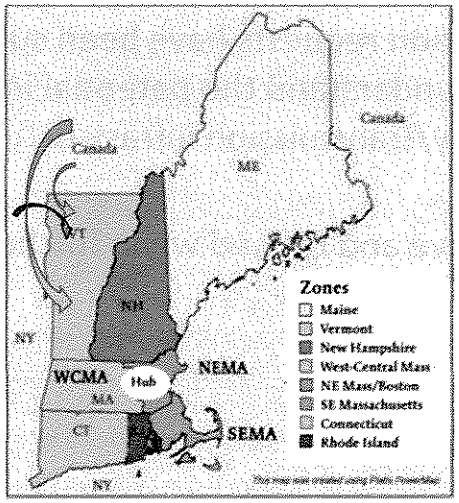
VT Imports & Transmission System Review

Draft Alternative & ROW Evaluation Methodology

January 2014



Prepared for:
Vermont Public Service Department

VT Imports & Transmission System Review

Alternative Evaluation Proposed Methodology

VELCO is working with our customers, regulators, ISO-NE and other stakeholders to better understand our options and opportunities with a focus on how best to maximize a project's value to Vermont. This draft tool / review methodology is intended to help with that understanding.

Proposed Methodology:

- This information was developed with the intent to evaluate the different VT power import alternatives and their impact to Vermont's Transmission Network and Vermont stakeholders
- Similar projects have been built more than 20 years ago (for example Highgate Converter and Phase I/II HVDC Link)
- Multiple independent interconnection requests have been submitted; the proposed methodology will also help better understand the potential impact to Vermont, VELCO, the Distribution Utilities and the energy/transmission infrastructure from the proposed Merchant Projects
- The review will initially be qualitative and refined when further analysis and evaluation is warranted.

Draft Transmission Project Evaluation Criteria

Transmission Network and ROW Impact Criteria

Transmission System Impact Criteria:

Evaluate the project's overall impact on local and regional system performance:

Criteria	Definition	Examples
Bulk System Reliability	Evaluate the benefits brought to the system to address N-1 and N-1-1 regional system contingencies	As outage contingencies are run on the system, thermal and voltage performance are impacted. The regional benefits can be assessed by looking at voltage performance and thermal limits reviews
Local Reliability	Review the benefits to the sub transmission system and local load need from each alternative	Review how the project provide future load growth support as well as system transfer capabilities
Operability	Review operational limitation created and/or removed by the alternatives	Review Impact on System Operation of Interface Limits (local generation zone, etc...)
Project Funding Mechanism	Review the complexity of the project funding mechanism and associated risk as well as the beneficiary pay criteria.	The local and regional transmission tariff provide different cost recovery mechanisms (i.e Participant Funded vs Pool Transmission Facilities and Socialized regional costs). As transmission projects provide a variety of benefits to the network it is important to review cost recovery alternatives
Other Region Benefits/Impact	Identify and rate additional benefit	An example would be evaluating relative impact on system losses

Project Execution / Permitting Criteria:

Evaluate the Project execution and permitting challenge:

Criteria	Definition	Examples
Capital Investment	Review estimated Capital Cost associated with each of the alternatives	Issue Conceptual Estimates for each major components
Ancillary System Upgrade	Review estimated Capital Cost associated with anticipated ancillary transmission system upgrades	Issue Conceptual Estimates for the anticipated ancillary transmission system upgrades
Constructability	Review the ability to use existing utility corridor to site the project	Evaluate existing right of way corridors and potential substation sites enabling ability to site the project
Aesthetic Impact	Review the potential aesthetic impact based on preliminary project configuration	Qualitative review/assessment of potential impact on Aesthetic
Environmental Impact	Review environmental implications with the preliminary project routing	Qualitative review/assessment of potential impact on Environmental and Historical Resources
Right of Way Impact	Review right of way and easement implications based on preliminary routing	Qualitative review/assessment Right of Way Requirement / Impact on existing infrastructure corridor
Noise, Public Health and Safety	Review Noise potential impact	Qualitative review/assessment of Noise, Public Health and Safety
Economic Benefit to the State	Assess potential economic benefit to the state	Qualitative review/assessment only (i.e. relative tax payments to state and municipalities)

Draft Transmission Project Evaluation Criteria

Power Supply Review Criteria

Evaluate the Project Power Supply Local and Regional Impact:

