1) Description of Mathematical Algorithm Used to Calculate Firm And Non-Firm ATC

Acronyms

ATC means Available Transfer Capability
CBM means Capacity Benefit Margin
ETC means Existing Transmission Commitments
TRM means Transmission Reliability Margin
TSR means Transmission Service Request
TTC means Total Transfer Capability

Definition

Available Transfer Capability (ATC) is a measure of the transfer capability remaining in the physical transmission network for the further commercial activity over and above already committed uses. Mathematically, ATC is defined as the Total Transfer Capability (TTC), less the sum of the following: Existing Transmission Commitments (ETCs), any Capacity Benefit Margin (CBM) and any Transmission Reliability Margin (TRM).

ATC Calculation Horizons

Transmission Provider uses the OATi webTrans ATC calculator for all its posted paths. This application provides three calculation horizons: Planning, Operational, Scheduling:

Planning Horizon

The Planning Horizon is from the end of the Operational Horizon to 10 years from now. These calculations do not incorporate tags as they are used for scheduling, which usually takes place closer to the actual flow date. These calculations include a representation of forecasted annual growth of Native Load and Network Load as set asides.

Operational Horizon

Operational Horizon is from the end of the Scheduling Horizon to 54 days from now. These calculations do include the impacts of tags.

Scheduling Horizon

Scheduling Horizon is the current real-time hour and the next following 168 hours. These calculations do include the impacts of tags.

Frequency

For all posted paths, there are two scheduled ATC calculations: an initialization calculation each day, and a calculation (and resulting release) on each Working Day of unscheduled firm capacity as non-firm. ATC calculations for any or all ATC horizons can also be manually triggered by the Transmission Provider at any time.

ATC is also recalculated for several types of events that impact a specific posted path for the applicable ATC horizon(s). Such events include a change in ETC due to the confirmation, curtailment, recall, or annulment of a reservation, a change of TTC, CBM, or TRM, or when, for non-firm ATC, a tag reaches the implement state.

Description of Firm ATC Algorithm

Firm Available Transfer Capability (Firm ATC) is the remaining transfer capability available for firm transmission reservations for a given path and for a given time horizon:

Firm ATC = TTC – Firm ETCs – CBM – TRM

Description of Non-Firm ATC Algorithms

Non-Firm Available Transfer Capability (Non-Firm ATC) is the remaining capacity available for additional non-firm transmission reservations for a given path and for a given time horizon.

Non-firm ATC Equation in the Planning Horizon:

Non-firm ATC = TTC – Firm ETCs – TRM– Non-firm ETCs

Non-firm ATC Equation in the Operating Horizon:

Non-firm ATC = TTC – Firm ETCs – TRM – non-firm ETCs + firm and non-firm tagged counter-schedules,

Non-firm ATC Equation in the Scheduling Horizon:

Non-firm ATC = TTC – tagged firm ETCs – tagged non-firm ETCs – TRM + firm and non-firm tagged counter-schedules.

Link to Actual Mathematical Algorithms

http://www.oatioasis.com/PSEI/PSEIdocs/ATC_Algorithm.pdf

2) Description of How Each ATC Component is Calculated

a) Total Transfer Capability (TTC)

i) Definition

Total Transfer Capability (TTC) is defined as the amount of electric power that can be moved or transferred reliably from one area to another area of the interconnected transmission systems by way of transmission lines (or paths) between those areas under specified system conditions. This value may reflect contractual arrangements or be based on certain equipment limitations or system conditions. TTC represents the reliability limit of a transmission path at any specified point in time. It may be a variable quantity, dependent upon operating conditions in the near term or forecasted conditions in the long term.

