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US Department of Energy

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Electricity Delivery and Energy Reliability

August 31, 2015

Mr. Brian Mills
Office of Electricity Delivery and Energy Reliability
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Re: Northern Pass Transmission LLC
Docket No. PP-371
Further Amendment to Presidential Permit Application

Dear Mr. Mills:

By letter dated August 19, 2015, Northern Pass Transmission LLC ("Northern Pass") advised the Department of Energy ("DOE") of certain changes it is making in the design of the Northern Pass Project ("Project"). The purpose of this submission is to formally amend the Amended Application for a Presidential Permit that it submitted to DOE on July 1, 2013 ("Amended Application") to reflect the new design of the Project.[1] Northern Pass believes that the Draft Environmental Impact Statement ("Draft EIS") that DOE issued on July 31, 2015 fully analyzes in its alternatives analysis the potential impacts associated with the Project design changes covered by this further amendment.

Specifically, Northern Pass proposes three amendments to the Presidential Permit Application: 1) an additional 52.3 miles of underground construction in state roads with the associated addition of two transition stations; 2) a change in technology from a conventional "current source converter" to voltage source converter (VSC) technology and associated changes in i) the Project size from 1,200 megawatt (MW) to 1,000 MW with a potential transfer capability of up to 1,090 MW, and ii) in the type of cable from mass impregnated to XLPE (cross-linked polyethylene) cable; and 3) a shift of less than 100 feet in the border crossing location.

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[1] The Amended Application superseded in its entirety an earlier filed application dated October 14, 2010. This further amendment addresses only those aspects of the Project as described in the Amended Application that Northern Pass is changing.

A. Description of Project Design Changes

1. Underground Transmission and Transition Stations

In its Amended Application, Northern Pass supported approximately eight miles of underground transmission. Northern Pass now proposes to construct an additional 52.3 mile underground segment, for a total of approximately 60.5 miles of underground transmission.

First, Northern Pass proposes 49.3 miles of underground construction along state roads between Bethlehem and Bridgewater that were evaluated in the Draft EIS as portions of Alternatives 4c and 5c. This 49.3 mile segment includes a stretch that begins on State Route 18, where Route 18 intersects the existing Eversource Energy transmission right-of-way, and continues along State Routes 116, 112 and 3, to the point at which Route 3 intersects the existing transmission right-of-way in Bridgewater. This segment takes the place of the corresponding portions of the Proposed Action described in the Northern Pass Amended Application dated July 1, 2013 ("Amended Application"), Alternative 2 in the Draft EIS.

Northern Pass also proposes a three-mile underground segment along state roads in the public right-of-way extending immediately to the north of the underground option evaluated in Alternative 5c. This segment begins at the point at which the existing transmission right-of-way intersects Route 302 and continues along Route 302 to Route 18 and along Route 18 for a total distance of three miles. This segment would take the place of an overhead segment that is part of Alternative 2 and that would pass over one site listed on the National Registry of Historic Places (the Rocks Estate) and would be visible from another site that is eligible for listing (Baker Cabins). This additional three-mile underground segment is proposed to avoid potential impacts on these two sites.

The potential impacts associated with underground construction in roadways are fully addressed in the Draft EIS at Sections 2.3.2.5, 2.3.3.5 and 2.3.4.5, among others. Although not specifically considered in the Draft EIS, the additional three-mile segment Northern Pass proposes to place underground in the roadway presents no impacts of a nature or degree not fully assessed in the Draft EIS. Rather, is a "minor variation [that is] qualitatively within the spectrum of alternatives discussed" as part of Alternative 5c in the Draft EIS. [2]

Exhibits 7A, 8A and 9A, attached hereto, reflect the routing that Northern Pass now supports, noting as relevant where Northern Pass is adopting an Alternative discussed in the Draft EIS. These maps correspond to, and take the place of, Exhibits 7, 8 and 9 submitted with the Amended Application. We also provide as Exhibit 2A a single map reflecting the entire route. It takes the place of Exhibit 2 submitted with the Amended Application.

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2 *See* Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations, 46 Fed. Reg. 18,026, 18,035 (1981).

As Northern Pass explained in the Amended Application, transition stations will be required where the Project moves from overhead to underground and from underground back to overhead. To accommodate the additional 52.3 miles of underground, two additional transition stations will be required, one in Bethlehem and one in Bridgewater. Both transition stations will be located on property owned by an affiliate of Northern Pass. The locations for these transition stations are shown on Exhibits 7A and 8A. The potential impacts associated with transition stations are addressed in the Draft EIS at Sections 4.1.1.2, 4.1.3.2, 4.1.7.1, 4.1.13.1 and 4.1.14.1, among others.