Criteria	Definitions and Example	
Power Supply Impact	**A new intertie can provide economic benefit to particular entities or the Pool as a whole depending on how it is funded and/or how it is used. If it is participant funded the path will be reserved for use for the funding entities (but open when not used), with some or all the benefits accruing to them. If "Pool funded", the benefits normally accrue generally to all Pool members, although certain participants may get more direct benefits due to the system configuration**	The full value proposition is highly dependent on the energy source from which the power is generated. Individual load serving entity may see different benefits based on their current power supply portfolio state and strategy. Power supply aside, transmission alternative may be review based on their funding mechanism and original investment cost recovery process.
Regional Supply Diversity	**Evaluate to what extent would each path contribute to the diversity of New England's power supply.**	Potential perspectives include: primary fuel source, firmness of deliveries, % reliance on one supplier/market.
Capacity	**Review the approximate additional capacity value that each potential import path would provide to New England. The funding mechanism will determine where the economic value of that capacity flows (i.e., to the transmission rights holders of that path, or to the region via tie benefits). This is also tie to the power source imported thru the line (firm power vs. intermittent)**	The regional capacity value of each potential intertie could credibly differ (i.e., a MW of nominal TC may not translate to a MW of New England capacity value), depending on the size, location, and source of the intertie. Presumably, this would ultimately be developed via ISO-NE through ICR analysis.
Support Vermont Renewable Goals	**Review what renewable resources will/could each path likely deliver, which would contribute to meeting Vermont SPEED goals or a potential future Vermont RPS.**	Note that existing renewables (e.g., existing large hydro) could potentially contribute to Vermont's total renewable goals. This may trigger the need to develop a summary of these total renewable goals for Vermont, and what resources are eligible.
Support Regional RPS	**Assess each path's ability to deliver power that could meet RPS requirements in other NE states, at a competitive price.**	Need to have a clear understanding of the extent to which existing large hydro could potentially contribute to regional RPS compliance (e.g., Class 2 in some states? CT Class 1 "safety valve" provision?). Also, NESCOE and other stakeholders have noted the conceptual potential for "firming" of intermittent new renewables with other sources (e.g., large hydro, combined cycle). Such an arrangement would be supportive of regional/VT renewable goals. Review how some of these alternatives (e.g., from HydroQuebec, which has large storage hydro) offer firming capability advantages relative to others.
Support Regional Emission Goals	**Evaluate how some of these projects address emission goals and standards in place in New England.**	RGGI (Regional Greenhouse Gas Initiative) goals, Massachusetts GHG emission goals (distinct from RPS).
Economic Benefit (LMP - Energy Impacts)	**Review the alternatives' impact on LMP. New imports into NE could potentially lower VT power costs, by lowering LMPs (energy, loss and/or congestion components). The energy components would be driven by regional bid stack displacement, and would likely dissipate over time. Local and detail analysis would be complex and costely. The initial evaluation will remain at a high level only.**	Relative impacts on VT power costs will likely depend on each import's size, and its proximity to Vermont. Quantification of LMP impacts is complex; generally not possible without a detailed and costly regional LMP simulation model. A very simplified zonal analysis suggests that a new 400 MW MW path could benefit VT DU's power portfolio, and that the effects of a more remote delivery point (e.g., Maine) would be significantly less.
Economic Benefit (LMP - Congestion & Loss Impacts)	**Relative impact on congestion and system losses which would be more local, and likely more persistent. Injection of substantial additional energy into the various ways that imported energy reduces energy costs to VT's DU's and/or the region, due to reduced marginal losses or congestion. Note that reduced losses and/or congestion costs reduce payments for supply as well.**	Injections of energy at different points in the (VT) system will impact the calculation of marginal losses, and may reduce congestion.
Economic Benefit (PPA pricing)	**Below-market pricing (explicitly, like 95% of LMP, or implicitly based on negotiated prices/formula), would provide value for VT and other buyers.**	Conceptually, can VT seek/demand economic value via PPA terms (e.g., via below-market pricing, or similar) while hosting the enabling transmission project. Are there constraints around this (possible analogy from VY federal case)
Economic Benefit (FCM price impacts)	**Additional regional capacity supply >> downward pressure on regional FCM clearing price. To the extent that the import delivers to NWVT, then it would provide protection against VT zonal price separation.**	Key review includes how much is VT at risk, as presently configured, of becoming a "short" FCM zone. Review if an additional path into VT remove the risk of VT becoming a "short" zone - or simply be blended into a larger "N-1" source. Review how does MOPR apply to imports
Ancillary Products	**Evaluate whether, and to what extent, the addition of a new intertie and/or energy flowing over new intertie may reduce the cost (or increase the credit) of certain ancillary services**	Review if less VAR support would be needed if a new line and/or scheduled energy contract is placed for the evaluated alternatives. This may be covered by anscillary transmission system benefits.

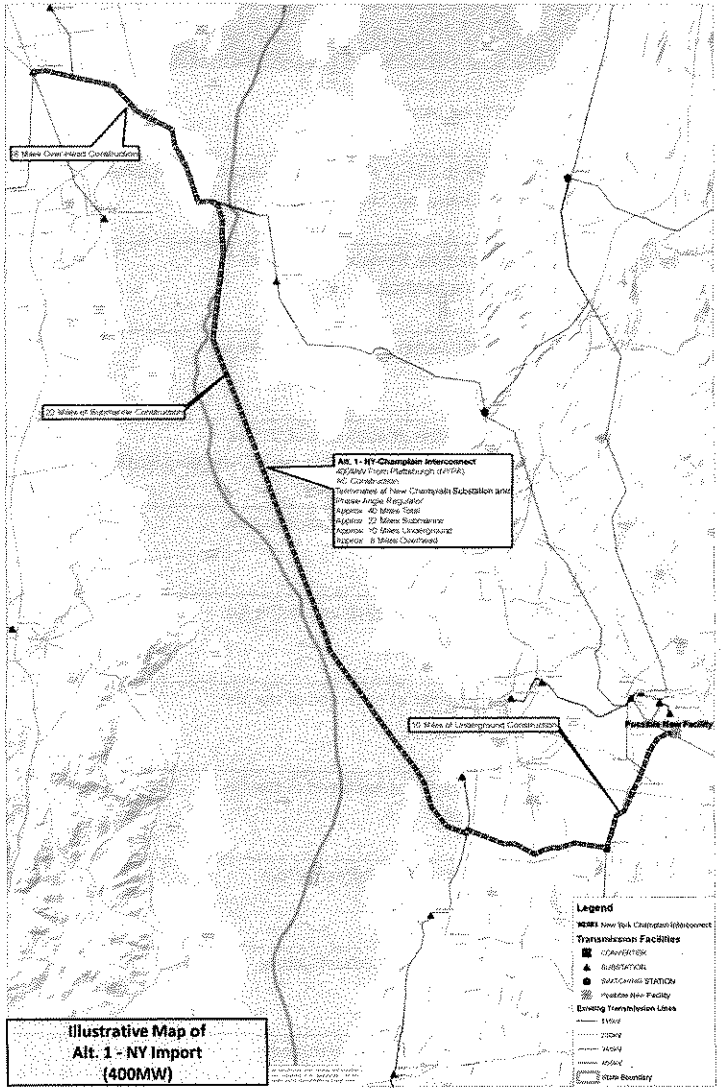
Transmission Project Configuration Alternatives

