UNITED STATES OF AMERICA
BEFORE THE
DEPARTMENT OF ENERGY
OFFICE OF ELECTRICITY DELIVERY AND
ENERGY RELIABILITY

NORTHERN PASS TRANSMISSION LLC

DOCKET NO. PP-371

AMENDED APPLICATION

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LIST OF ABBREVIATIONS

AAAC	All-Aluminum Alloy Concentric-Lay-Stranded
AC	alternating current
ACSR	Aluminum-Conductor Steel-Reinforced
ASCE	American Society of Civil Engineers
CEII	Critical Energy Infrastructure Information
CHPE	Champlain Hudson Power Express
CLRT	Connecticut Lakes Realty Trust
DC	direct current
DOE	United States Department of Energy
DSM	demand-side management
EEI	Edison Electric Institute
EIS	Environmental Impact Statement
EO	Executive Order
EPA	United States Environmental Protection Agency
EPRI	Electric Power Research Institute
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRMs	Flood Insurance Rate Maps
GIS	geographic information system
GRP	Grassland Reserve Program
HRE	Hydro Renewable Energy, Inc.
HVDC	high voltage direct current
ISO-NE	Independent System Operator – New England Inc.
LMP	locational marginal price
NEL	Northeast Energy Link
NEPA	National Environmental Policy Act
NESC	National Electric Safety Code

NHDES	New Hampshire Department of Environmental Services
NHDHR	New Hampshire Division of Historical Resources
NHDRED	New Hampshire Department of Resources and Economic Development
NHFGD	New Hampshire Fish and Game Department
NHNHB	New Hampshire Natural Heritage Bureau
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NWI	National Wetland Inventory
OPGW	optical groundwire
PSNH	Public Service Company of New Hampshire
RGGI	Regional Greenhouse Gas Initiative
ROW	right-of-way
SWQPA	Shoreland Water Quality Protection Act
TSA	Transmission Service Agreement
USACE	United States Army Corp of Engineers
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WMNF	White Mountain National Forest
WRP	Wetlands Reserve Program

INTRODUCTION

Pursuant to Executive Order (EO) 10485, as amended by EO 12038, and 10 C.F.R. § 205.320 *et seq*., Northern Pass Transmission LLC (Northern Pass or the Applicant) hereby submits this Amended Application to the United States Department of Energy (DOE) for a Presidential Permit authorizing the construction, connection, operation and maintenance of facilities for the transmission of electric energy at the international border between the United States and Canada. This Amended Application does not seek authority for any export of power from the United States. The information that follows is submitted in support of the Amended Application.

OVERVIEW OF AMENDMENTS TO APPLICATION

The Northern Pass Amended Application for a Presidential Permit has the same purpose and need as the Application originally submitted on October 14, 2010, and supplemented on February 15, 2011, and April 12, 2011: to build and operate a participant-funded transmission line to deliver 1,200 MW of competitively priced, clean, low-carbon, baseload power (approximately 98 percent hydropower) from Québec to New Hampshire and the rest of New England (the Project). The Project benefits remain substantially unchanged. The Project will:

- reduce regional wholesale power prices an estimated $206 to $327 million dollars annually;
- reduce CO_2 emissions by up to 5 million tons per year to assist in achieving the recently enhanced goals of the Regional Greenhouse Gas Initiative (RGGI) and the New Hampshire Climate Action Plan;
- create 1,200-1,500 direct and indirect jobs, particularly during construction;
- add up to $1.1 billion in tax revenues in towns throughout New Hampshire over the life of the Project;
- potentially postpone the addition of fossil fuel generation and associated transmission projects;
- provide electrical system benefits that result from the fact that high voltage direct current (HVDC) systems are highly dispatchable and can help balance intermittent resources like

wind, provide emergency support after outages and help meet New England reserve requirements that are falling because of expected retirements of coal- and oil-fired units; and

- reduce New England's heavy dependence on natural gas for power generation and thereby contribute to the solution of a reliability problem that Independent System Operator-New England Inc. (ISO-NE) has characterized as unsustainable.

The amended proposed route for the Project is 187 miles long. It is substantially unchanged in the Central and South Sections and in portions of the North Section – covering 135 miles of the 187 mile total length of the Project. The proposed route also continues to maximize the use of existing right-of-way (ROW). Specifically, it increases the use of existing ROW over the originally preferred route in both the North and South Sections. Additionally, in response to public feedback voiced about the visibility of the Project and its potential impact on private landowners, Northern Pass has substantially reconfigured the North Section to move the proposed route to a less populated area and to construct it in large part on land that Renewable Properties Inc., a Northern Pass affiliate, has purchased or leased, or where it otherwise has the right or ability to use the land for Project purposes. Northern Pass has also made changes in its design of the Project to reduce the visibility of the line.

This Amended Application reflects the following key developments in the Project since the filing of the original Application on October 14, 2010:

1. Northeast Utilities and NSTAR, previously partners in the Project, have merged.

2. Northern Pass has abandoned all previously identified alternative segments for the Project, with the exception noted in item 3 below.

3. Northern Pass has determined that the Project can meet the applicable requirements of the Federal Aviation Administration (FAA) for the construction of transmission structures near airports. This allows Northern Pass to locate the Project along the existing ROW near the Concord Airport, which is a segment Northern Pass originally designated as an

alternative route in the South Section. Thus, Northern Pass no longer needs or supports use of the route through Concord, Pembroke and Chichester, which was originally designated part of the preferred route in order to avoid the area near the airport.

4. To respond to public feedback about both the potential visual impacts of the Project and potential impacts on property rights, Northern Pass has selected a new proposed route for a portion of the North Section of the Project, the approximately 40 mile stretch where there is no existing transmission ROW. From the U.S./Canadian border, the proposed route now goes east and south through a less densely populated area of New Hampshire than the original route. Specifically, the towns in this portion of the North Section have a 70% lower population than the towns in which the previously proposed route was located. In addition, the new portion of the North Section is now in substantial part located on land that an affiliate of Northern Pass has purchased or leased, or obtained an easement from willing landowners. Compared to the original preferred route, this portion of the proposed route uses 155 fewer parcels of land (an 83% decrease). It also includes two underground segments, 2,300 feet and 7.5 miles in length respectively, and it includes the use of additional existing ROW in the towns of Dummer, Stark and Northumberland.

5. Since Northern Pass filed its original Application, New Hampshire amended its eminent domain law to preclude the use of eminent domain for projects like Northern Pass. The Amended Application addresses the amendment and its practical impact on routing for the Project. In particular, this change in law substantially limited the routing alternatives available to the Project. It required Northern Pass to focus on areas where there were landowners willing to sell or lease land, or grant an easement for Project use. The new proposed route in the North Section, where there is no existing transmission ROW, reflects the substantial success of Northern Pass in working with willing landowners to arrive at mutually acceptable terms for the creation of a new transmission corridor.

6. Northern Pass has significantly advanced the design of the Project, enabling it to provide more detail on proposed transmission structure locations and heights along the entire

proposed route. Northern Pass carried out this design work with the specific objective of reducing the visibility of the Project by taking advantage of natural topography and forested buffers and using reduced structure heights where possible. The Amended Application includes detailed information about structure heights and design and visual simulations that reflect the transmission structures in selected locations along the route.

7. The Amended Application presents one short alternative underground routing option in the new portion of the North Section. This alternative would be located on property that Renewable Properties Inc., a Northern Pass affiliate, has acquired, with the exception of approximately 100 feet that is privately owned and subject to a conservation easement. The alternative would involve a 1,100 foot underground segment that would cross under this 100 foot stretch of private land. Use of this alternative would require the consent of Connecticut Lakes Realty Trust (CLRT) and New Hampshire Department of Resources and Economic Development (NHDRED).

8. The Amended Application addresses more than a dozen alternatives that commenters on the Project have suggested might either take the place of the Project or represent an alternative design of the Project, including, for example: different routing alternatives (New York, Maine, Vermont); different Project designs (underwater, various lengthy underground options); different ways of meeting New England's power needs (local renewables, efficiency, demand-side management, natural gas); and different structure designs. Northern Pass shows that virtually all of the alternatives presented suffer from some combination of significant technical, economic, legal, environmental and practical challenges that would result in abandonment of the Project and would otherwise fail to meet the purpose and need for which the Project has been designed.

9. The Amended Application includes additional information on the potential environmental impacts of the Project and proposed measures to avoid or mitigate those impacts.

10. The Amended Application provides additional information on the historic and cultural resources in the general area of the Project, including the results of preliminary archeological surveys.

11. The Amended Application provides power system flow plots for the Project. They consist entirely of confidential Critical Energy Infrastructure Information (CEII), as designated by the Federal Energy Regulatory Commission (FERC) – information that Northern Pass routinely treats as confidential business information. Thus, the power system flow plots are being submitted as a confidential addendum to the Amended Application.

12. The Amended Application describes some modest adjustments to the technical specifications of the Project design, reflecting additional design work that has been completed.

13. The Amended Application addresses the ability of the Project to respond to the growing concern in ISO-NE about the impact on reliability of over-reliance on natural gas-fired power generation in the region and the substantially enhanced greenhouse gas reduction targets that the RGGI recently recommended for adoption by participating states and that the New Hampshire legislature has voted to approve.

14. To avoid confusion, Northern Pass has adopted a new system for designating exhibits, using numbers instead of letters. Previously submitted exhibits are among those that have been re-designated.

This Amended Application has been structured to allow DOE, cooperating federal agencies and interested members of the public to find in a single document both previously submitted and new information relevant to the Project as reconfigured. The Amended Application thus can be used in place of the Application that Northern Pass originally submitted on October 14, 2010, and supplemented on February 15, 2011, and April 12, 2011.

SECTION 1 – INFORMATION REGARDING THE APPLICANT

Northern Pass is a special purpose entity created to construct, own, operate and maintain the Project. The Project will capitalize on Hydro-Québec's excess capacity from hydroelectric generating facilities by enabling the delivery of approximately 1,200 MW of competitively priced, clean, low-carbon power into New Hampshire and the New England region.[1] The Project will be participant-funded by Hydro Renewable Energy, Inc. (HRE), an indirect, wholly-owned U.S. subsidiary of Hydro-Québec, under a Transmission Service Agreement (TSA) that was approved by the FERC on February 11, 2011.[2]

1.1 Legal Name of the Applicant

The legal name of the Applicant is Northern Pass Transmission LLC. Northern Pass has its principal place of business at Energy Park, 780 North Commercial Street, Manchester, NH 03101. Northern Pass is wholly owned by NU Transmission Ventures, Inc., itself a wholly-owned subsidiary of Northeast Utilities, a publicly-held public utility holding company. NU Transmission Ventures, Inc. has its principal place of business at 107 Selden Street, Berlin, CT 06037, and Northeast Utilities has its principal place of business at 56 Prospect Street, Hartford, CT 06103.

1.2 Legal Names of All Partners

Northern Pass is the sole Applicant for this Presidential Permit.

1 The electricity delivered over the Project will consist of "system" power comprised of approximately 98% hydroelectric generation, including both run-of-the-river and large hydro, with the balance made up of a combination of other sources of generation. The construction and operation of the Project will not result in Hydro-Québec building any additional hydroelectric generating facilities. Thus, the "no action" alternative (i.e., not constructing the Project) would not result in the cancellation or delay in construction of any hydroelectric generating facilities in Canada.

2 *Northern Pass Transmission LLC*, 134 FERC ¶ 61,095 (2011).

1.3 Communications and Correspondence

All communications and correspondence regarding this Amended Application should be addressed to the following persons:

Anne Bartosewicz Project Director – Transmission Northeast Utilities 107 Selden Street Berlin, CT 06037 (860) 665-2771 bartoab@nu.com	Mary Anne Sullivan Partner Hogan Lovells US LLP 555 13th Street, NW Washington, DC 20004 (202) 637-3695 maryanne.sullivan@hoganlovells.com

1.4 Foreign Ownership and Affiliations

Neither Northern Pass, nor NU Transmission Ventures, Inc., nor Northeast Utilities is owned wholly or in part by a foreign government or any instrumentality thereof. Northern Pass will have an undivided ownership of the Project facilities.

The HVDC facilities located on the Canadian side of the border will be owned and operated by Hydro-Québec TransÉnergie, a division of Hydro-Québec. Additionally, Northern Pass has executed a TSA with HRE, which is an indirect, wholly-owned U.S. subsidiary of Hydro-Québec. The TSA allocates 1,200 MW of transmission capacity over the Project to HRE on the U.S. side of the border in exchange for transmission service payments that cover the costs of, and investment in, the Project.

1.5 Existing Contracts with Foreign Entities for Purchase, Sale or Delivery of Electric Energy

As noted above, Northern Pass has executed a TSA with HRE. Northern Pass has no other direct or indirect contracts for the purchase, sale or delivery of electric energy with any foreign government or foreign-owned entities.

1.6 Corporate Authority and Compliance with Laws

Exhibit 1 is an opinion of counsel stating that the construction, connection, operation and maintenance of the Project is within the corporate power of the Applicant and that the Applicant has complied with and, if the proposed actions are performed in accordance with this Amended Application, will comply with all pertinent federal and state laws.

Neither the acquisition of NSTAR by Northeast Utilities nor any other development identified in this Amended Application changes the originally submitted opinion of counsel.

SECTION 2 – INFORMATION REGARDING THE TRANSMISSION LINES TO BE COVERED BY THE PRESIDENTIAL PERMIT

2.1 Project Overview

Northern Pass proposes to construct an HVDC electric transmission line[3] with a bidirectional 1,200 MW transfer rating running from the international border between New Hampshire and Canada to Franklin, New Hampshire, where it will connect with a 345 kV alternating current (AC) line. The northern HVDC conventional converter terminal will be constructed at the Des Cantons Substation in Québec, Canada; it will be connected to an HVDC line that will run southward in Québec for approximately 47 miles, where it will cross the U.S./Canadian border into Pittsburg, New Hampshire. The New Hampshire segment of the HVDC line will continue southward for approximately 153 miles to the southern HVDC conventional converter terminal. The southern HVDC converter terminal will be constructed in Franklin, New Hampshire. It will convert the direct current (DC) power to AC power.

Northern Pass proposes to construct the 345 kV AC line a distance of approximately 34 miles from the Franklin converter terminal to the Deerfield Substation in Deerfield, New Hampshire, which is owned by Public Service Company of New Hampshire (PSNH), a wholly-owned subsidiary of Northeast Utilities. A map showing the proposed route is attached as Exhibit 2.

Once the Project has completed commissioning and is ready for commercial operation, ISO-NE will assume operational control over the Project pursuant to the terms of a FERC-approved Transmission Operating Agreement between Northern Pass and ISO-NE. The Project will enable the bidirectional transmission of 1,200 MW of power between Québec and New England. Its objective is to provide clean, low-carbon, competitively priced electricity for consumers in New Hampshire and the rest of New England. This objective is consistent with, and will help satisfy the requirements and goals of, several important state and regional policies, including:

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[3] A direct current link is required to connect the Hydro Québec and New England electrical systems as they operate in an asynchronous manner.

- **New Hampshire Climate Action Plan**: The state climate action plan recommended the construction of high voltage transmission lines to bring hydropower and wind power from Canada as a complementary strategy to the development of non-carbon emitting sources of power in New Hampshire.[4]
- **RGGI's greenhouse gas emissions reduction targets**: There is a proposal to significantly tighten RGGI goals. Specifically, a recent agreement by the RGGI members calls for, among other things, lowering the 2014 regional CO_2 cap from 165 million tons to 91 million tons, a reduction of 45%, and prohibiting the reoffering of unsold 2012 and 2013 CO_2 allowances.[5] The New Hampshire legislature has voted to accept these more stringent emissions reduction targets.
- **New England Governors' Renewable Energy Blueprint:** The Blueprint specifically noted that New England's long history of collaborative working relationships with its Canadian neighbors would help it bring cost-effective, secure, low-carbon resources to the New England market.[6]

The Project has other important benefits as well. For example, it will help to respond to the nearly 8,300 MW of potential coal- and oil-fired generation retirements that ISO-NE faces between now and 2020.[7] In addition, it will increase fuel diversity in New England, which has become increasingly dependent on natural gas for power generation. The region's heavy

4 *New Hampshire Climate Action Plan*, at 44 (Mar. 2009), *available at* http://des.nh.gov/organization/divisions/air/tsb/tps/climate/action_plan/nh_climate_action_plan.htm. The Plan further states that the importation of electricity from Canadian hydropower and wind resources "could provide new power sources to offset future local and regional growth and facilitate retiring or curtailing the operation of fossil fuel-fired plants in New England." *Id.*

5 *See* RGGI News Release, *RGGI States Propose Lowering Regional CO_2 Emissions Cap 45%, Implementing a More Flexible Cost-Control Mechanism* (Feb. 7, 2013), *available at* http://www.rggi.org/docs/PressReleases/PR130207_ModelRule.pdf. In order for the updated RGGI requirements to take effect, the nine RGGI states, including all six New England states, will need to revise their CO_2 trading programs through their individual state-specific statutory and regulatory processes, and have such revisions take effect on January 1, 2014.

