<td>1.11.42</td>
<td>CBM</td>
<td>26</td>
</tr>
<tr>
<td>1.11.43</td>
<td>Process Flow Diagram</td>
<td>27</td>
</tr>
<tr>
<td>1.11.44</td>
<td>Definitions</td>
<td>29</td>
</tr>
</tbody>
</table>
Introduction

The North American Electric Reliability Corporation (NERC) has issued modeling standards (specifically MOD-001 and MOD-030) to ensure that calculations are performed by Transmission Service Providers to maintain awareness of available transmission system capability and future flows on their own systems as well as those of their neighbors.

This document will convey the criteria, methodology, and assumptions for the implementation of the Flowgate Methodology used by Cube Hydro Carolinas to calculate Available Flowgate Capability (AFC), Available Transmission Capability (ATC), Remaining Contract Path Capability, and the coordination of ATC information with other entities.

1.1 Roles and Responsibility

The Engineering group within Cube Hydro Carolinas, along with the Compliance and Operation groups, is responsible for maintaining and approving the ATCID.

1.2 Document Owner(s)

The Engineering group within Cube Hydro Carolinas is responsible for maintaining, modifying, revising, and updating the ATCID document.

1.3 Flowgate Identification Method

Cube Hydro Carolinas has adopted the Flowgate Methodology, as described in MOD-001-1a-R1. [MOD-001-1a-R1]

Use of the Flowgate Methodology will increase consistency and reliability in the development and documentation of transfer capability calculations for short-term use performed by entities using the Flowgate Methodology to support analysis and system operations. Calculations will be utilized to determine transfer capabilities in the hourly, daily and monthly horizon. [MOD-001-1a-R2]

1.4 AFC/ATC calculations Frequency

Cube Hydro Carolinas calculates ATC or AFC values as listed below using the Flowgate Methodology. Cube Hydro Carolinas’ two-part AFC calculation process is executed at regularly scheduled intervals via automated processes. These automated processes create hourly, daily, and monthly models and derive TDFs and AFCs from those models at the following frequency:

<table>
<thead>
<tr>
<th>Increment</th>
<th>Model Build &amp; AFC Calculation Frequency*</th>
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<tbody>
<tr>
<td>Hourly</td>
<td>Next 48 hours calculated hourly</td>
</tr>
<tr>
<td></td>
<td>Next 168 hours (at least) calculated daily</td>
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</table>

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<table>
<thead>
<tr>
<th>Frequency</th>
<th>Timeframes</th>
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<tbody>
<tr>
<td>Daily</td>
<td>Next 31 days (at least) calculated daily</td>
</tr>
<tr>
<td>Monthly</td>
<td>Next 13 months (at least) calculated daily</td>
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</table>

*These timeframes indicate when the models are built and new AFC values are calculated from these models. AFCs and resulting ATCs, however, are continuously decremented as Transmission Service reservations are confirmed. [MOD-030-02-R3.2 & R3.3]  [MOD-001-1a-R2]

1.5 **ATCID Availability and Implementation:**

Cube Hydro Carolinas prepares and updates as needed an Available Transfer Capability Document (ATCID) which is posted on the OASIS website (see below), which includes the details of the Flowgate methodology and its implementation and the process of validating the ATC and the AFC calculation.

http://www.oasis.osti.com/YAD/ [MOD-001-1a-R3]
1.6 Flowgate Methodology Descriptions:

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 simplified input assumptions. The resulting studies focus on how power would actually flow if the Transmission Service requests were to be approved.

The Flowgate Methodology involves the calculation of AFC on Flowgates modeled in the process. ATC on posted paths is then derived from the calculated AFCs.

[MOD-001-1a-R3.1]

1.7 Counterflows:

When applying transmission reservation impacts in the opposite direction of flow on a Flowgate in the AFC calculations, counterflow assumptions are used. Counterflow impact percentages are defined for each Flowgate and address:

- Firm (confirmed) reservation counterflow impact on firm AFC calculations 0%
- Firm (confirmed) reservation counterflow impact on non-firm AFC calculations 0%
- Non-firm reservation counterflow impact on non-firm AFC calculations 50%

Expected Interchange and internal counterflow assumptions are based on operating experience of normal Flowgate flows (rationale). At times, a Flowgate may experience higher or lower than normal Counterflows. If real-time or expected operating conditions change to the extent that higher or lower than normal, expected Interchange and internal Counterflows, the counterflow assumptions for the Flowgate can be changed to reflect the new conditions. Counterflow assumptions are reflected in the AFC process as a Flowgate attribute. The current counterflow setting in the OASIS system for Cube Hydro Carolinas is 0 except for non-Firm reservation. By setting the Counterflow value to 0, Cube Hydro Carolinas is taking more conservative approach.

[MOD-001.1a R3.2]

1.8 Counterflows Rational

Non-firm AFC utilizes Counterflows to allow for the known effect of Counterflows reservations on a Flowgate and to allow the interface to give equitable access. This non-firm energy can be reduced by an Interconnection Transmission Loading Relief procedure if real-time overloads are encountered.

