Planning Advisory Committee
WebEx Teleconference
February 17, 2021

Attendee	Organization
P. Bernard - Chair	ISO New England Inc.
M. Lyons - Secretary	ISO New England Inc.
M. Ainspan	NRG
R. Andrew	Eversource Energy
E. Annes	Connecticut Department of Public Utilities
N. Baldenko	Eversource Energy
K. Bashford	ISO New England Inc.
D. Bergeron	Maine Public Utilities Commission
P. Boughan	ISO New England Inc.
J. Breard	ISO New England Inc.
J. Brodbeck	Marble River
D. Burnham	Eversource Energy
E. Camp	Synapse Economics
D. Capra	NESCOE
D. Cavanaugh	Energy New England/Block Island
D. Chatterjee	Eversource Energy
Q. Chen	ISO New England Inc.
R. Collins	ISO New England Inc.
S. Conant	RLC Engineering
D. Conroy	RLC Engineering
J. Contino	Ocean Winds
W. Coste	ISO New England Inc.

F. Dallorto	ISO New England Inc.
B. D'Antonio	NESCOE
J. DiLuca	Eversource Energy
J. Dong	Eversource Energy
M. Drzewianowski	ISO New England Inc.
F. Ettori	VELCO
J. Fairchild	Avangrid
J. Fenn	Versant Power
K. Flynn	ISO New England Inc.
B. Forshaw	CMEEC
B. Fowler	Wheelabrator North Andover Inc.; Exelon Generating Company LLC; Nautilus Power; Dynegy Power Marketing, LLC; Entergy Nuclear Power Marketing LLC; Great River Hydro, LLC
J. Frasier	NYISO
N. Gangi	Eversource Energy
S. Garwood	New Hampshire Transmission
J. Grasse	New England Power
G. Heimgartner	Maine Public Utilities Commission
N. Hutchings	ISO New England Inc.
J. Iafrati	Customized Energy Solutions
B. Jagolinzer	Avangrid
S. Judd	ISO New England Inc.
S. Kaminski	New Hampshire Electric CoOp
T. Kaslow	First Light Power Resources
S. Kirk	Exelon Generation Company
A. Kniska	ISO New England Inc.

R. Kornitsky	ISO New England Inc.
M. Kotha	ISO New England Inc.
R. Kowalski	ISO New England Inc.
A. Krish	Boreas Renewables
S. Lamotte	ISO New England Inc.
R. McCarthy	ISO New England Inc.
Z. Li	Eversource Energy
P. Lopes	Mass DCAM
J. Lucas	Eversource Energy
X. Luo	ISO New England Inc.
E. Mailhot	ISO New England Inc.
K. Mankouski	ISO New England Inc.
A. Margolis	Vermont Department of Public Service
T. Martin	New England Power Company
A. McBride	ISO New England Inc.
P. Melzen	Eversource Energy
D. Norman	Versant Power
B. Oberlin	ISO New England Inc.
T. Paradise	Anbaric Development
D. Plante	Eversource Energy
H. Presume	VELCO
J. Rotger	Galt Power, Cross Sound Cable, BP Energy, Mercuria Energy and DTE Energy
E. Runge	Day Pitney
B. Sanderson	Anbaric Development
M. Saravanan	ISO New England Inc.

D. Schwarting	ISO New England Inc.
M. Scott	New England Power Company
C. Sedlacek	ISO New England Inc.
T. Shakespeare	Massachusetts Department of Public Utilities
P. Silva	ISO New England Inc.
R. Snook	Connecticut Department of Public Utilities
P. Sousa	Massachusetts Department of Public Utilities
M. Spencer	Jericho Power
R. Stein	Generation Group Member, NRG Power Marketing, HQ Energy Services, PSEG Energy Resources & Trade, SunEdison
B. Thomson	MMWEC
J. Truswell	ISO New England Inc.
P. Turner	Conservation Law Foundation
L. Willick	LS Power
P. Wong	ISO New England Inc.
A. Worsley	Boreas Renewables
J. York	LS Power
J. Zhang	ISO New England Inc.

