

Total Transmission Capability (TTC), Transmission Reliability Margin (TRM), and Available Transmission Capability (ATC)

Introduction

This document includes the following information:

- Basic explanations of TTC, ATC, and TRM
- List of NEPOOL interfaces and forecast/posting responsibilities
- Methods of determining TTC and TRM for each interface
- Information about the posting of TTC and ATC values for the NEPOOL interfaces, including the timeframes and frequency of updates

Basic Concepts and Definitions

Total Transfer Capability (TTC)

NERC Definition	The Total Transfer Capability (TTC) for an interface is the best engineering estimate of the total amount of electric power that can be transferred over the interface in a reliable manner in a given time-frame.
Basis for TTC	TTCs for NEPOOL interfaces are forecast by the ISO based on thermal, voltage, or stability limitations of the ties that comprise the interface. Power flow analysis is used to ensure that physical limits will not be violated for credible contingencies.
Future Forecasts	<p>The TTC forecast for periods <i>beyond 35 days out</i> is based on seasonal operating studies that take into account anticipated peak loads and generator maintenance schedules.</p> <p><i>Within 35 days</i>, a base TTC is calculated from historical “all lines in” data that takes into account seasonal load distributions. The base TTC is adjusted daily into a forecast value that accounts for:</p> <ul style="list-style-type: none">• forecast loads• actual and scheduled transmission and generator outages in NEPOOL and neighboring systems• changes in facility ratings

- anticipated loading of generators
- anticipated inter-Area schedules used for daily and weekly security analysis.

Variations across interfaces	Factors used in calculating TTC for each of the NEPOOL interfaces vary. Brief descriptions of these methods are given in Section 4.
ISO/Transmission Provider Responsibility	<p>The ISO calculates the forecast TTC for the NEPOOL interfaces on behalf of the transmission providers within New England.</p> <p>Individual Transmission Providers use the forecast TTCs according to their OASIS posting requirements.</p>

Transmission Reliability Margin (TRM)

Definition	<p>The Transmission Reliability Margin (TRM) is the portion of TTC that cannot be used for reservation of firm transmission service because of uncertainties in system operation. ISO New England uses the TRM to minimize the need to curtail firm transmission service.</p> <p>The TRM is available for reservation of non-firm transmission service. Note that when TRM = TTC, no firm transmission reservations can be made on the tie. Non-firm reservations can be made up to the value of TTC.</p>
Variability of TRM	The TRMs are interface-dependent, direction-specific and time-dependent. Methods used to determine TRM vary for each of the NEPOOL interfaces are described in Section 4.
ISO/Transmission Provider Responsibility	<p>The ISO calculates the forecast TRM for the NEPOOL interfaces on behalf of the transmission providers within New England.</p> <p>Individual Transmission Providers use the forecast TRMs according to their OASIS posting requirements.</p>

Available Transfer Capability (ATC)

Definition of Firm ATC	<p>Firm Available Transfer Capability (Firm ATC) for an interface is the capability for firm transmission reservations that remains after allowing for existing firm commitments and the TRM. Mathematically, Firm ATC is calculated using the equation:</p>
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$$\text{Firm ATC} = \text{TTC} - \text{TRM} - \text{Existing Firm Commitments}^*$$

* Existing Firm Commitments consist of, Firm transmission requests in the following status, Confirmed, Accepted and Study.

Definition of Non-Firm ATC
Non-Firm Available Transfer Capability (Non-Firm ATC) for an interface is the capability for non-firm transmission reservations that remains after allowing for existing commitments in the Confirmed and Accepted status. Mathematically, Non-Firm ATC is calculated using the equation:

$$\text{Non-Firm ATC} = \text{TTC} - \text{Existing Firm \& Non-Firm Commitments in the Confirmed and Accepted Status.}$$

Study Reservations Requests for service that are in the Study Status are excluded from the calculation of Non-Firm ATC.

Non-Firm ATC = a negative number The ISO will on occasion allow Customers to reserve hourly non-firm service above the TTC for a given interface in order to minimize the degree of non-use, as when energy flows are not scheduled against a transmission reservation. In such cases, the Non-Firm ATC equation would yield a negative value for Non-Firm ATC.

ATC Release timing tables
The various classes of Transmission Service have different timing constraints associated with each. For information on the window of time open for requesting each class of Transmission Service please refer to Tables T1 (Firm Service) and T2 (Non-Firm Service) of The General Business Practices found at, http://www.iso-ne.com/transmission_services_and_generation_interconnection/documents/Tariff_Specific_Business_Practices/General_Business_Practices/index.html

Additional Release of Hourly Non-Firm Service
Hourly Non-Firm Service is released per table T2 of the General Business Practices. Additionally, as of the noon daily trading deadline, calculation of ATC for Non-Firm Hourly Service is based on the maximum availability of the energy to be scheduled as opposed to the reserved transmission service. This effectively releases any unscheduled transmission service up to the TTC (no overbooking is allowed).

