

Appendix 40

System Stability and Reliability ISO-NE Approval



Stephen J. Rourke
Vice President, System Planning

January 9, 2014

Mr. Dennis Carberry
Northeast Utilities Service Company
107 Selden Street
Berlin, CT 06037-5000

Subject: Revision 1 – Northern Pass Transmission Project Proposed Plan Applications (PPAs)
NU-13-T20, NU-13-T21, NU-13-T22, NU-13-T23, NU-13-T24, NU-13-T25, NU-13-T26,
NU-13-X03

Dear Mr. Carberry:

This letter is to inform you that pursuant to review under Section I.3.9 of the ISO Tariff, no significant adverse effect has been identified with regard to the following PPAs, subject to the requirements described below:

NU-13-T20 - Transmission notification from Northeast Utilities Service Company (NU) on behalf of Northern Pass Transmission LLC (NPT) for the construction of a 345 kV air-insulated substation with an eight circuit breaker ring bus in Franklin, NH, a 1,200 MW nominal, bi-directional, bi-polar, HVDC line commutated converter station, and a 0/100 Mvar Static Var Compensator (SVC). The 345 kV Franklin Substation will interconnect to Public Service of New Hampshire's 345 kV Deerfield substation (POI), located in Deerfield, NH, via a 345 kV AC overhead transmission line and to the Des Canton Substation in Quebec, Canada, via an HVDC link. The HVDC link will be a 1,200 MW nominal, bi-directional HVDC line operating at ± 300 kV. The Franklin terminal will have two 600 MW, 12-pulse line commutated converters with the following reactive compensation: 400 Mvar (2x100 Mvar per pole) of harmonic filters; 350 Mvar (175 Mvar per pole) of thyristor switched capacitors (1x25 Mvar TSC branch, 1x50 Mvar TSC branch, and 1x100 Mvar TSC branch); 120 Mvar (2x60 Mvar) of mechanically switched reactors (MSR).

NU-13-T21 - Transmission notification from NU on behalf of NPT for the construction of a 153 mile HVDC transmission line, which includes 8 miles of underground cable, from the Franklin Converter Terminal Substation located in Franklin, NH to the US/Canadian border. The distance from the US/Canadian border in Quebec to the Des Canton Substation, which is where the HVDC line will terminate, is approximately 47 miles. The proposed HVDC transmission line is a bipolar, ± 300 kV, constructed of 2x2933 AAAC conductors per pole. A dedicated metallic return circuit will be of a single 2933 AAAC conductor. The underground portion of the HVDC line will be constructed of 2000 mm² copper conductor.

NU-13-T22 - Transmission notification from NU on behalf of NPT for the construction of a new 345 kV AC transmission line, 3132, from the Franklin Converter Terminal Substation to

the Deerfield 345 kV Substation. To accommodate termination of line 3132 at Deerfield, and to prevent transmission line crossings, the existing 345 kV Line 373 (Deerfield Substation to Scobie Pond Substation) will be re-positioned at the 345 kV Deerfield Substation to its own new bay position. Line 3132 will be constructed with two 1590 ACSR, 45/7 stranding, conductors per phase having 18-inch conductor spacers. The transmission towers will be a combination of H-frame, delta, and vertical structures.