2. Technology Change and Project Size Change

As described in Section 2.4.1 of the Draft EIS, the originally proposed 1,200 MW traditional HVDC technology, involving mass impregnated cable, is not practical or economic for long underground distances. Accordingly, the inclusion of additional underground requires a change in the technology for the Project from a conventional converter to VSC technology. The VSC technology would deliver 1,000 MW of power with the potential transfer capability of up to 1,090 MW. Voltage for the HVDC section will also change from ±300kV to ±320kV. The Draft EIS considers the potential impacts associated with this technology alternative, including the smaller Project size associated with the VSC technology, at Sections 4.1.2.3, 4.1.4.2, 4.1.10.2 and 5.1.2.4, among others.

3. Slight Shift in Border Crossing

As the result of siting needs on the Canadian side of the border, the border crossing must move from Latitude 45.017820, Longitude -71.501217 to Latitude 45.017719, Longitude -71.500028, a distance of less than 100 feet in an area that is similar in character throughout. This is reflected on the map shown in Exhibit 10A, a replacement for Exhibit 10 in the Amended Application. However, we note that the change is so modest that it is not visible at the scale of the map, which is the scale DOE regulations specify.

The slight shift in the location of the border crossing results in the shift of one structure by approximately 70 feet at the border crossing.[3] Northern Pass does not believe that this very modest change at the border crossing location will have any effect at all on the potential impacts evaluated in the Draft EIS.

3 Northern Pass originally anticipated that the border crossing change would not result in a location change for any structures. However, as the design process has continued, Northern Pass has concluded, in consultation with Hydro Quebec, that it would be desirable to move one structure approximately 70 feet.

B. Technical Information

DOE's regulations require the submission of certain technical information associated with a proposed import of electricity.[4] Because of the change in technology and Project size, some of the required technical information previously submitted also changes. The new information is as follows:

1. Number of Circuits

For the portion of the Project running from the international border to Franklin, New Hampshire, Northern Pass proposes to construct a single circuit ±320 kV HVDC transmission line. The line will be above ground, except for the approximately 60.5 miles of the line that will be installed underground. The total length of the HVDC portion of the Project is approximately 158.3 miles.

2. Operating Voltage and Frequency

The nominal operating voltage for the HVDC line will be ±320 kV and will consist of positive energized conductors and negative energized conductors. The dedicated metallic return conductor that was part of the prior Project design will be eliminated.

3. Conductors

As in the prior conventional converter technology-based design, the HVDC overhead conductor will employ a two-conductor bundle for the positive and negative energized poles. The bundle consists of "All-Aluminum Alloy Concentric-Lay-Stranded" (AAAC) conductors. Each conductor has a designation of 2,932.9 kcmil AAAC and has an outside diameter of 1.975 inches. Rated breaking strength of this conductor is 83,500 pounds. The proposed design would limit the tension in this conductor to 20,000 pounds under the National Electric Safety Code (NESC) heavy district loading case.

For the underground sections of the HVDC line, one cable is required for the positive pole and one cable is required for the negative pole. The cable will be type rated for ±320 kV DC with a diameter of approximately 4.5 inches. The conductor will be 2,380-2,500 mm^2 copper. Exhibit 3A shows cross-sections of these cables.

As also in the prior design, shield wire(s) will be installed on the structures to provide protection from lightning and to serve as a communications path. The HVDC structures will generally include two shield wires. The prior DC design consisted of one shield wire and a metallic return conductor that also provided shielding protection. With the removal of the metallic return conductor, a second

[4] 10 C.F.R. § 205.322. The technical specifications of the AC portion of the Project will not change from what was described in the Amended Application, except for structure heights, and thus the technical parameters for the AC portion of the line, except for structure heights, are not addressed here.

shield wire will be installed. One of the shield wires will always be an optical groundwire (OPGW) cable. This cable consists of a combination of aluminum/aluminum-clad strands making up the outer portion of the cable with multiple strands of aluminum tube to enclose fiber optics for communication. Both the OPGW and the shield wire (19#10 Alumoweld cable) will have an outside diameter of approximately 0.5 inches and a rated breaking strength of approximately 27,000 pounds. The tension on both of these cables will be limited to 5,400 pounds under the NESC heavy district loading case.