Capacity Benefit Margin (CBM), *Not Included in New England*

For NEPOOL, 'Existing Firm Commitments' means the existing firm transmission reservations. NEPOOL does not include a CBM component in any ATC calculations, because the CBM is reflected in the capacity requirements of load-serving entities.



If the capacity planning methods at NEPOOL change in the future, the value of the CBM component in the ATC calculations will be re-evaluated.

ISO/Transmission
Provider
Responsibility

The ISO calculates and updates Firm and Non-Firm ATCs for service with the NEPOOL RTG. ATC for the other interfaces is calculated and updated by the transmission providers who post those interfaces.

NEPOOL Interfaces

The ten external interfaces for which ATC values are currently posted on the NEPOOL OASIS node are listed in the table below. Some of these interfaces consist of a single tie and others have multiple ties.

The ISO determines the TTC and TRM for each interface. The Transmission Providers determine the ATCs based on existing commitments and post the values for TTC and ATCs on their individual OASIS sites.

Table: NEPOOL Interfaces and Transmission Providers

Interface	Transmission Providers	Comments
New York/New England	NEPOOL RTG	
NYPA/Vermont	NEPOOL RTG	Posted as subset of NY-NE
LILCO/Connecticut	NEPOOL RTG	Posted as subset of NY-NE
Hydro-Quebec-Sandy Pond	Individual owners of the hvdc tie	Phase II, ATC forecasted by individual owners
Hydro-Quebec-Comerford	Individual owners of the hvdc tie	Phase I, ATC forecasted by individual owners
New Brunswick-MEPCO	Maine Electric Power Company (MEPCO)	ATC forecasted by MEPCO
New Brunswick – MPS	Maine Public Service Company (MPS)	TTC and ATC are forecasted by MPS
Hydro-Quebec-CU in VT	Citizens Utilities (CU)	HQ Block Load; TTC and ATC are forecasted by CU
Hydro-Quebec-Highgate	Central Vermont Public Service Corporation (CVPS)	
MEPCO - New England	NEPOOL RTG; Maine Electric Power Company (MEPCO)	Separate postings by NEPOOL RTG and MEPCO

TTC and TRM for NEPOOL Interfaces

This section describes considerations used in determining TTC and TRM for each of NEPOOL interfaces.

New York-New England Interface

Tie Lines The New York/New England interface consists of eight ties:.

1. Plattsburgh-Sand Bar (PV-20) 115 kV line
2. Whitehall-Blissville (K37) 115 kV line
3. Hoosick-Bennington (K6) 115 kV line
4. Rotterdam-Bear Swamp (E205W) 230 kV line
5. Alps-Berkshire (393) 345 kV line
6. Pleasant Valley-Long Mountain (398) 345 kV line
7. Northport-Norwalk Harbor (1385) 138 kV cable
8. Smithfield - Salisbury (690) 69 kV line

Determination of TTC Base values of the TTC for this interface are created utilizing historical “all lines in” transfer limit data. This data takes into account such diverse factors as seasonal load distribution and facility ratings, load levels, thermal and stability limits, pumped storage operation, and other factors that typically influence interface transfer limits.

Historical load data, which is categorized by day type (weekday, Saturday, and Sunday), allows base values to be determined for 24 hours per day for all months of the year.

TTC & TRM TTC & TRM values are shown in the table below.

Table: TTC and TRM for New York – New England Interface

Direction	Quantity	Value	Comments
NY to NE	TTC	Based on power flow studies or historical values	
	TRM	200 MW	
NE to NY	TTC	Based on power flow studies	
	TRM	Days 1 – 12: greater of 15% or 200 MW; beyond 12 days: 400 MW	

NYPA-Vermont Interface

The values of TTC and TRM for NYPA to Vermont as determined by the methods stated below are based on the capability of the PV-20 line. *They are the values that would apply to the interface taken on its own.* However, values of TTC and TRM for NYPA to Vermont are part of the overall capability of the New York to New England interface and may be reduced accordingly. This is explained with an example at the end of the section.