NU-13-T23 - Transmission notification from NU on behalf of NPT for the modification of the 345 kV Deerfield Substation. The Deerfield 345 kV Substation will be reconfigured to accommodate the new NPT Project AC transmission line 3132 interconnection, the re-termination of the 345 kV Buxton to Scobie Pond transmission line 391, the addition of shunt capacitor banks, and the addition of one 0/+400 Mvar SVC. Four 345 kV shunt capacitor banks, 50 Mvar each, will each be installed with its own new 345 kV circuit breaker and will connect to the 345 kV bus via one new 345 kV, 50 kA circuit breaker. The existing Deerfield 345 kV series circuit breakers, (7310 & 7310S, and 851 & 851S), will remain in place. To accommodate termination of the new 345 kV Franklin to Deerfield line, and to prevent transmission line crossings, the existing 373 line (Deerfield Substation to Scobie Pond Substation) will be re-positioned to its own new bay position. The new transmission line 3132 will terminate at the vacated 373 line position. The existing bus protection scheme will be retained and reconfigured to accommodate the new line terminations. The existing 345 kV AC transmission line 391 that currently connects Buxton Substation to Scobie Pond Substation will be looped into and terminated at the 345 kV Deerfield Substation. The new 391S line will terminate between existing double circuit breakers 7332 and 3220. The 391N line will terminate in its own new bay position with two new 345 kV, 50 kA circuit breakers. A 0/+400 Mvar SVC, consisting of one 400 Mvar MSC branch and one 400 Mvar TCR branch, will be installed in the newly created bay position. The SVC output will be maintained near zero output by having control of the four 345 kV shunt capacitor banks in timeframes consistent with the analysis presented in the NPT report.

NU-13-T24 - Transmission notification from NU on behalf of NPT for the installation of a 210 Mvar of 345 kV capacitor banks at the 345 kV Scobie Pond Substation. The capacitor banks will be connected to 345 kV Scobie Pond Bus #2 via five 345 kV, 50 kA circuit breakers. The capacitor banks will be divided into four separate banks, three 60 Mvar banks and one 30 Mvar bank with each bank having its own dedicated circuit breaker and will connect to the 345 kV bus via one new circuit breaker. The capacitor banks will be equipped with voltage protection. In addition to the capacitor banks, two 345 kV, 50 kA circuit breakers will be installed. One circuit breaker is to be installed in series with the existing 9126 circuit breaker, and the other circuit breaker installed in series with the 262 circuit breaker.

NU-13-T25 - Transmission notification from NU on behalf of NPT for the termination of the 345 kV AC transmission line 391, 345 kV Buxton Substation to 345 kV Scobie Pond Substation at the 345 kV Deerfield Substation. Terminating line 391 at the 345 kV Deerfield Substation creates two separate transmission line circuits; line 391N from 345 kV Buxton Substation to 345 kV Deerfield Substation, and line 391S from 345 kV Deerfield Substation to 345 kV Scobie Pond Substation. The 391N line will terminate in its own new bay position at the 345 kV Deerfield Substation. The 391S line will terminate between the existing series circuit breakers 7332 and 3220. New primary and backup transmission line protection schemes will be installed for line 391N and line 391S. In addition to terminating transmission line 391 at the 345 kV Deerfield Substation, the Project requires that the new 391S line section be upgraded to a minimum Long Time Emergency (LTE) thermal rating of 1470 MVA. To achieve this thermal rating, conductor sag limitations will be removed and the line's

connecting hardware will be replaced so that the line can be operated to 140 degrees C. The proposed 345 kV transmission line 391N, 345 kV Buxton Substation to 345 kV Deerfield Substation, will be approximately 50 miles long, (Buxton to ME/NH border ~31 miles, ME/NH border to Deerfield ~19 miles). The proposed 345 kV transmission line 391S, 345 kV Deerfield Substation to 345 kV Scobie Pond Substation will be approximately 19 miles long.

NU-13-T26 - Transmission notification from NU on behalf of NPT for the 345 kV AC transmission line 373, 345 kV Deerfield Substation to 345 kV Scobie Pond Substation, to be thermally up-rated to a minimum LTE thermal rating of 1435 MVA. To achieve this thermal rating, conductor sag limitations will be removed and the line's connecting hardware will be replaced so that the line can be operated to 140 degrees C.