Item 1.0 – Chairs Remarks

Mr. Pete Bernard welcomed the committee and reviewed the days' agenda.

Mr. Bernard commented that the submission window for the 2021 Economic Study Requests is now open. The 2021 Economic Study Request Memo was posted on February 10, 2021. For those that are interested in submitting an Economic Study Request for 2021, the submission deadline is April 1, 2021 by 5:00 PM. Submission requests should be sent to PACMatters@iso-ne.com. Economic Study requests shall be as detailed as possible and presentations by the proponents of the Economic Study request will be made at the April 14th PAC meeting. The proponents' presentation materials for the April 14th PAC meeting need to be submitted to the ISO by April 8th at 12:00 PM.

Mr. Bill Fowler commented that today is Mr. Pete Bernard's last day serving as Chair of the PAC. Mr. Fowler expressed his appreciation from himself as well as all of NEPOOL, for Mr. Bernard's work managing this committee for almost 4-1/2 years now. For those that are not aware, the duties of the chair go far beyond just managing the flow of the meetings themselves -- they involve a great deal of preparation and follow-up as well. Mr. Bernard has done an exemplary job in that role, and we are all the better for it. Mr. Fowler hopes all of the PAC will join him in expressing our thanks to Pete for all his hard work, grace and patience with us, and in wishing Jody the best as she steps into her new role as PAC Chair. Mr. Jose Rotger, Mr. Frank Ettori, and Mr. Bob Stein echoed Mr. Fowler's appreciation.

Mr. Bernard thanked the committee for their kind words and expressed his strong support for Ms. Jody Truswell as she assumes the role of PAC Chair beginning in March 2021.

Item 2.0 – Ludlow 19S Full BPS Separation and Asset Conditions Project

Mr. Paul Melzen (Eversource Energy) reviewed the Ludlow 19S Full Bulk Power System (BPS) Separation and Asset Conditions Project located in Ludlow, MA. The existing cable system and relays at the installation are 50 years old and have deteriorated to the point where they no longer meet industry standards. There were two alternatives to address the issue. Alternative 1 creates a new 345 kV control enclosure and address both the 345 kV and 115 kV cable and relay issues. The cost is $42.9M (-25%/+50%). Alternative 2 will upgrade the 345 kV and 115 kV systems within the existing control enclosure and replace aging cables and relays. The cost is $41.1M (-25%/+50%). Eversource prefers Alternative 1 as Alternative 2 does not allow for future reliability upgrades or substation expansions. In addition, the outage durations associated with upgrades within the existing enclosure far exceed those associated with cutting over to new equipment. The construction start date is expected to be in early 2022 with a completion date expected in late 2022.

Q – Today there is an open bay. In Alternative 1, will the open bay remain?

A – We will be expanding the perimeter of the substation for the new control house so the open bay is not impacted.
Q – When do you expect to begin the project?
A – We expect to complete the project in 2022. We are still working on some of the project details. Currently, there is not a firm start date for the construction. Eversource believes construction will begin in early 2022, but we will take that back to confirm the start date.
Q – How will the outages be managed to minimize congestion?
A – Eversource expects there to be many outages associated with the project, but we expect the longest of them to last no longer than two weeks at a time with most of the outages being much shorter than that.
Q – What type of relays are being replaced?
A – They are microprocessor relays, but they are becoming obsolete and can no longer be supported.
Q - What is the lifespan of the microprocessor relays?
A – 15 to 20 years.

Item 3.0 – Eddy (NH) Substation Control House Relocation and Rebuild Project
Mr. Paul Melzen (Eversource Energy) reviewed the Eddy (NH) Control House Relocation and Rebuild Project located in Manchester, NH. The project calls for removal of the Eversource Eddy substation controls from the Amoskeag Hydro Power House to a control house controlled by Eversource to provide the required environmental conditions and physical security. The equipment includes relays, controls and batteries. The estimated cost of the project is $6.1M (-25%/+50%) with a projected in service date of Q4 2021.