6 *New England Governors' Renewable Energy Blueprint*, at 40-41 (Sept. 15, 2009), *available at* http://nescoe.com/Blueprint.html.

7 *ISO New England's Strategic Transmission Analysis, New England Electricity Restructuring Roundtable: Generation Retirement Study & 2020 Resource Options,* at 4 (June 14, 2013), *available at* http://www.iso-ne.com/pubs/pubcomm/pres_spchs/2013/final_rourke_raab_061413.pdf.

dependence on natural gas raises serious questions about the reliability of power delivery because the gas is also needed for home heating and industrial uses.[8]

The region will derive still further benefit from the fact that the 1,200 MW of power that the Project delivers will be competitively priced. According to a 2010 report by Charles River Associates, the Project is expected to reduce the wholesale price of power throughout New England by between $206 million and $327 million annually.[9]

Power flows will be baseload, not intermittent in the way that wind and solar power are. Over the long term, the Project will also help to meet future load growth requirements, and it may avoid or defer the need to construct new fossil fuel plants and associated transmission projects that would otherwise be required to produce an equivalent quantity of reliable power.

In its various rulings on the Project, FERC recognized the important benefits the Project will provide. For example, FERC noted: "this Project does not limit competition; in fact, we find that it does the opposite and increases competition by offering New England customers an additional supply resource."[10] In a subsequent decision, FERC also recognized other benefits the Project

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8 In testimony before the House Energy and Commerce Committee Subcommittee on Energy and Power on March 19, 2013, the President of ISO-NE pointed out that, without any unusual demand or weather conditions, in January and February 2013, the region experienced serious physical constraints in moving needed natural gas into the region and that wholesale electricity prices rose 100% and 300% respectively above 2012 levels for those months when generators could not get fuel to run. Testimony at 6, *available at* http://docs.house.gov/meetings/IF/IF03/20130319/100527/HHRG-113-IF03-Wstate-vanWelieG-20130319-U1.pdf. Commissioner Michael Harrington of the New Hampshire Public Service Commission explained that, during both months, New Hampshire "came very close" to having rolling blackouts "because of the natural gas shortages. David Brooks, *New England came close to 'rolling blackouts' in January and February snowstorms*, THE NASHUA TELEGRAPH, Mar. 17, 2013, *available at* http://nashuatelegraph.com/business/997183-464/new-england-came-close-to-rolling-blackouts.html. *See also* discussion *infra* at pages 71-73; ISO-NE Internal Market Monitor, *2012 Annual Markets Report,* at 3 (May 15, 2013), *available at* http://www.iso-ne.com/markets/mkt_anlys_rpts/annl_mkt_rpts/2012/amr12_final_051513.pdf (explaining that "[t]he region's use of natural gas for about half its electric energy has revealed both operational difficulties in coordinating the purchase and delivery of the fuel that generators need each day and the potentially insufficient infrastructure to supply all the natural gas the region's residential, commercial, industrial, and electric sectors demand during peak periods.").

9 *LMP and Congestion Impacts of Northern Pass Transmission Project*, at 31 (Dec. 7, 2010), *available at* http://www.northernpass.us/economic-impact/benefits.

10 *Northeast Utils. Serv. Co. & NSTAR Elec. Co.*, 129 FERC ¶ 61,279 at P 22(2009).

will bring to the region, noting that it will "reduce[] price volatility and lower locational marginal prices (LMP) in New England."[11]

FERC also identified a number of specific benefits to the regional power grid. It noted, for example, that the Project "will reduce congestion between Quebec and New England and facilitate integration and delivery of low-cost hydro-electric power. In addition, we find that with the addition of hydro-electric power to the base case, the existence of the [Project] will help mitigate overloads."[12] Finally, FERC commented that the Project "will include making available up to 1,200 MW of hydro-electric power previously unavailable from Quebec. The [Project] will not only diversify New England's power supply mix, but it will also allow more energy imported from Quebec to be delivered during peak hours when marginal generation costs and market-clearing prices are highest."[13]

In its recent report titled "Quantifying the Value of Hydropower in the Electric Grid: Final Report," the Electric Power Research Institute (EPRI) noted that hydroelectric resources "contribute significantly to the reliability of the grid in terms of energy, capacity, and ancillary services."[14] Among the specific potential hydropower benefits the EPRI report identified are: addressing other generation and load variability; providing scheduling that helps to optimize energy and ancillary services; providing fast regulation response; and, as noted above, adding generation diversity. Northern Pass is able to contribute positively to the New England grid in each of these respects.

The Project's use of HVDC technology also offers important benefits. Because it is asynchronous with the AC portion of the grid, the DC link will provide system support and may be able to limit the effects of a cascading blackout. Under most operating conditions, it also

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11 *Northern Pass Transmission LLC,* 134 FERC ¶ 61,095 at P 5(2011).

12 *Id.* at P 26.

13 *Id.* at P 40.

14 EPRI, *Quantifying the Value of Hydropower in the Electric Grid: Final Report,* at 2-4 (Feb. 2013), *available at* http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001023144.

experiences lower line losses (loss of power in the transmission process) over like distances compared to an AC line of similar voltage.

In addition to its energy and environmental benefits, the Project will bring significant economic and fiscal benefits to New Hampshire both during its construction phase and throughout the period the Project is operational. The Project will create an estimated 1,200-1,500 New Hampshire jobs during project construction. Among the jobs that will be created are: construction and forestry jobs, as well as professional and technical services jobs.[15] New economic activity in retail, accommodation and food services and other sectors is also expected, adding approximately $56 million to $69 million annually to New Hampshire household earnings during the construction phase.[16] The Project will also reduce energy costs for New Hampshire customers, saving New Hampshire residential and business customers $20 to $35 million annually. This in turn is expected to result in the creation of an additional 200 jobs in New Hampshire during the time the line is in operation.[17]

Once the Project is operational, it will add significantly to the tax base for both the State of New Hampshire and the 31 municipalities in which Project facilities will be located. Project property aggregate value will contribute an average of 10.2 % to the overall total property value for the towns through which the line will pass. That is expected to translate into approximately $28 million dollars in new tax revenues annually in the form of local, county and state education taxes. Over the 40-year life of the TSA with HRE, the added tax revenues to the state and local governments could total as much as $1.1 billion.[18]

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15 *Proposed Northern Pass Transmission Project Economic Impact Update: Estimated New Hampshire Jobs During 3 Year Construction Phase*, at 4 (Apr. 2011), *available at* http://www.northernpass.us/home/uploaded_file/Job_Impact_Study_April_2011_Final.pdf. The New Hampshire State Building and Construction Trades Council has stated that the Project will bring "overwhelming economic benefits to New Hampshire and countless local communities," and that "one of the biggest benefits of the Northern Pass project is its need for in-state labor…. New Hampshire's loggers, builders, equipment operators and laborers can all fill essential roles in the construction of the transmission line." Joe Casey, *Ignore the Northern Pass Fear and Rhetoric*, N.H. BUS. REV., Feb. 11, 2011, *available at* http://www.nhbr.com/February-11-2011/Ignore-the-Northern-Pass-fear-and-rhetoric/.

16 *Preliminary Economic and Fiscal Impacts of the Proposed Northern Pass Transmission Project,* at 3 (Oct. 2010), *available at* http://www.northernpass.us/pdf/NH_Economic_Impact_Study.pdf.

17 *Proposed Northern Pass Transmission Project Economic Impact Update*, *supra* note 15, at 1.

18 This estimate assumes that tax rates remain at current levels.

2.2 Technical Description

2.2.1. 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 ±300 kV HVDC transmission line. The line will be above ground, except for two short underground cable sections that are described below. The total length of the HVDC portion of the Project is approximately 153 miles.

For the AC portion of the Project, Northern Pass proposes to construct a single circuit 345 kV AC overhead transmission line running from Franklin to Deerfield, New Hampshire. The length of the AC portion of the Project is approximately 34 miles.

2.2.2. Operating Voltage and Frequency

The nominal operating voltage for the HVDC line will be ±300 kV and will consist of positive energized conductors, negative energized conductors and a dedicated metallic return conductor. The nominal operating voltage for the AC portion of the Project will be 345 kV, three-phase at a frequency of 60 Hz.

2.2.3. Conductors

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. The dedicated metallic return will utilize one 2,932.9 kcmil AAAC conductor.

For the underground sections of the HVDC line, two cables are required for the positive pole and two cables are required for the negative pole. The cable will be a mass impregnated type rated for 300 kV DC with a diameter of approximately 4.1 inches. The conductor will be 2,000 mm^2 copper. Two cables are also required for the metallic return. The cable will be a cross linked polyethylene type rated for 35 kV DC with a diameter of 3.4 inches. The conductor will be 2,000 mm^2 copper.[19] Exhibit 3 shows cross-sections of these cables.

The 345 kV AC conductor will be an "Aluminum-Conductor Steel-Reinforced" (ACSR) conductor that has the designation of 1,590 kcmil ACSR "Lapwing." It has an outside diameter of 1.504 inches. Rated breaking strength of this conductor is 42,200 pounds. The proposed design would limit the tension in this conductor to 11,400 pounds under the NESC heavy district loading case. The 345 kV AC line will use a two-conductor bundle for each energized phase.

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 include one shield wire, and the AC structures will include one or two shield wires depending on the structure configuration. 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. In cases where there are two shield wires, the second will be a 19#10 Alumoweld cable. Both the OPGW and the 19#10 Alumoweld cables 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.

19 During the detailed design process, the final size of the pole and metallic return conductors may be modified slightly based upon the thermal analysis of the soil adjacent to the cable.

2.2.4. Additional Information Regarding Overhead Lines

i. Wind/Ice Loading Design Parameters

Transmission structure strength requirements are determined by applying multiple structure loading conditions to each structure design. Structure designs are based on conductor tension, weather conditions and structure location. Multiple structure designs will be used throughout the Project to ensure efficiency.

Using standard industry practices,[20] 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.[21] 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 0ºF. 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 60ºF 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 15ºF.

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[20] Tension limit criteria and loading conditions are governed by national codes, local codes, or project developed standards. Common codes, standards, or guidelines include the NESC, American Society of Civil Engineers (ASCE) Manuals and individual project developed standards.

[21] Northern Pass-developed standards include construction and failure containment loads that are recommended in *ASCE Manual and Report on Engineering Practice No. 74: Guidelines for Electrical Transmission Line Structural Loading*. They are based on historical data from existing transmission facilities in New Hampshire and the rest of New England. These Project-developed standards provide additional reliability to the line.

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 15ºF.

ii. Description of Typical Supporting Structures

Northern Pass proposes to use lattice steel, tubular steel monopole and tubular steel H-Frame (AC line) structures.[22] Exhibit 4 shows the range of structure types that the Project proposes to use. Exhibit 4 also shows possible alternative structure designs.

The proposed structures heights are identified in Exhibit 5.[23] 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. Monopole configurations 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. The tubular steel H-Frame structures will consist of two smaller vertical poles that will be connected near the top of the structure with a crossarm, making them resemble the capital letter "H." Each of the vertical poles that make up the H-Frame structures will have an approximate base diameter of two to three feet, tapering to approximately one foot at the top. The two vertical poles will be separated horizontally by 26 feet. The crossarm is the widest piece of the structure and is approximately 52 feet wide. The H-Frame structures will have a combination of direct embed and concrete foundations. Concrete foundations for the H-Frame structures will be approximately three to four feet in diameter, and the direct embed foundations will consist of placing a portion of the poles into a three to four foot diameter hole and backfilling the hole with either native material, crushed rock or a mixture of the two, which will be compressed to provide a rigid support system. During the detailed

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22 *See* discussion in Section 4.11 regarding structure design.

23 These height ranges are based on the design as of the date of this filing and may change somewhat depending on public input and engineering considerations.

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, a dedicated metallic return conductor and an overhead shield wire. The 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 ±300 kV HVDC energized conductors of 28 feet for V-String insulator configurations and 38 feet for I-String insulator configurations on horizontal structures. Spacing between ±300 kV HVDC energized conductors will be 26 feet for vertical structures. For 345 kV AC energized conductors, the spacing will be 26 feet on horizontal structures and will be 22 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 to 17 feet. Minimum clearance to ground from the conductors will be 30 feet. Energized conductors will be attached to the structure using 20 DC type insulator disks per string.

This will provide approximately 10 feet of clearance between the energized conductors and the de-energized parts of the structure.

For the 345 kV AC circuit, the horizontal distance between an energized phase and the support structure will be 13 to 15 feet. Minimum clearance to ground from the conductors will be 29 feet. Energized phases will be attached to the structure using 17 insulator disks per string. This will provide approximately eight feet of clearance between the energized conductors and the de-energized parts of the structure.

vi. Underground and Underwater Lines

The Project will include two short underground segments. The first underground segment is in the vicinity of the Route 3 bridge-crossing of the Connecticut River in Pittsburg and Clarksville. This underground segment will be approximately 2,300 feet long. The second underground segment is located in Clarksville and Stewartstown. This underground segment will be approximately 7.5 miles long. It begins on property owned by Northern Pass in Clarksville, continues onto Route 145 and progresses along Old County Road into Stewartstown where it will continue onto North Hill Road, Bear Rock Road and to property owned by Northern Pass on Heath Road, where it will transition to an overhead line.[24]

Underground cables will be installed using a combination of construction techniques that include direct bury of the cable, installation of the cable in a duct bank or 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 depth of the directional boring sections will be approximately 65 feet below grade at its maximum depth; and the depth of the jack & bore will be approximately 10 to 15 feet below grade. The exact depth of the trenchless conduit installation, duct bank or direct buried

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24 For the underground segments in state and local roads,, Northern Pass has the ability to construct the line pursuant to New Hampshire law. N.H. REV. STAT. ANN. § 231:160 (2013).

cable may be adjusted based upon the final civil design. Exhibit 3 provides a technical diagram illustrating a cross section of the underground cable.

A facility must be installed at each end of an underground segment to allow transition to the overhead line. The transition station will resemble a small switching station. It will have an area approximately 160 feet by 180 feet, and it will be enclosed by a fence. The equipment at each transition station will include a line terminal structure, surge arresters, instrument transformers, disconnect switches, cable terminators, communications equipment, and a small control building. No cathodic protection is required for the underground segments.

As explained in Section 4.5, the Project will not employ underwater lines.

2.2.5. Southern HVDC Converter Terminal

The conversion from DC to AC will occur at a converter terminal located in Franklin, New Hampshire, on a 118-acre former campground site. The southern HVDC converter terminal will occupy approximately 21 acres of that site. The converter terminal will be designed for a continuous DC to AC transfer rating of 1,200 MW and will use conventional DC converter technology (current source converter technology). The converter terminal will be configured as a bipole system and include a dedicated metallic return conductor. The converter terminal will contain the following equipment and facilities:

- Valve Hall – The terminal will include an electrical enclosure for the thyristor (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 the 1,200 MW transfer rating of the station. The transformers will be located outdoors.

- AC Switchyard – 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 that will provide reactive compensation for the converter terminal. The AC filters and the capacitor banks will be air insulated and located outdoors.
- DC Switchyard – The terminal will include a ±300 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 – 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.

Exhibit 6 provides a drawing of a typical arrangement for a converter terminal.

2.2.6. AC System Interconnection

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.

2.2.7. *AC System Support Projects*

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 Project to date indicates that the following upgrades to existing AC transmission facilities will be required or are necessary to achieve the Project's purpose and need of delivering 1,200 MW:

- Deerfield Substation – The 345 kV AC line from Buxton, Maine to Londonderry, New Hampshire, presently goes by the Deerfield Substation with no electrical connection. This line will be terminated at Deerfield Substation splitting the line into two segments: Buxton, Maine to Deerfield, New Hampshire, and Deerfield, New Hampshire to Londonderry, New Hampshire. Terminating this line at Deerfield will require the construction of an additional 345 kV bay position, which will be done within the existing substation yard. Additionally, 345 kV capacitor banks to provide voltage support will be constructed in an area adjacent to the existing substation yard.