- Firm Counterflows are not utilized due to the fact that Firm energy is to be bought and used with the expectation that it is available for use. To implement Counterflows would allow for the unreliable sale of Firm Transmission

[MOD-001.1a R3.2.2]

1.9 Identities of TO’s and TSP’s from Which Cube Hydro Carolinas receives data:

Cube Hydro Carolinas receives data from the following identities (TO and TSPs) for use in the calculation of the ATC or AFC process:

1.9.1 Duke Energy
1.9.2 Progress Energy

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1.9.3 Any other entity which is deemed appropriate  

[MOD-001.1a-R3.3]

1.10 Identities of TO’s and TSP’s, which Cube Hydro Carolinas send data to:

Cube Hydro Carolinas sends data to the following identities (TO and TSPs) for use in the calculation of the ATC or AFC process:

1.10.1 Duke Energy

1.10.2 Progress Energy

1.10.3 Any other entity which is deemed appropriate  

[MOD-001-1a-R3.4]

1.11 Allocation Process

1.11.1 Multiple Lines Allocation

Cube Hydro Carolinas does not allocate transfer or Flowgate capability among multiple lines since the need for such allocation has not presented itself to Cube Hydro Carolinas.

Cube Hydro Carolinas does not utilize the allocation process for forward looking Congestion Management or seams agreement  

[MOD-001-1a-R3.5]

1.11.2 Multiple Owners Allocation

Cube Hydro Carolinas does not allocate transfer or Flowgate capability among multiple owners since the need for such allocation has not presented itself to Cube Hydro Carolinas

1.11.3 Congestion Management

The Congestion Management Process (CMP) allocates Flowgates capabilities among multiple entities to address issues such as forward-looking management and seams coordination.

1.11.4 Generations and Transmission Outages

Transmission and generation outages from the SDX are used to model topology information for AFC calculations. Cube Hydro Carolinas AFC process takes into consideration transmission and generation outages and additions or retirements in effect during the applicable period Cube Hydro Carolinas TSP area and adjacent TSP areas.

Cube Hydro Carolinas reports all of its outages regardless of the size and the duration of the outages to the VACAR group in its weekly meeting to ensure the reliability of the Bulk Electrical System (BES).

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1.11.4.1 **Daily Outage**

Outages that are in effect for part of the day are assumed to last the entire day when considering daily outage in the Automatic Model Building (AMB).

1.11.4.2 **Monthly Outage**

Outages that are in effect for part of a month are assumed to last for the specific period when considering monthly outage in the Automatic Model Building (AMB).

1.11.4.3 **Unmapped Outages**

Cube Hydro Carolinas does not consider outages which cannot be mapped in the AFC calculations. These unmapped outages cannot be considered in the AFC calculation until those outages are appropriately modeled in the base case and the applicable model update has been completed.

1.11.5 **ATCID Revision Notification**

Cube Hydro Carolinas notifies the following entities before implementing a new or revised ATCID document:

1.11.1 Each planning coordinator associated with the TSP’s area
1.11.2 Each Reliability Coordinator associated with the TSP’s area
1.11.3 Each Transmission Provider associated with the TSP’s area
1.11.4 Each Planning Coordinator adjacent to the TSP’s area
1.11.5 Each Reliability Coordinator adjacent to the TSP’s area
1.11.6 Each TSP whose area is adjacent to the TSP’s area

1.11.6 **ATCID Availability to entities in R4**

Cube Hydro Carolinas shall notify each the Planning Coordinator, Reliability Coordinator, Transmission Operator associated with Cube Hydro Carolinas prior to implementing a new or revised ATCID. Cube Hydro Carolinas shall also notify adjacent Planning Coordinators, Reliability Coordinators and Transmission Services Providers prior to implementing a new or revised ATCID. Cube Hydro makes available the ATCID to the aforementioned entities through a public posting of the document.

1.11.7 **Total Transfer Calculation (TTC) Assumptions**

When calculating Total Transfer Capability (TTC) or Total Flowgate Capability (TFC), Cube Hydro Carolinas uses assumptions no more limiting than those used in the planning of operations for the corresponding time period studied.
1.11.8 ATC/AFC Assumptions:
When calculating ATC or AFC, Cube Hydro Carolinas uses assumptions 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.

[MOD-001.1a-R7]

1.11.9 ATC Recalculation Frequency

Cube Hydro Carolinas ATC recalculation frequency meets or exceeds ATC recalculation frequency per MOD-001-1a-R8 requirement:

1.11.7 Cube Hydro Carolinas recalculates ATC hourly values once per hour
1.11.8 Cube Hydro Carolinas recalculates ATC daily values once per day
• Cube Hydro Carolinas recalculates ATC the monthly value once per week

[MOD-001.1a-R8]

1.11.10 ATC/AFC Data Request:

Cube Hydro Carolinas (CHC) shall provide all data requested from any Transmission Service Provider, Planning Coordinator, Reliability Coordinator or Transmission Operator from the following list within 30 days of a request from an appropriate requestor solely for use in the requestors ATC or AFC calculations if CHC has the specific data available including:

• Expected generation and Transmission outages,
Additions, and retirements
• Load forecasts.
• Unit commitments and order of dispatch, to include all designated network resources and other resources that are committed or have the legal obligation to run, as they are expected to run, in one of the following formats chosen by the data provider:
  – Dispatch Order
  – Participation Factors
  – Block Dispatch
• Firm and non-firm Transmission reservations.
• Aggregated capacity set-aside for Grandfathered obligations
• Firm roll-over rights.
• Any firm and non-firm adjustments applied by the Transmission Service Provider to reflect parallel path impacts.
• Power flow models and underlying assumptions.
• Contingencies, provided in one or more of the following formats:
  – A list of Elements
  – A list of Flowgates
  – A set of selection criteria that can be applied to the Transmission model used by the Transmission Operator and/or Transmission Service Provider
• Facility Ratings.
• Any other services that impact Existing Transmission Commitments (ETCs).
• Values of Capacity Benefit Margin (CBM) and Transmission Reliability Margin (TRM) for all ATC Paths or Flowgates.
• Values of Total Flowgate Capability (TFC) and AFC for any Flowgates considered by the Transmission Service Provider receiving the request when selling Transmission service.
• Values of TTC and ATC for all ATC Paths for those Transmission Service Providers receiving the request that do not consider Flowgates when selling Transmission Service.
• Source and sink identification and mapping to the model.