Q – Is Eversource considering doing the cabling work to meet a possible future BPS classification?
A – Yes, it is part of our design standard with separate and redundant equipment and cables.

Item 4.0 – Upper Maine 2029 Preliminary Preferred Solution
Ms. Jinlin Zhang (ISO-NE) reviewed the Upper Maine 2029 Preliminary Preferred Solutions for the areas time sensitive needs. The Highland Area needs were reviewed to resolve identified N-1 low voltage violations, N-1-1 thermal violations, and N-1-1 low voltage violations. In addition to common solution components, there were two potential solutions. The first is to install a +/-50 MVAR STATCOM at the Highland Substation (a total of $108M, including common solution components). The other solution calls for the construction of a 23-mile 115 kV line parallel to the existing S80 Highland to Coopers Mill (a total of $157M including common solution components). The Bangor Area needs were reviewed to resolve identified N-1-1 thermal violations; N-1-1 low voltage violations; and N-1 and N-1-1 high voltage violations. There were three potential solutions. The first is to install a +/-50 MVAR STATCOM and a 25 MVAR reactor at the Boggy Brook Substation ($41M). The second solution calls for the installation of

two 25 MVAR STATCOMS at the Boggy Brook Substation ($49M). The third solution is to construct a new 26-mile 115 kV line between Orrington and Boggy Brook (this alternative was removed from consideration due to excessive cost). Additional N-1-1 high voltage needs on the Keene Road and Enfield 115 kV, County Road 115 kV, Albion Road and Orrington 115 kV bus were reviewed. The solution to these needs consists of a 10 MVAR reactor at Keene Road 115 kV, installation of three switches at Orrington, and adjusting the voltage schedule on the Albion Road transformer. The needs identified in the Upper Maine Needs Assessment remain unchanged when the five generation projects procured through the RFP and the NECEC project and its associated upgrades were considered. The proposed solutions resolve issues identified in the Needs Assessment and introduce no new needs when they are combined with the five generation projects and NECEC.

Q – In regards to the Section 80 overload, wasn't rebuild of Section 80 part of the MPRP project and it still hasn't been constructed?
A – The MPRP project had a parallel line next to Section 80 to address the overload. That solution hasn't moved forward. The proposal here is to rebuild the existing Section 80.
Q – What is the cost accuracy percentages for the components of the new transmission line?
A - The cost accuracy of the other components is (+50/-25%).
Q – In alternative two regarding the parallel line, would that need a new right of way?
A – CMP stated that they plan to use the existing right of way but that will need to be confirmed.
Q – As part of the MPRP project, consideration was given to building one of the lines at 345 kV. Would that have had an impact on this work?
A - That is Section 254 and was proposed in 2008. That line would have no impact on Section 80.
Q – On slide 18, there are voltage violation that the STACOM will address, but there are also thermal overloads and how would a STATCOM address that?
A – The thermal overload is being caused by voltage collapse in the Bangor area. We can discuss this further offline.
Q – Has an analysis been performed on the five generation projects procured as part of the RFP? Are we building the Maine transmission system to the limit of what is necessary or should it be expanded to account for future generation projects?
A – We are required to find solutions to the identified needs. These needs did not change as a result of the addition of the five projects procured through the RFP. However, we are considering system expansion to account for future generation projects outside of FCM or the Maine RFP at this time.
Q – Will the Upper Maine upgrades eliminate any of the required NECEC upgrades?
A – The NECEC upgrades are not related to the Upper Maine study area.
Comment – The ISO should consider adding devices in the area that haven't been identified as needed but could end up being more cost effective by installing them now versus later and could

potentially increase transfer capabilities and facilitated easier interconnection of future generation resources in the area.