ii) Calculation Methodology

For Transmission Provider's posted paths for which Transmission Provider is the transmission operator, Transmission Provider generally uses a rated system path type methodology to calculate TTC. Specifically, Transmission Provider performs studies to determine the applicable TTC for posted paths for selected time periods. The process may take into account contractual arrangements, effects of system topology, generator operations, neighboring system conditions, or parallel path flows and may be based on thermal, stability, or voltage limitations. Transmission Provider's studies to determine posted path TTC limits are based on applicable NERC or WECC planning and operating criteria for maintaining reliability. If TTC is to be calculated for a posted path internal to Transmission Provider's Transmission System, TTC may be calculated based on the net of local load and local generation. Additional information regarding determination of TTC for specific paths may be found in Transmission Provider's path ratings document (http://www.oatioasis.com/PSEI/PSEIdocs/ATC_Algorithm.pdf) as posted and updated from time to time on Transmission Provider's OASIS. For Transmission Provider's posted paths for which Transmission Provider is not the transmission operator but has capacity ownership rights, Transmission Provider is notified of, and posts as TTC, Transmission Provider's share of transfer capability.

iii) Databases Used in TTC Assessments

The power flow studies used in Transmission Provider's TTC assessments are based on system base cases developed through the Western Electricity Coordinating Council (WECC).

iv) Assumptions Used in TTC Assessments

For the time period under study, the heavy and light load cases using data for planned outages are established. Within those cases, reasonable ranges of expected sub-regional transfers are assumed. If applicable, typical generation variations are included in the studies. The applicable seasonal thermal ratings are applied. N-1 and N-2 conditions are studied to assess system performance based on applicable NERC and WECC planning and operating criteria for maintaining system reliability and under a set of system states/conditions that can reasonably occur for that given period.

v) PSE Path Specific

The following was, in part, extracted from a study report in response to NERC Standard TOP-002-2 R12. R12 states - "The Transmission Service Provider shall include known SOLs or IROLs within its area and neighboring areas in the determination of transfer capabilities, in accordance with filed tariffs and/or regional Total Transfer Capability and Available Transfer Capability calculation processes."

The following paths are discussed below -
Tacoma Power (TPWR) – PSEI
Seattle City Light (SCL) – PSEI
Centralia – PSEI
Snohomish PUD (at Beverly) – PSEI
Bonneville (BPAT) – PSEI
MidColumbia (MIDC) – PSEI

Of the six posted paths listed above, four must have their ratings adjusted under various conditions. These conditions include seasonal ambient temperatures and/or facility outages. The adjustment of these path ratings must be reflected in the posted OASIS[1] Total Transfer Capabilities (TTCs).

At the time of this posting, the BPAT.PSEI–PSEI.SYSTEM and MIDC–PSEI.SYSTEM path ratings do not require adjustment under any studied scenario. For BPAT.PSEI–PSEI.SYSTEM, that posted rating is far less than the combined thermal capability of the interconnected facilities. The MIDC–PSEI.SYSTEM contractual arrangement with the Bonneville Power Administration (BPA) does not limit the posted capacity by either seasonal or facility conditions.

[1] Open Access Same-Time Information System

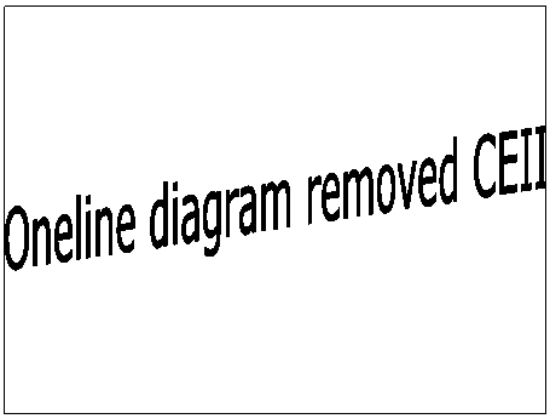

Figure 1. TPWR - PSEI

The above shows the interconnection between PSE and Tacoma Power. A path rating of 240 MWs in both directions is posted year-round on the PSE OASIS. Under normal operating conditions (all facilities in service), the limiting element is the Starwood transformer bank.

Sensitivities

Seasonal impact due to summer ratings of interconnected facilities, but only under outage conditions.

Critical Outages

n-1 (loss of one facility)

A loss of the Starwood transformer or the 110 kV tie to Tide Flats reduces the posted path capacity to 0 MWs.