NU-13-X03 - Transmission notification from NU on behalf of NPT to increase the 326 Line SPS summer thermal mode setpoint to 1515 MVA. The 326 Line SPS is the NPCC #26 Type 1 SPS. The 326 line summer thermal rating, N/LTE/STE, will be 1358/1515/1515 MVA. The NPT Project SIS determined that the NU portion of the 345 kV AC transmission line 326, 345 kV Scobie Pond Substation to the PSNH/NEP border, will be thermally upgraded to a minimum summer LTE thermal rating of 1515 MVA. To achieve this thermal rating, conductor sag limitations would be removed and the conductor's connecting hardware would be replaced, from the 345 kV Scobie Pond Substation through to the New Hampshire (PSNH)/Massachusetts (NEP) border, so that the line can be operated to 140 degrees C. The 326 Line SPS would require a thermal mode setpoint change from 1430 MVA to 1515 MVA. The 326 transmission line has been upgraded as part of the New Hampshire/Vermont 10-Year Study Plan while the NPT study was nearing completion. The present 326 transmission line summer thermal rating (N/LTE/STE) is 1358/1429/1429 MVA. The 326 line's summer thermal LTE rating is limited by the 326 Line SPS thermal mode set point of 1429 MVA. The present 326 transmission line conductor summer thermal rating, N/LTE/STE, is 1358/1747/1906 MVA.

The in-service date of the Project is June 2017.

The Reliability Committee (RC) reviewed the materials presented in support of the proposed project on December 19, 2013. After significant discussion on the topic, the proposed motion to find that the Project did not have a significant adverse effect on the reliability or operating characteristics of the transmission facilities of NU, the transmission facilities of another Transmission Owner or the system of any other Market Participant in accordance with Section I.3.9, as amended at the meeting, did not pass nor did an additional modified motion proposed by Nextera Energy Resources.

Having given due consideration to the RC review and discussion, ISO New England has determined that implementation of the plan will not have a significant adverse effect upon the reliability or operating characteristics of the Transmission Owner's transmission facilities, the transmission facilities of another Transmission Owner, or the system of a Market Participant once the following requirements are met:

1. The Northern Pass Transmission Project be limited to no more than 1,200 MW of imports into the United States from Québec as measured at the point of interconnection at Deerfield Substation in New Hampshire, as studied and described in the report titled "The Northern Pass Transmission Project Proposed Plan Application Analysis," performed by RLC Engineering dated December 2013 (NPT PPA Analysis) and subject to the system upgrades via the PPAs NU-13-T20 through

NU-13-T26 and NU-13-X03. The Project is prohibited from exporting power from New England to Quebec as this condition was not considered in the NPT PPA Analysis.

2. In that the Project System Impact Study (SIS) included Sub-Synchronous Torsional Interaction (SSTI) screening analyses in accordance with the Electric Power Research Institute (EPRI) guidelines, and those screening analyses illustrated a risk of potential interaction with a number of generators, as indicated in the NPT PPA Analysis, NPT will complete a comprehensive SSTI and control interaction analysis in coordination with the Franklin HVDC converter, Franklin SVC and Deerfield SVC manufacturer(s). NPT will specify and install all detailed control systems for the Project to perform under the conditions considered in the NPT PPA Analysis, including those required to mitigate SSTI for existing generators and reduce the risk of SSTI with future generators, and provide for backup protection systems, to ensure compliance with the applicable industry standards and good utility practice, and be deemed as acceptable to ISO New England, in consultation with the RC and affected generators, prior to the commercial operation of the Project, provided that the Project HVDC terminal will not trip or unacceptably reduce output in addition to the loss of another resource, including imports on other transmission facilities.
3. ISO New England will initiate and complete SIS's as required for any Interconnection Request under Schedules 22 or 23 of the Tariff without consideration of the detailed control systems and SSTI mitigation of the Project described in Item #2 until NPT provides working models of those controls and SSTI mitigation to ISO New England that are deemed as acceptable to ISO New England. The Project SSTI mitigation and control design specified in the above Item # 2 must consider any valid Interconnection Request under Schedules 22 or 23 of the Tariff having its SIS initiated or any plan for a modification to the system that has at least substantially completed analysis required under Section I.3.9 of the Tariff for the Project to demonstrate compliance with Section I.3.9 of the Tariff. NPT will be responsible for the necessary upgrades identified by the ISO to mitigate the unacceptable interactions between existing and new Interconnection Requests and the Project until such time as it presents the approved working models described in this Item #3.
4. NPT will update the PPA studies for the Project, as determined by ISO New England, if any of the models and assumptions for the Project used in that analysis change for any reason, including those resulting from completion of the detailed design of the controls of the HVDC terminal or the SVC's comprising the Project. Any such update will consider: (1) any relevant Interconnection Request under Schedules 22 or 23 of the Tariff that has an initiated SIS; (2) any plan for a modification to the system that has at least substantially completed analysis required under Section I.3.9 of the Tariff or has been supported by ISO New England to meet identified system needs.
5. NPT will require the HVDC converter manufacturer to use best efforts to employ a design that can recover from commutation failure and converter blocking in as close to 8 cycles (or less) as possible.
6. NPT will require Hydro Québec TransÉnergie to mitigate the risk of a single event that causes the loss of both the NPT HVDC and the Hydro Québec Phase II HVDC at