Item 5.0 – Western and Central New Hampshire 2029 Preliminary Preferred Solution

Mr. Fabio Dallorto (ISO-NE) reviewed the Western and Central New Hampshire preliminary preferred solutions for the areas time sensitive needs. The Western NH Area needs were reviewed where N-1-1 low voltage violations were identified. There were two potential solutions. The first is to install a +/-50 MVAR synchronous condenser at the North Keene Substation with a 115 kV breaker ($36.2M). The second alternative calls for splitting the I-135N Bellows Falls-Monadnock Tap-Fitzwilliam 115 kV Line at a new Gilsum Road Substation, and constructing a ne line between Gilsum Road and North Keene ($33.9M). ISO recommends adopting Solution Alternative 1. The Central NH Area N-1-1 low voltage needs were reviewed. There were two potential solutions. The first is to install a +/-50 MVAR Synchronous Condenser at the Huckins Hill Substation with a 115 kV breaker ($36M). The second alternative calls for constructing a 10-mile 115 kV line between Pemigewasset and Webster and installing one 115 kV breaker at Webster and four 115 kV breakers at Pemigewasset ($37M). ISO recommends adopting Solution Alternative 1.

Q – In Alternative 1, you chose to use a +50/-25 MVAR synchronous condenser instead of a STATCOM. Why?
A – The synchronous condenser strengthens the system and is consistant with other devices that are constructed in the area.
Q – Is the Webster area a congestion point? If so, it doesn't seem to be addressed as a potential solution?
A – ISO doesn't believe the Webster area is a major congestion point. The major issues in the state are located further north in Coos County, and these solutions wouldn't have a significant impact on the northern NH issues.
Q – Will the Planning Procedures be revised to reflect the selection of more expensive solutions but could have a longer term benefit to the system?
A – We plan to discuss this issue as part of the Dynamic Reactive Device Technologies presentation later today.

Item 6.0 – Looking Forward: Dynamic Reactive Device Technologies

Mr. Brent Oberlin (ISO-NE) reviewed the pros and cons of using power electronic devices, STATCOMs and Static VAR Compensators (SVCs), versus synchronous devices. In deciding which option is the most cost effective solution, one type of device may be the most cost effective at address identified needs through the ten-year planning horizon, but longer term trends may be more favorable to the installation of another type of devise. The presentation reviewed the differences between STATCOMS, SVCs, and synchronous condensers. The

projected expansion of renewable generation technologies are based upon power electronics. With this influx, the available short circuit strength and inertia will decrease as synchronous generator retire or are operated less often. This also could impact system protection, transient stability and frequency control. ISO concludes that although a STATCOM or SVC may resolve a system need seen for 2030, it may not be the best long-term solution. ISO wants to move toward using synchronous condensers as the preferred dynamic reactive device to address system concerns as it can resolve both short circuit and inertia issues, while avoiding potential control interactions with inverter based resources. Stakeholder feedback on this presentation is requested back to ISO by March 4th.

Q – Synchronous condensers have low inertia. Do they have the capability to have a higher inertia?
A – Yes, you can specify synchronous condensers with higher inertia capability but it still would not have the inertia capability of a large MW steam generator.
Q – Have you considered using retiring generators as synchronous condensers?
A – We will take that back for discussion.
Comment – Synchronous condensers are not the only technology that could assist in addressing inertia issues.
Comment – ISO should develop a mechanism developers be allowed to pay for the cost of a STATCOM and the region pay any additional cost so that a synchronous condenser would be installed.

Item 7.0 – Branford (CT) 11J A3 Bus Replacement Project

Mr. Paul Melzen (Eversource Energy) reviewed the Branford 11J A3 Bus Replacement Project located in southern CT. The project calls for the replacement of the 40 year old self-contained fluid filled (SCFF) cable at the Branford Substation. The cable has had significant maintenance performed on it since 2005 due to fluid leaks which impact reliability as well as creating an environment risk. The project call for the replacement of the SCFF cable with a three-phase cross-linked polyethylene (XLPE) cable and replacement of two existing bus support structures. Estimated cost is $8.8M with an in service date of Q4 2021.

There were no questions from the committee on this topic.

Item 8.0 – Transmission Line Refurbishment Projects for Lines K22, K24, and K34

Mr. Hantz Presume (VELCO) reviewed the Transmission Line Refurbishment Project for Lines K22, K24 and K34 due to deteriorating structures and equipment. The project cost of the K22 Line work is $9.7M with a completion date of 2022. The K24 Line work is $15.2M with a completion date of 2024. The project cost of the K34 Line work is $6.7M with a completion date of 2022.