A loss of one of the three PSE lines connected to the Starwood bus would impact the posted path rating. The three lines are Starwood-Midway 115kV, Starwood-White River 115kV, and Starwood-Christopher 115kV.

All three transmission lines have a summer limit of 110 MWs, a spring/fall rating of 144 MWs, and a winter rating of 176 MWs. Therefore, under n-1 conditions, the path rating should be reduced to 220 MWs during the summer conditions.

n-2 (loss of multiple facilities)

With two transmission lines out of service, the posted path rating should be reduced to match the capacity of just one facility – 110 MWs during the summer months, 144 MWs during the spring/fall months, and 176 MWs during winter.

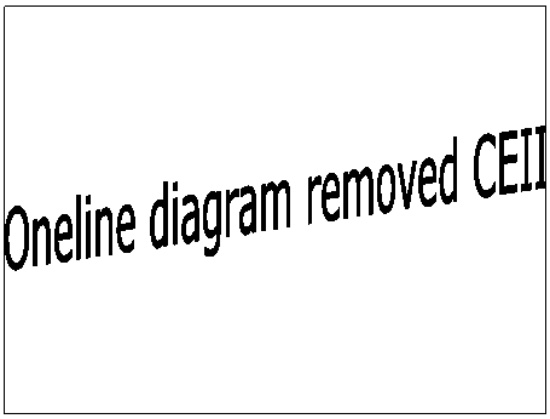

Figure 2. SCL - PSEI

The above shows the interconnection between PSE and Seattle City Light (SCL). This interconnection is made up of three lines. These three lines are HorseRanch Tap-Bothell 230kV, Bothell-Sammamish 230kV, and Talbot N-South 230kV.

A path rating of 500 MW in both directions is posted year-round on the PSE OASIS. This rating was a conservative number agreed to by PSE and SCL. Under normal operating conditions (all facilities in service), the interconnected path capability exceeds 1800 MW.

Sensitivities

The path rating is impacted under summer condition, but only under n-2 outage conditions.

Critical Outages

n-1 (loss of one facility)

Even with the loss of the highest-rated facility (Bothell–Sammamish 230kV), the remaining in service lines exceed 900 MW TTC, far eclipsing the posted 500 MW.

n-2 (loss of multiple facilities)

The only critical outage would be the loss of both ties to the SCL Bothell bus, Bothell–Sammamish and Bothell–HorseRanch Tap. If both these facilities were lost, the posted SCL.SYSTEM–PSEI.SYSTEM path rating would equal the line capacity for the South–Talbot N (355 MWs during the summer, 406 MWs during the spring/fall, and 459 MWs during the winter).

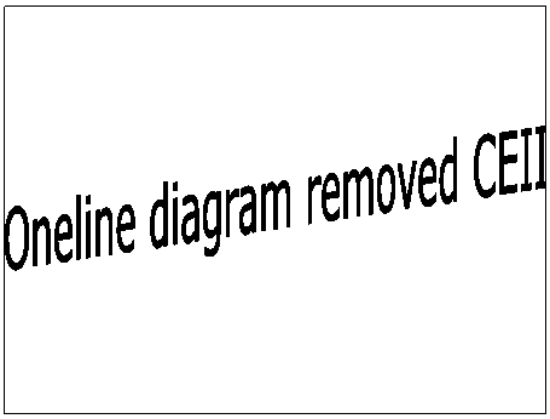

Figure 3. Centralia - PSEI

The above shows the interconnection between PSE and the Centralia plant. This interconnection is made up of two lines, Tono–Blumaer 115kV and Tono–Rochester 115kV, one 400MVA phase shifting transformer, one 400 MVA 500kV/115kV transformer, and contractual rights across BPA's Paul 500kV bus. A path rating of 400 MW is posted during the winter season on the PSE OASIS.

Sensitivities

The path rating is impacted by certain facility outages.

