THE STATE OF NEW HAMPSHIRE

BEFORE THE

SITE EVALUATION COMMITTEE

DOCKET NO. 2015-04

JOINT PRE-FILED TESTIMONY OF KENNETH BOWES, DAVID PLANTE, NICHOLAS STRATER, AND MARC DODEMAN

APPLICATION OF PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE D/B/A EVERSOURCE ENERGY FOR A CERTIFICATE OF SITE AND FACILITY FOR CONSTRUCTION OF A NEW 115 kV TRANSMISSION LINE

THE SEACOAST RELIABILITY PROJECT

July 1, 2018

General Background

Q. Please state your names, titles, and business address.

A. My name is Kenneth Bowes. I am a Vice President of Transmission Performance at Eversource Energy ("Eversource"), currently assigned to the Seacoast Reliability Project (the "Project") being developed by Public Service Company of New Hampshire d/b/a Eversource Energy ("PSNH") . My business address is 107 Selden Street, Berlin, Connecticut, 06037. My curriculum vitae was provided as Attachment A of my pre-filed testimony dated March 29, 2017.

My name is David Plante. I am the Manager of the Project Management Department for Public Service Company of New Hampshire d/b/a Eversource Energy ("PSNH"). My business address is 13 Legends Drive, Hooksett, NH. My curriculum vitae was provided as Attachment A of my pre-filed testimony dated April 12, 2016.

My name is Nicholas Strater. I am a Principal and the Trenchless Practice Leader at Brierley Associates. My business address is 167 South River Road, #8, Bedford, NH, 03110. My curriculum vitae is attached hereto. *See* Attachment A.

My name is Marc Dodeman. I am a Director of Submarine Cable Projects at LS Cable America, Inc.. My business address is 222 Bridge Plaza South, Suite 560, Fort Lee, New Jersey, 07024. My curriculum vitae is attached hereto. *See* Attachment B.

Q. Please describe the purpose of this testimony.

A. The purpose of our testimony is to address and respond to the New Hampshire Department of Environmental Services' ("NHDES" or the "Department") Final Decision dated February 28, 2018. We understand that the Department recommended that the Site Evaluation Committee "consider having the Applicant conduct a more thorough evaluation of the Horizontal Directional Drilling (HDD) method for installing cable under Little Bay." On April 6, 2018 the New Hampshire Site Evaluation Committee ("NHSEC") issued a revised procedural order that required the Applicant to file Supplemental Testimony and Information Pertaining to HDD studies. This testimony is presented to comply with these requirements and provide further information on the HDD options for crossing Little Bay with underground cables.

Q. Have you reviewed the pre-filed testimony submitted by Counsel for the Public and the interveners in this matter?

A. Yes, we have. We understand that the Town of Durham and Conservation Law Foundation have suggested that using HDD construction technology may be a better alternative for the Project to cross Little Bay than using jet plow technology.

Q. Are you familiar with the New Hampshire Department of Environmental Services Final Decision and the DES request for a further evaluation of HDD?

A. Yes, we are. The Department issued a final approval for construction of the Project using jet plow technology. The final approval recommended that the SEC consider requiring the Applicant to conduct a further evaluation of HDD. The final decision also listed certain criteria that the Applicant should consider as part of an HDD evaluation, including, assessing the possibility of using HDD for crossing all of Little Bay and using HDD only in the areas where hand-jetting is proposed (i.e. using HDD for shore landings).

Q. Are you familiar with HDD? If so, please describe your qualifications and experience and that of any other individuals who have assisted you in reviewing the Seacoast Reliability Project.