**1.11.11 TSP Future Data Availability:**

Cube Hydro Carolinas makes its own current data available in the format maintained by the Transmission Service Provider for up to 13 months into the future; all of Cube Hydro Carolinas data are posted in the OASIS website and available for review.

**1.11.12 TSP Future Data Request Schedule:**

The above requested data shall be made available to the requestor on a schedule specified by the requestor (but no more frequently than once per hour unless mutually agreed to by the requestor and provider).

**1.11.13 Flowgates Selection Criteria:**

Cube Hydro Carolinas updates its Flowgates files at least on yearly basis, the criteria’s of selecting candidates Flowgates are based on performing contingency analysis to identify CHC Flowgates which responds to great than or equal to 5% of generation to load or Transfer Distribution Factor (TDF) under the current basecase or under the contingent seed case

Flowgates are identified by one of several methods (criteria):
• Flowgates identified as part of coordination agreements
• Flowgates requested for inclusion by another TSP
• Flowgates subject to interconnection-wide congestion management procedure within the last twelve month
• Flowgates identified by screening tests

**1.11.14 Flowgates Identified as Part of Coordination**

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Agreements & Requests by another TSP

Cube Hydro Carolinas includes and shares Flowgates with the following neighboring utilities including but not limited to

- Duke Power Company (DUKE)
- Progress Energy Company (PEC)
- South Carolina Electrical and Gas Company (SCEG)
- Any other entity which is deemed as appropriate

1.11.15 Source and Sink Definition

Sink for AFC Calculation [MOD-030-02-R1.2.2]

Cube Hydro Carolinas defines the sink used for AFC calculations as the Point of Delivery (POD) field of the transmission reservation.

Source for AFC Calculation [MOD-030-02-R1.2.1]

Cube Hydro Carolinas defines the source used for AFC calculations as the Point of Receipt (POR) field of the transmission reservation.

1.11.16 Source and Sink Mapping

The POR/POD identification and mapping to the model are done using the MUST POR/POD file which can be located in the “must_porpod.sub” file in the PowerGEM program [MOD-030-02-R1.2.3]

1.11.17 Generator Grouping

The Automatic Model Builder (AMB) in TARA handles the grouping of generators by using generator block dispatch, each block contains a set number of generators and blocks are dispatched based on order. Each block is dispatched until all units have reached their maximum generation capability. Cube Hydro Carolinas generators order of dispatch and grouping is done in the “YAD.CA”, which is represent the Yadkin system Control Area file in the PowerGEM program [MOD-030-02-R1.2.4]

1.11.18 Flowgates used in the AFC Process-R2:

Cube Hydro Carolinas include Flowgates used in the AFC process based on the results of first contingency transfer analysis for ATC Paths internal to a Transmission Operator’s system up to the path capability such that at a minimum the first three limiting Elements and their worst associated Contingency combinations with an OTDF of at least 5% and within the Tops system are included [MOD-030-02-R2.1.1]

1.11.19 First Contingency Criteria:

Cube Hydro Carolinas uses first contingency criteria consistent with those first Contingency criteria used in the planning for the applicable time period, Cube Hydro Carolinas has no internal Special Protection Systems [MOD-030-02-R2.1.1.1]
11.20 Contingency Limiting Elements

Only the most limiting element in a series configuration will be included as a Flowgate.

[MOD-030-02-R2.1.2] [MOD-030-02-R2.1.2.2]

If any limiting element is kept within its limit for its associated worst contingency by operating within the limit of another Flowgate, then no Flowgate needs to be established for such limiting elements or Contingencies.

[MOD-030-02-R2.1.1.3]

11.21 First Contingency Result Transfer

Cube Hydro Carolinas includes Flowgates which is used in the AFC process based on the result of the first contingency analysis from all adjacent BA source and sink (as defined in the ATCID) combinations up to the path capability such that at a minimum the first three limiting Elements and their worst associated Contingency combinations with an Outage Distribution Factor (OTDF) of at least 5% and within the Transmission Operator System are included as Flowgate unless the interface between such adjacent BA is accounted for using another ATC methodology.

[MOD-030-02-R2.1.2]

- **Special Protection**

For the two previous screening scenarios, the same contingency file used in the planning of operations will be used in the Flowgate test for applicable time periods, including use of any Special Protection Systems. Cube Hydro Carolinas has no internal Special Protection Systems.

[MOD-030-02-R2.1.1.1]

[MOD-030-02-R2.1.2.1]

- **Limiting Elements**

Only the most limiting element in a series configuration will be included as a Flowgate.