Critical Outages

n-1 (loss of one facility)

A loss of the 400MVA phase shifting transformer or the Tono 500kV/115kV transformer reduces the posted path capacity to 0 MW. A loss of either of the two PSE lines connected to the Tono bus would require a reduction of the posted path rating. Each transmission line has a summer limit of 265 MVA, a spring/fall rating of 289 MVA, and a winter rating of 314 MVA. Therefore, under n-1 conditions, the path rating would be 265 MWs during the summer, 289 MWs during the spring/fall, and 314 MWs during the winter.

n-2 (loss of multiple facilities)

With both of the transmission lines out of service, the posted path rating would be 0 MW.

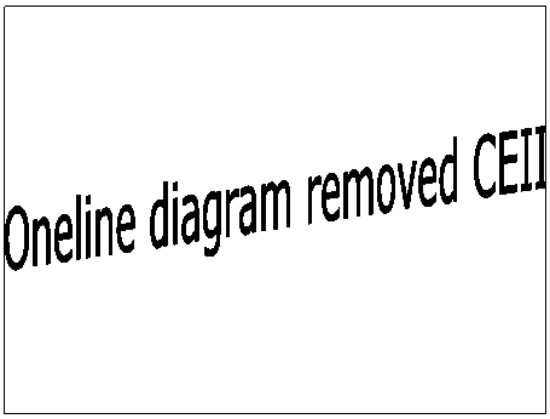

Figure 4. Snohomish - PSEI

The above shows the interconnection between PSE and Snohomish PUD (SNPD). A TTC of 200 MWs in both directions is posted year-round on the PSE OASIS. With all PSE facilities in service, the 200 MWs TTC is used to recognize certain Snohomish facilities limitations east of the Beverly bus.

Sensitivities

The path rating is impacted by certain facility outages.

Critical Outages

n-1 (loss of one facility)

The only n-1 outage that impacts the path rating is, during summer conditions, the loss of the Beverly Park - Cottage Brook 115kV which would reduce the posted path rating of 200 MWs to 157 MWs.

n-2 (loss of multiple facilities)

During all seasons, the loss of Beverly – Cottage Brook 115kV and Beverly - Anderson Canyon 115kV does not change the posted rating of 200 MWs.

The loss of Beverly – Cottage Brook 115kV and Beverly - Anderson Canyon 115kV reduces the path rating to 110 MWs in summer conditions, 144 MWs in spring/fall conditions, and 176 MWs in winter conditions.

The loss of Beverly – Cottage Brook 115kV and Beverly - Beaver Lake 115kV reduces the path rating to 47 MWs in summer conditions, 60 MWs in spring/fall conditions, and 73 MWs in winter conditions.

BPAT – PSEI

Table 1 – BPAT Intertie Facilities

Facility (kV)	Summer Rating(MVA)	Winter Rating(MVA)	Spring Rating(MVA)
Portal Way - Custer 115/230	429	484	449
Bellingham - BPA Bellingham #2 115	209	273	240
Bellingham - BPA Bellingham #3 115	265	314	289
Whatcom #1 (Terrell - BP Refinery) 115	402	478	438
Sedro Woolley - BPA Bellingham 230	695	835	765
Sedro Woolley Tap - BPA Cust-Murray 230	467	528	495
Horse Ranch Tap - BPA Mon-Snoh 230	521	680	601
Klahanie - BPA Maple Valley 230	303	622	463
Talbot Hill - BPA Maple Valley #1 230	809	943	876
Talbot Hill - BPA Maple Valley #2 230	1291	1566	1429
Christopher Tap - BPA Coving-Tacoma #2 230	838	1092	962
White River - BPA Covington #1 230	566	697	632
White River - BPA Covington #2 230	541	641	591
White River - BPA S. Tacoma 230	319	416	365
Olympia - BPA Olympia #1 115	265	314	289
Olympia - BPA Olympia #2 115	265	314	289
S. Bremerton - BPA Shelton 230	619	733	674
S. Bremerton - BPA Kitsap 115	265	314	289
Bremerton - Navy Yard 115	201	239	219
Frondale - BPA Fairmount 115	110	176	144
Monroe - Sammamish 230	664	786	723
Chico - BPA Kitsap 115	110	176	144
Totals	**10154**	**12621**	**11366**

The above table shows the interconnecting facilities between PSE and the Bonneville Power Administration (BPAT) modeled in PSE's powerflow data base. Until recently, PSE posts a TTC of 3600 MW in both directions year-round on the PSE OASIS. The 3600 MW TTC was revised for 2007-2008 winter conditions to a value of 4140 MWs. As shown above, the sum of individual facility ratings exceeds both these TTC values.