Kenneth Bowes: Eversource performs trenchless underground installations on a daily basis for new gas and electric services. For underground crossings of driveways and roads, it is the preferred method for the replacement of failed direct buried underground electric facilities with a cable-in-conduit replacement system. The drill sizes required for these projects tend to be of small diameter (4” or less) and up to a few hundred feet in length. The HDD equipment is mounted on a small trailer or self-contained vehicle designed for this purpose. I also have experience with HDD for larger drill sizes and lengths with both Eversource gas and electric transmission projects. These HDD projects include a single drill of approximately 2,500 linear feet for a new gas pipeline through a large hilly area in central Connecticut, and several longer river crossings including one for the Middletown-Norwalk transmission project under the Housatonic River of 2 HDD drill paths of approximately 1,400 linear feet each with a maximum depth of approximately 47 feet below the river bottom. Eversource is also in the permitting phase for an underground electric cable system in Boston Harbor to install a replacement 115kV electric Harbor Electric Energy Company (HEEC) cable between the South Boston K Street Substation and the Deer Island Wastewater Treatment Facility. The proposed submarine cable route is approximately 2.73 miles in length. For 2.10 miles of the crossing, we propose to install the electric cable using a hydroplow and use HDD to install a conduit for the electric cable along the westernmost 3,000 linear feet of this crossing and to access onto Deer Island (approximately 500 linear feet).

David Plante: I am familiar with Horizontal Directional Drilling and other trenchless construction technologies and have a general engineering understanding of the design concepts, construction methods and applicability to various project scenarios. I am not an expert on trenchless construction technologies. My role here is to provide input on general project management topics as they apply to the use of HDD as a potential method to construct the Little Bay crossing.

Nicholas Strater: I have been working in the tunneling and trenchless industry since 1993. I have been involved in the planning, design, and construction oversight of numerous HDD installations throughout North America. My resume, Attachment A, lists specific projects that included use of HDD.

Marc Dodeman: I have been working in the submarine cable installation industry, including overseeing HDD operations, since 1996. I have specialized in shallow water operations and intertidal operations. My resume, Attachment B, lists specific projects that included use of HDD.

General HDD Technology

Q. Please provide a general overview of HDD and where and why HDD is typically used.

A. HDD is a trenchless method of installing underground utilities along a pre-designed bore path using a surface- launched drill rig. The process involves initially drilling a small diameter “pilot” hole to establish an accurate bore path, then gradually enlarging the hole through a series of reaming passes. All stages of the HDD drilling process involve pumping a bentonite (a fine clay) based drilling fluid into the borehole. The drilling fluid maintains borehole stability, removes cuttings, and cools the drilling tools. Once the borehole is opened to the required diameter, the product pipe can be pulled through the bore to allow for use by the utility. These pipes can be used directly for gas, water and other similar utilities or as conduits for electric and telecommunications cables.

HDD was first developed in the 1960s for gas pipeline installation. The technique was found to be beneficial for installing these utilities under roadways without having to cut open the roadway and incur the traffic delays or restoration costs. As the technology evolved it began to be used for other utility applications including telecommunications. In the early 1990's telecommunications companies were engaging in large infrastructure buildouts requiring underwater cable systems due to the increase in data usage. Those installations faced two problems. First, large cable laying vessels could not approach close to the shore landings due to rough surf zones. Second, environmental regulatory bodies were also beginning to realize the importance of sand dunes to coastal environments as well as the importance of limiting disturbance to coastal vegetation which provide erosion protection. Because of these issues, HDD began to be used as an alternative to open trenching and other installation techniques. The HDD was completed to bypass the sand dunes as well as surf zones so that the cables could be pulled directly from the ship through the HDD to a suitable land location. Since that time, HDD has been used in the electric utility industry as well where challenges prohibit the use of other installations.

HDD is a common alternative to open-cut cable installation when surface disturbance is impracticable or not desirable. Examples of locations where HDD is a common installation technology include under interstate highways where open cut excavation is not possible due to traffic. HDD installations are also used to avoid sensitive cultural and natural resource areas, and for avoidance of existing infrastructure such as underground utilities. An additional application involves when deep burial depths are required that cannot be safely or cost effectively met with open-cut installation methods (for example, the PSE&G Bergen-Linden Project in Newark Bay). HDDs were required due to the need for that submarine cable system to cross under a United States Army Corps of Engineers (USACE) maintained Panamax Depth

Federal Navigation Channel crossing Newark Bay. It was critical that the entire submarine cable system was buried entirely below the USACE-dictated dredging depth, to ensure that the HDD system would not be subject to damage by present and future channel maintenance dredging activities. Open cut, jet plow and other technologies could not physically and cost-effectively meet the required depth.