4. Additional Information Regarding Overhead Lines

i. Wind/Ice Loading Design Parameters

The wind and ice loading design parameters do not change with the VSC design. Transmission structure strength requirements will be determined by applying multiple structure loading conditions to each structure design. Structure designs will be based on conductor tension, weather conditions and structure location. Multiple structure designs will be used throughout the Project.

Using standard industry practices, tensions can be calculated at each weather condition required for design of the Project. The weather conditions considered for the Project design are governed by the three NESC loading cases required for this area of the United States (Rule 250B, Rule 250C and Rule 250D) and Project-developed standards. These weather cases result in loads from ice, wind, and combined ice and wind. Loads generated by such weather conditions are increased by load factors as specified in NESC Rule 253 and in the Project design standards. In addition to the increase in loads, strength factors, published in the same references, are applied to the transmission line components, such as structures, attachments and foundations. These industry standard methods result in safe and reliable infrastructure.

Rule 250B is the NESC heavy district loading case. It consists of a wind velocity of 40 mph, 0.5 inches of ice and a wire temperature of 0°F. This is the only loading case that requires an additional NESC constant of 0.3 lb./ft. The constant is applied to every foot of conductor. Rule 250C considers extreme wind. A wind velocity of 100 mph at 60°F is the weather condition applied during this case. Rule 250D is a loading case that considers wind and ice. It contains a wind velocity of 40 mph, 1 inch of ice and a wire temperature of 15°F.

In addition to the loading conditions required by the NESC, the design will incorporate an additional combined wind and ice case to address loading conditions in New Hampshire. The case consists of a wind velocity of 40 mph, 1.25 inches of ice and a wire temperature of 15°F.

ii. Description of Typical Supporting Structures

For the overhead portion of the HVDC line, Northern Pass proposes to use lattice steel and tubular steel monopole structures. Exhibit 4A, which replaces Exhibit 4 from the Amended Application, shows the range of structure types that the Project proposes to use. Exhibit 4A also shows possible alternative structure designs.

The proposed structures heights are identified in Exhibit 5A, which replaces Exhibit 5 from the Amended Application. In the new Project design, average structure heights are approximately five feet lower than in the prior design.

As in the prior design, the lattice configuration will have an approximate base dimension of 30 feet by 30 feet and taper to a six foot by five foot column half way up the structure. Lattice structures will be anchored to four concrete foundations at the corners of the base approximately three to five feet in diameter.

Likewise, monopole configurations will not change. They will be approximately five to ten feet in diameter at the base, tapering to approximately one to two feet in diameter at the top. These structures will be anchored to concrete foundations approximately seven to twelve feet in diameter.

During the detailed design process, other foundation designs may be considered where they might improve constructability, reduce environmental impacts or achieve other benefits.

The arms of the structures support insulator strings, bundled conductors and overhead shield wires. One of the two overhead shield wires will have a fiber optic core to enable communications and system protection functions between the two HVDC converter terminals and between the Franklin HVDC converter terminal and the Deerfield Substation.

iii. Structure Spacing

The majority of structures will be spaced approximately 600 to 650 feet apart; maximum spacing will be approximately 1,000 feet. The distance between structures will depend on the terrain, the height of the structures, and proximity to adjacent structures within the ROW. Larger spans between structures generally require taller structures.

iv. Conductor Spacing

The Project will employ spacing between ±320 kV HVDC energized conductors of 28 feet for V-String insulator configurations on horizontal structures. Spacing between ±320 kV HVDC energized conductors will be 26 feet for vertical structures.

v. Line to Ground and Conductor Side Clearances

For HVDC clearances, the horizontal distance between each energized conductor and the support structure will be 12 feet. Minimum clearance to ground from the conductors will be 30 feet. Energized conductors will be attached to the structure using 21 DC type insulator disks per string.

This will provide approximately ten feet of clearance between the energized conductors and the de-energized parts of the structure.

5. Underground Line

The Project will include three underground segments. The first underground segment is in the vicinity of the Route 3 bridge-crossing of the Connecticut River in Pittsburg and Clarksville. To accommodate a small shift in the location of the transition station, this underground segment will increase from approximately 2,300 feet to 0.7 mile long. The second underground segment is approximately 7.5 miles long in Clarksville and Stewartstown. These two underground segments were described in the Amended Application. The final underground segment is the 52.3 mile segment described in Section A.1 above. All three will be underground in public roadways, and the installation method for all three segments will be the same.