Table: TTC and TRM for NYPA - Vermont Interface

Direction	Quantity	Condition	Value/Method
NYPA to VT	TTC	Summer(5/1-10/31)	Up to 140 MW Value is based on operating procedures for PV-20
		Winter (11/1-4/30): Highgate to VT > 200 MW	Up to 140 MW
		Winter (11/1-4/30): Highgate to VT ≤ 200 MW	Up to 155 MW
	TRM	Summer	TRM = 0
		Winter: Highgate to VT > 200 MW	TRM = 0
		Winter (11/1-4/30): Highgate to VT ≤ 200 MW	TRM = 0
VT to NYPA	TTC	.	TTC = 0 Flows in this direction are on an emergency basis only
		TRM	TRM = TTC

Examples of Limitation

The ATC on the NYPA – Vermont interface may be limited by the ATC for the NY to NE interface as shown in the following firm ATC examples.

NYPA / VT ATC ≤ NY / NE ATC

Suppose:

- TTC for NYPA-VT Interface = 140 MW
- Firm reservations on NYPA-VT = 100 MW

- TRM for NYPA-VT = 0
- Firm ATC= TTC- TRM – Firm commitments

If ignoring the NY to NE interface capability

- Firm ATC for NYPA to VT = (140 - 0 - 100) = 40 MW

If Firm ATC for NY to NE Interface is greater than Firm ATC for NYPA to VT

If Firm ATC for NY-NE is 500 MW

- Firm ATC for NYPA to VT = (140 - 0 - 100) = 40 MW

If Firm ATC for NY to NE Interface is less than Firm ATC for NYPA to VT,

If Firm ATC for NY-NE is 30 MW

- Firm ATC for NYPA to Vermont = Firm ATC for NY to NE = 30 MW, since 30 MW is less than the 40 MW calculated above for NYPA – VT Firm ATC

LILCO-Connecticut Interface

The values of TTC and TRM for the LILCO – Connecticut interface as determined by the methods stated below are based on the capability of the 1385 cable. *They are the values that would apply to the interface taken on its own.* However, values of TTC/TRM for LILCO – CT are linked to the overall capability of the New York to New England interface and may be reduced accordingly. The treatment with respect to the NY - NE interface is similar to that of the NYPA-VT interface.

LILCO / CT ATC ≤ NY / NE ATC

TTC and TRM values for this interface are shown in the table.

Table: TTC and TRM for LILCO – Connecticut Interface

Direction	Quantity	Value	Comments
LILCO to CT	TTC	LTC rating of cable	Thermal limitation for flow on the 1385 cable.
	TRM	0 MW	
CT to LILCO:	TTC	LTC rating of cable	TTC is the same for both directions
	TRM	TTC-200	

New Brunswick (NB) - MEPCO Interface

Base values of the TTC for this interface are determined utilizing historical “all lines in” transfer limit data. This data takes into account such diverse factors as seasonal load distribution and facility ratings, load levels, thermal and stability limits, and other factors that typically influence interface transfer limits.

The New Brunswick to New England interface has a minimum flow needed to maintain system reliability for source contingencies in the Maritimes.

Note that this interface is not posted by the NEPOOL RTG; it is posted by MEPCO.

Table: TTC and TRM for New Brunswick – MEPCO Interface

Direction	Quantity	Value	Comments
NB to NE:	TTC		The TTC is based on the stability limit of 700 MW
	TRM		As posted by the Transmission Provider (MEPCO)
NE to NB	TTC:	Based on power flow studies	Typically zero or flows required from NB to NE due to minimum tie flow reliability requirements
	TRM		As posted by the Transmission Provider (MEPCO)

MEPCO-New England Interface

Values of TTC for this interface are based on thermal limitations derived from power flow analysis which reflects both summer and winter facility ratings.

Values are shown in the table below.

Table: TTC and TRM for MEPCO – New England Interface

Direction	Quantity	Value	Comments
MEPCO to NE:	TTC	Based on power flow studies	Posted by both NEPOOL RTG and MEPCO.
	TRM	$TRM = TTC - 700$	
NE to MEPCO	TTC:	Based on power flow studies	Posted by both NEPOOL RTG and MEPCO.
	TRM	10% of TTC	

Highgate-Vermont

Table: TTC and TRM for Highgate to Vermont

Direction	Quantity	Value	Comments
Highgate to VT	TTC	225 MW limit	
	TRM		As posted by the Transmission Provider (CVPS)
VT to Highgate	TTC	TTC = 0	Flows in this direction are on an emergency basis only
	TRM		As posted by the Transmission Provider (CVPS)

Hydro-Quebec to Sandy Pond

This is the interface for Phase II.

Table: TTC and TRM for Hydro-Quebec to Sandy Pond Interface

Direction	Quantity	Value	Comments
HQ to Sandy Pond	TTC	Up to 2000 MW	TTC based on the Phase II mode of operation (isolated or synchronous) and on transfer limitations in NEPOOL, PJM, or NYPP
	TRM		As posted by the individual Transmission Provider
Sandy Pond to HQ	TTC	Up to 1200 MW	TTCs are based on the ability of the Hydro-Quebec system to sustain a source contingency
	TRM		As posted by the individual Transmission Provider

NOTE: Phase I & II cannot operate simultaneously. Normal operation is over the Phase II facility..