HDDs are also often selected to drill below beaches and sand dunes, thus preserving dune grasses that bind dune sands together. They are also selected in areas where large lay vessels (Cable ships) with deep drafts cannot safely approach the landing area for initial and final cable landing operations, whereby the HDD pipe is drilled from land into water depths that can safely allow the approach of these vessels. In the case of the Little Bay project, a shallow draft barge has been selected which can make the approach to the landings in extremely shallow water.

Please refer to the report titled *Horizontal Directional Drilling and Jet Plow: A Comparison of Cable Burial Installation Options for a 115-kV Electric Transmission Line in Little Bay* ("HDD Technical Report") for additional information.

Q. In general, what types of projects are best suited for using HDD as a construction method?

A. HDD is most commonly used for small diameter pipes and cables, typically less than 36 inches. Common HDD lengths range from about 500 to 3,500 feet, although longer installations are technically viable using larger equipment. Installations in either soil or bedrock are possible, provided the appropriate drilling tools are utilized.

Q. Please explain the difference between full HDD and shore landing HDD.

A. A full HDD is a complete crossing of an obstacle from an entry and exit point on either side of the obstacle. For this Project, a full HDD would be a single complete bore from a point in Durham, NH to a point in Newington, NH, with the bore completely under Little Bay.

A shore landing HDD or "partial" HDD uses the same drilling technique but extends only below the shoreline. Typically, a shore landing HDD involves drilling from an onshore location to an area in the waterbody where open cut or plowing installation techniques can more cost-effectively be completed or the environmental concern is lower. For this Project, there would be two shore landing HDDs. The first would be from the shore in Durham, NH out to a location where the cable could be installed by jet plow, with a second HDD from the shore in Newington, NH to a location where the cable could be installed by jet plow.

Q. Please describe the borehole drilling process that could be used in HDD installations in Little Bay.

A. The HDD process begins by drilling a small diameter (approximately 10 inches) pilot hole along a predesigned trajectory. During drilling, the location of the drill head is tracked using a downhole survey tool, connected to the ground surface by a wireline located within the drill rods. For the full HDD installation, the pilot hole may be established using a single drill rig, or two drill rigs drilling to a predetermined intersect point below Little Bay (intersect method).

For the shore landings, the pilot hole would be advanced by a land based drill rig to a barge or pile supported work platform located in Little Bay. The drilling fluid flowing to the exit would be contained in a steel conductor casing, or gravity cell.

Once the pilot hole is completed, it would be enlarged by a series of pull or push reams, depending on the subsurface conditions encountered. The additional diameter achieved with each back ream pass is dependent on the subsurface conditions and the reaming tool used. For the Project, it is anticipated that three to four reaming passes would be required. At this time, a final reamed borehole diameter of approximately 48 to 52 inches is anticipated for both the full and HDD shore landing installations to accommodate the 36-in casing (steel or HDPE) required to contain the cable duct bundle. This is consistent with industry practice, which suggests that final borehole diameter should be at least equal to the outer diameter of the casing, plus 12 inches.

During all stages of drilling and reaming, a bentonite-based drilling fluid is pumped down the center of the drill rods into the borehole. Once the drill fluid exits the hole, it is pumped through a recycling system, and reused.

Q. The DES Final Permit requested that Eversource explain why a bore hole smaller than 40 inches cannot be used for three 6-inch diameter cables.

A. The question presented in the DES Final Permit conditions is no longer relevant. As discussed above, the use of HDD across Little Bay will require six power cables. *See* HDD Technical Report, Appendix B (Ampacity Report) for a further explanation. To accomplish an HDD installation for both full and shore landing HDD, the selected contractor would have to complete two parallel boreholes, each with a final reamed borehole diameter of approximately 48 to 52 inches.