[MOD-030 R2.1.2.2] [MOD-030-02-R2.1.2.2]

- **Limiting Elements/Contingency**

If a limiting element is kept within its limit for its associated worst Contingency by operating within the limits of another Flowgate, then no new Flowgate will be established for such limiting elements or Contingencies.

11.22 Flowgates Subject to Interconnection-Wide Congestion Management Procedure within the Last Twelve Months

Cube Hydro Carolinas will include any Flowgate within its Reliability Coordinator area that has been subjected to an interconnection-wide congestion management procedure within the last twelve months, unless the Flowgate was created to address temporary operating conditions.

[MOD-030-02-R2.13]

11.23 Flowgates Requested For Inclusion by another TSP

If another TSP asks Cube Hydro Carolinas to include in its AFC process Flowgates that fall

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outside Duke Energy Carolinas’ and Duke Energy Progress’ TSP areas, the Flowgate must be included in the requesting TSP’s methodology, and the Flowgate must pass the following screening tests:

- Any generator within Cube Hydro Carolinas TSP area has at least a 5% PTDF or OTDF impact on the Flowgate when delivered to the aggregate load of CHC’s TSP area, or
- A transfer from any BA within Cube Hydro Carolinas TSP area to an adjacent Area has at least a 5% PTDF or OTDF impact on the Flowgate.

- Cube Hydro Carolinas may utilize distribution factors less than 5% if desired.

The limiting Element/Contingency combination will be included in the requesting TSP’s methodology.

### 1.11.24 Flowgates List

Cube Hydro Carolinas has established a list of Flowgates by creating, modifying, or deleting Flowgate definitions at least once per calendar year.

Cube Hydro Carolinas has established a list of Flowgates by creating, modifying, or deleting Flowgate that have been requested as part of R2.1.4 within thirty calendar days from the request.

### 1.11.25 TFC Establishment

Cube Hydro Carolinas utilizes summer and winter facility ratings. As such, TFCs used in the ATC calculation will reflect these seasonal ratings. In instances where there is a difference in derived limits, such as a tie line, the most limiting parameter is used when determining TFC. By definition, TFC is not to exceed its thermal rating, or in the case of a Flowgate used to represent a specific operating constraint (such as a voltage or stability limit), is not to exceed the associated System Operating Limit.

### 1.11.26 TFC Update

Cube Hydro Carolinas establishes the TFC once per calendar year at minimum.

If Cube Hydro Carolinas is 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 will be updated within seven calendar days of the notification.

Cube Hydro Carolinas will provide the Transmission Service Provider with the TFCs within seven calendar days of their establishment.

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1.11.27 Transmission Model

Cube Hydro Carolinas utilizes the commercially available model building software PSSE for its model building process. PSS®E tool utilizes a starting point basecase that is used to derive multiple power flow snapshot models covering defined horizons. From these snapshots, Flowgate base flows and GSFs relative to a reference bus are calculated.

Cube Hydro Carolinas participates in the SERC Intra-Regional Near-Term Power Flow Study Group (NTSG) and Intra-Regional Long-Term Study Group (LTSG). CHC provides modeling data, data assumptions and basic methodology information to insure the accuracy of their system in the regional power system models and seasonal studies.

Models of Cube Hydro Carolinas transmission and generation system are included in the SERC regional system models. Cube Hydro Carolinas' models are updated annually through the LTSG Power Flow Data Bank and incorporated into the North American Electric Reliability Council (NERC) Multi-Regional Model Working Group (MMWG). The NTSG participant updates occur twice a year for peak load cases for summer and winter. The NTSG also provides five seasonal model updates on a quarterly basis plus 13 months of coordinated interchange. The NTSG seasonal models are used for CHC’s near-term contingency analysis. The LTSG develops the load flow models that are submitted to the NERC MMWG. NTSG studies are used to determine any transmission, facility or voltage limit when transferring power between SERC members. The NTSG OASIS base cases are used to determine Total Transfer Capability (TTC) and ATC of the SERC members.

Cube Hydro Carolinas utilizes the Power Grid Engineering and Market (PowerGEM) software for the ATC calculation. The PowerGEM software uses the Transmission Adequacy and Reliability Assessment (TARA) tool for the AFC calculation. The Automated Model Builder (AMB) in TARA generates transmission models which simulate system conditions for different horizons needed to adequately calculate transmission line transfer capability. These models are derived from the NERC MMWG models, the SERC LTSG models and the SERC NTSG models previously mentioned. The transmission models contain the system topology and generation data provided by Tops for the Eastern Interconnection which includes the VACAR RC Area and adjacent RC Areas. Within the model, there is some equivalent representation of radial lines and facilities below 161kV.
1.11.28 Transmission Model Requirements-R3

Cube Hydro Carolinas Transmission model includes generation facility ratings, such as generation maximum and minimum output levels as specified by the Generator Owners of the facilities.

[MOD-030-02-R3.1]

[MOD-03-020-R3.4, R3.5& R5.1]

Cube Hydro Carolinas model is updated at least once per day for the AFC calculations for intra-day, next day, and days two through 30.

[MOD-030-02-R3.2]

Cube Hydro Carolinas model is updated at least once per month for AFC calculation for month two through 30.

[MOD-030-02-R3.3]

Cube Hydro Carolinas model contains modeling data and system topology for the Facilities within it Reliability Coordinator’s area- Equivalent representation of radial lines and Facilities 161KV or below is included.