- Scobie Pond 345 kV Substation, Londonderry, New Hampshire – 345 kV capacitor banks to provide voltage support will be constructed in an area adjacent to the existing substation yard.

- 345 kV Transmission Line Upgrades – The two existing 345 kV AC transmission lines between the Deerfield Substation and the Scobie Pond Substation will be reconductored to provide additional power flow capabilities.
- One 345 kV AC transmission line from the Scobie Pond Substation to the Lawrence Road Substation in Hudson, New Hampshire will be reconductored to provide additional power flow capabilities.

The AC system upgrades, while necessary to support interconnection requirements, also provide several reliability benefits to the New England electrical system, including: reactive compensation to help maintain system voltages and reactive reserve; improved power transfer capabilities and greater power deliverability in New Hampshire; and dynamic voltage support to better dampen voltage swings.

ISO-NE should shortly conclude its review of the Project under its I.3.9 process and issue its report. 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 additional AC system upgrades that ISO-NE determines are required.

2.3 General Area Maps and Border Area Map

Exhibits 7, 8 and 9 contain general area maps of the North, Central and South Sections showing the proposed location of the Project facilities. A detailed map showing where the Project proposes to cross the international border is attached as Exhibit 10. This map includes the exact longitude and latitude of the crossing. The proposed crossing point has moved slightly to the south from the originally proposed location, but it is still within Pittsburg, New Hampshire.[25]

2.4 Bulk Power System Information

2.4.1. Expected Power Transfer Capability

The Project's rated power transfer capability between the Québec and the New England transmission systems is approximately 1,200 MW, *i.e.,* it is designed to deliver 1,200 MW of power at the Deerfield Substation, the termination point of the Project. Based on available vendor estimates, the Project's short term overload capability is expected to be in the range of 10% to 15%. The actual short term overload capability will be determined in the detailed engineering design phase.

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[25] In its February 15, 2011 submission, Northern Pass identified two potential alternative border crossings. Northern Pass no longer supports those alternatives because they would lengthen the route, require the acquisition of many more parcels of land (some from unwilling landowners) and offer no apparent environmental or other benefits.

2.4.2. System Power Flow

System power flow plots for the Project are being submitted to DOE as a confidential exhibit, Exhibit 11, to this Amended Application because they consist entirely of confidential CEII, as designated by FERC, information that Northern Pass routinely treats as confidential business information.[26] They show the power flows in the Applicant's service area for heavy summer and light spring load periods, with and without the proposed international interconnection, for the year the Project is scheduled to be placed in service and for the fifth year thereafter.

As explained in Section 2.2.7, ISO-NE should shortly conclude its review of the Project under its I.3.9 process, the process required by the ISO-NE tariff for evaluating the impact of any proposed new transmission facilities on the ISO-NE controlled grid. Northern Pass will provide DOE with the ISO-NE report as soon as the review process is complete and ISO-NE approves the report.

2.4.3. Interference Reduction Data

The potential for electrical interference associated with the HVDC line has been analyzed for the conductor configurations identified in Section 2.2.3. 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.

Interference issues associated with the 345 kV AC line are being addressed using the Project design standards. These standards establish requirements for the conductor size, tension of the line, distance to other lines and distance to the edge of the ROW. The conductor and AC voltage

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26 *See* 18 C.F.R. §§ 388.112-388.113.

selected for this line results in a relatively low level of corona, which in turn minimizes radio interference.

Electrical interference from the converter terminal is also being addressed using 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.

2.4.4. Relay Protection

The southern HVDC converter terminal's protective relaying systems will utilize microprocessor-based devices that conform to Northeast Utilities, 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.

2.5 Rebuilding Existing Facilities

Northern Pass has sought 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 lines along the proposed route is determined by the space available within the ROW. The clearances between lines within the ROW and the distance to the edge of the ROW are governed by NESC requirements that are designed to assure safe and reliable operation of the lines. Where necessary to relocate existing lines, Northern Pass will move them to an open area in the existing ROW that is adjacent to the current location of the existing lines.

In order to maximize the use of existing ROW and to reduce structure heights, in the HVDC portion the Project will relocate approximately 51 miles of existing 115 kV lines and 12 miles of 34.5 kV lines. For the 345 kV AC portion of the Project, approximately 16 miles of existing 115 kV lines and five miles of 34.5 kV lines must be relocated.

There are some areas in Concord where relocation of existing facilities is not necessary to meet code requirements, but the Project will relocate lines in order to significantly reduce structure heights for the 345 kV line. Specifically, six additional miles of 115 kV line will be relocated to allow use of H-frame structures. The H-frame has a typical height of 80 feet, which is the lowest height of the AC structure design alternatives.

Tangent structures on the relocated 115 kV lines will be direct-embedded. This means that part of the structure itself will be buried in the ground to provide the structural support. These direct-embedded structures will have ground openings approximately three to five feet in diameter. Once the structure is placed in the hole it will be back-filled with either native material, crushed rock or a mixture of the two, and compressed to provide a rigid support system. Angle and dead-end structures will be self-supporting, that is, an anchor bolt foundation will be designed to take the larger loading of these structures. These foundations will have a diameter of approximately four to eight feet.

SECTION 3 – INFORMATION REGARDING ENVIRONMENTAL IMPACTS

3.1 Introduction

The Project is designed to provide clean, low-carbon, competitively priced and reliable hydroelectric power from Québec to consumers in New Hampshire and throughout New England. The Project will be located within existing transmission line ROW for 147 miles of the 187 mile total (approximately 79%) in order to avoid or minimize environmental impacts. Of the 40 miles of new transmission corridor, Northern Pass is likewise seeking to avoid, minimize and mitigate environmental impacts while still meeting the construction, performance and reliability needs of the Project.

Northern Pass anticipates that DOE and other federal agencies will thoroughly analyze the environmental impacts associated with the Project during preparation of an Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act (NEPA) and DOE's implementing NEPA regulations. Those impacts will also be reviewed during the state permitting processes. Topics likely to be addressed include land use and infrastructure; geology and soils; engineering; hazardous materials; electric and magnetic fields; impacts on water resources, wetlands and floodplains; impacts on vegetation, wildlife, fish, threatened and endangered species; air quality, climate change and noise considerations; socioeconomic impacts; cultural (archeological, historical, etc.) resources and visual resources; and electric system operation and reliability, including the Project's ability to assist in reducing the region's growing dependence on natural gas for power generation.

In the discussion that follows, Northern Pass describes the Project impacts that it is aware of based on its analysis to date. Northern Pass also describes some of the measures it plans to take in order to minimize Project impacts.

3.2 Assessment of Environmental Impacts

Northern Pass has performed a preliminary assessment of the potential environmental impacts of the Project, including the impacts on both natural and cultural resources. Some of the resulting information was included in the original Northern Pass Application filed in October 2010. The discussion that follows includes both that information and additional information that Northern Pass has collected in the interim. As noted above, Northern Pass anticipates that the information presented here will be further refined, expanded and updated through DOE's NEPA review and the federal and state permitting processes.

The effort to develop a proposed route for the Project began with the establishment of a project area. The boundaries of the Project area were established based on the need to (i) locate a transmission line crossing at the border between Québec and New Hampshire and (ii) connect into the AC system grid at a location that allows for the delivery of 1,200 MW. Power flow and environmental routing analysis studies were used to establish the proposed site of the HVDC converter terminal in Franklin and the AC terminal location at the existing Deerfield Substation.

In its initial consideration of siting options, Northern Pass sought to minimize environmental impacts by, among other things, maximizing the use of existing ROW, avoiding conservation areas and identifying the shortest route feasible. Specifically, the original routing effort included examining publicly available information databases and data collected through meetings with state and federal natural resource agencies, non-governmental organizations and other interested stakeholders. Primary sources of data were color aerial photographs, field identification of residences, businesses and public facilities, and geographic information system (GIS) data from various state and local agencies. The GIS data included federal and state lands, conservation easements, historic and archaeological resources, parks, surface waters and other resources. Most of the data was quantified using GIS software; additional data was calculated by measuring information directly from the aerial photography.

Using GIS software, all of this information was incorporated into maps of the Project area so that the locations of known constraints, such as publicly or privately held conservation areas, could be identified and taken into consideration and so that constraint maps could be developed. The objective was to identify routes that began at the international border between Canada and New Hampshire, extended to the converter terminal location in Franklin and continued to the Deerfield Substation, while avoiding or minimizing impacts to both population centers and natural resources.

Route segments were then laid out within the Project area to create hundreds of potential route variations, avoiding known constraints to the extent possible, and taking advantage of opportunities to follow existing linear facilities such as transmission line corridors, roads, and railroads where the Project could share existing ROW. The potential routes consisted of individual segments that could be combined to form a continuous path between endpoints. This step included consideration of multiple alternatives through each section of the Project area. A first level review of these initial alternatives resulted in the elimination or modification of some alternatives because of either potential impacts to human or natural resources, or engineering barriers such as steep slopes.

Northern Pass then conducted a second level review in which it quantified the social and environmental resources that would be affected by the remaining route alternatives. This evaluation of the routes included applying a numeric value to each of the alternative segments based on the potential effects on resources in that segment. The quantitative data were totaled for all of the potential routes. These data were used in evaluating the remaining alternatives, through the application of a mathematical comparison of the routes, to identify the routes with the least overall social and environmental impacts. This process resulted in the route and the alternative segments Northern Pass proposed in October 2010.

Northern Pass originally anticipated that it would address property acquisition at a later step in the process, as is commonly done for transmission projects. However, the original proposed route and alternative segments triggered public comments, especially in areas with no pre-existing ROW. As a result, Northern Pass undertook a partial rerouting effort designed to respond to feedback received from the public. The rerouting focused on the portion of the North Section where there is no existing transmission ROW.

In undertaking a reconfiguration of the route, Northern Pass used the information it had collected in its original routing effort, but it also took account of public comments, particularly those associated with visibility. It focused on routing options in less populated areas to the extent possible, and it undertook an extensive property acquisition effort, negotiating mutually acceptable arrangements with willing landowners. The result is a proposed route that is located slightly further east than the original route, continues to maximize use of existing ROW, traverses a far less populated portion of northern New Hampshire, and relies in large part on property that an affiliate of Northern Pass has acquired in fee or by way of lease or easement for Project purposes from willing property owners.

The result of this effort is that existing ROW constitutes 79% of the new proposed route. For the northern 40 miles where there is no pre-existing transmission ROW, Northern Pass is using a combination of 7.5 miles of developed transportation corridors and 32.25 miles of land that an affiliate of Northern Pass has in large part purchased or obtained rights to use for the new ROW. This portion of the new route involves 155 fewer landowner parcels than would have been required for the section of the original route above the Lost Nation Substation, an 83% decrease, and goes through towns that collectively have a 70% lower population than the towns in which the previously proposed route was located.

Like the original route, the proposed route is divided into three geographic sections, North, Central and South. Only the North Section has changed substantially:[27]

- North Section - The 70 mile section located between the U.S./Canadian border and Whitefield Substation, in Whitefield, New Hampshire, that is shown on Exhibit 7;

[27] As explained in Section 4.2.1, Northern Pass has withdrawn its support for the alternative segments in the Central and South Sections that were described in the original Application.

- Central Section - The 83 mile section from the Whitefield Substation to the converter terminal in Franklin, New Hampshire that is shown on Exhibit 8; and
- South Section - The 34 mile AC portion of the Project from the converter terminal in Franklin to the existing Deerfield Substation in Deerfield, New Hampshire that is shown on Exhibit 9.

Field investigations were conducted in the winter, spring and summer of 2010 on most portions of the proposed route located on existing ROW. These field studies included wetland and stream delineations; vernal pool surveys; threatened and endangered species surveys; wildlife habitat assessments and tracking; and archeological Phase I-A surveys. To date, evaluation of the new portions of the proposed route has been based primarily on a desktop analysis of existing natural and cultural resource data. A description of the resources along the proposed route follows.

3.2.1. Wetlands, Floodplains and Water Resources

Avoiding and minimizing impacts to rivers, streams, lakes, ponds, floodplains and wetlands crossed by the Project is an important Project objective. The Project corridor contains several large wetland systems and many smaller ones; several large rivers and floodplains; many ephemeral, intermittent and perennial streams; several ponds; and vernal pools. Wetlands, floodplains and streams along the proposed route are listed in Exhibit 12. The Project is being designed to minimize impacts to these features, and many will be avoided completely.

There will be some ground disturbance associated with the installation of the transmission structures and foundations. Temporary access road construction and matting, temporary crane pads and adjacent transmission line relocations also have the potential to directly impact wetlands, streams and vernal pools. There will be some removal of trees in wetlands, along streams and in vernal pool buffers. This has a secondary impact, in that it may change the structure and function of the habitat. However, the overhead transmission lines will span sensitive resources, and structure foundations and access roads will be located outside of wetlands and vernal pools to the extent practicable.

The Project will adhere to all state and federal regulations pertaining to wetland and stream resource protection. For example, New Hampshire's stream-crossing rules will apply to all streams and rivers that must be crossed by equipment. Any permanent stream crossing structures (culverts and bridges) required for the Project will meet design criteria based on detailed stream analysis and classification. Additionally, the Project will comply with all requirements of the New Hampshire Shoreland Water Quality Protection Act (SWQPA), which places restrictions on clearing and earth disturbance within the protected shoreland of public waters, Designated Rivers, and fourth order and larger streams. Erosion and sediment controls will be used to protect surface water quality in all streams, including those in the White Mountain National Forest (WMNF), which are designated by the New Hampshire Department of Environmental Services (NHDES) as Outstanding Resource Waters.

For both temporary and permanent direct and secondary wetland impacts that are unavoidable, Northern Pass will implement mitigation measures in consultation with the responsible resource agencies. Natural resource mitigation is expected to include active restoration of temporary Project impacts by grading, seeding, and planting appropriate native vegetation; possible restoration of degraded wetlands or streams in other locations in the Project watersheds; and preservation of in-kind resources in geographically appropriate locations. Additionally, Northern Pass anticipates an in-lieu-fee component of mitigation, in the form of a contribution to the NHDES Aquatic Resource Mitigation fund.

Northern Pass has begun coordination with the NHDES, the Environmental Protection Agency (EPA), the United States Fish and Wildlife Service (USFWS) and the U.S. Army Corps of Engineers (USACE), and that will continue during the permitting process. Northern Pass also anticipates that DOE will undertake an analysis of floodplain, wetland and water resource impacts during its review of the Project under NEPA.

The sections that follow describe the wetlands, floodplains and water resources in each area of the Project, and the nature of the potential impacts to those resources, if any.

i. North Section

Northern Pass has conducted field surveys on 18 miles of the 70-mile North Section – covering the existing transmission ROW between the Lost Nation Substation in Northumberland and the Whitefield Substation. The remaining 52 miles north of the Lost Nation Substation, comprised of a combination of existing ROW, developed transportation corridors and newly acquired property interests, were evaluated through either a preliminary field review or a desktop analysis using publically available data sources. The following descriptions of the natural resources present along the North Section are based on a combination of these field surveys and desktop analyses.

The North Section spans several fourth order or greater streams and rivers that are subject to the SWQPA. These include the Connecticut River, which is also a Designated River under the New Hampshire Rivers Management and Protection Act and an American Heritage River under the EPA's American Heritage River Protection Program; the Upper Ammonoosuc River; Otter Brook; the Israel River; and Halls Stream. The North Section also includes approximately 50 other named and unnamed perennial streams or stream segments, and numerous intermittent and ephemeral streams. By spanning the majority of these streams and rivers overhead, the Project minimizes direct impacts to these resources. In areas where the transmission line will be located underground, measures will be taken to minimize impacts, including directionally boring under the larger channels and replacing culverts where necessary. Although there will be some secondary water quality and habitat effects from canopy reduction, mitigation will be undertaken to address those effects.

In reconfiguring the proposed route in the North Section, Northern Pass has avoided all lakes or ponds that are subject to the SWQPA.

Based on a review of the May 26, 2011 Federal Energy Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) for Coos County, there are floodplains associated with Phillips Brook and the Upper Ammonoosuc River in Stark; the Connecticut River in Clarksville and

Pittsburg; Halls Stream in Pittsburg; Roaring Brook and Dean Brook in Northumberland; and the Israel River and Otter Brook in Lancaster. The proposed route crosses approximately two linear miles of floodplain. At this point in the Project design, Northern Pass does not anticipate that it will have any impact on flood storage in these floodplains.