Design Options

Q. Has Eversource evaluated different HDD design options for the Little Bay Crossing?

A. Yes. As described in the HDD Technical Report in Sections 2.2 and 3.2, Eversource evaluated two HDD design configurations for crossing Little Bay, full HDD and shore landing HDD. For each of those options, two design configurations were reviewed. Eversource evaluated Design A (one cable per phase conductor, for a total of three conductors) and Design B (two cables per phase for a total of six phase conductors) to evaluate the ampacity considerations and open sheath voltages for the cable to determine how many cables and bores would be required to meet the electrical loading requirements of the Project.

Also, as described in Section 3.2 of the report, it was determined that for the Little Bay crossing, either HDD design option (full or shore landing) would require 6 power cables (and two fiber optic communications cables). Eversource determined that three cables in a single bundle cannot provide the required ampacity and meet the open sheath voltage requirements for the Project. For an additional discussion of the ampacity analysis, please refer to Appendix B of the HDD Technical Report (Ampacity Report).

The need for two cables per phase (6 power cables total) for both the full HDD and shore landing HDD cable installation adds additional engineering complexity to the design and installation. For the full HDD option, two manholes will be required on both sides of Little Bay to transition from the HDD installation to the terrestrial duct bank system. The cables installed in the HDD bores will be pulled into the manholes (3 cables per manhole). The cables will then be spliced to underground cables in an underground duct bank system from the manhole in Newington and from the manhole to the riser structure in Durham.

For the shore landing HDD option, two manholes will be required on the Newington side of Little Bay to transition from the HDD installation to the riser structure. On the Durham side of Little Bay, it is anticipated that the cables will be run to a manhole then to the riser structure. At the riser structures, all six conductors will be brought up the pole and connected to the overhead line. A riser structure with six cables will be taller and larger in diameter and have more supporting equipment than one supporting 3 underground cables.

Property Rights

Q. Does the Applicant presently have the requisite property rights to construct the Project using HDD technology?

A. As discussed in Section 3.2.11 in the HDD Technical Report, Eversource does not presently possess the land rights required for installation of the Project using either HDD option.

Q. Describe the general workspace requirements that are needed for a typical HDD.

A. An HDD of this size and length typically requires at least 30,000 sf of workspace for the drilling and other support equipment. This area would be required on both shores of the Bay regardless of whether the Project used a full or partial HDD. In addition to the required workspace for drilling, a staging area for pipe, which is pulled into the borehole, is required. Typically, for lengths similar to this Project, the pipe staging area is approximately 65 feet wide and extends the full length of the pull. This allows one continuous pull without the need to stop and weld additional sections. A diagram of this setup location is in the HDD Technical Report at Figure 12. To accommodate such a work area, Eversource would need to acquire additional rights to construct an HDD in these locations as depicted in the HDD Technical Report at Figure 11 for full HDD and at Figure 14 and 15 for shore landing HDD. In addition to obtaining new rights for the work areas, Eversource would need to acquire an easement for the perpetual rights to own, operate and maintain the underground line.

Q. Does Eversource currently own the requisite rights for the workspace requirements to construct the Project using HDD installation technology?

A. No, Eversource does not presently possess the land rights required for the workspace using either HDD option. On the Newington side of Little Bay, Eversource is constrained by a 100-foot wide easement for overhead lines within the Gundalow Landing area. While some of these easements have been modified and some additional easements procured for the Project, none of these existing easements allow for the type or scope of construction work needed for the installation of HDD across Little Bay. In addition, while the proposed workspace on the Newington side is technically feasible from a design and engineering perspective, it is in the middle of the Gundalow Landing neighborhood. Eversource recognizes that if the workspace were located there, it would create significant disruption for the adjacent residents. In recognition of that fact, Eversource also assessed locating the workspace further from the Bay (see Report at Section 3.2.4 and the testimony that follows).

On the Durham side of Little Bay, Eversource owns in fee the parcel of land situated on the shoreline, but is again constrained by owning only a 100-foot wide easement for overhead lines inland of that parcel. The staging area needed for an HDD installation on the Durham side would have to extend beyond the Eversource parcel, and would need to use private lands for which no rights exist other than the existing Eversource overhead easement.