the transmission line crossing south of the HQ Nicolet Substation in Québec by a method found to be acceptable by ISO New England. This can be accomplished by undergrounding the NPT HVDC at the crossing or another method found to be suitable.

7. The NPT project's Franklin terminal HVDC control scheme will be considered a Type 1 Control system in accordance with NPCC C-33.
8. The Project's HVDC facilities shall be designed such that it can withstand and continue operation through multiple commutation failures and/or blocking events consistent with the performance demonstrated in the dynamics testing of Extreme Contingencies.
9. NPT will perform a voltage coordination analysis to determine the switching of the Deerfield capacitors by the Deerfield SVC that is necessary in order to maintain adequate reactive reserve margin on the SVC.

A determination under Section I.3.9 of the ISO Tariff is limited to a review of the reliability impacts of a proposed project as submitted by Participants and does not constitute an approval of a proposed project under any other provisions of the ISO Tariff.

Sincerely,



Stephen J. Rourke
Vice President, System Planning

cc: Proposed Plan Applications

**APPENDIX 1
INTERCONNECTION REQUEST
FOR ELECTIVE TRANSMISSION UPGRADE**

The undersigned Interconnection Customer submits this request to interconnect its Elective Transmission Upgrade (“ETU”) to the Administered Transmission System under Schedule 25 – Elective Transmission Upgrade Interconnection Procedures (“ETU IP”) of Section II to the ISO New England Inc. Transmission, Markets and Services Tariff (the “Tariff”). Capitalized terms have the meanings specified in the Tariff.

PROJECT INFORMATION

Proposed Project Name: Northern Pass Transmission Project (Q499)

1) Description of the ETU objective (select one of a, b, c, d, or e):

a. Addition of a specific technology:

i) Type of new facility (check all applicable):

DC AC controllable non-controllable Other (Explain):

ii) Address(es) or Location(s) of the ETU (including Town/City, County & State or a map detailing such information):

Route Map included in Application submittal

iii) Location(s) of the proposed Point(s) of Interconnection and associated terminals:

The Northern Pass Transmission (NPT) Project includes a new HVDC interconnection from the Province of Québec to south-central New Hampshire. The NPT Project will provide a new international interconnection for New England and allow for the import of significant amounts of economically priced, low carbon energy that will help the region in meeting its environmental requirements for CO2 reductions. This new Project is designed to deliver 1090 MW of power at an

operating voltage of ± 320 kV DC. It is expected to be completed in 2018, assuming timely review of state and federal permitting applications. The Canadian segment of the DC line will connect to the 230-kV system in Québec at the Des Cantons Substation where the northern HVDC converter terminal will be located. The HVDC line will run southward in Québec for approximately 47 miles where it will cross the Canada / US border into New Hampshire. The New Hampshire segment of the DC line will continue southward for approximately 153 miles to the southern HVDC converter terminal in the City of Franklin, New Hampshire. The HVDC converters are expected to use voltage source converter HVDC technology and the line will be a symmetrical monopole design and use overhead and underground construction. The HVDC segment of the Project is expected to locate facilities within Coos, Grafton, Belknap and Merrimack counties in New Hampshire. This segment of the Project is expected to use existing Eversource rights-of-way (ROW), acquired ROW and public roads.

