## Attachment C

## Methodology to Assess Available Transfer Capability

This Attachment C outlines the Transmission Service Provider's methodology for determining Available Transfer Capability.

### 1. Definitions

**1.1 Available Transfer Capability (ATC)** – As defined under the Commission approved NERC Glossary of Terms[1].

**1.2 Capacity Benefit Margin (CBM) –** As defined under the Commission approved NERC Glossary of Terms.

**1.3 Native Load -** As defined under the Commission approved NERC Glossary of Terms.

**1.4 Operating Horizon –** The period of time that begins at the end of the Scheduling Horizon and extends through 168 hours.

**1.5 Planning Horizon –** The period of time that begins at the end of the Operating Horizon and extends through the end of the posting period (current month plus 12 months).

**1.6 Scheduling Horizon –** The period of time that begins with the current hour and extends out one hour.

**1.7 Total Transfer Capability (TTC) –** As defined under the Commission approved NERC Glossary of Terms.

[1] NERC Glossary of Terms available on BCUC Website (bcuc.com) under Mandatory Reliability Standards.

## 2. Description of Mathematical Algorithm Used to Calculate Firm and Non-Firm ATC

The Transmission Service Provider uses the Rated System Path Methodology in the assessment of firm and non-firm ATC for all ATC paths in the Scheduling Horizon, Planning Horizon, and Operating Horizon. ATC is calculated using software which uses variable parameter settings and calculation adjustments to establish formulas for the various firm and non-firm ATCs consistent with the mathematical algorithms used by the Transmission Service Provider.

The mathematical algorithms for firm and non-firm ATC consist of the following formulas:

**For Firm ATC ($ATC_F$)**

$$ATC_F = TTC – ETC_F – CBM – TRM + Postbacks_F + Counterflows_F$$

Where:

$ATC_F$ is the firm Available Transfer Capability for the ATC path for that period.

TTC is the Total Transfer Capability of the ATC path for that period.

$ETC_F$ is the sum of existing firm commitments for the ATC path during that period.

CBM is the Capacity Benefit Margin for the ATC path during that period.

TRM is the Transmission Reliability Margin. It is 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 as per the Commission approved NERC Glossary of Terms.

$Postbacks_F$ are changes to firm Available Transfer Capability due to a change in the use of firm Transmission Service for that period, as defined in Business Practices.

$Counterflows_F$ are adjustments to firm Available Transfer Capability as determined by the Transmission Service Provider and specified in their Available Transfer Capability Implementation Document (**ATCID**).[2]

**Non-Firm ATC ($ATC_{NF}$)**

$$ATC_{NF} = TTC – ETC_F – ETC_{NF} – CBM_S – TRM_U + Postbacks_{NF} + Counterflows_{NF}$$

Where:

$ATC_{NF}$ is the non-firm Available Transfer Capability for the ATC path for that period.

TTC is the Total Transfer Capability of the ATC path for that period.

$ETC_F$ is the sum of existing firm commitments for the ATC path during that period.

$ETC_{NF}$ is the sum of existing non-firm commitments for the ATC path during that period.

$CBM_S$ is the Capacity Benefit Margin for the ATC path that has been scheduled during that period.

$TRM_U$ is the Transmission Reliability Margin for the ATC path that has not been released for sale (unreleased) as non-firm capacity by the Transmission Service Provider during that period

$Postbacks_{NF}$ are changes to non-firm Available Transfer Capability due to a change in the use of Transmission Service for that period, as defined in Business Practices.

[2] ATCID available on BC Hydro's Transmission Website on bchydro.com.

$Counterflows_{NF}$ are adjustments to non-firm Available Transfer Capability ATC as determined by the Transmission Service Provider and specified in its ATCID.

The components of the above formulas are further described in detail in this Attachment C. The specific mathematical algorithms are further described in the Transmission Service Provider's ATCID, Transmission Reliability Margin Implementation Document (**TRMID**)[3] and the TTC/ATC Business Practice webpages posted on bchydro.com.

## 3. Process Flow Diagram Illustrating ATC and ATC Calculation

ATC calculation is specified in BC Hydro's ATCID. The flow diagram is located at BC Hydro's ATC Methodology webpage on bchydro.com.