[MOD-030-02-R3.4]

Cube Hydro Carolinas model contains modeling data and system topology (or equivalent representation) for immediately adjacent and beyond Reliability Coordination area.

[MOD-030-02-R3.5]

1.11.29 Transmission Service Impact-R4

Source

Cube Hydro Carolinas makes available to the Transmission Service Provider a Transmission model to determine Available Flowgate Capability (AFC) that meets the following criteria:

- If the source, as specified in the ATCID, has been identified in the reservation and it is discretely modeled in the TSP’s Transmission model, Cube Hydro Carolinas uses the discretely modeled point as the source.
- If the source, as specified in the ATCID, has been identified in the reservation and the point can be mapped to an “equivalence” or “aggregate” representation in the TSP’s Transmission model, Cube Hydro Carolinas uses the modeled equivalence as the source.
- If the source, as specified in the ATCID, has been identified in the reservation and cannot be mapped to a discretely modeled point or equivalence or aggregate it will be mapped to the immediate adjacent BA associated with the TSP from which power is to be received as the source.
- If the source, as specified in the ATCID, has not been identified in the reservation, CHC uses the immediately adjacent BA associated with the TSP from which power is to be received as the source.

[MOD-030-02-R4]

Sink

- If the sink, as specified in the ATCID, has been identified in the reservation and it is discretely modeled in the TSP’s Transmission model, Cube Hydro Carolinas uses the discretely modeled point as the sink.
- If the sink, as specified in the ATCID, has been identified in the reservation and the point and the point can be mapped to an “equivalence” or “aggregate” representation in the

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TSP’s transmission model, Cube Hydro Carolinas uses the modeled equivalence or aggregate as the sink.

- If the sink, as specified in the ATCID, has been identified in the reservation and the point cannot be mapped to discretely modeled point or an “equivalence” representation in the TSP’s model, Cube Hydro Carolinas uses the immediately adjacent Balancing Authority associated with the TSP receiving the power as the sink.
- If the sink, as specified in the ATCID, has been identified in the reservation uses the immediately adjacent Balancing Authority associated with the TSP receiving the power as the sink. [MOD-030-02-R4]

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### 1.11.30 AFC Calculation-R5

When calculating AFC, Cube Hydro Carolinas uses the models provided by the Transmission Operator [MOD-030-02-R5.1]

Transmission and generation outages from the SDX are used to model topology information for AFC calculations. Cube Hydro Carolinas’ AFC process takes into consideration transmission and generation outages and additions or retirements in effect during the applicable period for Cube Hydro Carolinas TSP area and adjacent TSP areas.

Cube Hydro Carolinas include in the Transmission model expected generation and transmission outages, additions, and retirements with the scope of the model specified in the ATCID and in effect during the applicable period for the AFC calculation for the Transmission Service Provider’s area, all adjacent Transmission Service Providers, and any Transmission Service Provider with which coordination agreement have been executed. [MOD-030-02-R5.2]

For external Flowgates, identified in R2.1.4, Cube Hydro Carolinas uses the AFC provided by the Transmission Service Provider that calculates the AFC for that Flowgate.

For external Flowgates identified through AFC coordination, the AFCs that Cube Hydro Carolinas calculates will be overridden by the AFCs provided by the TSP that calculates AFC for that Flowgate. [MOD-030-02-R5.3]

---

### 1.11.31 ETC Firm Commitment Calculation-R6

Flow impacts from committed uses of a TSP’s transmission system are considered in the AFC calculation as ETC. For both firm and non-firm, ETC contains two major components: ETC model and ETCAFC. ETC model is the impact of ETC accounted for in the model building process, and ETCAFC is the impact of ETC accounted for in the AFC calculation process. Processes are in place to ensure that no double counting takes place between transmission commitment impacts accounted for in ETC model and transmission commitment impacts accounted for in ETCAFC.

\[ ETC = ETC_{\text{model}} + ETC_{\text{AFC}} \]

**ETC<sub>model</sub> – All Horizons**

When calculating the impact of the ETC for firm commitments (ETC<sub>f</sub>) for all time periods for a Flowgate, Cube Hydro Carolinas sums the followings:

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The impacts of firm Network Integration Transmission Service, including the impacts of generation to load for the Cube Hydro Carolinas TSP area. These values are calculated from:

- Load forecast for the time period being calculated. Cube Hydro Carolinas serves 62 MW of load at the Tennessee Operations site. Cube Hydro Carolinas has no Network Service load.

  [MOD-030-02-R6.1.1]

- Unit commitment and generation block dispatch, including all designated network resources needed to meet the forecast load. Cube Hydro Carolinas has no Network Service load.

  [MOD-030-02-R6.1.2]

The impact of any firm Network Integration Transmission Service, including the impact of generation to load in the model referenced in R5.2 and has a distribution factor equal to or greater than percentage used to curtail in the interconnection-wide congestion management procedure used by the TSP for all adjacent TSP and other TSP with which coordination agreements has been executed based on:

- Load forecast for the time period being calculated, including Native Load and Network Service Load.

  [MOD-030-02-R6.2.1]

- Units 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 TSP’s ATCID.

  [MOD-030-02-R6.2.2]

- The impact of all confirmed firm Point To Point (PIP) Transmission Service expected to be scheduled for the Cube Hydro Carolinas TSP area and adjacent TSP areas for which reservations are exchanged and which are not included in the model. The reservations from adjacent TSPs are scrubbed to ensure that no double counting takes place.