Based on a combination of field surveys, National Wetland Inventory (NWI) mapping and Natural Resource Conservation Service (NRCS) data that maps poorly and very-poorly drained soil, the 70 mile long center line of the North Section crosses an estimated 15 linear miles of wetlands. Direct, permanent wetland impacts will be small, as the overhead lines will span wetlands and structures will be located in upland areas to the extent practicable. Approximately four miles of these wetlands are currently forested and clearing will result in conversion of portions of these forested wetlands to shrub and emergent wetlands. In addition, seven vernal pools are known to be present in the field surveyed portion of the North Section between the Lost Nation Substation and the Whitefield Substation.

Field delineations of wetland boundaries and vernal pool surveys for the remaining portions of the North Section are underway and will be completed according to generally accepted methods and standards and included in future Project documents and permit applications. Northern Pass will submit the resulting data when it becomes available.

ii. Central Section

The Central Section includes approximately six linear miles of primarily shrub and emergent wetlands. In Lincoln, the existing electric transmission line ROW passes through Bog Pond, a large pond/wetland system in the WMNF, portions of which are subject to the SWQPA. The Central Section also includes 119 ephemeral streams or stream sections, 132 intermittent streams and 128 perennial streams, including eight that are covered by the SWQPA. These are the Johns River, the Ammonoosuc River, the Gale River, Moosilauke Brook, the Pemigewasset River, Eastman Brook, the Mad River and the Squam River. The Ammonoosuc River is also a Designated River under the New Hampshire Rivers Management and Protection Act. In addition, Northern Pass has documented 82 vernal pools within the Central Section. By spanning these waterways overhead, the Project minimizes impacts to these resources. Additionally, the use of existing ROW minimizes tree clearing.

Northern Pass has reviewed FEMA FIRMs for Grafton, Merrimack and Coos Counties.[28] In Grafton County, the proposed route passes through 22 Zone A or Zone AE floodplains (i.e., land subject to a one percent chance of annual flooding) associated with 18 different water courses. The total length of Zone A or AE areas along this portion of the Project route is just over two miles. In Merrimack County, the proposed route passes through four Zone A or Zone AE floodplains for a length of approximately one-half mile. In addition to Zone A and Zone AE, approximately 100 feet of the Central Section is mapped as having a 0.2% annual chance of flooding. The preliminary Coos County FEMA maps did not identify any floodplains in the Central Section.

iii. South Section

The proposed South Section route center line intersects approximately six miles of primarily shrub and emergent wetlands, including the southwestern edge of Turtle Pond (also known as Turtletown Pond) in Concord, portions of which are covered by SWQPA. There are 17 vernal pools documented in the South Section. However, the overhead transmission lines will span these sensitive resources, and structure foundations and access roads will be located outside of wetlands and vernal pools to the extent practicable.

The South Section ROW also includes 36 ephemeral streams, 39 intermittent streams and 27 perennial streams or stream segments. The South Section crosses four rivers: the Merrimack River in Northfield and Franklin; the Soucook River; the Suncook River; and the Lamprey River, all of which are covered under the SWQPA. This portion of the Merrimack River and the Lamprey River are also Designated Rivers under the New Hampshire Rivers Management and Protection Act. By spanning these waterways overhead, the Project minimizes impacts to these

[28] FEMA maps for Belknap County are not available.

resources. Additionally, the use of existing ROW minimizes tree clearing.

Northern Pass reviewed FEMA FIRMs for Rockingham and Merrimack Counties. In Rockingham County, the Project traverses five Zone A floodplains (i.e., areas subject to a one percent chance of annual flooding). The total length of Zone A areas along this portion of the proposed route is slightly greater than one-half mile. In Merrimack County, the proposed route passes through 11 individual Zone A or Zone AE floodplain areas that sum to less than one mile of the segment. In addition to Zones A and AE, approximately 500 linear feet of this section is mapped as having a 0.2% annual chance of flooding.

iv. Southern HVDC Converter Terminal

The Franklin converter terminal site, located on a former campground, is comprised of approximately 118 acres, of which approximately 14 acres are mapped wetlands. Approximately 3,500 linear feet of streams, including one perennial and three ephemeral streams and two vernal pools, are located on the site. Northern Pass will site the converter terminal to avoid affecting these resources.

v. AC System Support Projects

The required expansion area at the Deerfield Substation includes approximately one acre of wetlands and 350 linear feet of streams. The wetland resources at the Scobie Pond Substation expansion area are minimal; they will be quantified once field investigations are completed. The Deerfield to Scobie Pond corridor connecting these substations is approximately 18 miles long and contains two transmission lines. The Scobie Pond to Lawrence Road Substation ROW is approximately 11 miles long and contains several transmission lines. These corridors were evaluated principally through desktop analysis using publically available data sources, although some pre-existing field-delineated data were used for the Scobie Pond to Lawrence Road corridor. The necessary upgrades to the lines in these corridors are similar in nature to the periodic line maintenance and upgrade work that typically occurs on transmission lines, and natural resource impacts associated with such work are typically minor and mostly temporary in nature.

The Deerfield to Scobie Pond corridor spans the Lamprey and North Branch Rivers, which are both Designated Rivers and subject to SWQPA. The corridor also includes several named and unnamed streams and drainages, including Shields Brook, Fordway Brook and Beaver Brook. The Deerfield to Scobie Pond corridor does not cross any lakes or ponds that are subject to SWQPA.

The Scobie Pond to Lawrence Road corridor includes several named and unnamed streams, including Beaver Brook, Chase Brook and Nesenkeag Brook. This part of the corridor does not cross any waters that are subject to SWQPA.

Based on a review of the FEMA FIRMs for Rockingham County, there are several Zone A, Zone AE and subject to a 0.2 percent annual chance of flooding floodplains located along the Deerfield to Scobie Pond corridor, most of which are associated with the larger perennial drainages and ponds including the Lamprey River, North Branch River, and other named and unnamed water resources. In total, the Deerfield to Scobie Pond corridor crosses approximately two and a half miles of these mapped floodplain areas. No permanent impacts to flood storage in these floodplains are expected.

A review of the FEMA FIRMs for Rockingham and Hillsborough Counties reveals several Zone A, Zone AE, and subject to a 0.2 percent annual chance of flooding floodplains located along the Scobie Pond to Lawrence Road corridor, most of which are associated with the larger streams and wetland complexes. This portion of the AC System Interconnect crosses approximately 0.75 miles of these mapped floodplain areas. No permanent impacts to flood storage in these floodplains are expected.

Based on NRCS data mapping of poorly and very-poorly drained soil areas and NWI mapping, the approximately 18 mile long center line of the Deerfield to Scobie Pond corridor crosses an estimated four linear miles of wetlands. Approximately 2.5 linear miles of wetlands are crossed by the center line of the Scobie Pond to Lawrence Road corridor. Field delineations of wetland boundaries and vernal pool surveys will be completed according to generally accepted methods and standards and included in future Project documents and permit applications.

3.2.2. Critical Wildlife Habitat

The proposed route does not cross land that the USFWS has designated as a critical habitat for any endangered species. There currently is no designated critical habitat for any species in the State of New Hampshire.

3.2.3. Threatened or Endangered Wildlife or Plant Life

The USFWS New England Field Office database lists five federal endangered animal species with ranges that encompass portions of the proposed route. They include the eastern cougar, Indiana bat, grey wolf, dwarf wedgemussel and the Karner blue butterfly. The recently updated federal list now includes Canada lynx for New Hampshire. Winter tracking survey results have confirmed the presence of Canada lynx along portions of the proposed route in the North Section. The eastern cougar, Indiana bat and grey wolf are not known to occur in New Hampshire. Dwarf wedgemussel is known to be present in New Hampshire, and a potentially suitable habitat for dwarf wedgemussel is present within 1,000 feet of the proposed route. However, there is no record of this species within this area. The Karner blue butterfly is known to be present along a very small portion of the proposed route in the South Section. In addition to these wildlife species, the USFWS also lists the small whorled pogonia as a threatened plant species with ranges that encompass portions of the proposed route. Based on field inventories conducted to date, neither of these species nor any other federally-listed threatened or endangered plant species have been observed along the proposed Project route.

The New Hampshire Natural Heritage Bureau (NHNHB), in the Division of Forests and Lands at the Department of Resources and Economic Development, is responsible for identifying, tracking and protecting New Hampshire's threatened and endangered plants and exemplary natural communities. The NHNHB maintains a comprehensive database of threatened and endangered species throughout New Hampshire. Four state threatened or endangered plant species and two state exemplary natural communities were documented within the proposed route to date. In the North Section, Wiegand's sedge (endangered) and Medium Level Fen and Poor Level Fen systems (exemplary natural communities) were documented within the portion of the North Section that contains existing ROW, all in the WMNF. In the South Section, spiked needle grass (endangered), wild lupine (threatened) and blunt-leaved milkweed (threatened) were documented within the proposed route. Additional field surveys are planned for targeted species occurrences based on desktop analysis and field survey protocols agreed upon with NHNHB and the USFWS.

The Nongame and Endangered Wildlife Program of the New Hampshire Fish and Game Department (NHFGD) is the steward for the state's endangered or threatened nongame wildlife, that is, species that may not be hunted, fished or trapped. State threatened animal species occurring within 1,000 feet of the proposed route on existing ROW are peregrine falcon in the Central Section, and the eastern hognose snake and the northern black racer (snake) in the South Section. Species-specific surveys have confirmed the presence of American marten (threatened) in the North and Central Sections and northern black racer (threatened) in the South Section of the proposed route. Additionally, Blanding's turtle, listed as state-endangered, was observed during field surveys of the South Section.

Further desktop and field assessments to identify the presence of, or potentially suitable habitat for, other federal and state-listed species not currently known to be present within 1,000 feet of the proposed route are planned. To date, none of these species of interest or sign of their presence has been observed during various Project-related field surveys.

Northern Pass will confer with resource agencies regarding appropriate measures to protect resources and mitigate impacts during construction, including: selecting low impact construction techniques; adhering to timing restrictions for certain activities within known habitats of threatened or endangered species to avoid impacts; conducting field monitoring of construction activities and locations; restoring temporarily disturbed habitats; and providing compensatory habitat preservation for any permanent loss of threatened or endangered species habitat.

Northern Pass will continue to coordinate with the USFWS, the U.S. Forest Service (USFS), EPA, NHFGD, NHNHB, NHDES, USACE and scientists from research institutions and environmental organizations and others to ensure that potential impacts to threatened and endangered species and habitats have been carefully considered and are avoided, minimized or mitigated.

Federal and state lists of threatened and endangered species that may or are known to occur along the proposed route based on agency records, habitat review and field work, from the Lost Nation Substation to Deerfield Substation, are listed in Exhibit 12. Northern Pass will ask NHNHB for its data for the portion of the North Section north of the Lost Nation Substation in Northumberland and the AC System Support Project areas to support the permitting process.

3.2.4. Navigable Waterway Crossing

The USACE designates the Connecticut River as a navigable river in New Hampshire from the Massachusetts Border, north to Pittsburg. The proposed route crosses the Connecticut River once at the town line between Clarksville and Pittsburg under the river bed, resulting in no impacts to the river or its navigability. There will be some temporary construction work within the protected shoreland, which will be conducted in accordance with the SWQPA.

The Project also crosses the Merrimack River. The Merrimack River has been designated by the USACE as a navigable waterway south of Concord to the Massachusetts/New Hampshire border. However, the Project crosses the Merrimack River north of Concord, where the Merrimack River is not designated as navigable. Therefore, Northern Pass will have no impact on the navigable portion of the Merrimack River.

3.2.5. Indian Land

There is no federally-designated Indian land in the areas along the proposed route.

3.2.6. Federal Lands

The proposed route crosses four major federal natural resource areas, the WMNF, the Appalachian National Scenic Trail (Appalachian Trail), the Pondicherry Division of the Silvio O. Conte National Fish and Wildlife Refuge, and the Franklin Falls Flood Control Project.

The proposed route crosses the WMNF in two locations totaling approximately 11 miles, all in areas where there is existing transmission line ROW. Northern Pass proposes to construct the Project within this existing ROW. The Appalachian Trail crosses the proposed route within the WMNF. The policies of both the USFS and the National Park Service (NPS) specify that any new crossings of these lands should be at already disturbed locations, and the proposed route is consistent with those policies. Northern Pass believes that a Special Use Permit will be necessary for one location within an existing transmission corridor in the WMNF.

The Silvio O. Conte National Fish and Wildlife Refuge was established to conserve the abundance and diversity of native plants and animals and their habitats in the approximately seven million acre Connecticut River watershed in Connecticut, Massachusetts, New Hampshire and Vermont. The NPS has designated the refuge a National Natural Landmark. The proposed route crosses approximately one mile of the Pondicherry Division of the Silvio O. Conte National Fish and Wildlife Refuge, on existing ROW.

The Franklin Falls Dam was constructed by the USACE in 1943 on the Pemigewasset River to protect cities and towns along the Merrimack River from flood damage. The Franklin Falls Reservoir lands extend along the Pemigewasset River from New Hampton to Franklin, New Hampshire. The proposed route crosses approximately one mile of Franklin Falls Reservoir lands in Franklin and Hill, New Hampshire in an existing transmission corridor.

The proposed route crosses one property in the town of Lancaster that has a Grassland Reserve Program (GRP) conservation easement held by the United States Department of Agriculture (USDA) NRCS. The goal of the GRP is to protect, restore and enhance grassland, including rangeland, pastureland and shrub land. Approximately 0.4 miles of the proposed route intersects this easement, but exclusively on existing ROW that predates and takes precedence over the GRP easement.

The proposed route also crosses several parcels with Wetland Reserve Program (WRP) conservation easements held by the USDA NRCS – all on existing ROW that predates and takes precedence over the WRP easement.

3.3 Historic and Cultural Resources

Northern Pass completed a Phase I-A archeological survey, which has been accepted by New Hampshire Division of Historical Resources (NHDHR), to address both Native American and historical period European-American archeological resources within the existing ROW along the proposed route and at the proposed HVDC converter terminal site in Franklin. To date, Northern Pass has only done a desktop review of the part of the North Section north of Lost Nation Substation. The Project is following the Section 106 process under the National Historic Preservation Act for identifying and evaluating archeological resources through a phased approach. Upon identifying the presence of a resource, its eligibility status will be assessed using criteria of the National Register of Historic Places. If determined eligible, strategies will be developed to mitigate adverse effects of the proposed undertaking on any subsurface archeological resources that would be considered eligible for inclusion on the National Register of Historic Places. Such strategies could include relocation of proposed ground-disturbing activities, protection of the soil surface with timber mats or other means, or complete excavation/recovery of sites and/or artifacts.

Review of the New Hampshire Old Graveyard Association database revealed that no graveyards have been previously recorded within the portion of the proposed route with pre-existing ROW or at the southern HVDC converter terminal site.

Consistent with Section 106 and complementing the work being conducted by DOE in the EIS process, Northern Pass will support further archeological and historical research and field studies for the Project and coordinate with the State Historic Preservation Office during the NEPA and federal and state permitting processes. Those efforts will enable Northern Pass to develop more refined impact mitigation plans.

In the sections that follow, Northern Pass describes the historic and cultural resources it expects to find in each Section of the Project.

3.3.1. North Section

Northern Pass completed an archeological resources desktop review for the following towns through which the North Section of the proposed route passes: Pittsburg, Clarksville, Stewartstown, Dixville, Millsfield, Dummer, Stark and Northumberland, New Hampshire. Field work and review of other documents available at the NHDHR were completed for the remainder of the North Section of the proposed route in Lancaster, Dalton, Whitefield, and Northumberland south of the Lost Nation Substation. During the NHDHR file search, previously recorded archeological sites within approximately 1.5 miles of the Project corridor (a three-mile wide research area) were noted.

No State or National Register listings or eligible sites are known within the proposed corridor. Only a handful of archeological surveys have previously been completed along the North Section of the Project route, and only a few sites have been recorded within 1.5 miles of the proposed corridor. This available data indicates that both Native American sites and archaeological resources of the historic period may be expected in the proposed Project corridor.