## 4. Description of How Each ATC Component is Calculated for the Operating and Planning Horizons

### 4.1. Total Transfer Capability (TTC)

#### 4.1.1. Calculation Methodology

When performing the technical studies to determine the TTC for those ATC paths:

a. Power system simulation software is used to model the transmission system, adjust the generation pattern and load levels to determine the TTC (either a maximum flow or reliability limit) that can be simulated on each ATC path while satisfying all mandatory reliability standards in effect in British Columbia (**B.C.**) and BC Hydro planning criteria.

b. TTC will be determined either prior to a new transmission element being brought into service or when a modification to a transmission element would affect the TTC.

[3] TRMID available on BC Hydro's Transmission Website on bchydro.com.

c. Once the TTC determination is made, it remains fixed and changes only if there is a physical or operational change to the transmission system or a transmission component which requires a change to TTC.

d. When either transmission facilities are either jointly owned, or capacity on the ATC path is limited by contract, the TTC will be set at the lesser of the maximum allowable limit based upon the capacity allocated by contract or pursuant to joint ownership arrangements and the reliability limit.

Additional information regarding determination of TTC for special conditions for specific paths may be posted and updated from time to time on the Transmission Service Provider's OASIS.

### 4.1.2. Databases Used in TTC Assessments

The Transmission Service Provider uses the transmission system model database from the up to date system base cases that are developed annually by WECC for its member use in planning and operating studies. WECC base cases include:

- All contiguous transmission systems within the WECC regional interconnection.
- Initial condition models of system elements are modeled as in service as consistent for the time period and conditions being studied.
- All generation and control system parameters (either a single generator or multiple generators) greater than 20 MVA at the point of interconnection are represented.
- Load is allocated to appropriate buses based on load forecasts developed by the balancing authorities for time period and conditions being studied.
- Transmission and generation facility additions and retirements are represented consistent with the time period represented. Series compensation is modeled at the expected operating level.

- Facility ratings are modeled as provided by the transmission and generator owners for the time period being studied.

- Phase shifters are modeled with automatic controls disabled.

- Special protection systems and/or remedial action schemes are modeled, as appropriate, if they are currently in place or are projected to be implemented within the studied time horizon.

### 4.1.3. Assumptions Used in TTC Assessments

When performing technical studies to determine the TTC for ATC paths, the Transmission Service Provider will use data and assumptions as follows:

#### 4.1.3.1. Load Levels

TTC is based upon initial system conditions where all transmission elements are modeled as in service consistent for the time period being studied. System conditions affecting TTC, including load levels typical for the posting period (e.g., heavy summer period) determine the starting point for study conditions.

#### 4.1.3.2. Generation Dispatch

Generation resources internal and external to the Transmission Service Provider's service territory are adjusted (within their capabilities) to provide a maximum TTC.

#### 4.1.3.3. Modeling of Planned and Contingency Outages

Values for TTC on all ATC paths are the same for both the Planning and Operating Horizons.

- Power transfers into the BC Hydro service territory are increased until a maximum transfer limit is reached or until a critical contingency with a limiting element is identified that limits the TTC. System planning performance requirements are defined in Table 1 –

Steady State & Stability Performance Planning Events in NERC standard TPL-001-4. System performance for outages must meet the mandatory reliability standards in effect in B.C. and BC Hydro reliability criteria.

- In addition, system performance for planned outages must meet the requirements as outlined in the mandatory reliability standards in effect in B.C. and BC Hydro reliability criteria. Any significant reductions in ATC path capability from the system normal TTC are posted on OASIS as necessary.

### 4.2. Existing Transmission Capacity

#### 4.2.1. Determination Methodology

Existing transmission commitments can be separated into two categories: firm or non-firm transmission commitments. This distinction defines their impacts on the calculation of firm or non-firm ATC.