Construction Equipment

Q. Describe the type of construction equipment generally required for an HDD installation of this type.

A. Staging areas for both the entry and exit pits for HDD will contain all necessary equipment needed to support the drilling operation, including the drill rig, control cab, generator, drill pipe rack, mud pump, drill fluid recycling unit, slurry holding pit, office and crew space. A drill fluid containment barge would be staged in the vicinity to provide response to an inadvertent drill fluid return within Little Bay (IR, or “frac-out”). As the HDD process will require large, heavy drill rigs and support equipment (e.g., recyclers) which will need to be transported to and from the site(s) by road, additional traffic control plans will need to be developed. These traffic control plans will need to consider maximum vehicle widths and equipment loads, particularly where secondary road and bridge use is required.

Subsurface Conditions and Inadvertent Returns

Q. Has Eversource evaluated the subsurface conditions across Little Bay?

A. Yes. The subsurface conditions in the vicinity of the Little Bay crossing were assessed through a limited test boring program, a geophysical survey, and evaluation of readily available geologic literature. The results from the initial survey are provided in section 3.2.3 of the HDD Technical Report. Additional sample test borings will be required to facilitate HDD and cable design for the Little Bay crossing. The subsurface conditions across Little Bay, which are dominated by bedrock, increase the likelihood of an unsuccessful drill attempt. If there is an unsuccessful attempt, the HDD contractor would have to take significant corrective actions or start over.

Q. Has Eversource assessed the likelihood of an inadvertent return of drilling fluid based upon the subsurface conditions in Little Bay?

A. Yes, Eversource has conducted a preliminary assessment of the potential for an inadvertent return ("IR"). An inadvertent return is a condition whereby the drilling mud (bentonite slurry) being pumped into the borehole during drilling operations finds a point of egress through a fracture and seeps out onto the surface. As discussed in section 3.2.3 of the HDD Technical Report, by using the results of the geophysical survey, Eversource's contractors completed a preliminary annular pressure analysis ("frac-out analysis") for the Full HDD Option and the Shore Landing Options to evaluate the risk of IR during pilot hole drilling, assuming industry standard practices. The results from the preliminary annular pressure analyses are provided in Figures 7, 8 and 9 of the Report.

For the Full HDD Option, the majority of the borepaths are anticipated to be located in bedrock, and the confining capability has been assessed by means of the Total Stress Method. For the HDD Shore Landing Option, the borepaths are located in both bedrock and soil. In this case the confining capabilities have been assessed using both Total Stress and the Delft Equation.

The potential for an IR may be considered greatest at locations where the anticipated range of downhole drill fluid pressures are close to or exceed the estimated confining capabilities of the surrounding materials. The results of the preliminary annular pressure analyses suggest the following:

- For the Full HDD Option, the risk of IR is greatest in the middle of Little Bay, where the depth of bedrock cover over the bores is limited.
- For the Shore Landing HDD Option, risk of IR is greatest near the HDD exits, where the bores transition from bedrock to soil, and the depth of the bores decrease.
- The risk of IR associated with the Shore Landing HDD Option appears to be greater than the risk associated with the Full HDD Option.

The annular pressure analysis is considered a tool to identify areas of potential risk; it is not considered an exact predictor of the location or degree of an IR. In addition, the annular pressure analysis is not an accurate predictor of borehole leakage, where drill fluid leaks to the adjacent materials through existing porosity or fractures.

Q. Based on the results of the preliminary annular pressure analysis, please describe any specific concerns about using HDD due to the subsurface condition of the Bay and describe the construction risks.

A. Based on the preliminary annular pressure analysis, and prior experience with similar projects, there is a risk of an IR occurring while installing the Project using HDD across Little Bay. The occurrence of an IR in Little Bay, or on either shore, would require the contractor to stop drilling, repair the borehole (through swabbing or plugging the release point) or if necessary redirecting the borehole around the release point, and containing and removing the drill fluid released to the surface.

For land-based portions of the HDD, an IR could be contained using hay bales and shallow surface excavations, and removed by hand tools and vacuum trucks. This remediation activity may result in additional surface disturbance, including temporary impacts to vegetation.