The underground sections will be installed using a combination of construction techniques that include: i) direct bury of the cable, ii) installation of the cable in a duct bank, and iii) the use of trenchless technology. The trenchless technology will include jack & bore and directional boring. The depth of the direct buried cable will be approximately four feet below grade. The depth of the duct bank will vary based upon its configuration and will have at least 2.5 feet of cover over the duct bank. The maximum depth of the directional boring sections will be approximately 65 feet below grade; and the maximum depth of the jack & bore will be approximately 25 to 30 feet below grade. The exact depth of the trenchless conduit installation, duct bank or direct buried cable may be adjusted based upon the final design. Exhibit 3A provides a technical diagram illustrating a cross section of the underground cable.

Transition stations will be installed at each end of each underground segment to allow transition to the overhead line. Each transition station will resemble a small switching station. As with the prior design, it will be enclosed by a fence. The VSC transition stations will have a smaller area than for the conventional converter technology design, approximately 75 feet by 130 feet, instead of 160 feet by 180 feet. The equipment at each transition station will include a line terminal structure, surge arresters, instrument transformers, cable terminators, communications equipment, and a small control enclosure.

As with the prior design, no cathodic protection is required for the underground segments.

6. Southern HVDC Converter Terminal

The conversion from DC to AC will occur at a converter terminal located in Franklin, New Hampshire, at the previously identified 118-acre former campground site. The southern HVDC converter terminal will occupy only about eight acres of that site, instead of the previously estimated 21 acres. The converter terminal will be designed for a continuous DC to AC transfer rating of 1,000 MW, with the potential transfer capability of 1,090 MW. The converter terminal will be configured as a symmetric monopolar system. The converter terminal will contain the following equipment and facilities:

- Valve Hall – The terminal will include an electrical enclosure for the insulated gate bi-polar transistors (valves) that will also contain control, protection and monitoring equipment.
- Converter Transformers – The terminal will include oil-filled power transformers with a primary voltage of 345 kV AC. The ratings of the transformer connection to the valve hall will be determined by the HVDC equipment vendor based on maximum transfer rating of the terminal. The transformers will be located outdoors.
- AC Switchyard – As with the prior design, the terminal will include a 345 kV AC switchyard to interconnect the 345 kV line that will extend to the Deerfield Substation. The AC switchyard will be air insulated and located outdoors.
- AC Filters and Capacitor Banks – The terminal will include high voltage AC filters consisting of capacitors, reactors and resistors. The AC filters will be designed to prevent the injection of harmonic currents into the AC transmission system. The terminal will also include high voltage capacitor banks and a reactor that will provide reactive compensation for the converter terminal. The AC filters, and the capacitor banks will be air insulated and located outdoors. The reactor will be oil insulated and also installed outdoors.
- DC Switchyard – The terminal will include a ±320 kV DC switchyard which will be the termination point of the HVDC line. The DC switchyard will be air insulated and located outdoors.
- DC Filters – As with the prior design, the terminal will include DC filters consisting of capacitors, reactors and resistors. The DC filters will be designed to prevent the injection of harmonic currents into the DC transmission system. The DC filters will be air insulated and located outdoors.

Northern Pass does not yet have a replacement for Exhibit 6, a drawing of a typical arrangement for a VSC converter terminal, but we will provide one to DOE when it becomes available.

7. AC System Interconnection

As in the prior design, the Project's interconnection to the New England electrical system will be at the existing PSNH Deerfield Substation located in Deerfield, New Hampshire. The 345 kV AC line from the converter terminal will connect to an existing terminal in the Deerfield Substation. In order to establish the new line position for the 345 kV line from the converter terminal, an existing 345 kV line connection in the substation will be relocated. This will require the addition of terminal structures, 345 kV switches, breakers, bus work, instrument transformers and associated protection and control devices inside the existing Deerfield Substation.