Transmission Development Alternative Configurations

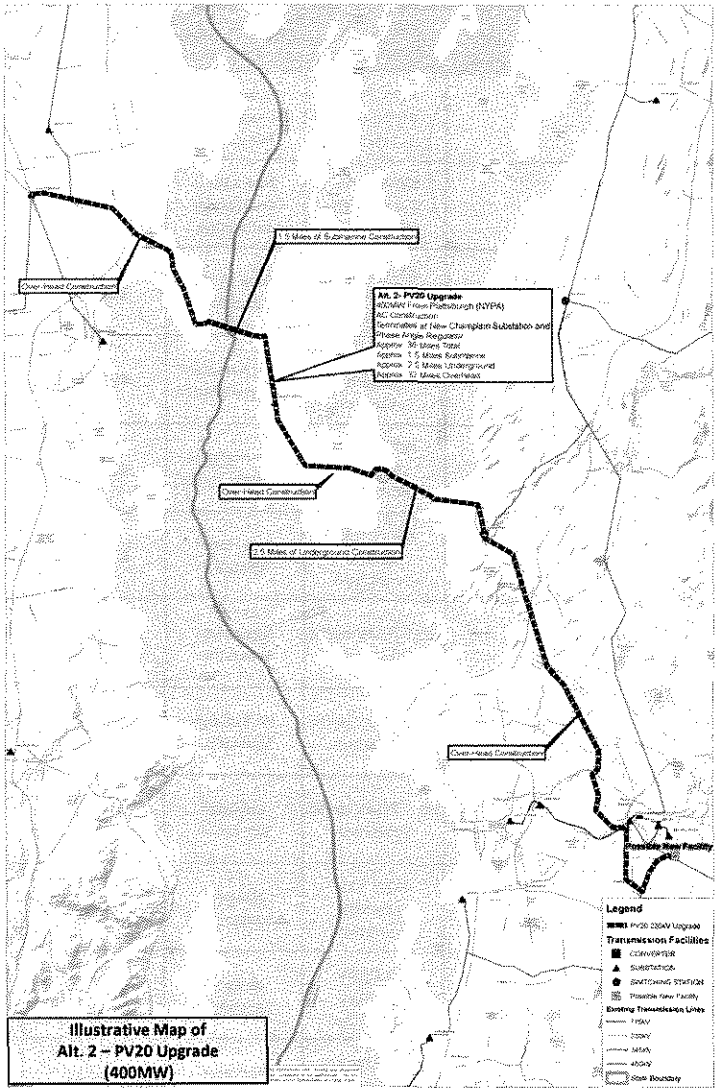
Alternatives	Concept Point of Origin	Concept Point of Delivery	Import (MW)	Tie Type	Scope Summary / Anticipated Ancillary Upgrades (TBD)
Alt 1. NY Import New 230kV AC Tie	NYPA 230kV Plattsburgh Substation	New 230kV Champlain Substation	400MW	Dedicated AC Tie	• Build a new 230/115 kV Champlain Substation • Pricing node may need to be modified in NY
Alt 2. NY Import PV20 Upgrade	NYPA 230kV Plattsburgh Substation	New 230kV Champlain Substation	400MW	Shared Tie	• Convert existing NY/NE tie to 230kV and increase capacity to 400 MW • Build a new 230/115 kV Champlain Substation
Alt 3. NY Import Modify Market	NYPA 115kV Plattsburgh Substation	Essex 115kV Substation	150MW	Shared Tie	• Leverage Existing Infrastructure. Review Line limitation • Review Interregional Pricing Method (NYISO/ISO-NE Interface)
Alt 4. HQ Northern VT HVDC Express Tie	HQ-T 115kV Bedford Substation	New Champlain Converter Station	400MW	Dedicated DC Tie	• DC Line with Rectifier and Inverter at each end of the tie • New Champlain Site (DC / AC)
Alt 5. HQ Northern VT HVDC Tie	HQ-T 115kV Bedford Substation	New Highgate Converter Station	400MW	Dedicated DC Tie	• DC Line with Rectifier & Inverter at each end of the tie • Reinforce AC System between Highgate and a new Champlain Station
Alt 6. HQ Western VT High Capacity HVDC Tie	HQ-T 115kV Bedford Substation	New Haven Substation	600MW	Dedicated DC Tie	• DC Line with Rectifier & Inverter at each end of the tie • AC Upgrades TBD
Alt 7. HQ-Northwest VT Extra High Capacity HVDC Tie	HQ-T 765kV Hertel Substation	New Haven Substation	1000MW	Dedicated DC Tie	• DC Line with Rectifier & Inverter at each end of the tie • AC Upgrades to be reviewed
Alt 8. HQ-Central VT Extra High Capacity HVDC Tie	HQ-T 765kV Hertel Substation	W. Rutland Substation	1000MW	Dedicated DC Tie	• DC Line with Rectifier & Inverter at each end of the tie • AC Upgrades to be reviewed
Alt 9. HQ-Central VT Extra High Capacity HVDC Tie	HQ-T 765kV Hertel Substation	Coolidge Substation	1000MW	Dedicated DC Tie	• DC Line with Rectifier & Inverter at each end of the tie • AC Upgrades to be reviewed
Alt 10. HQ Eastern VT Variable Frequency Transformer	HQ 115kV Stanstead Substation	Newport Substation	100MW	Shared Tie	• Leverage Existing Transmission Line Infrastructure • 115kV AC Upgrades
Alt 11. HQ Eastern VT Variable Frequency Transformer	HQ 230kV Stanstead Substation	Newport Substation	200MW	Shared Tie	• Leverage Existing Transmission Line Infrastructure • 115kV / 230kV AC Upgrades
Alt 12. HQ Eastern VT HVDC	HQ 230kV Stanstead Substation	Newport Substation	400MW	Shared Tie	• Leverage Existing Transmission Line Infrastructure • 115kV / 230kV AC Upgrades to Commerford

Transmission Project Configuration Alternatives

Configuration Location and Illustrative Routes



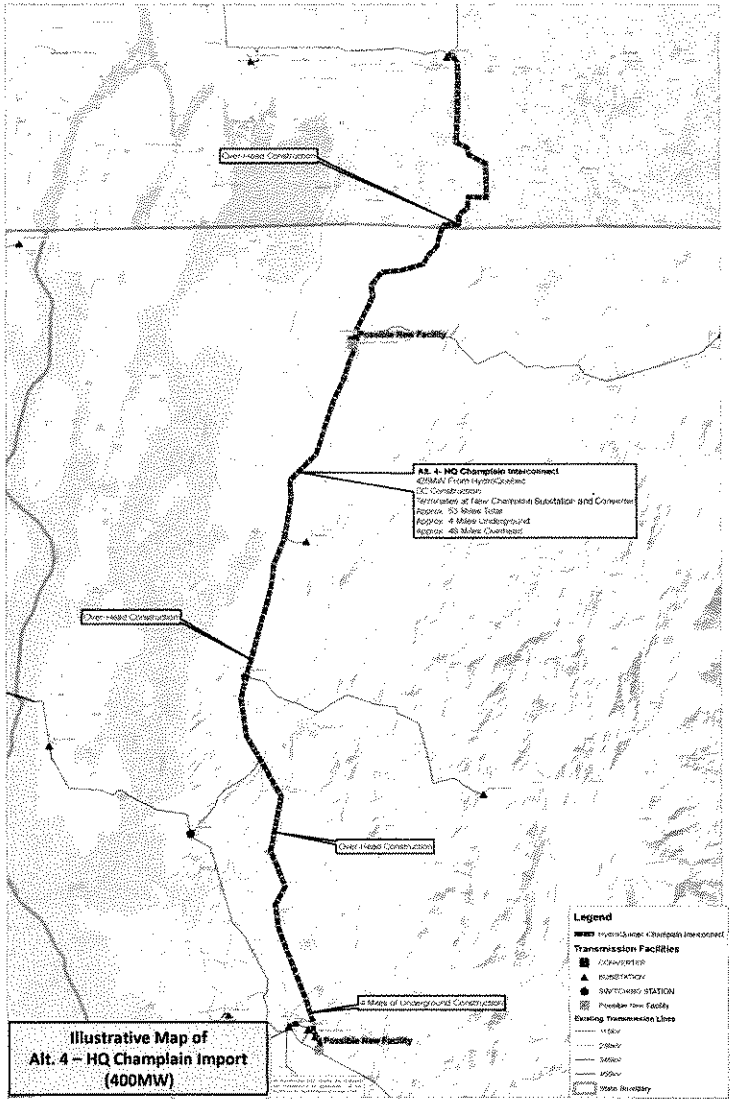
Illustrative Map of Alt. 1 - NY Import (400MW)