Q – *Why don't you replace all of the wood pole structures now because they are all the same age?*
A – We have done work on this line in the past to replace various structures and once this project is completed, we don't believe we will need to replace additional structures on the K34 line in the future.

Item 9.0 – Stochastic Time Series Modeling for ISO-NE: Results and Next Steps

Mr. Steven Judd (ISO-NE) reviewed the Stochastic Time Series Modeling for ISO-NE: Results and Next Steps that provided an overview of the DNV GL report detailing the results of the stochastic time series analysis of variable energy resources (VER). The 2020 ISO VER Revision 2 data set contained hourly time series wind data in New England for eight years (2012-2019). It included 37 on-shore and one off-shore existing wind plants and 12 future off-shore wind plants. This was expanded by DNV GL to a 20-year analysis (2000-2019), and also added solar and load profiles to show the co-dependencies between wind, solar, and load. The expanded data set added all previous data from Revision 2 expand to a full 20 years, aggregate BTM solar by load zone, and load (gross less EE) and weather profiles by Load Zone. The historical data set was then run through DNV's Stochastic Engine to create 1000 20-year alternate historical time series realizations to perform probabilistic analysis. The wind resources totaled 4457 MW of total nameplate (1319 MWs on-shore, 3137 MWs off-shore). Solar was calculated as 7725 MWs of total nameplate based on the PV draft forecast for 2029. In reviewing system reliability during heat waves and cold spells, as cold increases so does wind output. As heat wave intensity increases, wind output decreases but reduced cloud cover tends to increase solar output. A review was performed on the impacts of long duration wind lulls. All of these observations, plus many others, are supported by detailed charts and graphs. A summary of the actual DNV GL report was posted as supplemental materials for the February 17th PAC meeting.

Q – On slide 3, is the DNV GL report available to review?
A – Yes, we will be posting that presentation in the near future.
Q – On slide 24, 2nd bullet does the model account for high winds cutouts?
A – It does and is reflected in the data.
Q – On slide 26, regarding the lull of off-shore wind, how are they geographically reviewed.
A – This refers to the four state contracted off-shore wind plants in the fereral lease area south of Cape Cod. They are not geographically diverse and relatively closely located.
Comment – On slide 27 regarding the heat wave and cold snap percentiles, should they be divided out by the winter and summer seasons versus the entire year.
Comment – Regarding the high wind cutouts, ISO should provide additional data to determine the risk. Also, the stochastic studies should be expanded to the entire Northeast region to include NY.

A – ISO did not have enough funds to perform analysis on high-speed wind cutouts but will take note of the request for possible future work. The stochastic work has been discussed during JIPC calls with PJM and NYISO and they are aware of the work.
Q – What does the data show regarding a very rapid down ramp of off-shore wind?
A – On slide 53, we review a 1, 2 3, and 4 hour down ramp of the wind resources. Typically, large off-shore ramps can occur during Nor'easters when the wind units are taken off line due to wind speeds in excess of 25 m/s.
Q – On the off shore wind farms, the 1200 MW capacity of the largest value for a single site. Is that an accurate value or projected value?
A – It is a projected value as it is the size of our largest single source loss. The future wind farms in the 2021 data set were chosen to explore the diversity of the wind resources in areas where we do not have current facilities. It does not indicate feasibility of interconnection or optimal placement of future resources.
Q – What do the solar profiles represent?
A - They represent an average total Load Zone value for the five largest cities in each Load Zone to represent an aggregate behind-the-meter Load Zone profile.
Q – What data will be made available to the stakeholders?
A - The presentation and the DNV GL report. We will also provide the 2021 VER dataset when it is available in March-April timeframe. We may also be able to provide the representative 8760 profiles after some further review internally to make sure we are in line with the Information Policy.

Several stakeholders commended Mr. Judd and ISO-NE for development of this presentation.