Sensitivities

Note: studies have not been rigorously applied to determines this path's TTC.

Critical Outages

n-1 (loss of one facility)

To be determined

n-2 (loss of multiple facilities)

To be determined

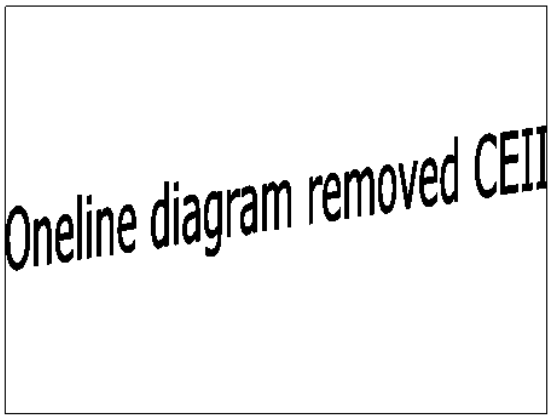

Figure 5. MIDC - PSEI

The MIDC-PSEI.SYSTEM path is a component of the West of Cascades-North path (Path 4 in the WECC Path Rating Catalog) which is operated by Bonneville Power Administration's Transmission Services. The MIDC-PSEI.SYSTEM path represents PSEI's contractual ability to move 450 MWs to/from facilities at the various Mid-Columbia projects to facilities in the Puget Sound region west of the Cascades Mountains. These facilities include the physical interconnections between PSE and Chelan PUD (CHPD):

- Anderson Canyon-Beverly 115kV – 50 MWs, and
- Rocky Reach-White River 230kV - 400 MWs

Sensitivities

There is no seasonal impact solely due to thermal ratings of interconnected facilities. Through PSE's contractual arrangement with the West of Cascades-North path operator, the Bonneville Power Administration (BPA), 450 MW TTC is not limited by temperature or status of PSE' s facilities.

b) Existing Transmission Commitments (ETCs)

i) Definition

Existing Transmission Commitments (ETCs) are a Transmission Provider's existing transmission capacity obligations which may include grandfathered transmission contracts, OATT transmission reservations, native load usage, reasonably forecasted (over the Planning Horizon) native or network load growth, or other obligations that impact firm ATC.

ii) Calculation Methodology To Determine Transmission Capacity Set Aside for Native Load, Network Load, and non-OATT Customers

The confirmed transmission service requests (TSRs) for native load and Network Load are based on the designated Network Resources for those loads and are modeled using the specified megawatt quantity, point(s) of receipt, and point(s) of delivery. Transmission capacity for service for Network Load, native load, and non-OATT customers is accounted for by confirmed TSRs, which are included in ETC and deducted as such in the determination of ATC.

Transmission service for non-OATT customers (such as grandfathered or pre-Order No. 888 contracts) are modeled using the specified megawatt quantity, point(s) of receipt, and point(s) of delivery. Transmission capacity for service for

non-OATT customers is accounted for by confirmed TSRs, which are included in ETC and are deducted as such in the determination of ATC.

In addition, for the Planning Horizon, firm set asides on posted path(s) are used to represent forecasted annual growth of native load and Network Load over the Planning Horizon. Transmission capacity for growth of native load or Network Load is accounted for by committed use set asides, which are included in ETC and are deducted as such in the determination of ATC. These firm set asides are updated annually.

iii) Incorporation of Point-To-Point Transmission Service Requests

Existing, confirmed TSRs for Point-To-Point Transmission Service are modeled using the specified megawatt quantity, point(s) of receipt, and point(s) of delivery. Transmission capacity for service for Point-To-Point customers is accounted for by confirmed TSRs which are included in ETC and are deducted as such in the determination of ATC.