NPT will also require certain 345-kV AC facilities to be added to the New England bulk power transmission grid in order to connect the new HVDC terminal to the 345-kV bulk power transmission grid. These will include a new, 34 mile radial 345-kV circuit from the HVDC converter terminal in Franklin, NH to the existing PSNH Deerfield Substation in Deerfield, NH. This segment of the Project will locate facilities in Merrimack and Rockingham counties in New Hampshire. The AC facilities will also use overhead construction and include any necessary substation and terminal additions at Deerfield and Franklin substations as well as any additional system upgrades that may be required as a result of the ISO-NE technical project review process.

This interconnection request is for injection for power into New England from Quebec.

iv) Transmission transfer capability, including:

- (1) Energy transfer capability and direction(s) of flow**
- (2) Capacity transfer capability and direction(s) of flow**
- (3) Other:**

1090 MW delivered at Deerfield substation. The direction of flow is from Quebec to New England.

v) Indicate whether the study should consider:

- (1) Both directions of flow**

(2) One direction of flow only

(3) Explain:

The study is for imports into New England only

b. ___ Modification to existing PTF, MTF or OTF that is part of or interconnected to the Administered Transmission System. Explain.

c. ___ Specific performance objective associated with specific Generating Facility(ies)/resources:

i) Identify Generating Facility(ies)/resources, including Queue Positions:

ii) Identify the specific performance goals/objectives of the ETU (e.g., energy integration):

d. ___ Increase in transfer capability between points, including:

i) Transfer points (from/to)

ii) Energy transfer capability increase and direction(s) of flow

iii) Capacity transfer capability increase and direction(s) of flow

iv) Other

e. Other specific and clearly described discrete objective:

2) Projected Dates:

a. Commercial Operation: 04/2019 _____

b. Trial Operation: 03/2019 _____

c. In-Service: 02/2019 _____

3) This request is for (check either Internal ETU or External ETU options):

a. An Internal ETU (check one of i or ii):

i) The interconnection of proposed new (check one):

(1) PTF;

(2) OTF or MTF.

ii) A modification to, an increase in the transmission capability of, or other specific proposed objective associated with (check one):

(1) existing internal PTF;

(2) existing internal MTF or OTF that is interconnected to the Administered Transmission System.

b. An External ETU (check i or ii or iii and specify the other Control Area interconnecting to Quebec _____)

- i) The interconnection of proposed new (*check one*):
- (1) PTF;
 - (2) OTF or MTF.
- ii) A modification to, an increase in the transmission capability of, or other specific proposed objective associated with (*check one*):
- (1) existing external PTF
 - (2) existing external MTF or OTF.
- iii) A change from NI Interconnection Service to CNI Interconnection Service for a controllable MTF or OTF (no physical change to facilities).
- 4) For External controllable OTF or MTF in the importing direction, applicant requests (*check one*):
- a. NI Interconnection Service (i.e., energy only): _____ MW
 - b. CNI Interconnection Service (i.e., capacity and energy): 1090 MW
- i) If CNI Interconnection Service, does the Interconnection Customer request Long Lead Facility treatment? Yes or No
- If yes, provide to ISO-NE, together with this Interconnection Request, the Long Lead Facility deposit and other required information as specified in Section 3.2.3 of the ETU IP, including a justification for Long Lead Facility treatment.
- 5) Evidence of Site Control (*check one*):
- a. If for CNI Interconnection Service, Site Control is included with this Interconnection Request form, as required.
 - b. If for NI Interconnection Service (*check one*):
- i) Site Control is provided with this Interconnection Request form.

ii) In lieu of evidence of Site Control, a \$10,000 deposit is provided with this Interconnection Request form (refundable within the cure period as described in Section 3.3.3 of the ETU IP).

iii) Site Control is not provided because the proposed modification is either: a) to existing MTF, OTF or PTF and by checking this option, the Interconnection Customer certifies that the proposed modification does not require additional real property, or b) to PTF and the Interconnection Customer does not own such PTF.