Archeological resources of the historic period are expected to reflect land use patterns related to town growth, development and economy. Resources may also reflect various settlement periods and include components representative of several hundred years of town history. Sites may include components dating to the period of early exploration in the seventeenth century, to the times of the French and Indian Wars in the eighteenth century, to settlement in the late eighteenth century and early nineteenth century, and continued town development into the twentieth century. Resources may be agricultural, industrial, commercial or residential in nature, with such elements as cellar holes, walls, dumps, foundations, mills or dams. Logging camps may be expected as may other types of industrial sites such as tanneries, charcoal kilns, brick kilns or railroad components.

The proposed route would cross overhead of roads reflected on historic maps in the towns along the Project route and underground along several others. Most settlements were positioned within river valleys or along streams, although historic settlements also occurred on higher hillsides. While historic maps show a number of dwellings in proximity to the proposed corridor location, much of the proposed corridor appears to be vacant land, lacking historic period structures and most likely used for timbering. Nevertheless, some remains, features or components associated with dwellings may occur within the proposed corridor. A review of historic maps revealed residences, a school house, sawmills and other structures adjacent to the road along the 7.5 mile underground section. The historic maps and the New Hampshire Old Graveyard Association database indicate the presence of old graveyards in proximity to the 7.5 mile underground portion of the North Section.

Several sensitivity areas were identified in the field surveyed portion of the North Section of the proposed route, including: two in Northumberland, south of the Lost Nation Substation; seven in Lancaster; and four in Whitefield, north of the existing Whitefield Substation.

Northern Pass will complete a full Phase I-A archeological survey for the remainder of the North Section, including full background research and verification during the Phase I-A walkover inspection to define any historic or Native American resources or zones of resource sensitivity. The archeological survey will follow NHDHR guidelines.

3.3.2. Central Section

Based on information obtained from the NHDHR, there is one property within the ROW that is listed on the National Register of Historic Places and one located within the ROW that is eligible for listing. These are, respectively: the Rocks Estate in Bethlehem and a segment of the Appalachian Trail. The Appalachian Trail is a National Scenic Trail designated under the National Trail System Act of 1968. Although the Appalachian Trail in New Hampshire has not been nominated to or listed on the National Register, it is eligible for listing on the National Register. There are no properties on the State Register of Historic Places on the Project corridor.

Northern Pass has completed Phase I-A archeological surveys of the Central Section. They included documentary research, walkover inspection and data compilation. They also considered both Native American and historic period European-American resource potential. Sensitivity areas vary in size and extent from several hundred feet to several thousand feet along the proposed corridor; all are likely to extend beyond the edge of the ROW.

Sensitivity areas were identified in each town along the Central Section of the proposed route, including: one in Whitefield, south of the Whitefield Substation; five in Dalton; nine in Bethlehem; four in Sugar Hill; two in Easton; one in Lincoln; three in Woodstock; ten in Thornton; five in Campton; two in Holderness; four in Ashland; seven in Bridgewater; one in Bristol; nine in New Hampton; four in Hill; and 11 in Franklin, north of the proposed southern HVDC converter terminal. In addition, three Native American and four historic period European-American archeological sites have been previously recorded within the existing ROW along the Central Section of the proposed route.

3.3.3. South Section

Based on information obtained from NHDHR, there are no historic individual properties within the South Section ROW that are listed on the State or National Register or are considered eligible for listing. The Deerfield Center Historic District in Deerfield lies within one mile of the ROW and is listed on the National Register of Historic Places.

Northern Pass has completed Phase I-A archeological surveys of the South Section. They included documentary research, walkover inspection and data compilation. They also considered both Native American and historic period European-American resource potential. Sensitivity areas vary in size and extent from several hundred to several thousand feet along the proposed corridor; all are likely to extend beyond the edge of the ROW.

Several sensitivity areas were identified in each town along the Project's proposed route south of the proposed southern HVDC converter terminal, including two in Northfield, seven in Canterbury, ten in Concord, nine in Pembroke, three in Allenstown and seven in Deerfield. In addition, eight Native American and one historic period European-American archeological sites have been previously recorded within the existing ROW south of the proposed southern HVDC converter terminal.

3.3.4. Southern HVDC Converter Terminal

Northern Pass completed a Phase I-A archeological survey for the proposed southern HVDC converter terminal site. A large section of the converter terminal site was previously developed for use as a campground. The campground facilities include several loop roads, bath houses, and a large playing field with a playground and a pool. While much of the original landscape has been preserved, impacts resulted from such activities as cutting and grading for roadways and camp sites, placement of a septic system, installation of utility lines, and general landscaping. A former gravel pit is located on the property, and extensive logging occurred in the southern sector of the property.

Walkover inspection revealed four broad zones of archeological resources sensitivity within the property. These zones include: two areas of Native American site sensitivity; one zone of historic resource sensitivity associated with standing structures dating to the mid-1800's; and one zone that includes a historic period cellar hole foundation site. The converter terminal facilities will be designed to avoid areas of archeological and historic resource sensitivity.

A review of town files maintained by NHDHR indicated that there are no sites or properties listed on the National or State Registers of Historic Places within the converter terminal site.

3.3.5. AC System Support Projects

Northern Pass completed an archeological resources desktop review for the corridor between the Deerfield Substation and the Scobie Pond Substation in the towns of Deerfield, Candia, Raymond, Chester, Auburn, Derry and Londonderry. Research indicates that no individual properties or districts are listed within the corridor on the State or National Register of Historic Places. Research also indicates that no graveyards have been previously recorded within the Deerfield to Scobie Pond corridor.

A Phase I-A archeological survey was conducted in 1977 for the Tenneco Gas Pipeline project within the Deerfield to Scobie Pond corridor that resulted in identification of one Native American archeological site. Other Native American sites may occur within the proposed corridor, particularly in the vicinity of surface water features such as rivers, streams, ponds or wetlands, as well as in higher terrain where stone may have been available for tool manufacture. Historic maps and sources reveal that the proposed corridor crosses a number of roadways in the towns between Deerfield and Londonderry. Maps depict historic buildings in proximity to the Deerfield to Scobie Pond corridor. It is expected that remains, features or components associated with these historic period structures may be present within the proposed corridor.

A Phase I-A archeological survey was conducted in 2011 for the transmission corridor between the Scobie Pond Substation and Lawrence Road Substation. The results of the field inspection and archival research indicated that this project area was not archeologically sensitive, despite previously recorded sites within and adjacent to the corridor. This finding was based on extensive prior archeological studies approved by NHDHR, and substantial prior disturbance within the corridor.

Northern Pass will complete a full Phase I-A archeological survey for the remaining portions of the AC System Support Project areas, including full background research and verification during the Phase I-A walkover inspection, to define any historic or Native American resources or zones of resource sensitivity. The archeological survey will follow NHDHR guidelines.

3.4 Visual Impacts

Much of the public feedback about the Project has focused on visibility. Locating 147 miles of the Project within existing transmission ROW minimizes visual impacts. In the portions of the North Section of the proposed route where there is no existing transmission ROW, other steps have been taken to minimize visibility. These steps include taking advantage of natural topography and forested buffers, reducing certain structure heights, relocating the proposed route to a less populated area and placing a portion of the line underground. In the South Section, between the Franklin Converter and the Concord Airport, additional 115 kV line relocations will enable Northern Pass to lower structure heights of the 345 kV line.

Visual simulations are used to gauge visual impacts and landscape changes and are an integral part of any visual impact assessment. Exhibit 13 contains visual simulations that Northern Pass has commissioned to indicate what the Project will look like at various locations. These visual simulations will provide communities a sense of what the Project will look like in the landscape from a range of typical vantage points.

Important considerations to take into account regarding the visual simulations prepared for this Project include:

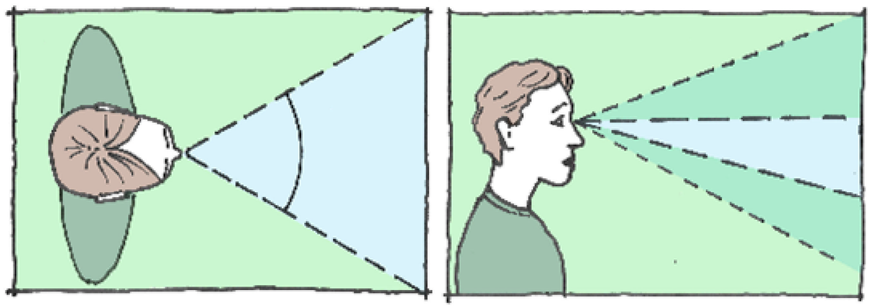
- Visual simulations represent an approximate view of what the Project will look like from one vantage point at one point in time;
- Simulations are developed for places from which the Project may be visible. It is important to recognize that, for every simulation location selected, there are other locations that will have no visibility of the Project and that are therefore not the subject of a simulation. The result is that simulations tend to overemphasize any project's visibility;
- When preparing simulations, the time of day shown is a function of when the field work was done; viewers may experience the Project at other times of day when it may appear differently; and
- Simulation locations are chosen to provide a representative sample of viewing locations.

The simulation locations for the Project were selected for several purposes:

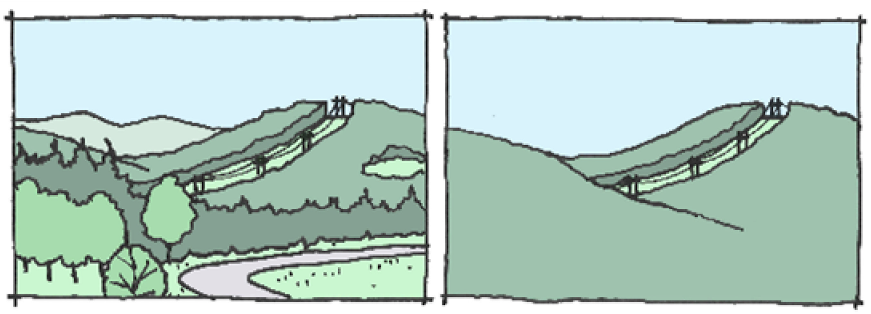
- To convey to the public what the Project will look like at typical locations from which the Project will be visible, including road crossings, highway locations, and public facilities;
- To provide a sense of what the Project will look like from key vantage (observation) points and public viewing areas in the Project corridor; and
- To provide a sense of "worst case" locations where the Project will be highly visible and unobstructed, to be balanced with a selection of other vantage points.

Members of the public, the Project team, and LandWorks (the Northern Pass visual assessment consultant) suggested the locations for the simulations. Many of the locations selected were considered to have local, state or national significance as scenic or recreational resources. Other locations for simulations included those within conserved landscapes, as well as road crossings where the public might view the Project on a regular basis.

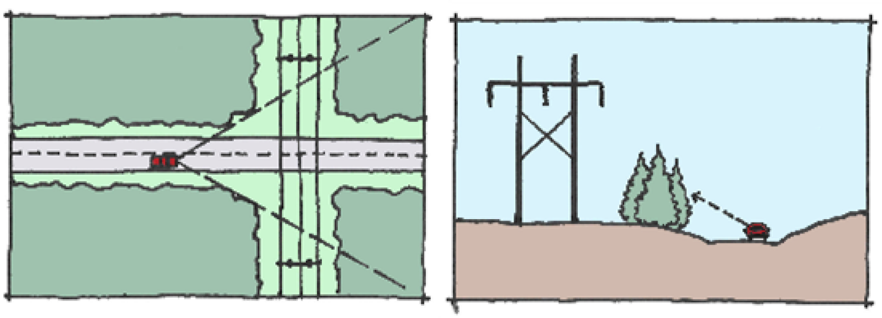
The drawings below provide some basis for how we see things in the landscape and ways in which the presence and location of transmission corridors affect visibility and the nature of that visibility.



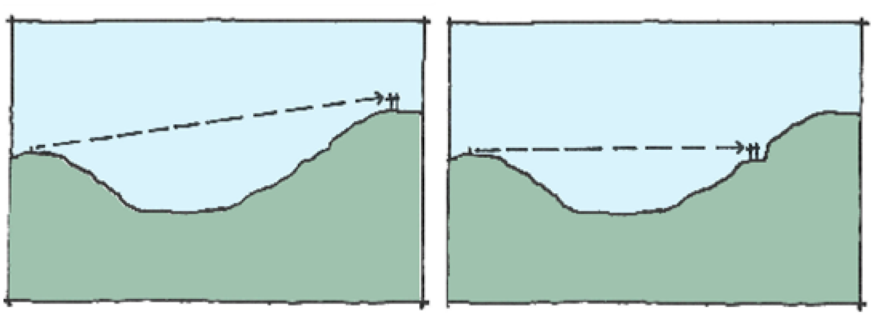
1. How humans perceive the visual environment is based, in part, on the capacity of the human eye to "take in" visual elements in a typical view. These illustrations depict the horizontal and vertical "cone of vision" for the human eye.



2. Landscapes that have many elements in them are able to better accommodate visual change, These two illustrations depict how a transmission line is readily de-emphasized, or "visually absorbed" by a landscape with a number of distinct elements, versus a landscape where the corridor is the only feature.



3. At road and trail crossings, the human cone of vision coupled with movement through the landscape can reduce or eliminate views of transmission structures. Roadside or trailside vegetation and screening can also de-emphasize or eliminate views of a transmission line.



4A. Transmission line structures are likely to be more visible when they are seen against a backdrop of sky, referred to as "sky-lining" or sky-lighting".

4B. Transmission line structures are less visible/noticeable when there is a vegetative or landform backdrop that provides "back grounding".

Using the methodology described in Exhibit 13, LandWorks produced the visual simulations of the Project that are also contained in Exhibit 13.

3.5 ROW, Operations & Maintenance

The transmission corridor in the new portion of the North Section where there was no pre-existing transmission ROW will be 150 feet wide.[29] This width was selected because it will accommodate not only the operation of the transmission line, but also construction, maintenance and repair activities. It is designed to accommodate both steady state and extreme weather conditions, based on both NESC design requirements and good utility practice.

For the Central and South Sections and a portion of the North Section, Northern Pass intends to use existing transmission ROW under an arrangement with PSNH. The width of the part of the route located in the existing ROW varies from 150 feet to 392.5 feet.[30] Northern Pass will likely acquire temporary easements or licenses during the construction process as necessary to accommodate construction activities (e.g., access and lay down areas) along some portions of the proposed route.

For the portions of the route where there are already transmission lines, operations, maintenance and repair will not change substantially from what occurs today. Along the entire route, maintenance of the existing lines, rebuilt lines and the new Project will be performed in accordance with Northeast Utilities system maintenance policies and procedures, the elements of which include:

- Identifying industry best practices for a specific preventative maintenance program;
- Assuring compliance with regulatory and power coordination authority standards and guidelines;
- Establishing maintenance practices that are practical and cost effective;

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29 There is one parcel along this portion of the proposed route where the easement is 300 feet wide. However, Northern Pass anticipates that it will only use 150 feet of this easement.

30 The wider portions of the existing ROW are wider because they host two or more lines.

- Establishing maintenance practices that monitor equipment operating conditions and provide trend data; and
- Providing a written description of the maintenance program.

Specific requirements for high voltage transmission lines include:

- Aerial patrol of lines each year for inspection of structures and conductors;
- Foot patrol of the lines each year to visually inspect the facilities;
- Thermographic inspection of lines two times per year;
- Patrol of lines after every operation (i.e., permanent or temporary line faults) if the specific cause cannot be identified;
- Aerial patrol of lines each year for vegetation management inspection; and
- Three year vegetation maintenance within cleared areas, ten year side trimming and tree removal as required.

Maintenance activities in the ROW, depending on the natural features and accessibility of the ROW, can be carried out on foot, or by line truck, track mounted vehicle, all-terrain vehicle or snowmobile. Any of these activities can have an impact on the environment if not performed in a sensitive manner. All vegetation management and line maintenance activities associated with the Project's new lines will be performed in accordance with the New Hampshire Division of Forest and Lands Best Management Practice for Utility Maintenance.[31] The Best Management Practice publication provides guidance for identifying appropriate means and methods for vegetation management and maintenance in or within the vicinity of jurisdictional wetlands. Northern Pass will provide a field manual summarizing the Best Management Practice to all contractors performing maintenance work in the ROW.

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[31] *Best Management Practices Manual for Utility Maintenance in and Adjacent to Wetlands and Waterbodies in New Hampshire*, Interim Jan. 2010, *available at* http://www.nhdfl.org/library/pdf/Publications/DESUtilityBMPrev3.pdf.