iv) Accounting for Rollover Rights

Transfer capability on a path needed in the event transmission rights are rolled-over is posted as ATC such that transmission service requests for such capability may be submitted; however, Transmission Customers that exercise their rollover rights and qualify under the Tariff for rollover of rights on a path will in accordance with the Tariff take priority over lower priority firm reservations on that path.

v) Process For Ensuring that Non-Firm Capacity is Released Properly

Requests for Non-Firm Point-To-Point Transmission Service are to be made in accordance with section 18.3 of the Tariff. Not later than 10:00 A.M. of a Working Day, non-firm ATC on each posted path is recalculated to include any unscheduled firm ATC for such path and posted on the Transmission Provider's OASIS. This recalculation and posting is typically performed about one week prior to real time.

c) Available Flowgate Capacity (AFC) Methodology

Not applicable.

d) Transmission Reliability Margin (TRM)

i) Definition

Transmission Reliability Margin (TRM) is that amount, if any, of transmission transfer capability on a path set aside for any of the following: load forecast and load distribution error, variations in facility loadings, uncertainty in transmission system topology, loop flow impact, variations in generation dispatch, automatic sharing of reserves, and other uncertainties as identified through the NERC reliability standards development process.

ii) Calculation Methodology

Methodologies used in the Western Interconnection to calculate path TTC limits include a reliability component that has many of the same characteristics as TRM, such as load forecast and load distribution error, variations in facility loadings, uncertainty in transmission system topology, loop flow impact, and variations in generation dispatch. For purposes of calculating ATC, TRM for those characteristics is set to zero because those characteristics are included in the determination of the posted path TTC limit. As indicated above, Transmission

Provider's studies to determine posted path TTC limits are based on applicable NERC or WECC planning and operating criteria for maintaining reliability. Currently, there is no TRM set aside on any posted path for any ATC calculation horizons.

iii) Databases Used in TRM Assessments

As indicated above, the power flow studies used in Transmission Provider's TTC assessments are based on system base cases developed through the Western Electricity Coordinating Council (WECC) and methodologies used in the Western Interconnection to calculate path TTC limits include a reliability component that has many of the same characteristics as TRM.

iv) Conditions Under Which the Transmission Provider Uses TRM

Not applicable because currently there is no TRM set aside on any posted path for any ATC calculation horizons.

e) Capacity Benefit Margin (CBM) Practice

Currently, there is no CBM set aside on any posted path for any ATC calculation horizons. Should Transmission Provider's merchant function or any other load-serving entity with load in Transmission Provider's Balancing Authority area request CBM be set aside, these requests must be made on the OASIS via a Transmission Service Request (that identifies such request in the comments section as a request for CBM), which will allow CBM set aside for such requests but unused (i.e., unscheduled/un-tagged CBM) CBM to be released for non-firm use. Transmission Provider will evaluate any request for CBM set aside on a case-by-case basis based on transmission availability and the basis for the request. Transmission Provider will annually reevaluate its own need for CBM set asides.

f) Capacity Benefit Margin

i) Definition

Capacity Benefit Margin is that amount, if any, of firm transmission transfer capability reserved by Transmission Provider for Load-Serving Entities (LSEs), whose loads are located on Transmission Provider's Transmission System, to enable access by the LSEs to generation from interconnected systems to meet 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.

ii) Databases Used in its CBM Assessments

The determination of any databases to be used in any CBM assessment by Transmission Provider would depend upon an evaluation of the requested CBM and the circumstances of the requesting LSE.

iii) Demonstration of No Double-Counting of Contingency Outages When Performing CBM, TTC, and TRM Calculations

Not applicable because as indicated above currently there is no TRM or CBM set aside on any posted path for any ATC calculation horizons.

g) Procedures for Allowing the Use of CBM

Not applicable because currently there is no CBM set aside on any posted path for any ATC calculation horizons. At any time that CBM has been requested and set aside for an LSE whose loads are located on Transmission Provider's Transmission

System, such LSE may request to use CBM by submitting a tag referencing the TSR for the CBM. Transmission Provider will use reasonable efforts to evaluate such requests on a case-by-case basis under applicable reliability standards governing the conditions for which CBM may be used.