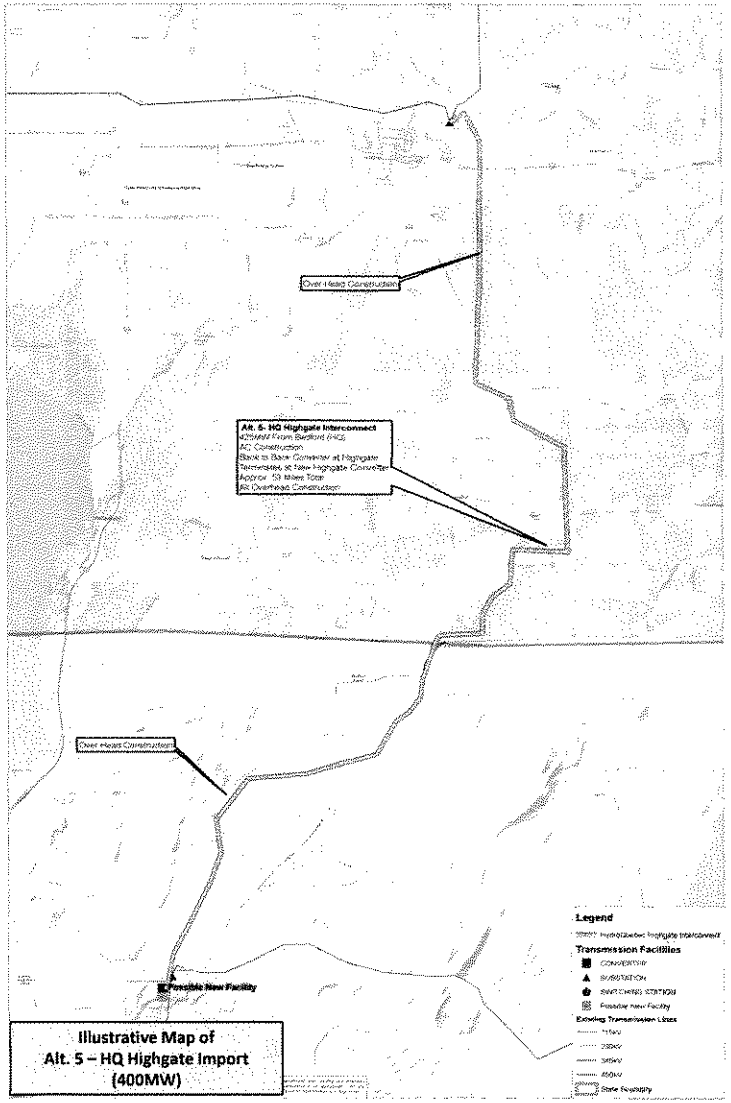


Illustrative Map of Alt. 2 – PV20 Upgrade (400MW)

Transmission Project Configuration Alternatives

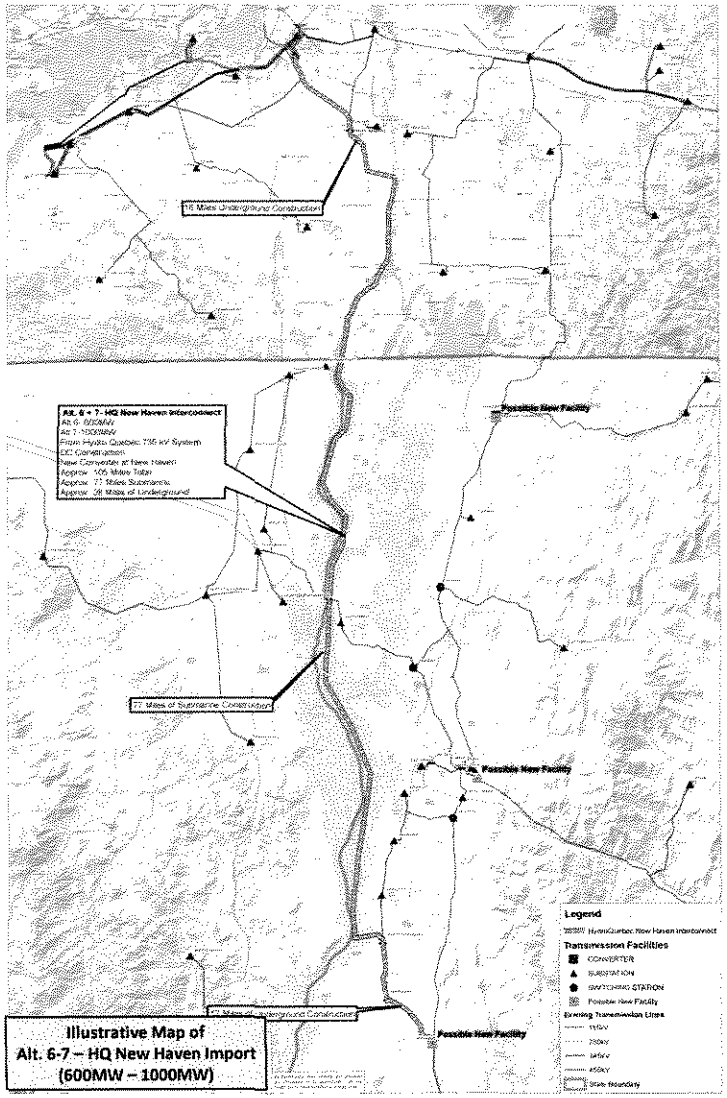
Configuration Location and Illustrative Routes (Excluding AC Reinforcements TBD)