Maintenance associated with transition stations, the southern HVDC converter terminal, the underground cables and the Deerfield and Scobie Pond Substation upgrades will also be performed in accordance with Northeast Utilities system maintenance policies and procedures, the elements of which include:

- Monitoring, testing and maintaining civil, electrical, protection and communication equipment including visual inspection, sampling, trending, testing, maintenance and time based equipment replacement; and
- Monitoring on-line key electrical devices to determine equipment status, load levels, and temperature and to identify any abnormal conditions.

SECTION 4 – ALTERNATIVES TO THE PROPOSED FACILITY

4.1 Introduction

The applicable DOE NEPA regulations require an Applicant to describe "all practical alternatives to the proposed facility."[32] Case law and agency guidance make clear that, in evaluating what is a "practical alternative" to a proposal made by a private party, the agency must consider "the applicant's purposes and needs and the common sense realities of a given situation in the development of alternatives."[33] Alternatives that do not meet the applicant's purpose and need, taking into account economic feasibility, are not practical alternatives.[34]

Of course, an applicant's notion of what is reasonable is not all-controlling, particularly insofar as it concerns the means of achieving the applicant's project purpose.[35] At the same time, however, identifying reasonable alternatives does not include redefining a project into an entirely different project. The courts recognize that agencies should not evaluate alternatives that are "fanciful or hypothetical."[36] And, as the Supreme Court has emphasized, "to make an impact statement something more than an exercise in frivolous boilerplate, the concept of alternatives must be bounded by some notion of feasibility." Alternatives are feasible only if they are, among other things, "meaningfully compatible with the time-frame of the needs to which the underlying proposal is addressed."[37]

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32 10 C.F.R. § 205.322(d).

33 Council on Environmental Quality, *Guidance Regarding NEPA Regulations*, 48 Fed. Reg. 34,263, 34,267 (Jul. 28, 1983).

34 *See e.g., Roosevelt Campobello Int'l Park Comm'n v. EPA*, 684 F.2d 1041, 1047 (1st Cir. 1982) (agency's consideration of alternatives in an EIS was sufficient where the agency evaluated only deep water ports given that the applicant's purpose and need was to build a refinery at a port that could accommodate supertankers, accepting the applicant's position that sites that lacked deep water would be economically infeasible); *Envtl. Law & Policy Ctr. v. NRC,* 470 F.3d 676, 682-84 (7th Cir. 2006) (Nuclear Regulatory Commission did not err in refusing to consider energy efficiency options as part of an EIS on a proposed nuclear plant where the applicant defined its purpose as "generating baseload energy").

35 *Dubois v. Dep't of Agric.*, 102 F.3d 1273, 1288 (1st Cir. 1996) (rejecting applicant's suggestion that the agency should not consider the option of requiring the applicant to create artificial water storage ponds in lieu of using an existing pond to meet its water needs for an expanded ski resort).

36 *Grazing Fields Farm v. Goldschmidt,* 626 F.2d 1068, 1074 (1st Cir. 1980).

37 *Vermont Yankee Nuclear Power Corp. v. Natural Res. Def. Council*, 435 U.S. 519, 551 (1978)*, quoting Natural Res. Def. Council v. Morton,* 458 F.2d 827, 838 (D.C. Cir. 1972).

In the discussion that follows, Northern Pass examines a wide range of alternatives to the Project – many of them proposed by commenters in the scoping process and through other venues. In providing this information, Northern Pass does not mean to suggest that these alternatives are reasonable. Indeed, as Northern Pass explains below, many of the alternatives identified by others represent a "no action" alternative because they are either not executable or they do not meet the purpose and need for which the Project has been proposed, i.e., to deliver 1,200 MW of clean, low-carbon, competitively-priced, baseload power from Québec to New Hampshire and the rest of New England, and are instead proposals for entirely different projects. Some proposed alternatives are cost prohibitive; some have technical challenges that could not likely be overcome; still others present legal impediments, for example, those that fail to take account of the fact that Northern Pass does not have access to eminent domain authority to change the scope of the easements governing existing transmission ROW. Many of the alternatives suffer from more than one of these problems and ignore the "common sense realities of [the] situation"[38] that render them impractical or impossible to execute. Northern Pass believes that the proposed route best meets the technical and economic goals of the Project with the least degree of impact to the environment.

4.2 Routing Segment Alternatives

4.2.1 Original Route and Alternative Segments

In October 2010, Northern Pass proposed a route that it believed was reasonable and minimized any harm associated with the Project. Public comments, particularly with respect to that part of the North Section where there is no existing transmission ROW, persuaded Northern Pass to seek a new route. In its April 12, 2011 submission to DOE, Northern Pass withdrew its support for alternatives that it had previously concluded were practical alternatives to its proposed route.[39]

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38 48 Fed. Reg. at 34,267.

39 In the April 2011 submission, Northern Pass also indicated that, provided it could satisfy FAA requirements, it would seek to use existing ROW in the area of the Concord Airport and abandon the route it had proposed through Concord, Pembroke and Chichester. Northern Pass now confirms that it has determined that it can satisfy FAA requirements for use of the ROW near the Concord Airport, and thus it does not seek to use the route it had originally proposed for that area.

Northern Pass also advised DOE that it was exploring additional routing alternatives for the North Section that would meet the needs of the Project. As explained above, Northern Pass is proposing a new route in the North Section in large part on land that its affiliate has purchased or leased or obtained an easement on from willing property owners.

Just as it did when proposing the original route, in pursuing the new proposed route, Northern Pass sought to maximize the use of existing ROW, minimize encroachment upon conservation areas, minimize the environmental impacts of both construction and operation of the line, promote reliability, and minimize visual impacts to New Hampshire communities. While the new proposed route is slightly longer, it makes greater use of existing ROW and developed transportation corridors; it relies in large part on land that an affiliate of Northern Pass has successfully acquired in fee or by way of lease or easement for Project purposes from willing property owners; it affects fewer parcels of land; it largely avoids more populated areas; it affects far fewer residents and landowners than the originally preferred route would have; and it reduces visibility of the line both through routing changes and refinement of the transmission line design.

For purposes of the alternatives analysis, the original route and its alternative segments (except near the Concord Airport) should no longer be deemed practical and should be eliminated from further consideration.[40] This is because acquiring the property that would be needed to build the Project along the originally proposed route and its alternatives is almost certainly unachievable. By comparison, the new proposed route, which is in large part either on existing ROW or on land that an affiliate of Northern Pass has acquired, leased or obtained an easement for from willing landowners, is preferable for all the reasons identified above.

In this connection, it should be noted that, while Northern Pass indicated from the beginning that it did not wish to rely on eminent domain authority to acquire the necessary properties for the route (or the alternative segments), by virtue of a change in New Hampshire law in 2012,

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[40] If DOE were to conclude that the original route and alternative segments warrant analysis, the environmental characteristics of the affected area are described in the October 14, 2010 Presidential Permit Application on pages 18-30.

eminent domain authority is no longer available for transmission projects like the Project.[41] Consequently, any alternatives must be assessed in light of the practical reality that any new transmission ROW or change in the scope of existing ROW in New Hampshire must be acquired through negotiations with willing sellers. While Northern Pass was able to overcome the efforts made by opponents of the Project to block its acquisition of the property rights needed to construct the Project along the proposed route, a change to the proposed route could present an insurmountable challenge if a landowner or easement holder wished to block the Project.

4.2.2. Possible Alternative Segment in North Section

Northern Pass has identified one alternative segment to the proposed route. As described in Section 2.2.4.vi, the proposed route proceeds south and then east from property owned by an affiliate of Northern Pass in Clarksville, continues onto Route 145 and progresses along Old County Road into Stewartstown where it will continue onto North Hill Road, Bear Rock Road and to property that an affiliate of Northern Pass has acquired. The alternative route would proceed east and then south almost entirely on property that Northern Pass has acquired,[42] with the exception of approximately 100 feet of land subject to ongoing timbering activity that is owned by CLRT and, is subject to a conservation easement held by the NHDRED. Because of the conservation easement, overhead is not a viable option there, and CLRT and NHDRED would have to consent to the construction of an underground segment across that short distance. For constructability and visibility purposes the underground segment would be approximately 1,100 feet long.

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41 New Hampshire amended its law in 2012 to preclude the use of eminent domain for any transmission line unless ISO-NE designates it as a reliability project. *See* N.H. REV. STAT. ANN. § 371:1 (2013) (stating "No public utility may petition for permission to take private land or property rights for the construction or operation of an electric generating plant or an electric transmission project not eligible for regional cost allocation, for either local or regional transmission tariffs, by ISO-New England or its successor regional system operator."). This change in law affects both the acquisition of property and amendments to existing easements.

42 Northern Pass holds only a 62.5% interest in one of the parcels along the alternate route. If it were pursuing this alternative route, Northern Pass would have to sue for partition to obtain the right to construct on that parcel.

4.3 Other Proposed Transmission Corridors

Some have suggested that one or another of two other proposed transmission projects is an alternative to the Project: (i) the proposed Champlain Hudson Power Express (CHPE) in New York; and (ii) the proposed Northeast Energy Link (NEL) in Maine, New Hampshire and Massachusetts. Neither of these is feasible, nor would either serve the purpose and need of the Project.

4.3.1. Champlain Hudson Power Express

The CHPE project, which is being developed by Transmission Developers, Inc., a Canadian corporation, is a 1,000 MW HVDC project that will deliver largely hydropower from Québec into New York City to meet power requirements there. While CHPE is similar to the Project insofar as it would transmit low carbon power generated in Canada into the United States, CHPE has a very different purpose and need: it is a merchant project that has been designed, sized and routed to serve only the downstate New York market, not New Hampshire and the rest of the New England market that the Project is designed to serve.

CHPE's sole currently planned converter terminal where power can be delivered is in Astoria, Queens, that is, in New York City.[43] In its Order approving the CHPE project, the New York Public Service Commission supported its finding of public interest, convenience and necessity based on the CHPE project's "unique and substantial benefits" of "serv[ing] New York City load while displacing more-polluting generation sources, advanc[ing] major energy and policy goals as set forth in [New York] City's *PlaNYC 2030: A Greener, Greater New York* and in Commission and State documents, and rely[ing] almost entirely on private investment."[44] With

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[43] Early in the history of CHPE, there was a proposal to also deliver power to Connecticut. CHPE abandoned that idea in 2010 after determining that it was not financially viable. See *Supplement to Application of Champlain Hudson Power Express, Inc.,* Case No. 10-T-0139, at 2 (Jul. 22, 2010), *available at* http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=10-T-0139.

[44] *Champlain Hudson Power Express, Inc.,* Order Granting Certificate of Environmental Compatibility and Public Need, Case No. 10-T-0139, at 100 (Apr. 18, 2013), *available at* http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=10-T-0139.

that approval in hand, and based on statements from CHPE that "the permitting process remains on track with a goal of achieving all needed federal and state permits by the end of 2013,"[45] it is not reasonable to think that CHPE would put its project at risk by expanding the focus to include New England.

In addition to the very fundamental differences in the purpose and need for the two projects, there are multiple technical problems that make co-location of the two projects infeasible. CHPE is a 1,000 MW project that uses a different HVDC converter terminal technology – a voltage source converter. Any proposal that would more than double the transmission capacity now planned for CHPE—to enable it to also deliver the 1,200 MW of power Northern Pass seeks to deliver—would require a complete redesign of the project using a different technology, an entirely new environmental analysis of the impacts of the new project, and an entirely new set of regulatory determinations concerning the economics and the public interest of the project.[46] It is difficult to estimate what the environmental impacts of the much larger hypothetical combined project would be, but by way of example, Northern Pass notes that the underground elements of CHPE in particular would have to change dramatically to handle the larger project. Additionally, CHPE would have to run a line underwater in Long Island Sound to deliver power to New England, greatly complicating the technical and economic challenges.

Finally, Northern Pass has no ability to force the developers of CHPE to re-design its project to serve Northern Pass purposes as well. In short, the "common sense realities" of the situation, to which the courts have said federal agencies must pay attention in NEPA alternatives analyses, plainly demonstrate that combining the Project with CHPE is not a practical alternative.

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45 Champlain Hudson Power Express: Project Development Portal, *Champlain Hudson Power Express Receives Key New York State Permit, Achieves Another Major Milestone* (Apr. 18, 2013), *available at* http://www.chpexpress.com/press-releases/041813.php.

46 The CHPE NEPA review is already well underway. According to DOE's EIS schedule for the CHPE project, a draft EIS is expected to be available for public comment in the summer of 2013. *See Project Schedule for DOE's Environmental Impact Statement for the Champlain Hudson Power Express Project*, *available at* http://chpexpresseis.org/schedule.php.

4.3.2. Northeast Energy Link

In 2007, Bangor Hydro Electric Company, a subsidiary of Emera, Inc., and National Grid Transmission Services Corporation first announced their intention to build NEL, a participant-funded 230-mile, 1,100 MW HVDC transmission line from Orrington, Maine to Tewksbury, Massachusetts, to deliver principally wind power into southern New England, again using a voltage source converter. NEL is similar to the Project insofar as it has been proposed as a participant-funded project that would deliver renewable energy into the New England market. NEL, however, is intended to be a vehicle for the development of wind resources in Maine, as well as a conduit for resources from New Brunswick, and not as a means to bring hydropower from Québec.

Although first announced six years ago, NEL is in the very early stages of development. As far as has been made public, there are no subscribers for NEL and, while the transmission line could facilitate the development of wind generation in Maine, the wind projects it would hope to serve do not yet exist, nor have they been proposed in response to the announcement of the plan to build NEL. The project likewise has neither filed nor obtained required FERC approvals for a TSA, and it has not made an ISO-NE I.3.9 Proposed Plan Application to allow evaluation of its impact on the New England transmission system. By contrast, Northern Pass has fully subscribed the capacity of the Project; secured rights for the proposed route; completed a substantial part of the engineering design work; nearly concluded the I.3.9 review process; performed many environmental studies; filed applications with DOE, WMNF and FERC; received FERC approval for the Project's TSA; and engaged in many public discussions about the Project.

If the NEL project is ultimately successful, it will complement the Northern Pass Project, focused as it is on delivering wind power to southern New England, but it is not a practical alternative to, a substitute for, or a candidate for combination with the Project.

Finally, as is the case with CHPE, Northern Pass has no ability to force the developers of NEL to re-design its project to serve the Project's purposes.

4.4 Vermont Transmission Corridor

The existing New England Hydro/Hydro Québec Phase I/Phase II ±450 kV HVDC transmission line runs south from the Canadian border through Vermont, New Hampshire and into Massachusetts where it can deliver up to 2,000 MW of power to New England. Northern Pass evaluated whether it might seek the right to share this ROW instead of developing a new route in New Hampshire. Based on this evaluation, Northern Pass concluded that the Vermont option was not viable because the existing ROW is not wide enough to also accommodate the Project (even by relocating the existing line), and much of the area it traverses in Vermont is now subject to conservation and recreational easement limitations that would in all likelihood preclude expansion of the ROW.

Because of the size limits of the existing ROW, in order to co-locate the two transmission projects a wholly new ROW, parallel to the existing Phase I/Phase II ROW, would have to be created. Creating this parallel path would require disturbance of conserved and undeveloped land and create such a wide ROW that it would result in potentially significant habitat fragmentation.[47] Additionally, much of the ROW in Vermont is now conserved, which was not the case when the existing Phase I/Phase II project was built. It includes lands protected by the Kingdom State Forest, the Silvio O. Conte National Wildlife Refuge, West Mountain Wildlife Management Area, Victory State Forest and Victory Basin Wildlife Management Area.

While there are two possible ways a Vermont route might be brought into New Hampshire, neither provides a means to avoid conservation lands. The first would enter New Hampshire just north of Littleton where it would connect to an existing PSNH ROW and go east through Dalton.

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47 Studies of forest-interior Neotropical migrant birds along-non-forested corridors suggest that these species do not avoid forest margins along narrow corridors, but that edge avoidance (fragmentation effect) by forest-interior species occurs along forest-dividing corridors more than 150 feet wide. Adam C. Rich et al., *Defining Forest Fragmentation by Corridor Width: The Influence of Narrow Forest-Dividing Corridors on Forest-Nesting Birds in Southern New Jersey,* CONSERVATION BIOLOGY, VOL. 8, NO. 4, at 1109-21 (Dec. 1994).