Depending on depth and location, an IR within Little Bay could be contained with a gravity cell. This operation would require a dedicated standby vessel to be anchored over the IR area; a gravity-cell containment system to be placed over the IR location with a barge mounted crane; and a diver-operated vacuum operation to be conducted until all bentonite is transferred up to frac-tanks tanks on the barge. Depending on the water depth and current, the use of a gravity cell could be supplemented by placement of silt booms.

In addition to the technical challenges associated with an IR, as discussed in the HDD Technical Report and the joint pre-filed testimony of Sarah Allen and Ann Pembroke, in the event of an IR within Little Bay, there may be environmental impacts.

Q. Please describe any known measures to minimize the effect from a potential inadvertent return of bentonite fluid to surface waters.

A. In general, it is best practice to select areas for HDD construction that are underlain by geologic materials which provide sufficient confining capacity to contain the drill fluid pressures required for construction. HDD may be problematic in areas underlain by very soft soils, variable bedrock, and soils containing gravel, cobbles and boulders.

If HDD were to be used for this Project, for either a full installation or shore landing, an HDD design would be developed, to the maximum extent feasible, to minimize the risk of an IR by targeting geologic materials (where possible) with in-situ strengths capable of withstanding the anticipated drill fluid pressures. In addition, the HDD contractor would be required to monitor and control downhole drill fluid pressures during drilling.

<u>Complete HDD</u>

Q. Has Eversource assessed the technical requirements for complete HDD?

A. Yes. The general and specific technical requirements for full HDD are presented in Sections 2.2 and 3.2 of the HDD Technical Report.

Q. Has Eversource assessed the design criteria for a complete HDD?

A. Yes. As described in the HDD Technical Report, a full HDD installation would follow an approximately 6,000-ft long bore path, with a minimum depth of 70 feet below the bottom of the Bay.

The entry area for a full HDD installation would be in the Town of Newington, to the south of the existing Eversource easement in the middle of Gundalow Landing (Figure 10), approximately 600 feet from the edge of Little Bay. Preliminary evaluation suggests that it will not be possible to place the HDD entry location within the existing Eversource easement due to the limited bending capabilities of the steel casing.

The exit pit for a full HDD installation would be on the western shore in the Town of Durham, within the existing Eversource easement (Figure 11), approximately 500 feet from the edge of Little Bay. It should be noted that the limited bending capability of the steel casing will require that the bore paths be located to the south of the Eversource easement near the shore. This is shown on Figure 4.

The preliminary geometry for the full HDD option is shown on Figure 4 of the HDD Technical Report. In this case, the minimum curvature radius of the bores will be controlled by the 36-in steel casing. For the purpose of this study, a minimum bending radius of 3,600-feet has been assumed for the casing, consistent with industry practice. To accommodate the existing Eversource easement configurations, multiple compound curves will be required. Although technically feasible, a parallel bore path configuration of this length and geometry will be technically challenging to construct. Partial location of the full HDD option alignment outside of the existing Durham and Newington easement limits will be required. As shown on Figure 4, the full HDD option bore paths will be placed almost entirely in bedrock.

As discussed previously an HDD entry area located east of Little Bay Road was also considered for the full HDD installation to address the anticipated impacts to residential abutters. Relocation of the entry pit would require an approximately 7,400-ft long bore path, which is uncommonly long. While this length is technically achievable, it would add significant complexity to the installation, given the geometry of two parallel bore paths, the diameter of the boreholes and the subsurface conditions present. Increasing the bore length would also add significant risk of success and cost and create delays in the Project schedule.

Q. How long would it take to complete a full HDD installation across Little Bay take?

A. It is expected that construction time for a full HDD installation across Little Bay will be approximately 28 months, depending on the specific HDD methods employed by the drilling contractor. Except for critical stages of the drilling operation that would require 24-hour work, the majority of construction activities would occur 6 days a week for 12 hours per day. The estimated time required to complete HDD could increase due to IRs, drill break, difficulty in completing the desired borepath geometry, and other unforeseen construction complications.

Q. Please elaborate as to which HDD installations would require certain operations to continue throughout a 24-hour work period.