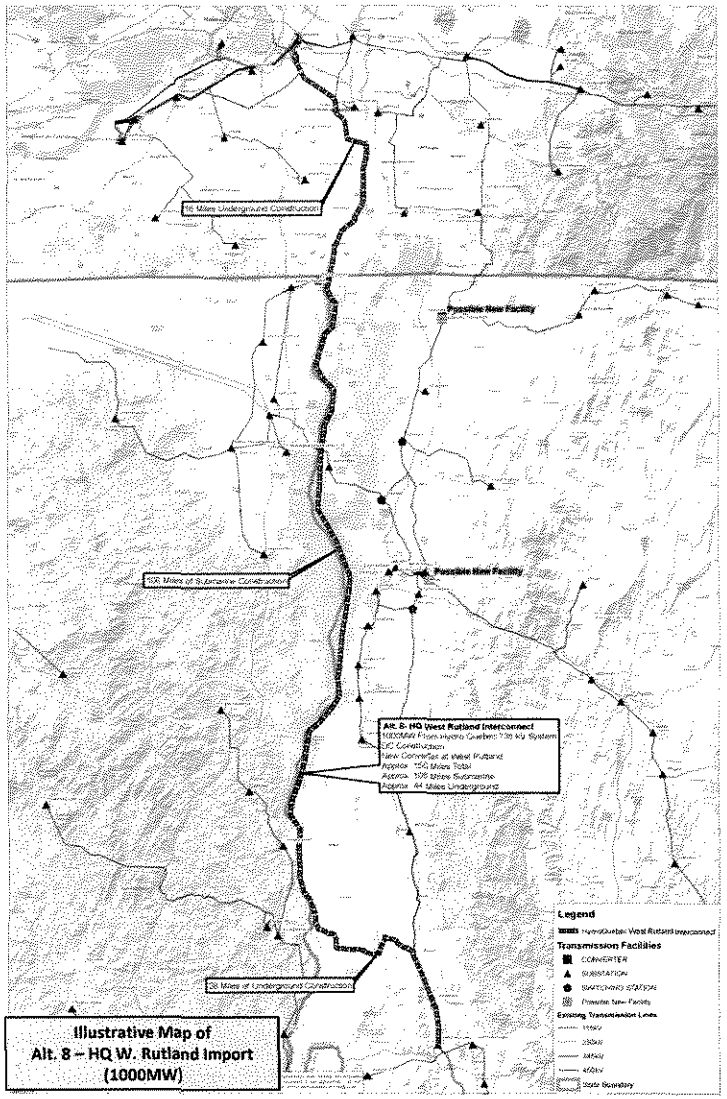


Transmission Project Configuration Alternatives

Configuration Location and Illustrative Routes



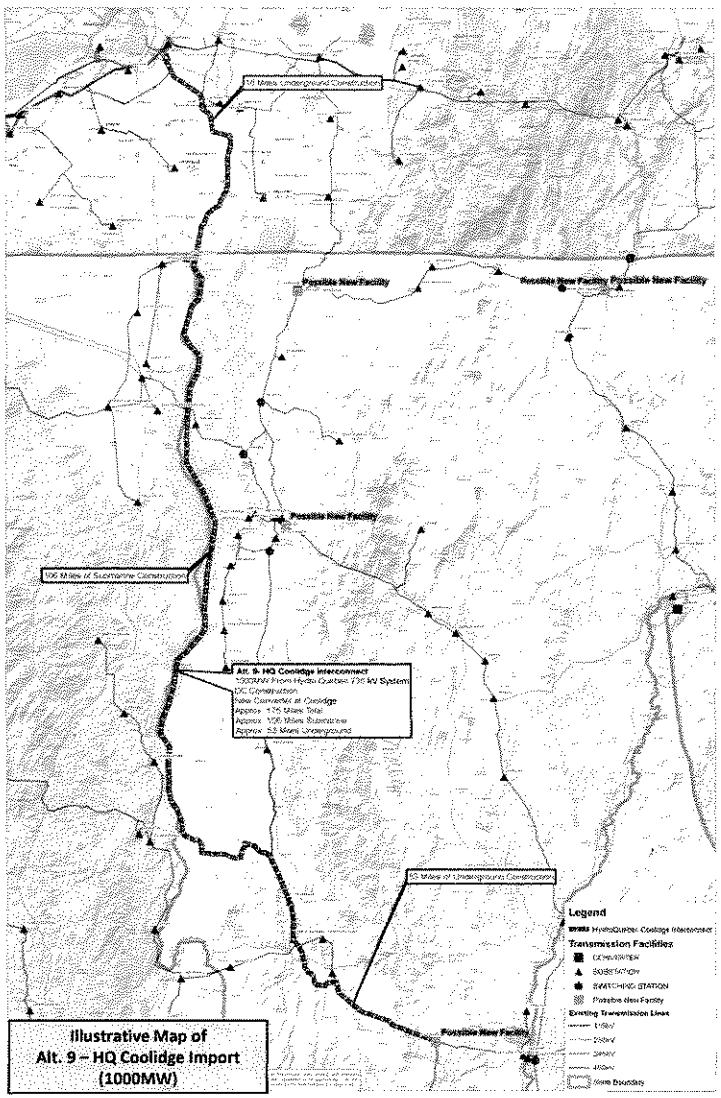
Illustrative Map of
Alt. 6-7 – HQ New Haven Import
(600MW – 1000MW)



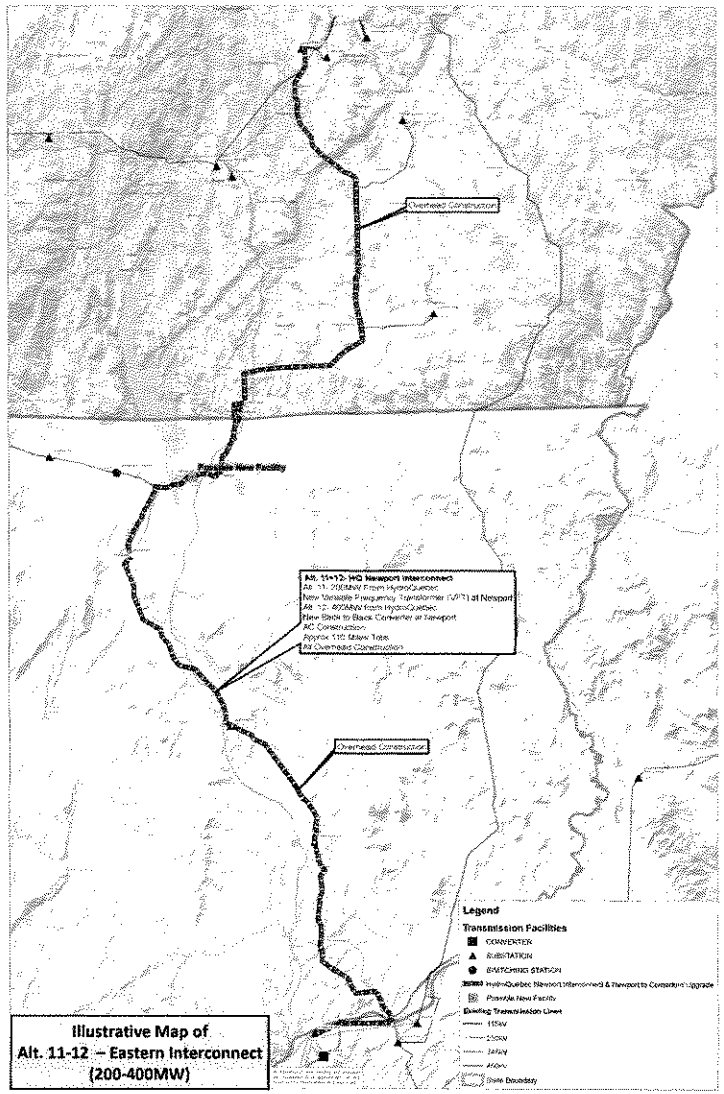
Illustrative Map of
Alt. 8 – HQ W. Rutland Import
(1000MW)