This route would connect to the proposed Project route southwest of the Whitefield Substation. The second Vermont alternative would follow the Vermont ROW to Littleton, where it would connect with an existing PSNH ROW and travel through Littleton and Bethlehem to Sugar Hill, where it would then connect with the proposed Project route.

For either Vermont alternative, expanding upon the existing Phase I/Phase II ROW would require traversing 15 more miles of conservation land than the Project's proposed route in New Hampshire and require up to 13 more miles of construction on land where there is no pre-existing ROW in Vermont than would be required in New Hampshire under the Northern Pass proposed route.

Given the conservation protections that apply to a significant amount of the land that would be needed to create as much as 53 miles of new ROW parallel to the existing ROW in Vermont, it would not be feasible to acquire it for a transmission line, even if disturbing such conserved land could be deemed environmentally preferable to the proposed route of the Project. Thus, the Vermont route is not a practical alternative; it is in effect a "no action" alternative.

4.5 Underwater Line

Pointing to the example of the CHPE project, several members of the public argued in their scoping comments that Northern Pass should have included in its Application the alternative of an underwater line. CHPE is able to take advantage of the fact that waterways of considerable length and depth lie between the power source and the power delivery point. Northern Pass does not have that option.

The underwater option is not technically feasible for the Project because, unlike Lake Champlain and the portions of the Hudson River that the CHPE project is designed to traverse underwater, the Connecticut River, the largest north-south waterway in the relevant area, which runs along the Vermont/New Hampshire border, can only be navigated by shallow draft vessels above Enfield, Connecticut. Such shallow draft vessels cannot accommodate the equipment needed to install an underwater cable. Thus, an underwater option that might be feasible in other locations and circumstances cannot be used in the New Hampshire portion of the Connecticut River, and there is no alternative waterway.

Specifically, the CHPE Presidential Permit Application describes the equipment needed to lay and then maintain an underwater cable at the required depths, which CHPE explains generally range from three to four feet to 15 feet beneath the bed surface.[48] Most reaches of the Connecticut River in northern New Hampshire are too narrow or too shallow to accommodate vessels larger than canoes, kayaks and small motorized boats. Dams and waterfalls also occur along the Connecticut River, requiring even those in small watercraft to portage around them.[49] The Skagerrak, which is a vessel that is designed for laying cable under water, illustrates the impracticability of the underwater approach for the Project. The Skaggerak has a dead weight of 9,373 tons, a beam of 32 meters and is 112 meters long. The draft of this vessel – without the cable loaded onboard – is 5.4 meters. A vessel of such proportions simply cannot navigate the Connecticut River where it would be needed to lay the cable for the Project.

In short, there is simply no viable underwater route for the Project.

4.6 Underground Line

Numerous commenters have suggested that the entire Project should be installed underground. Several alternatives have been suggested for how the line might be placed underground: (i) along highways; (ii) along the proposed route; and (iii) along a railroad bed (as discussed in Section 4.7). There are some issues in common for all three of these alternatives, and there are some that are particular to each. None of them, however, represents a practical alternative to the Project.

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48 *CHPE Presidential Permit Application*, OE Docket No. PP-362, at 7-10, *available at* http://energy.gov/oe/downloads/application-presidential-permit-oe-docket-no-pp-362-champlain-hudson-power-express-inc.

49 *See* Connecticut River Joint Commission, Inc., Maps of the Connecticut River, *available at* www.crjc.org/boating/boating1.htm.

4.6.1. Generally Applicable Challenges for an Underground Transmission Line

Installing an HVDC transmission line underground requires some or all of the following:

- Excavation of a trench along the underground route;
- Use of construction techniques such as jack & bore, directional boring and micro-tunneling to go under rivers, streams or wetlands, or to go through mountains and other sensitive area where open trench construction is not preferred or feasible;
- Installation of a duct bank (including conduits), in areas where direct bury is not advisable, with a dimension of approximately three feet by five feet with the top of the duct bank located 30 inches below finish grade. Such a duct bank must be encased in concrete or flowable backfill for physical protection;
- Installation of cable splice vaults or splicing pads approximately 60 feet long, 15 feet wide and eight feet tall (vaults only) and located approximately every 1,800 feet. The specific dimensions between splice locations are driven by the cable length that can be transported over the road and the physical conditions (terrain, wetlands, water bodies, etc.) of the cable installation location. The specific distance between splicing locations could vary from less than 1,000 feet to approximately 3,000 feet based on these factors;
- Use of large pieces of equipment, including:
  - flatbed trucks to deliver the cable reels (approximately 12 to 14 feet high and weighing approximately 25 to 30 tons each);
  - cranes needed to lift and place the splice vaults (if utilized) into the ground; and
  - a cable-pulling rig needed to install the cable into the completed duct bank system.
- ROW terrain that is accessible by the required large equipment along the length of the ROW to allow the cables reels to be placed in the proper position for installation, and allow the cable splice trailers to access the splice locations.

Because cable trenching involves more extensive and permanent disruption of the affected land, inevitably, underground placement typically results in greater impacts than an overhead line in all respects except visibility. It also presents enhanced operations and repair challenges. In an Edison Electric Institute (EEI) survey, utilities identified numerous challenges associated with operating underground, including:

- Longer timeframes and more difficult challenges in installing, maintaining and repairing equipment;
- Greater difficulty to upgrade or make system changes;
- Greater susceptibility to flooding and damage from dig-ins;
- Difficulty of making repairs in frozen ground or areas of heavy snow;
- Need for greater coordination with landowners; and
- Need for more specialized skills and training to maintain systems. [50]

Addressing these challenges entails significant extra costs. The higher costs relate to every aspect of an underground project, including: installation, facility replacement, material costs, design redundancy, operations and maintenance, repairs that require specialty contractors and labor-intensive work to locate faults. EEI also notes that underground projects in geographic areas with severe frost and rocky conditions can face significantly increased costs.[51] Just to build it, however, EEI estimates that an underground line can entail costs that are five to ten times the cost of a comparable overhead line.[52] It is because of the technical, construction, operational and cost considerations that, according to a 2009 EEI report, only approximately one percent of U.S. transmission lines are underground.[53] For a project like Northern Pass that is designed to deliver competitively priced power to the market, these additional costs are economically infeasible if they affect any substantial portion of the line. In NEPA terms, these considerations render the

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50 Edison Electric Institute, *Out of Sight, Out of Mind 2012,* at 26-27 (Jan. 2013), *available at* http://www.eei.org/ourissues/electricitydistribution/documents/undergroundreport.pdf.

51 *Id*. at 26.

52 *Id.* at vi. EEI estimates that the costs of an overhead line range from $174,000 to $11 million per mile, whereas the costs of an underground line can range from $1.4 million to $30 million per mile. *Id.* at 30.

53 Edison Electric Institute, *Out of Sight, Out of Mind Revisited,* at 15 (Dec. 2009).

construction of an underground line for the Project over any significant distance an unreasonable alternative.

4.6.2. Underground Challenges in State Highway ROW

Some have suggested that, because existing highway routes are already disturbed, underground construction along such highway routes is a practical alternative to the Project as proposed by Northern Pass. The proposed route involves one 2,300 foot segment mostly under a state highway and one 7.5 mile segment along several state and locally maintained roads where there is no clearly available alternative. These underground portions that Northern Pass is proposing will present some construction challenges.[54] However, there are no interstate highways in New Hampshire along the proposed route between the international border crossing and the delivery point in Deerfield that the Project could use in the way that the NEL project envisions using I-95 in Maine.

If the NEL project proceeds, it may be able to use a portion of I-95 that begins in Bangor, Maine, which is accessible to the potential wind resources in northern Maine, and extends south to Massachusetts and southern New England, the location of the intended load. By contrast, the location of I-93 in New Hampshire does not accommodate the needs of the Project. In particular, I-93 is not located anywhere close to the entry point of the power at the U.S./Canadian border in northern New Hampshire.[55]

To construct the Project underground along a state highway located in an area where it could carry the power from where it enters at the Canadian border to where it is needed, from Pittsburg to Deerfield, New Hampshire, would entail some significant construction challenges, including

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54 See Section 4.2.2 for a description of an alternative to the North Section that requires agreements and approvals with a landowner and the State.

55 Chapter 220, Laws of NH 2012, established a commission, referred to as the "SB 361 Commission," to study the feasibility of establishing energy infrastructure corridors within existing transportation ROWs. Its final report was issued November 30, 2012. This report listed I-93 as one of four corridors identified as a possible energy infrastructure corridor in New Hampshire. The other three corridors (I-95, I-89 and NH 101) are not located anywhere useful for Project purposes.

dealing with river and stream crossings and culverts all along the route and disruption to the communities along the route. The most direct path would be along Route 3, from Pittsburg to Franconia, I-93 through Franconia Notch State Park to Concord, Routes 393/4/202 to Northwood and finally Route 107 to the vicinity of the Deerfield Substation, a distance of approximately 170 miles. To carry out the necessary construction activities using the large equipment required to do the job, extended closures of major state roads would likely be required in many areas. The impacts would range from nuisance delays for construction in the roadway shoulder area to single lane closures to multiple lane closures of a road for short periods of time. The challenges for construction seem to be nearly insurmountable in certain state roads because of the volume of traffic, the lack of a bypass to reroute traffic and the limited construction area available along the roadway, particularly in the Franconia Notch State Park. Further, once the Project was operating, access to the underground cable would be required in order to operate and make repairs in the event of a cable failure.

Finally, the construction costs at best might still be at the low end of EEI's estimate of the costs of underground construction, i.e., five times more expensive than overhead construction. As noted above, the single 7.5 mile underground segment from Clarksville to Stewartstown adds more than $100 million to the cost of the Project. Any significantly greater distance would be cost prohibitive and would not take into account the other economic, environmental and practical realities.

In short, any extended underground option in highway ROW along busy state highway corridors would be cost-prohibitive and a serious logistical burden for New Hampshire residents and visitors. Thus, such an option would be in effect another "no action" alternative.

4.6.3. Underground Challenges Along the Proposed Route

There are many factors that make an underground route along the entirety of the Project impractical. A significant portion of the proposed route is located in mountainous areas with steep grades. The installation of a cable requires that a permanent roadway be established along the route in order to transport the large cable reels and cable pulling equipment. Additionally, an underground installation would generally require splicing the cables approximately every 1,800 feet.[56] Splicing areas for the cable need to be located on relatively flat terrain, not on the kind of steep slopes present in many areas of the Project.

Building the cable system would also have a greater impact on natural resources than an overhead line. The cable system would require that significant construction activities be performed in a continuous straight line. This would afford limited opportunities to avoid wetlands and other sensitive resources within the corridor. By contrast, an overhead line can span sensitive areas, thereby minimizing the disturbance.

In some cases, it is possible to install a conduit system with a trenchless technology like directional boring. The trenchless construction method would require the use of large equipment at the sending and receiving end of the directional boring locations. Such equipment could not be transported to certain areas of the Project, including, for example, the WMNF, where adequate roads do not exist. Exhibit 14 contains additional information regarding directional boring and photographs of the equipment used for trenchless construction.

As described above, the proposed route crosses hundreds of small streams and several rivers that would require cable installation techniques noted above. In areas other than along a state highway, an underground cable system and the associated trenching requirements may also have a greater adverse impact on archeological resources and sensitive plants and plant communities than an overhead line.

Providing access to the entire underground cable route when there is a failure on the line would also present much greater operating challenges than an overhead route, creating the risk that, in the event of trouble with the cable, it would be out of service for an extended period to allow for

[56] Distance between splice locations is driven primarily by the ability to transport the cable. Locations along the proposed route that are adjacent to state highways would allow transport of greater lengths of cable. Remote areas, by contrast, would likely require shorter lengths and more frequent splices because of the difficulty of transporting the heavy cable to such locations.

diagnosis and repair of the problem. Installation of an underground cable system in the WMNF, in particular, would not be practical because of the significant construction impacts and year round access requirements of an underground cable system.

If Northern Pass were to attempt to construct substantial parts of the Project underground in combination with other overhead sections, it would entail a further drawback. Unlike low-voltage lines, an HVDC line at ± 300 kV requires a "transition station" at each location where the line would connect the overhead and underground portions of the line. A transition station requires above- and below-grade construction, is surrounded by a chain link fence and occupies an area approximately 160 feet by 180 feet. To include four such permanent facilities (two for each proposed underground segment of the Project) along the 153 mile HVDC line path involves relatively modest impacts. However, building such facilities at regular locations along the line to accommodate each transition between the overhead and underground segments could aggravate, not mitigate, a broad array of the impacts of the Project, including those to wetlands and historic and cultural resources.

Finally, there is an important legal impediment to underground construction along the proposed route. Northern Pass has the right to use the existing PSNH ROW in accordance with and under the conditions of the easements on record. While all of the easements along the Project path allow for overhead lines, very few provide rights to construct underground facilities. More than 600 easements would have to be modified for Northern Pass to be authorized to install an underground line. With the passage of legislation in New Hampshire that removed eminent domain rights for the Project, as described in Section 4.2.1 above, it is extremely unlikely that underground rights in existing ROW could be secured along the entire proposed route.

4.7. Railroad ROW

Some have also suggested that Northern Pass could construct the Project along railroad ROW in northern New Hampshire because the land is at a reasonable grade and is already disturbed.

Northern Pass reviewed the potential to use the railroad ROW for an overhead line in the portion of the North Section of the Project area where there is no pre-existing transmission ROW. The railroad ROW in this area is owned by two entities, the State of New Hampshire and a private railroad operator. The portion that belongs to the State of New Hampshire has been taken out of active service. Some of it is used for rail car storage; on the rest, the track has been removed and the ROW is part of the state recreational trail system. It is possible that the State might be willing to share its ROW. However, the use of the approximate 13 miles of active track on the privately-owned section of the rail bed is uncertain at best, as a railroad operator of an active track can be expected to have legitimate concerns about any activity that could affect the stability of the rail system.

More importantly, even if both the State of New Hampshire and the private railroad operator were willing to share the railroad ROW, further expansion of this ROW would be required. The majority of the railroad track system in New Hampshire has a ROW width of 66 feet with the tracks centered in the ROW. As discussed in Section 3.5, the Project needs a ROW width of approximately 150 feet. Therefore, the alternative of using existing railroad ROW for an overhead line would require Northern Pass to significantly expand the ROW, resulting in the likely disruption or dislocation of businesses, homes and other structures that are located adjacent to the railroad ROW. With the passage of legislation in New Hampshire that removed eminent domain rights for the Project, as described in Section 4.2.1, it is extremely unlikely that the expanded ROW rights that would be needed could be secured along the entire portion of the North Section where there is no pre-existing ROW.

Northern Pass also considered whether an underground cable along the railroad ROW in the portion of the North Section where there is no pre-existing transmission ROW was feasible. However, in addition to having ROW limitations that would impede the installation of an overhead line along this portion of the Project, there are numerous other factors along the railroad ROW that would limit the ability to construct, operate and repair an underground cable. These factors include, but are not limited to, the following: the inability to satisfy requirements to maintain a safe distance between the track and a cable system; elevated track which further limits the area available for construction; and the presence of 20 streams, three ponds and associated wetlands adjacent to the track, as indicated by a desktop survey. There are also six conservation areas along the railroad ROW that would have to be crossed. These factors affect a significant portion of the railroad ROW in the North Section where there is no existing transmission ROW. Finally, the same cost-prohibitive nature of extended underground segments described above in Section 4.6 would also apply to underground construction in the railroad ROW.

Use of a railroad ROW for the remainder of the Project is not an option because there are no continuous sections of railroad track in the general vicinity of the proposed route to get from the North Section to the South Section of the Project area. Specifically, in the Central Section, there is no railroad ROW in the area of Franconia Notch State Park in Franconia and Lincoln, nor in portions of the WMNF. Likewise, there is no railroad ROW in the vicinity of the Project's southern terminus at the Deerfield Substation.

For all of these reasons, railroad ROW for either an overhead or underground line is not a practical alternative; it is in effect a "no action" alternative.

4.8. New England-Based Renewable Energy Projects

Many commenters have said they would prefer locally-based renewable energy projects, including wind, small hydro and solar. Although it provides low-carbon renewable power, the Project does not compete with such renewable energy projects to the extent they are designed to meet the requirements of the New Hampshire Renewable Portfolio Standard, for which the Project does not qualify. To the extent such locally based renewable energy projects exceed what is required to meet the requirements of the New Hampshire Renewable Portfolio Standard, they depend on a variety of subsidies, some of which appear to have uncertain futures. Additionally, they would not meet the purpose and need for which the Project is being proposed. Finally, none of these resources would provide the large quantity of baseload power the Project is designed to deliver.