  [MOD-030-02-R6.3]

- The impact of all confirmed firm Point To Point (PIP) Transmission Service expected to be scheduled for Cube Hydro Carolinas TSP area and adjacent TSP areas for which reservations are to be scheduled, filtered to reduce or eliminate duplicate impact from transactions using the Transmission Service from multiple TSP, including roll-over rights for Firm Transmission Service contracts having a distribution factor equal or greater than the percentage used to curtail in the Interconnection-wide congestion management procedure used by the TSP, for all adjacent TSP’s and any other TSP with which coordination agreements have been executed.

  [MOD-030-02-R6.4]

- The impact of any grandfathered firm obligations that are modeled in the starting point case for all BA Areas in the transmission model.

  [MOD-030-02-R6.5]

- The impact of any Grandfathered firm obligation expected to be scheduled or expected to flow that have ea distribution factor equal to or greater than the percentage used to curtail in the Interconnection-Wide congestion

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management procedure used the TSP, for all adjacent TSPs and any other TSP with which the coordination agreements have been executed.

1.11.32 ETC Non-Firm (ETCAFC-NF) Commitment Calculation - R7

ETCAFC-NF in the planning and study horizons is calculated using the followings:

- Non-Firm ETCAFC-NF - Operating Horizon
  For non-firm AFC calculations in the operating horizon, ETCAFC-NF = zero, i.e., there are no additional ETC impacts beyond what is included in the model. This approach effectively releases unscheduled firm transmission to the non-firm market.

- The impact of all confirmed non-firm PTP Transmission Service expected to be scheduled for the CHC TSP area [MOD-030-02-R7.1]

- The impact of any confirmed non-firm Point-to-Point Transmission Service expected to be scheduled, filtered to reduce or eliminate duplicate impacts from transactions using Transmission service from multiple Transmission Service Providers, that have a distribution factor equal to or greater than the percentage used to curtail in the Interconnection-wide congestion management procedure used by the Transmission Service Provider, for all adjacent Transmission Service Providers and any other Transmission Service Providers with which coordination agreements have been executed. [MOD-030-02-R7.2]

- The impact of any Grandfathered non-firm obligations expected to be scheduled or expected to flow for the Transmission Service Provider’s area. [MOD-030-02-R7.3]

- The impact of any Grandfathered non-firm obligations expected to be scheduled or expected to flow that have a distribution factor equal to or greater than the percentage used to curtail in the Interconnection-wide congestion management procedure used by the Transmission Service Provider, for all adjacent Transmission Service Providers and any other Transmission Service Providers with which coordination agreements have been executed. [MOD-030-02-R7.4]

- The impact of non-firm Network Integration Transmission Service serving Load within the Transmission Service Provider’s area (i.e., secondary service), to include load growth, and losses not otherwise included in Transmission Reliability Margin or Capacity Benefit Margin. [MOD-030-02-R7.5]

- The impact of any non-firm Network Integration Transmission Service (secondary service) with a distribution factor equal to or greater than the percentage used to curtail in the Interconnection-wide congestion management procedure used by the Transmission Service Provider, filtered to reduce or eliminate duplicate impacts from transactions using Transmission service from multiple Transmission Service Providers, for all

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adjacent Transmission Service Providers and any other Transmission Service Providers with which coordination agreements have been executed.

[MOD-030-02-R7.6]

- The impact of other non-firm services are determined by the Transmission Service Provider.

[MOD-030-02-R7.7]

1.11.33 Firm AFC Calculations [MOD-030 R8]

In accordance with the MOD-030-02-R8 reliability standard, the following equation is employed when calculating firm AFC for a Flowgate for a specified period:

\[ AFC_F = TFC - \text{ETC}_F - CBM_i - TRM_i + \text{Postbacks}_F + \text{Counterflows}_F \]

Where:

- \( AFC_F \) is the firm Available Flowgate Capability for the Flowgate for that period
- \( TFC \) is the Total Flowgate Capability of the Flowgate
- \( \text{ETC}_F \) 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 CBM on the Flowgate during that period
- \( TRM_i \) is the impact of the TRM on the Flowgate during that period
- \( \text{Postbacks}_F \) are changes to firm AFC due to a change in the use of Transmission Service for that period
- \( \text{Counterflows}_F \) are adjustments to firm AFC due to power flows in the opposite direction of the Flowgate

[MOD-030-02-R8]

1.11.34 Non-Firm AFC Calculations [MOD-030 R9]

In accordance with the MOD-030-02-R9 reliability standard, the following equation is employed in calculating non-firm AFC:

\[ AFC_{NF} = TFC - \text{ETC}_{NF} - CBM_{Si} - TRM_{Si} + \text{Postbacks}_{NF} + \text{Counterflows}_{NF} \]

Where:

- \( AFC_{NF} \) is the non-firm AFC for the Flowgate for that period
- \( TFC \) is the Total Flowgate Capability of the Flowgate
- \( \text{ETC}_{NF} \) is the sum of the impacts of existing firm Transmission Service commitments for the Flowgate during that period
- \( \text{ETC}_{NF} \) 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 CBM schedules on the Flowgate during that period
- \( TRM_{Si} \) is the impact of the unreleased TRM on the Flowgate during that period
- \( \text{Postbacks}_{NF} \) are changes to non-firm AFC due to a change in the use of Transmission Service