Transmission Project Configuration Alternatives

Configuration Location and Illustrative Routes



Illustrative Map of
Alt. 9 – HQ Coolidge Import
(1000MW)

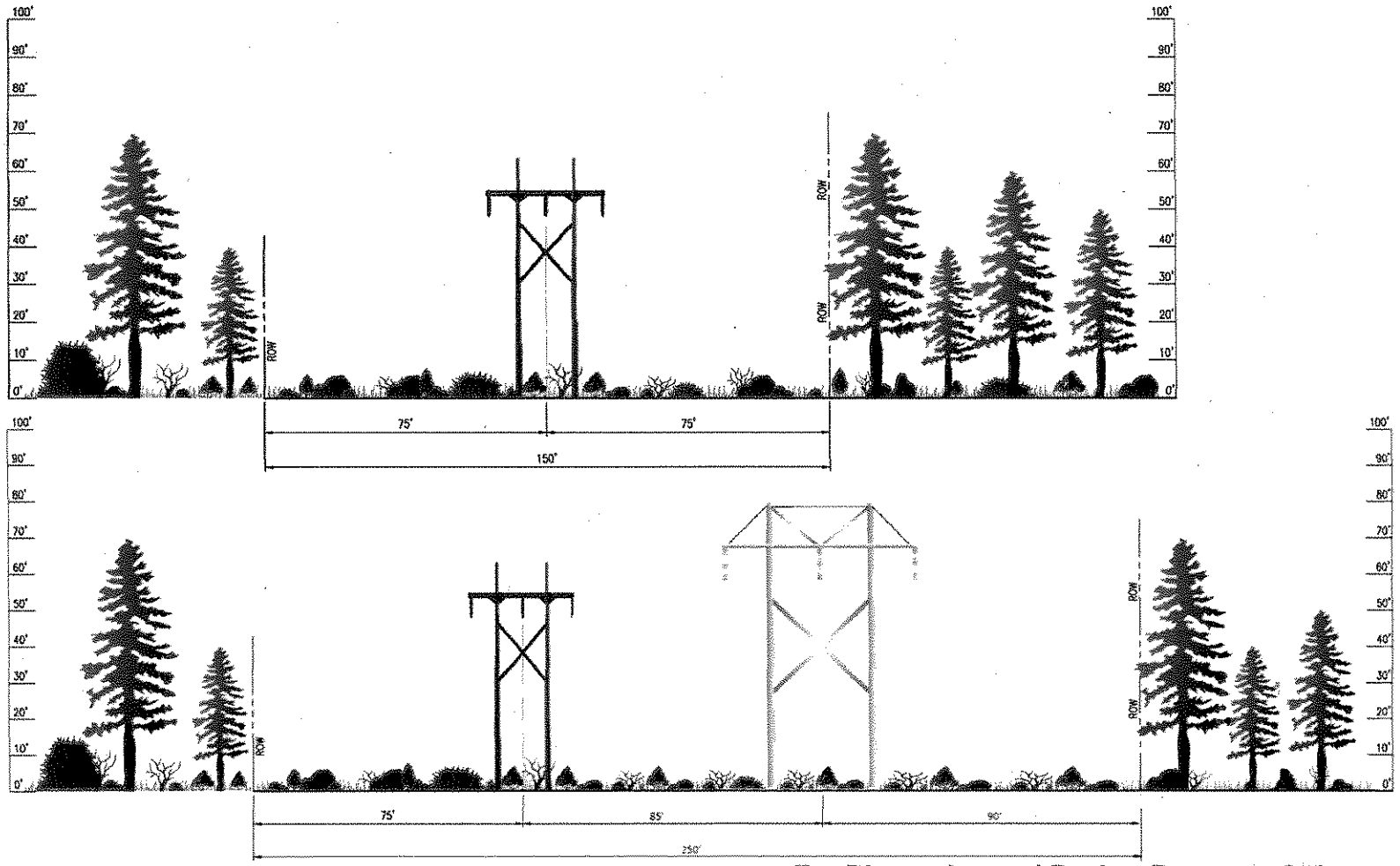


Illustrative Map of
Alt. 11-12 – Eastern Interconnect
(200-400MW)

Transmission Project Configuration Alternatives

Typical Right of Way Cross-Sections – 345kV / 115kV Parallel

Some of the alternative configurations will require improvement to the existing transmission network, for example to increase corridor transfer capacity, below is an example of increasing the corridor width from 150' to 250' to accommodate a new High Capacity Line (345kV typical H-Frame). Other line configurations exists, such as single pole construction but these time of line arrangement would have to be assessed on a case by case basis.