Item 10.0 – 2020 Economic Study Sensitivities Review

Mr. Richard Kornitsky (ISO-NE) reviewed the 2020 Economic Study Sensitivities that reviewed the NGrid request to "provide stakeholders analysis of potential pathways to best use MWh of clean energy resources and to meet state goals cost effectively while leveraging transmission and/or storage devices". The study focuses on the year 2035. The study reviewed the simulations to optimize banked energy over a simulated 1200 MW tie from CEMA/NEMA to HQ with only exports allowed. The results show a return of banked energy is primarily from curtailed imports results in the replacement of gas resources. There are some dispatchable resources need to provide reserves. Energy banking shows there is a significant reduction in energy that would have gone unused. A portion of the banked energy from imports is not returned over the new tie because the energy is curtailed at $5/MWh. There is a total of 14.4 TWh of energy curtailed without energy banking and a net of 9.6 TWh is curtailed with energy banking. Energy banking also results in a 24% reduction of CO2 from gas resources. The study also reviewed battery sensitivities. Batteries reduce the amount of curtailed renewables and leads to a much higher use of pumped resources. The final 2020 Economic Study Report is expected by Q2 2021.

Q – When you state imports on slide 14, does that means energy brought into New England and exports are energy exchanges to from New England to Quebec?
A – That is correct.
Q – Can you explain how you derived the 12% loss of the renewables on the 1200 MW tie on slide 11?
A – That is the loss percentage from exporting renewables to Quebec and then provided back to New England at a later time.
Q – On slide 20, the goal of energy banking is to curtail imports or exporting to Quebec over the new tie. Why is the banked energy to Quebec returned at only 50% of the original export?
A – We curtail the returned banked energy from Quebec at a reference price of $5 MWh. The 50% energy reduction reflects that energy curtailment in favor of renewable energy available in New England.
Q – On slide 24, are the solid blue and orange bars the total returned energy?
A – The solid blue bar is the total returned energy and the orange bar is the curtailed energy.
Q – On slide 27, the gas generation is there for reserves. If we had unlimited import capability, would the gas energy would be greatly reduced or eliminated.
A – That is correct.
Comment – The 2020 Economic Study show a significant need for additional storage capability and a need to increase the transfer capabilities over Phase II.

Item 11.0 – Boston 2028 RFP and Order 1000 Lessons Learned Update

Mr. Brent Oberlin (ISO-NE) provided an update regarding the initial observations concerning lessons learned from stakeholder comments that were received and reviewed at the December 2020 PAC meeting. Comments on the process were received from Anbaric, Avangrid, NGrid, NEEC, NESCOE, Transource, a Public Submitter, and ISO. The comments are located in the Appendix of the presentation. Some of the topics discussed included the following:

- Installation of Elements on the PTO System/Land Ownership
- Cure Period
- Storage
- Modeling and Stability
- Redacted Submissions should be made public
- PAC presentations should be allowed by the QTPS for submitted proposals
- Cost recovery for Non-incumbents for Phase One development and Phase Two solutions
- Providing a single list of questions and responses in RFP 360
- Allowing for separate RFPs for each need of the project

Comments on the Lessons Learned should be submitted to ISO by March 11th.

Comment - PJM is working with stakeholders and provided information in December that would allow storage to be considered as transmission. Perhaps you could speak to them as well as MISO to share lessons learned on Order 1000 in different control areas.

Comment – ISO should allow more flexibility on potential changes to project submission regarding transparency to others similar to the PJM RFP/Order 1000 process.

Comment – NESCOE agrees on evaluation of projects on a cost effective basis but other considerations should be taken into account such as future cost avoidance. Also, as part of the negotiated Order 1000 proposal, the Phase One costs should be assumed by the developer and any changes to that in the tariff would be contested by NESCOE.

Item 12.0 – Closing Remarks

The next PAC meeting will be Wednesday, March 17, 2021 via WebEx Teleconference.

Meeting Adjourned at 5:45 PM

Respectively submitted

Marc Lyons

Secretary, Planning Advisory Committee