A. HDD contractors will perform certain critical HDD installation operations continuously during a 24-hour period. Those critical stages of the drilling operation would include, for example, casing pipe pullback, equipment failures or clean-up activities for an IR of drilling fluids. However, it is anticipated that the majority of the construction activities would occur 6 days a week for 12 hours per day.

Q. Describe the workspace areas that would be required for complete HDD.

A. A full HDD installation would require one or more large HDD rigs. The staging areas for a full HDD drilling operation will require a minimum work/staging area of 100 x 300 feet (30,000 square feet) on each side of Little Bay, as shown on Figures 10, 11, and 12 of the HDD Technical Report. Smaller, tighter work space areas reduce the efficiency of the HDD operation. The staging area would contain the drill pits and equipment needed to support the drilling operation, including the drill rig, control cab, generator, drill pipe rack, mud pump, drill fluid recycling unit, slurry holding pit, office and crew space and parking. The size of the staging area is dependent upon developing an appropriate workflow between various construction activities. The work areas are further described at 3.2.5 and 3.2.13 of the HDD Technical Report.

Q. Describe any other potential impacts associated with a complete HDD installation.

A. In addition to the size and disturbance from the work areas described above, it is expected that noise and construction traffic associated with HDD operations would be significant.

Noise associated with the HDD operations would result from initial site clearing and grading activity and later from the installation of the steel casings, operation of the HDD drill and hydraulic power units for the drill motor, electric pumps used for circulating the drilling fluid, diesel site generators and additional diesel powered light plants and from conventional construction noise sources such as large vehicle back-up alarms, front-end loader or back-hoes (required to load drill pipe sections into the drill rig) and cranes to handle casing pipe string.

Most larger HDD drills and support equipment typically produce a sustained noise level between 95 and 105 dB(A). Noise levels would be reduced by use of equipment mufflers and temporary noise barriers (i.e. sound walls), laced around the limits of the construction zone. The noise reduction would be quantified by instrumentation placed at adjacent receptors (e.g., residential structures). *See* Figure 13 of HDD Technical Report.

HDD operations will cause additional roadway traffic in both Durham and Newington, resulting from equipment delivery/removal, material delivery (casing, conduit, etc.), spoils removal, and work force transportation. This additional traffic will be active at least 6 days per week. The size and weight of the land-based HDD construction equipment and the cable spools are significant. Delivery and removal of these items will require development of a project-specific transportation plan, which must consider roadway loading limits, bridge weight restrictions, equipment height limitations, and truck turning radii. The HDD drilling operations also pose a risk for an IR occurring on privately owned property.

Q. What is the estimated cost of complete HDD?

A. The approximate conceptual cost estimate (-25%/+50%) of the Project, when incorporating the full HDD option, is expected to be $216 million, $132 million more than for the Project using full jet plow installation. The estimate includes mobilization, drilling and reaming, the duct material, steel casing, thermal grout, and the cable.

<u>Shore Landing HDD</u>

Q. Has Eversource assessed the technical requirements for using HDD at shore landings?

A. Yes. In general, the technical requirements for a shore landing HDD are very similar to those for a complete HDD. In addition, a shore landing HDD would require the placement of a gravity cell or conductor casing at the HDD offshore exit area for the duration of drilling operations. The barge at the exit area would be fitted with frac-tanks, pumping equipment, a crane, and a dive team and would be on site throughout the entire operation until the HDPE conduit is installed. Hand jetting would then be performed between the end of the drill pipe and where the plow was deployed and the plow share fully articulated to specification cable burial depth. Specific technical requirements for shore landing HDD are discussed in more in Sections 2.2 and 3.2 in the HDD Technical Report.

Q. Has Eversource assessed the design criteria for shore landing HDD?

A. Yes. As described in the HDD Technical Report, the Shore Landing HDD option would involve use of HDD to install the casing and duct below the eastern and western nearshore areas of Little Bay, and then connecting the two HDD segments with a jet plow installation across the center of Little Bay. These installations would involve drilling from land (from Newington and Durham, at the locations described above, Figure 5) to predetermined exit points in Little Bay.