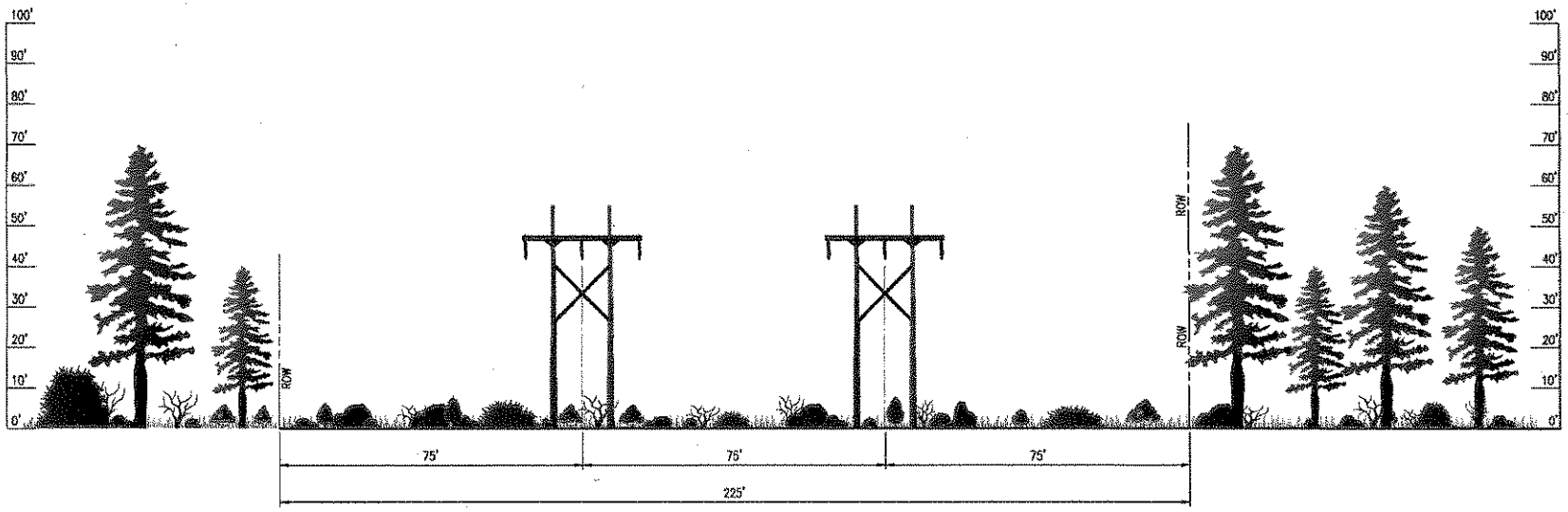


For Discussion and Review Purposes Only

Transmission Project Configuration Alternatives

Typical Right of Way Cross-Sections – 115kV / 115kV Parallel line

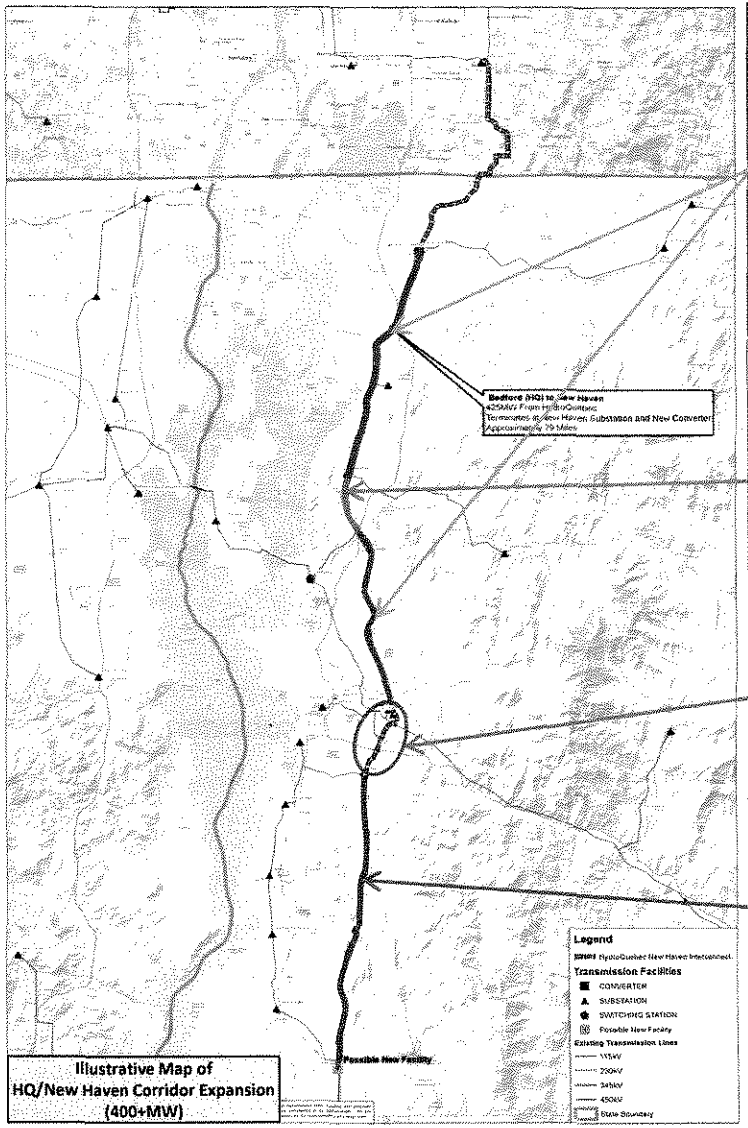
Some of the alternative configurations may require a second 115kV parallel transmission line based on capacity requirements.

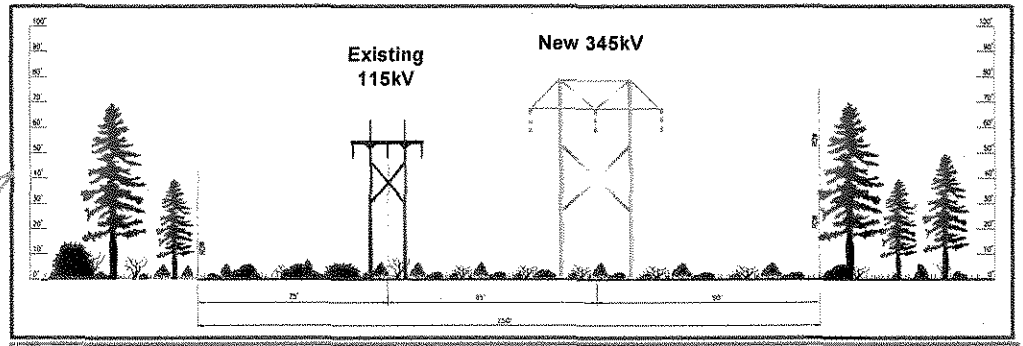


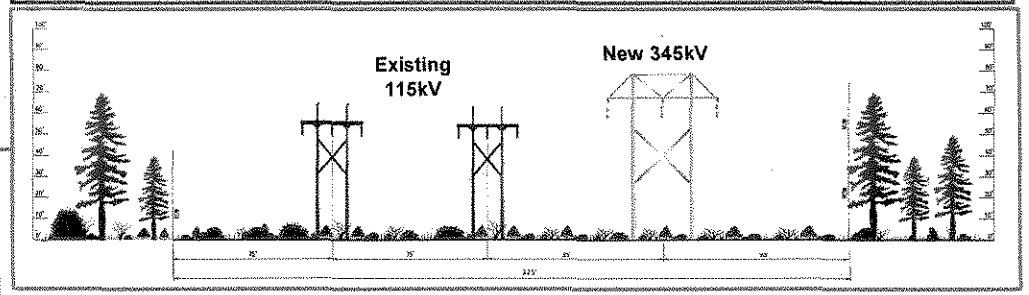
Once some our preliminary analysis and technical review are conducted for the set of alternatives considered, different corridor configuration will be conceptualized as part of this evaluation.