Hydro-Quebec to Comerford

This is the interface for Phase I.

Table: TTC and TRM for Hydro-Quebec to Comerford Interface

Direction	Quantity	Value	Comments
HQ to Comerford	TTC	Up to 690 MW Typically zero if Phase II is in service	Based on the equipment rating of 690 MW for import to New England
	TRM		As posted by the individual Transmission Provider
Comerford to HQ	TTC	Typically zero	For emergency exports to HQ
	TRM		As posted by the individual Transmission Provider

Determination and Posting of TTC & ATC

Location of Postings

TTC and ATC values for all NEPOOL PTF interfaces are posted on the NEPOOL OASIS node. The values are accessed through the OASIS site of the Transmission Provider as identified in the table, "NEPOOL Interfaces and Transmission Providers". Some interfaces are posted by more than one Transmission Provider.

Updates to TTC and ATC

TTC and TRM values are calculated and posted for each of the following time frames:

- Hourly
- Daily
- Weekly
- Monthly
- Yearly

Base TTC values for the longer term postings are determined using an "all lines in" normal system configuration. Closer to real time, changes to the normal configuration as a result of scheduled maintenance or unscheduled outages are known and can result in more or less restrictive transfer limitations.

Short term analysis may be performed to assess the effects of outages and other changes on base TTCs. Adjustments to the base TTC values are made to nearer term values as appropriate to reflect the changes in limitations.

Updates to TTC

The ISO evaluates all TTC values, with the exception of yearly values, for each interface a minimum of once per business day and whenever changes in system conditions warrant. For interfaces posted by providers other than the NEPOOL RTG, the ISO provides the forecast TTC for interfaces to the transmission providers within New England, as indicated in the table entitled "NEPOOL Interfaces and Transmission Providers" on page 5 of this document.

Updates to ATC

The ISO calculates and updates ATC for service with the NEPOOL RTG several times each day for the next day and the time frame beyond, and as needed due to unforeseen changes in system conditions.

The ISO has a back-end application that dynamically recalculates the ATC and updates the OASIS posting as each transmission reservation request with the NEPOOL RTG is confirmed.

ATC for the interfaces posted by other transmission providers is calculated and updated by those transmission providers.

Posted TTC and ATC values

Hourly TTCs & ATCs:

Twenty-four (24) hourly TTC and Non-Firm Hourly ATC values are provided for the current day, plus the next 11 days, for each interface.

Adjustments made to the base TTC values for posted interfaces can be seen in hour-by-hour detail.

Daily TTCs & ATCs:

TTC, Firm ATC, and Non-Firm ATC values for the current day plus the next 34 days are summarized for all interfaces

The TTC values for the first 12 days in this group are adjusted for hourly maintenance and details can be viewed in the Hourly TTC section. Days 13 through 35 use historical data base TTC values.

Weekly TTCs & ATCs:

TTC, Firm ATC, and Non-firm ATC values are shown for the current week plus the next 12 weeks for each interface.

A week always starts at 0001 on a Monday and ends hour ending 24 on the following Sunday. The TTC value shown is the minimum value within the defined 7-day week.

Note that the TTC values for the first 5 weeks (made up of the current week plus the next 4 weeks) will reflect adjustments made for known hourly or daily maintenance. The remaining weeks (6 through 13) use TTC values from the historical data base except if maintenance is scheduled that would effect any of those weeks in their entirety.

Monthly TTCs & ATCs:

The monthly TTC and ATC values cover the current month and the next 12 months for a total of 13 calendar months. Each interface has minimum TTC values posted which are based on the historical database.

If maintenance is scheduled for an entire month the Monthly TTCs will reflect it here.

Yearly TTCs &
ATCs:

Values for the Yearly TTC reflect 2 years beyond the current year. TTC values for each interface are not posted on a seasonal basis, but rather indicate the minimal value between Summer and Winter analysis.

Reference documents/resources

Further information about TTC/ATC and the criteria governing ATC/TTC within NEPOOL is available from the following documents:



- NERC Policy 3, Interchange. Section E: Transfer Capability
- *Available Transfer Capability Definitions and Determination*. NERC, June, 1996
- *Revised NPCC Methodology and Procedure for the Determination and Posting of Available Transfer Capability*. NPCC, 1998
- *NEPOOL Open Access Transmission Tariff. Attachment C*.
- *NEPOOL Operating Procedure 19 (OP19) Transmission Operations*