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Service for that period

**Counterflows** are adjustments to non-firm AFC due to power flows in the opposite direction of the Flowgate

### 1.11.35 AFC Calculation Horizons and Frequency

[MOD-030-02 R10, R10.1, R10.2, R10.3]

Cube Hydro Carolinas has identified three distinct horizons for the calculation of AFC and ATC: Operating, Planning, and Study. The AFC calculation horizons are defined as follows:

- For hourly AFC, once per hour. Transmission Service Providers are allowed up to 175 hours per calendar year during which calculations are not required to be performed, despite a change in a calculated value identified in the AFC equation.
- For daily AFC, once per day
- For Monthly AFC, once per week

<table>
<thead>
<tr>
<th>AFC Time Horizon</th>
<th>AFC Horizon Time Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating</td>
<td>Prior to 10:00 EPT, current hour - midnight of the current day. After 10:00 EPT, current hour - midnight of the next day</td>
</tr>
<tr>
<td>Hourly Planning</td>
<td>End of Hourly Operating horizon – midnight of the day 6 days beyond the current day</td>
</tr>
<tr>
<td>Daily Planning</td>
<td>End of Hourly Planning horizon – midnight of the day 31 days beyond the current day</td>
</tr>
<tr>
<td>Monthly Study</td>
<td>End of Daily Planning horizon – last day of the month at least 13 calendar months from current month</td>
</tr>
</tbody>
</table>

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1.11.36 Converting AFC to ATC

When converting Flowgate AFCs to ATCs for ATC Paths, Cube Hydro Carolinas converts those values based on the following algorithm: [Violation Risk Factor: To Be Determined] [Time Horizon: Operations Planning]

\[
ATC_{AFC} = \text{min}(P)
\]

\[
P = \{PATC_1, PATC_2, \ldots, PATC_n\}
\]

\[
\text{PATC}_n = \frac{\text{AFC}_n}{\text{DF}_{np}}
\]

Where:

- **ATC** is the Available Transfer Capability.
- **P** is the set of partial Available Transfer Capabilities for all “impacted” Flowgates honored by the Transmission Service Provider; 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 Transmission Service Provider on an OTDF Flowgate or PTDF Flowgate.
- **PATC** is the partial Available Transfer Capability for a path relative to a Flowgate n.
- **AFC** is the Available Flowgate Capability of a Flowgate n.
- **DF** is the distribution factor for Flowgate n relative to path p.
1.11.37 Software’s List:

- PSS®E, Power System Simulations for Engineer
- Power Grid Engineering Management (PowerGEM)
- <www.power-gem.com>
- Cube Hydro Carolinas links in the OATI website
- TARA: Transmission Adequacy & Reliability Assessment, part of the PowerGEM software
- PAAC: PowerGEM Available AFC/ATC calculation

1.11.38 Data Inputs:

- Static Inputs:
  - Base Case from PSSE®: derived from the Southeastern Reliability Corporation (SERC) Open Access Same-Time Information NTSG group, the base case is modified such that:
  - Flowgates files are checked for accuracy, CHC Flowgates files are located in the “.fgt folder” in the PowerGEM software
  - Area names are edited to match the current NERC POR/POD names
  - Generators dispatch files are checked for accuracy
  - Subsystem files which are used to define the POR/POD files are checked and updated
  - ATC POR/POD files
- Dynamic Inputs:
  - SDX loads, Generator and Transmission Outage
  - EMS Real Time Flows
  - NERC Tag Dump Data
  - OASIS reservation Data
  - AFC Overrides

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1.11.39 Contract Path Limit
The interface between Cube Hydro Carolinas’s transmission system and that of adjacent Areas is considered to be an import/export path. Each import and export path is associated with a Contract Path Limit.

- This Contract Path Limit is the minimum of:
  - The sum of the ratings of the ties
  - The maximum transfer expected to occur on the import or export path. This value is based on traditional transfer test levels. Cube Hydro Carolinas’ ATC calculation takes into consideration Contract Path Limits. This is accomplished by calculating Remaining Contract Path Capability (RCPC) for import and export paths in parallel with the AFC process. RCPC on import and export paths is calculated according to the following formula:

\[
RCPC_p = \text{Contract Path Limit}_p - \sum \text{Reservations or Schedules}_p
\]

\(RCPC_p\) = The Remaining Contract Path Capability on import or export path \(p\)
\(\text{Contract Path Limit}_p\) = The Contract Path Limit on import or export path \(p\)
\(\text{Reservations or Schedules}\) = Reservations or Schedules (depending on the horizon) reserved or scheduled on import or export path \(p\)

RCPC for an import or export path is decremented based on the POR/POD of the reservation or schedule, and these reservations/schedules, whether firm or non-firm, are not netted. In other words, a reservation or schedule on the export path “CHC-to-Neighbor A” does not impact the RCPC for the import path “Neighbor A-to-CHC”, and vice versa. Pass-through reservations/schedules decrement two separate import/export paths – the import path from the POR and the export path to the POD. The RCPC used in the evaluation of a pass-through Transmission Service request is the lesser of the RCPC on the corresponding import and export path.