Transmission Project Configuration Alternatives

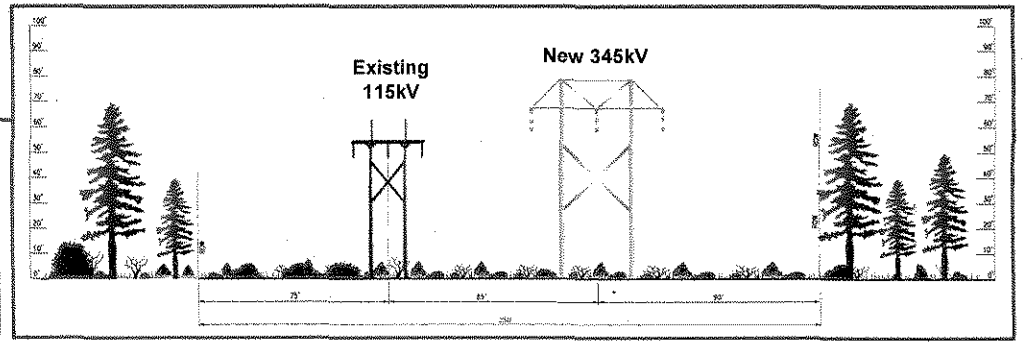
Terrestrial Transmission Line ROW Conceptual Review – Increased HQ Import







Constraint Right of Way Area



For Discussion and Review Purposes Only

Current Inter-Regional Transmission Facilities

- **Pool Transmission Facility (PTF)** are the transmission facilities owned by PTOs, over which the ISO shall exercise Operating Authority in accordance with the terms set forth in the TOA, rated 69 kV or above required to allow energy from significant power sources to move freely on the New England Transmission System, and include all transmission lines and associated facilities owned by PTOs rated 69 kV and above, except for lines and associated facilities that contribute little or no parallel capability to the PTF (as defined in this OATT). [...]
- **Merchant Transmission Facilities (MTF):** are the transmission facilities owned by MTOs, defined and classified as MTF pursuant to Schedule 18 of the OATT, over which the ISO shall exercise Operating Authority in accordance with the terms set forth in a MTOA or Attachment K to the OATT, rated 69 kV or above and required to allow energy from significant power sources to move freely on the New England Transmission System (Cross Sound Cable)
- **Other Transmission Facility (OTF)** are the transmission facilities owned by Transmission Owners, defined and classified as OTF pursuant to Schedule 20, over which the ISO shall exercise Operating Authority in accordance with the terms set forth in the OTOA, rated 69 kV or above, and required to allow energy from significant power sources to move freely on the New England Transmission System. OTF classification shall be limited to the Phase I/II HVDC-TF.

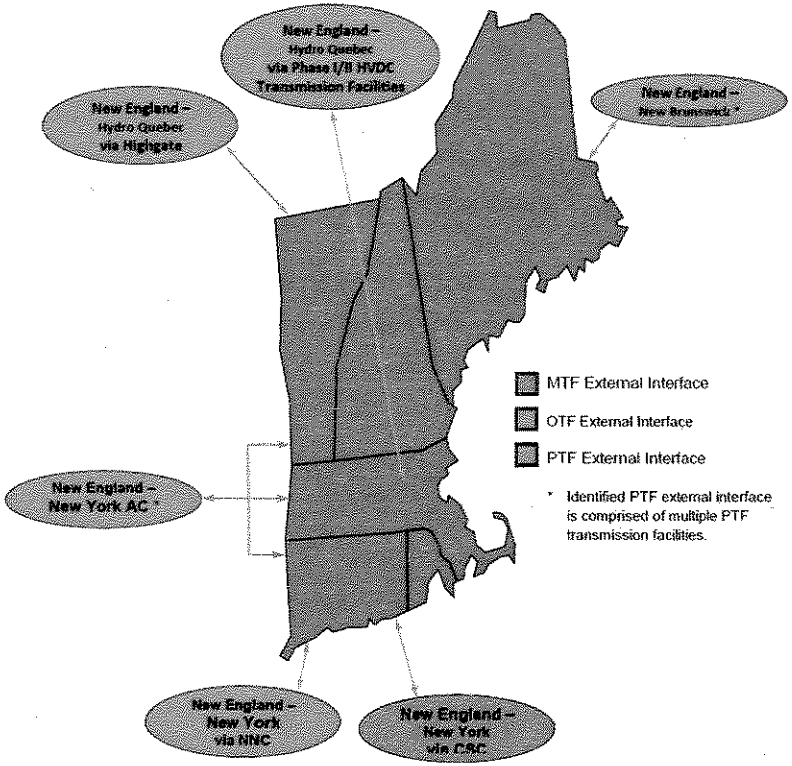


Figure 1. Graphical representation of New England Control Area external interfaces with neighboring BAAs

Active Interconnection Requests

Current Proposed Elective Transmission Upgrades (ETU)

1. NY-VT: **Grand Isle Intertie** (230kV AC - QP314)
   - **400 MW** Capacity
   - 230 KV Phase Angle Regulator-controlled Tie at a new Champlain Substation Site
   - Plattsburgh Substation upgrade
   - Submarine Cables (Lake Champlain) / underground or OH 230kV
   - Target In Service Date: 6/2017

2. HQ-VT: **New England Clean Power Link** (320kV DC - QP425)
   - **1,000 MW** Capacity
   - 320 DC Transmission Tie
   - AC/DC Converter connecting to HQ 75kV System
   - AC/DC Converter connecting to VT 345kV System
   - Target In Service Date: 12/2018

3. HQ-VT: **Highgate Expansion** (BTB Converter - TBD)
   - **425 MW** Capacity
   - 120/115kV Transmission Lines
   - Back to Back Converter Station
   - Target In Service Date: 06/2018