#### 4.2.2. Firm Existing Transmission Commitments

The following algorithm is used when calculating firm ETC (**$ETC_F$**) for all time horizons:

$$ETC_F = NL_F + NITS_F + GF_F + PTP_F + ROR_F + OS_F$$

Where:

$NL_F$ is the firm capacity set aside to serve peak Native Load forecast commitments for the time period being calculated, to include losses, and Native Load growth, not otherwise included in Transmission Reliability Margin or Capacity Benefit Margin.

$NITS_F$ is the firm capacity reserved for Network Integration Transmission Service[4] servicing load, to include losses, and load growth, not otherwise included in TRM and CBM.

$GF_F$ is the firm capacity set aside for grandfathered Transmission Service and contracts for energy and/or Transmission Service, where executed prior to the effective date of the Transmission Service Provider's Open Access Transmission Tariff or "safe harbor tariff".

$PTP_F$ is the firm capacity reserved for confirmed Point-to-Point Transmission Service.

$ROR_F$ is the firm capacity reserved for roll-over rights for contracts granting Transmission Customers[5] the right of first refusal to take or continue to take Transmission Service when the Transmission Customer's Transmission Service contract expires or is eligible for renewal.

$OS_F$ is the firm capacity reserved for any other service(s), contract(s), or agreement(s) not specified above using Firm Transmission Service as specified in the ATCID.

### 4.2.3. Non-Firm Existing Transmission Commitments

$$ETC_{NF} = NITS_{NF} + GF_{NF} + PTP_{NF} + OS_{NF}$$

Where:

$NITS_{NF}$ is the non-firm capacity set aside for the Network Integration Transmission Service serving load (i.e., secondary service), to include losses, and load growth otherwise not included in TRM and CBM.

[4] Network Integration Transmission Service (**NITS**) - Service that allows an electric transmission customer to integrate, plan, economically dispatch and regulate its network reserves in a manner comparable to that in which the Transmission Owner serves Native Load customers.

[5] Transmission Customers - 1. Any eligible customer (or its designated agent) that can or does execute a Transmission Service agreement or can or does receive Transmission Service. 2. Any of the following entities: Generator Owner, Load-Serving Entity, or Purchasing-Selling Entity.

$GF_{NF}$ is the non-firm capacity set aside for grandfathered Transmission Service and contracts for energy and/or Transmission Service, where executed prior to the effective date of the Transmission Service Provider's Open Access Transmission Tariff or "safe harbor tariff".

$PTP_{NF}$ is the non-firm capacity reserved for confirmed Point-to-Point Transmission Service[6].

$OS_{NF}$ is the non-firm capacity reserved from any other service(s), contract(s), or agreement(s) not specified above using non-firm transmission service as specified in the Transmission Service Provider's ATCID.

### 4.3. Transmission Reliability Margin

#### 4.3.1. Calculation Methodology

The Transmission Service Provider sets aside certain transmission capacity amounts for the TRM to account for the components of uncertainty of aggregate load forecast, variations in generation dispatch and inertial response and frequency bias, and transmission system topology uncertainty for each ATC path.

The capacity amount set aside to account for the components of uncertainty of aggregate load forecast, variations in generation dispatch and inertial response and frequency bias have been established based on operating experience; they have proven sufficient and effective.

[6] Point-to-Point Transmission Service - The reservation and transmission of capacity and energy on either a firm or non-firm basis from the Point(s) of Receipt to the Point(s) of Delivery.

For calculating $ATC_F$, the Transmission Service Provider may set aside additional capacity amount to account for transmission system topology uncertainty due to unplanned and forced outages and maintenance outages. The capacity amount required for this component of uncertainty is determined based on applicable system operating orders. For more information, refer to the Transmission Service Provider's TRMID posted on bchydro.com.

### 4.4. Capacity Benefit Margin

#### 4.4.1. Practice

For information, refer to the Transmission Service Provider's ATCID posted on bchydro.com.

### 4.5. Counterflows

#### 4.5.1. Practice

Counterflows are determined in the manner described in the Transmission Service Provider's ATCID posted on bchydro.com.

## 5. Firm Transmission Service on BCHA – AESO Path

Notwithstanding any other provision in this Tariff, the Transmission Service Provider shall limit sales of firm transmission service on the BCHA - AESO path to 480 MW.