By way of comparison, even if Northern Pass were to operate at only two-thirds of its capacity (it is expected to be able to operate at 100% capacity), it would be equivalent to 2,297 MW of installed wind capacity that would require modern wind towers that are generally 400 feet high[57] to be placed on approximately 130,000 acres of land, assuming a generous 35% capacity factor for the wind turbines. Alternatively, the Project, again operating at two-thirds capacity, it would be equivalent to 6,700 MW of installed solar capacity, operating at a 12% capacity factor and occupying more than 35,000 acres of land.

To put those numbers in context, in all of New England, the current seasonal claimed capability is 162 MW for all wind resources and 38 MW for all solar resources.[58] ISO-NE reports that in 2012, the contribution of wind and solar to Net Energy Load, the electric energy produced by generation and imports to satisfy all residential, commercial and industrial customer demand, was 1.00% for wind (1,170 GWh) and 0.03% for solar (36 GWh).[59]

Additionally, as the EPRI Report on the value of hydro to the grid noted, hydro facilities like Northern Pass "have the ability to cycle to help manage net-load variability and uncertainty that results with high wind and solar penetration."[60] Thus, Northern Pass should be deemed complementary to, not an alternative to, a wind and solar strategy.

Similarly, while locally-based, small hydroelectric projects (less than 30 MW) could complement the Project, they are not a practical alternative to the 1,200 MW of baseload power that the Project is designed to deliver. There are 284 small hydroelectric facilities currently in

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57 In contrast, the Project structures will generally range from 65-135 feet high for the HVDC line and 55-155 feet high for the 345 kV lines. Exhibit 5 provides the proposed distribution of transmission structure heights along the proposed route for the Project.

58 *ISO-NE Seasonal Claimed Capability Monthly Report* (June 7, 2013), *available a*t http://www.iso-ne.com/genrtion_resrcs/snl_clmd_cap/index.html. The seasonal claimed capability (SCC) is defined by ISO-NE as "the maximum dependable load carrying ability of a generating unit or units, excluding capacity required for station service use. The rating is based on the SCC Audits conducted according to Market Rule 1, and ISO New England Manual for Registration and Performance Audition M-RPA." *ISO-NE CELT Report: 2013-2022 Forecast Report of Capacity, Energy, Loads and Transmission*, at A.1.2 (May 1, 2013), *available at* http://www.iso-ne.com/trans/celt/report/2013/2013_celt_report.pdf.

59 *ISO-NE 2012 Energy Sources in New England: 2012*, *available at* http://www.iso-ne.com/nwsiss/grid_mkts/enrgy_srcs/

60 *EPRI Report* at A-3.

operation in New England, which collectively have a winter seasonal claimed capability of 766 MW and a summer seasonal claimed capability of 564 MW.[61] Importantly, as these figures illustrate, small hydroelectric plants have lower generating capabilities during the summer months, when electric demand in New England is at its peak. By comparison, the Project will provide 1,200 MW of year-round, baseload generation.

Further, even if the Project were to operate at only two-thirds of its capacity, it would be equivalent to approximately 27 new small hydroelectric facilities with generating capabilities of 30 MW, or 40 new small hydroelectric facilities with generating capabilities of 20 MW. To put this in context, of the 284 small hydroelectric facilities operating in New England today, only six have a winter seasonal claimed capability of more than 20 MW, while 237, or approximately 83%, have a winter seasonal claimed capability of less than 5 MW. While these small hydro systems can generate small amounts of clean, low-carbon power for localized use, the Project will provide year-round hydroelectric energy to thousands of customers in New Hampshire and the rest of New England.

4.9. Demand-Side Management and Energy Efficiency

Commenters have also urged that demand-side management (DSM) and energy efficiency could meet the need for which the Project is being proposed. The courts have already rejected the claim that energy efficiency measures represent a practical alternative to a major new addition of baseload power supply. As noted above, *Envtl. Law & Policy Ctr. v. NRC,* 470 F.3d at 682, upheld an agency's refusal to consider energy efficiency alternatives as part of an EIS where the applicant defined its project purpose as "generating baseload energy."

Even if this directly relevant case law did not exist, analysis by ISO-NE demonstrates why DSM and energy efficiency do not represent a reasonable alternative to the baseload power the Project

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61 *ISO-NE Seasonal Claimed Capability Monthly Report, supra* note 58. Of the 284 small hydroelectric plants in the New England region, 78 are located in New Hampshire. Together, they have a total seasonal claimed capacity of 116 MW in the winter months and 87 MW in the summer months. *Id.*

can supply. They simply cannot fill the gap between the supply and the demand for power in ISO-NE for the foreseeable future.

DSM is used for peak-load shaving. ISO-NE manages a very active DSM program. Since 2008, DSM has participated, alongside generation, in the ISO's Forward Capacity Markets, committing to be available to meet demand three years hence. During this period, the participation of DSM has almost doubled, so that the most recent DSM commitments account for about 5% of peak demand for 2015-16.

Additionally, the New England states have been among the leaders in energy efficiency initiatives for many years. The six New England states sponsor a total of 125 individual energy efficiency programs that provide financial incentives to promote the replacement of inefficient electrical devices with more efficient devices or processes. These programs have been funded by system benefits charges and revenues from the RGGI, ISO-NE's Forward Capacity Market and state budgets. ISO-NE estimates that, between 2008 and 2011, the New England states have spent approximately $1.2 billion on energy efficiency, resulting in an annual reduction in electricity use of 826 GWh and total peak demand savings of 514 MW.[62]

ISO-NE recently made its first energy efficiency forecast. It anticipates that, between 2015 and 2021, the New England states will invest another $5.7 billion in spending on energy efficiency, that is, more than four times the cost of the Project. With that investment, ISO-NE predicts that between 2012 and 2021, peak demand is projected to grow at an annual rate of approximately one percent, or almost 2,300 MW.[63] Northern Pass can make a significant contribution to meeting this new peak demand that will occur even with aggressive efficiency measures. In other words, ISO-NE forecasts a highly successful and well-funded energy efficiency program that still requires new power resources to meet new demand.

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62 *ISO on Background: Energy-efficiency forecast,* at 10-21 (Dec. 12, 2012), *available at* http://iso-ne.com/nwsiss/pr/2012/ee_forecast_slides_final_12122012.pdf.

63 *Id.*

Additionally, ISO-NE projects that 8,300 MW of older, less efficient coal- and oil-fired generation is at risk of retirement by 2020, but it has concluded that, without substitute resources, only 950 MW of that less environmentally desirable generation will be able to retire.[64] The Project seeks to be part of the new, cleaner, baseload resources that will be required in addition to the forecasted demand reductions. In short, energy efficiency, including DSM, complements the Project, but it is not a practical alternative to the Project. Both are needed.

4.10. Natural Gas-Fired Generation

Natural gas is abundant in the United States as a result of advances in hydrofracturing technology, and it has been the fastest-growing source of power generation in New England. Specifically, from 1990 to 2011, the total electric energy production from natural-gas fired generators in New England rose from approximately 5% in 1990,[65] to 15% in 2000, to 52% in 2011.[66]

ISO-NE has identified a host of reliability concerns that this increased dependence on natural gas-fired generation creates. For example:

- generators depend on non-firm transportation to save money, but that means the gas may not be there when needed;
- pipeline capacity into New England may be insufficient, creating a risk of supply disruptions;
- dispatch obligations often do not match fuel nominations, and there is an absence of no-notice service in pipeline tariffs;
- there are differences in timing between the electricity markets and pipeline nomination systems; and

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64 *ISO New England's Strategic Transmission Analysis, supra* note 7, at 14.

65 *Addressing Gas Dependence*, Discussion Draft, at 3 (July 30, 2012), *available at* http://www.naesb.org/pdf4/geh080212w1.pdf.

66 *ISO-NE Regional Update: New Hampshire SB 381Commission*, at 28-31 (Aug. 30, 2012), *available at* http://www.iso-ne.com/pubs/pubcomm/pres_spchs/2012/sb361_nh_studycom_8_30_12.pdf.

- gas supply disruptions can arise from extreme weather events and unanticipated maintenance issues.[67]

All of these concerns have led ISO-NE to acknowledge that "there is no longer any uncertainty about the existence of reliability problems as a direct result of gas dependence."[68] As Jay Apt, the executive director of the Electricity Industry Center at Carnegie Mellon University recently explained, "a region like New England that relies on a single fuel source like natural gas for the bulk of its power does leave itself open for more disruptions than a region with a more diverse fuel mix…. It's not a knock against natural gas; it's a knock against a single fuel source."[69]

New England's dependence on gas is ISO-NE's number one concern.[70] As ISO-NE explained in its 2013 Regional Electricity Outlook, "the lack of dependable fuel arrangements by generators, limited on-site fuel storage or alternative fuel arrangements, and increasing constraints on the pipeline system have hindered the performance of New England's natural gas generators, creating serious, immediate risks to grid reliability."[71] Further, in its recent 2012/2013 Winter Reliability Assessment, the North American Electric Reliability Corporation found that, while New England "is not the only region in North America facing potential gas dependency and electric reliability issues, the issues are exacerbated there because of the swift switch to gas as the fuel of choice for power and relatively small firm pipeline capacity commitments from generators."[72] While ISO-NE is working toward solutions to the reliability issues, the addition to the market of 1,200 MW of clean, low-carbon, baseload generation that does not suffer from any

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67 *Addressing Gas Dependence*, *supra* note 65, at 4-12.

68 *Id.* at 17.

69 Matthew L. Wald, *In New England, a Natural Gas Trap*, N.Y. TIMES, Feb. 15, 2013, *available at* http://www.nytimes.com/2013/02/16/business/electricity-costs-up-in-gas-dependent-new-england.html.

70 *ISO-NE Regional Update: New Hampshire SB 381 Commission*, at 36 (Aug. 30, 2012), *available at* http://www.iso-ne.com/pubs/pubcomm/pres_spchs/2012/sb361_nh_studycom_8_30_12.pdf.

71 *ISO-NE 2013 Regional Electricity Outlook*, at 16 (Jan. 31, 2013), *available at* http://www.iso-ne.com/committees/comm_wkgrps/strategic_planning_discussion/materials/2013_reo.pdf. ISO-NE executive vice president and chief operating officer, Vamsi Chadalavada, recently explained that "[t]he underlying issue in New England is that gas pipeline capacity is inadequate to keep prices steady in times of high home heating demand." In New England, a Natural Gas Trap, *supra* note 69.

72 North American Electric Reliability Corp., *2012/2013 Winter Reliability Assessment*, at 7 (Nov. 2012), *available at* http://www.nerc.com/news/Headlines%20DL/2012-2013%20Winter%20Reliability%20Assessment.pdf.

of these problems must be seen as welcome among those responsible for reliable operation of the grid in New England.

Even if it were possible to disregard both the Applicant's purpose and need and the environmental benefits of the low-carbon source of power the Project will deliver, the reliability concerns plainly establish that more natural gas-fired generation should not be deemed a reasonable alternative to the Project. As with renewables such as solar, wind and small hydro, and as with energy efficiency and DSM, natural gas-fired generation is a complement to the Project; it is not a practical alternative. Used in combination, as they should be, these technologies represent a responsible, balanced energy policy.

4.11. Alternative Structure Designs

There are a variety of transmission structure types that Northern Pass could employ. Structures can vary both in height and design, and differing designs are desirable at different locations to address operational, environmental and aesthetic interests. In designing the Project, Northern Pass is doing all that it reasonably can to minimize impacts of the line, recognizing that minimizing one impact can increase another. For example, when lower structures are used, more structures are required. That may reduce the number of locations from which the line can be seen, but the increased number of structures could increase wetlands or other on-the-ground impacts in certain areas, as well as the visibility impacts.[73]

The base structure design for the Project is lattice structures. In certain locations where ROW constraints or other factors dictate, Northern Pass plans to use steel monopole or H-Frame structures.

The structure heights that Northern Pass is proposing for the HVDC portion of the Project range from 65 feet (three structures) to 135 feet (one structure). Northern Pass is proposing to construct the overwhelming majority of the structures at heights between 80 feet (148 structures)

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73 Exhibit 4 describes and illustrates the structure design alternatives.

and 100 feet (121 structures) for the HVDC portion of the Project, with the largest numbers of structures proposed to be 85 feet (244 structures) and 90 feet (291 structures).[74]

There are far fewer structures in the 345 kV AC portion of the Project, and there is much greater variability in height because of space restrictions in the existing corridor. The proposed Project has AC structures ranging in height from 50 feet (one structure) to 155 feet (one structure), with the majority of the structures ranging from 70 feet (21 structures) to 130 feet (26 structures). The largest number of 345 kV structures will be 80 feet tall (40 structures).[75]

Northern Pass acknowledges that there is an almost unlimited number of alternative mixes of structure designs that could be considered reasonable alternatives for NEPA purposes. They represent alternative means of achieving the Project's objectives that should be considered in an alternatives analysis. Northern Pass intends to work with local communities to adjust structure locations and designs to further minimize visibility of the line where feasible.

4.12. No Action Alternative

The no action alternative, not constructing the Project, would obviously eliminate the Project's direct impacts to environmental, historical and cultural resources in the area along the new proposed route.[76] However, that would be at the expense of losing the Project's capacity for delivering 1,200 MW of clean, low-carbon, baseload power and achieving the policy objectives of improving regional fuel diversity and meeting RGGI goals, as well as bringing significant economic and fiscal benefits to New Hampshire and the rest of New England.

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74 *See* Exhibit 5.

75 *Id.* The taller structures tend to be located in lower lying areas and would not be needed if the terrain were flat. Therefore, they are generally not substantially more visible than the lower adjacent structures. For example, the single 155 foot structure is at the base of a steep grade.

76 Note, however, that, the no action alternative would not result in the cancellation, or delay in construction, of any hydroelectric generation facilities in Canada. The power to be delivered by the Project into New England will be comprised of Hydro Québec system power, including approximately 98 percent hydropower, including run-of-river and large hydro resources available to Hydro Québec.

The injection of reliable, renewable power from the Project will help the New England region meet its future load growth needs. FERC has identified numerous benefits from the Project, including: increasing competition by offering New England customers an additional supply resource; mitigating system overloads; and lowering wholesale market power prices in New England by allowing more energy to be imported from Québec during peak hours when marginal generation costs and market-clearing prices are the highest. Northern Pass can also help mitigate energy market price volatility, which is often driven by the price of fossil fuel-based sources of power, as well as the newly emerging reliability concern of over-reliance on natural gas in the New England power market. At the same time, the addition of 1,200 MW from the Project to the regional energy mix would allow the retirement of older, less efficient, fossil fuel plants.

With RGGI's recent proposal to lower the regional CO_2 emissions cap by 45%, the need to develop sources of low-carbon, renewable power and the need to reduce reliance on fossil fuels are greater than ever. The Project is expected to reduce regional CO_2 emissions by up to five million tons per year. Without this help in meeting RGGI's lower future targets, other transmission lines that would likely have environmental, historical and cultural resource impacts of the same character and magnitude as those created by the Project would need to be built to deliver that power.

Executive Order 12866 directs federal agencies to consider the costs and benefits of their regulatory actions, and an interagency working group of eleven federal agencies, including the Department of Energy, recently concluded that the "social cost of carbon" has a 2015 value of between $12 and $109 per ton of CO_2 emitted.[77] Because approval of Northern Pass will result in the avoidance of up to 5 million tons of CO_2 each year, using the social cost of carbon measure, failure to approve the Project would result in lost benefits valued at as much as $60 million to $545 million a year. It is appropriate for DOE to weigh this value in its determination of whether issuance of a Presidential Permit for this Project serves the public interest.

[77] U.S. Government Interagency Working Group on Social Cost of Carbon, *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866* at 3. (May 2013).

Additionally, without this Project's capacity to bring Hydro-Québec's excess hydropower to the U.S., in order to satisfy future load growth and provide the same level of service from non-intermittent power sources, new power plants would likely need to be built. In summary, as a practical matter the no action alternative does not really serve to avoid impacts; it will only result in similar and potentially more significant impacts to environmental, historical and cultural resources. Based on the Project's combination of characteristics and benefits, the no action alternative is a poor option.

SECTION 5 – VERIFICATION

Exhibit 15 contains a verification of the contents of this Amended Application by an officer of Northern Pass having knowledge of the matters set forth herein.