1.11.40 ATC on Posted Paths
When determining ATC posted path, the following equation is used:

\[
\text{ATC}_{\text{posted path}} = \min \left[ \text{ATC}_{\text{AFC}}, RCPC_p \right]
\]

Where:

\(\text{ATC}_{\text{posted path}}\) = the Available Transfer Capability for that path that is posted on OASIS
\(\text{ATC}_{\text{AFC}}\) = the ATC for that posted path derived from the AFC process
\(RCPC_p\) = Remaining Contract Path Capability for the applicable import/export path \(p\)

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1.11.41 TRM

Cube Hydro Carolinas has elected not to maintain or use a Transmission Reliability Margin (TRM) in the operation and planning of the Transmission System.

1.11.42 CBM

Cube Hydro Carolinas has elected not to maintain or use a Capacity Benefit Margin (CBM) in the operation and planning of the Transmission System.
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This document is confidential and intended solely for the use of the individual or entity to which they are addressed. If you are not the intended recipient, you may not review, copy, or distribute this document.
1.11.44 Definitions

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

- **Available Transfer Capability (ATC)**
  A measure of the transfer capability remaining in the physical transmission network for further commercial activity over and above already committed uses.

- **ATC Path**
  Any combination of Point of Receipt and Point of Delivery for which ATC is calculated; and any path posted on OASIS.

- **Balancing Authority (BA)**
  The responsible entity that integrates resource plans ahead of time, maintains load-interchange-generation balance within a Balancing Authority Area, and supports interconnection frequency in real time.

- **Balancing Authority Area (BA Area)**
  The collection of generation, transmission, and loads within the metered boundaries of the Balancing Authority. The Balancing Authority maintains load-resource balance within this area.

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

- **Contract Path**
  An agreed upon electrical path for the continuous flow of electrical power between the parties of an Interchange Transaction

- **Existing Transmission Commitments (ETC)**
  Committed uses of a Transmission Service Provider’s transmission system considered when determining ATC or AFC.

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

Flowgate Methodology
The Flowgate Methodology is characterized by identification of key facilities as Flowgates. Total Flowgate Capabilities (TFCs) are determined based on facility ratings and voltage and stability limits. The impacts of Existing Transmission Commitments (ETCs) are determined by simulation. The impacts of ETC, Capacity Benefit Margin (CBM) and Transmission Reliability Margin (TRM) are subtracted from the Total Flowgate Capability, and Postbacks and Counterflows are added, to determine the Available Flowgate Capability (AFC) value for that Flowgate. AFCs can be used to determine Available Transfer Capability (ATC).

Generator Shift Factor (GSF)
A factor to be applied to a generator’s expected change in output to determine the amount of flow contribution that change in output will impose on an identified transmission facility or Flowgate.

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

Interconnection Reliability Operating Limit (IROL)
A System Operating Limit that, if violated, could lead to instability, uncontrolled separation, or cascading outages that adversely impact the reliability of the bulk electric system.

Load-Serving Entity (LSE)
Secures energy and Transmission Service (and related interconnected operations services) to serve the electrical demand and energy requirements of its end-use customers.

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

Open Access Same Time Information Service (OASIS)
An electronic posting system that the Transmission Service Provider maintains for transmission access data and that allows all transmission customers to view the data simultaneously

Open Access Transmission Tariff (OATT)
Electronic transmission tariff accepted by the FERC requiring the Transmission Provider to furnish to all shippers with non-discriminating service comparable to that provided by Transmission Owners to themselves.

Outage Transfer Distribution Factor (OTDF)
In the post-contingency configuration of a system under study, the electric Power Transfer Distribution Factor (PTDF) with one or more system facilities removed from service (outaged).
- **Point of Delivery (POD)**
  A location that the Transmission Service Provider specifies on its transmission system where an interchange transaction leaves or a Load-Serving Entity receives its energy.

- **Point of Receipt (POR)**
  A location that the Transmission Service Provider specifies on its transmission system where an interchange transaction enters or a generator delivers its output.

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

- **Sink for AFC Calculation**
  Cube Hydro Carolinas defines the sink used for AFC calculations as the Point of Delivery (POD) field of the transmission reservation.

- **Source for AFC Calculation**
  Cube Hydro Carolinas defines the source used for AFC calculations as the Point of Receipt (POR) field of the transmission reservation.

- **System Data Exchange (SDX)**
  A database that serves as a repository for transmission outages, generation outages, and load forecast data for the Eastern Interconnection.

- **System Operating Limit (SOL)**
  The value (such as MW, MVar, Amperes, Frequency or Volts) that satisfies the most limiting of the prescribed operating criteria for a specified system configuration to ensure operation within acceptable reliability criteria, System Operating Limits are based upon certain operating criteria. These include, but are not limited to:
    - Facility ratings (applicable pre- and post-contingency equipment or facility ratings)
    - Transient stability ratings (applicable pre- and post-contingency stability limits)
    - Voltage stability ratings (applicable pre- and post-contingency voltage stability)
    - System voltage limits (applicable pre- and post-contingency voltage limits)

- **Tag Dump**
  A database that contains tagging data for the Eastern Interconnection.

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

- **Transfer Distribution Factor (TDF)**
  The portion of an interchange transaction, typically expressed in per unit that flows across a transmission facility (Flowgate).

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

- **Transmission Service**
  Services provided to the transmission customer by the Transmission Service Provider to move energy from a Point of Receipt to a Point of Delivery.

- **Transmission Service Provider (TSP)**
  The entity that administers the transmission tariff and provides Transmission Service to transmission customers under applicable Transmission Service agreements.