6) This Interconnection Customer requests (*check one*):

a. A Feasibility Study to be completed as a separate and distinct study, or

b. A System Impact Study with the Feasibility Study to be performed as the first step of the study.

c. If seeking CNI Interconnection Service, does the Interconnection Customer request a preliminary non-binding, analysis to identify potential upgrades that may be necessary to qualify resources for participation in a Forward Capacity Auction? Yes or No

Note: The above selection of a or b is not required as part of the initial Interconnection Request; however, the Interconnection Customer shall select either option and may revise this selection up to within five (5) Business Days following the Scoping Meeting.

7) The ETU technical data specified within the applicable attachment to this form (*check one*):

a. Is included with the submittal of this Interconnection Request.


b. Will be provided on or before the execution and return of the Feasibility Study Agreement (Attachment B) or the System Impact Study Agreement (Attachment A), as applicable.

CUSTOMER INFORMATION

	<u>Interconnection Customer</u>	<u>Customer Representative</u>
Company Name:	Northern Pass Transmission LLC	Same
Address: (PO Box)	PO Box 270	
(Street)		
(City, State, ZIP)	Hartford, CT 06141-0270	
Phone:	860-728-4551	
FAX:		
Email:	james.muntz@eversource.com	

ISO Customer ID# (if available): _____

This Interconnection Request is submitted by:

Authorized Signature:  Date: 5/29/15
 Name (type or print): James A. Muntz
 Title: President – Northern Pass Transmission LLC
 Company: Northern Pass Transmission LLC

In order for an Interconnection Request to be considered a valid request, it must:

(a) *Be accompanied by a deposit of \$50,000.00, which may be refundable in accordance with Section 3.3.1 of the ETU IP;*

(b) *For CNI Interconnection Service, include documentation demonstrating Site Control. If for NI Interconnection Service, demonstrate Site Control or post an additional deposit of \$10,000. If the Interconnection Customer with an Interconnection Request for NI Interconnection Service demonstrates Site Control within the cure period specified in Section 3.3.3 of the ETU IP, the additional deposit of \$10,000 shall be refundable (An Interconnection Customer does not need to demonstrate Site Control for an Interconnection Request for a modification to its existing PTF, MTF or OTF facility where the Interconnection Customer has certified that it has Site Control and that the proposed modification does not require additional real property);*

- (c) Include a detailed map (2 copies), such as a map of the quality produced by the U.S. Geological Survey, which clearly indicates the site of the new facility and pertinent surrounding structures;*
- (d) Include a one-line diagram of the facilities (2 copies);*
- (e) Include all information required on the Interconnection Request form; and*
- (f) Include the deposit and all information required for Long Lead Facility treatment, if such treatment is requested in accordance with Section 3.2.3 of the ETU IP.*

In addition, within sixty (60) days of submitting an Interconnection Request to the System Operator, the Interconnection Customer with a request for an External ETU, shall provide evidence that it has submitted a valid request with the other Control Area to which it seeks to interconnect.

All Interconnection Requests must be sent to the System Operator by any of the following methods:

By Mail to:

ISO New England Inc.

1 Sullivan Road

Holyoke MA 01040-2841

Attention: Transmission Strategy & Services

By FAX to:

413 540-4203

Attention: Transmission Strategy & Services

By Email to:

IRTT@iso-ne.com

ISO New England Inc. Use

Date Elective Transmission Upgrade Request Received: _____

Received By: _____

Deficient

Date Cured: _____

Date Deemed Valid Application: _____

Deemed Valid By: _____