8. AC System Support Projects

As Northern Pass previously explained, ISO-NE Tariff Section I.3.9 requires the preparation of a system impacts study for any transmission project. The ISO-NE evaluation of the 1,200 MW Project indicated that certain upgrades to existing AC transmission facilities, which were described in the Amended Application, would be required to achieve an interconnection with the New England electrical grid. Northern Pass anticipates that ISO-NE will complete the I.3.9 evaluation for the Project with a transfer capability of up to 1,090 MW in the near future, and it anticipates that there will be little or no change from the upgrades described in the Amended Application, except that the Project anticipates that it will not be necessary to reconductor the 345 kV AC transmission line from the Scobie Pond Substation to the Lawrence Road Substation in Hudson, New Hampshire. The Project also anticipates that it will not have to reconductor the two 345 kV lines from Deerfield to Scobie Pond, but it will raise nine or so structures by approximately five feet and one structure by approximately ten feet to achieve the required line ratings.

Once ISO-NE's I.3.9 review is complete, Northern Pass will provide DOE with a copy of ISO-NE's report and detailed information regarding any changes to the AC system upgrades that ISO-NE determines are required.

9. Bulk Power System Information

i. Expected Power Transfer Capability

The Project's rated power transfer capability between the Québec and the New England transmission systems is approximately 1,000 MW, *i.e.,* it is designed to deliver 1,000 MW of power, with the potential to deliver 1,090 MW, at the Deerfield Substation, which is the termination point of the Project.

ii. Interference Reduction Data

As with the prior Project design, the potential for electrical interference associated with the HVDC line has been analyzed for the conductor configurations described above. Radio interference is generated by corona occurring on the conductors. The conductor and DC voltage selected for this line results in a relatively low level of corona, which in turn minimizes radio interference. Historically, transmission lines could result in electrical interference with analog television signals. This kind of interference no longer occurs because television is now broadcast digitally throughout the United States.

Similarly, as with the prior Project design, electrical interference from the converter terminal will be addressed in Project design standards. Specifically, equipment spacing and minimum conductor size requirements have been established to minimize electrical interference. Additional criteria regarding other converter terminal design features will be developed during the Project's detailed design phase to further minimize interference effects.

iii. Relay Protection

As with the prior Project design, the southern HVDC converter terminal's protective relaying systems will utilize microprocessor-based devices that conform to Eversource Energy, Institute for Electrical and Electronics Engineers, North American Electric Reliability Corporation and Northeast Power Coordinating Council requirements. Specific protection schemes, equipment and functional devices will be determined during the Project's detailed design phase.

10. Rebuilding Existing Facilities

In the new Project design, Northern Pass continues to take advantage of existing transmission ROW to the maximum extent feasible in order to minimize environmental and other impacts of the Project. There are areas along the existing ROW where relocating existing electric lines is necessary. In these areas, the existing 115 kV transmission lines and 34.5 kV distribution lines will be relocated within the ROW to create room for the Project facilities.

The need to relocate existing transmission or distribution lines is determined by total space available within the ROW, required clearances between lines within the ROW, and distances to the edges of the ROW. Clearances required between lines and between lines and vegetation (tall-growing trees) at ROW edges are governed by NESC requirements designed to assure safe and reliable transmission and distribution line operation.

In order to maximize the use of existing ROW and reduce structure heights in the HVDC portion of the Project, approximately 39.5 miles of existing 115 kV lines and 11.7 miles of 34.5 kV lines will be relocated. For the 345 kV AC portion of the Project, approximately 22.8 miles of existing 115 kV lines and 6.5 miles of 34.5 kV lines must be relocated.

C. Additional Project Benefit Commitments

In connection with its public announcement of its intention to put an additional 52.3 miles of the Project underground, Northern Pass also committed to provide two additional substantial benefits to the people of New Hampshire. Specifically, Northern Pass agreed to dedicate 5,000 acres of land for preservation, recreation and mixed use in the North Country of New Hampshire. Northern Pass also committed to establish a $200 million Forward NH Fund that will provide support for economic development programs, clean energy innovations, and programs to grow jobs and support tourism throughout the State. These benefits will become available as a direct result of the construction and operation of the Northern Pass Project.

Conclusion

Northern Pass requests that DOE accept this amendment of its application for a Presidential Permit. Northern Pass no longer supports those overhead elements of the Project as proposed in the July 1, 2013 Amended Application that are replaced by the 52.3 miles of underground construction described in this amendment. Northern Pass proposes to build the Project described herein, which is comprised almost entirely of elements of the Proposed Action (Alternative 2), Alternative 4C and Alternative 5c, as described in the Draft EIS that DOE issued in July. Thus, Northern Pass believes that the potential impacts associated with the new design are fully evaluated in the Draft EIS.

Northern Pass would be pleased to provide any additional information that DOE may require.

Respectfully submitted,

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