Based on existing site conditions, it is anticipated that the eastern (Newington) HDD shore landing would be approximately 2,630-ft in plan length, and the western (Durham) HDD shore landing would approximately 2,730-ft in plan length. Each HDD shore landing would be drilled to a depth of at least 65 feet below bottom of the Bay. In this case, a jet plow installation, as well as hand jetting, would be required to connect the HDD shore landings would be about 1,950 feet in plan length.

The preliminary geometries for the HDD shore landing options are shown on Figure 5 of the HDD Technical Report. In this case the minimum curvature radius of the bores will be controlled by the HDD drill rod steel. For the purpose of this study, a radius of 2,000-feet has been assumed. As shown on the preliminary geologic profile on Figure 5, the HDD shore landings installations would encounter fill, stratified glacial deposits, glacial till and bedrock.

Q. Describe the work space areas that would be required for HDD shore landings.

A. For planning purposes, the work space dimensions required are assumed to be the same as those described for the Full HDD installation (above), and shown on Figure 12 of the HDD Technical Report.

Q. Describe any other impacts associated with HDD at shore landings.

A. In addition to the impacts to abutters associated with a full HDD installation, which are the same for using an HDD for shore landings, a small section of diver hand jetting will still be required at each HDD shore landings. The HDD will also be required to keep a gravity cell barge fitted with pumps, frac-tanks and a dive spread on standby during all drilling operations should an inadvertent return occur.

Q. How long would it take to complete the HDD for shore landings?

A. It is expected that construction time for a completing HDD for shore landings would be approximately 10 months for the shore landings, assuming both are constructed concurrently. This time estimate does not account for the 3 week jet plow installation process and one month hand jetting installation.

Q. What is the estimated cost of HDD at shore landings?

A. The approximate conceptual cost estimate (-25%/+50%) of the Project with the two shore landing HDD installations (including the additional cost for the jet plow installation between the two-shore landing) is expected to be $184 million, $100 million more than for the Project using full jet plow installation. The estimate includes mobilization, drilling and reaming, and the duct material, as well as the marine support equipment.

Other Additional Impacts from HDD

Q. If the Project were to use HDD, how would that impact the design of the Project for the crossing between the two transition structures?

A. HDD installation places cables in closer proximity to each other as well as at deeper depths than a submarine installation. This combination creates a condition where the cables cannot dissipate excess heat as quickly and can mutually heat other cables around them. Cables are limited to certain temperature conditions beyond which they begin to degrade and potentially fail. Larger cables or additional cables are used to mitigate the effects of this heating. As described in the HDD Technical Report in Section 2.2.1, a review of the cable design required for HDD found more cables (two cables per phase, six cables total) are required to meet the ampacity requirements for the Project. This is compared to three cables required for the submarine cable design. These six cables would be installed in two HDD bores, each with three cables. The additional cables, as well as HDD installation, add some additional complexity to the Project. First, in order to meet the project requirements a thermal grout needs to be installed in the HDD bores surrounding the inner ducts. This helps dissipate heat from the cables. Installing the grout requires a significant amount of material to be imported to the site, additional bore hole size as well as challenges during installation. Second, it is not possible to pull cables through the HDD directly to a riser pole. As a result, manholes are required in both Newington and Durham to transition from the cable installed in the HDD to cables that would run to the riser structures. This results in two manholes, approximately 10'x10'x35', in both Durham and Newington. Third, the riser poles need to be redesigned to support six cables instead of three on the submarine design. This will result in a larger diameter pole as well as a taller pole. Finally, for six cables per phase a larger (wider) duct bank would be required in from manhole locations to riser structure. This results in additional excavation materials as well as excess soils to dispose.

<u>Conclusion</u>

Q. Please explain why HDD was not selected as a construction method for this project

A. While both installation methods are technically feasible, the technical risks of HDD are substantially higher than jet plowing due to the size of the bore, subsurface conditions and length necessary to cross Little Bay. HDD also has significantly longer construction periods, staging areas in residential areas, requires more developed road infrastructure to accommodate construction equipment and delivery of materials and requires the acquisition of additional land rights. The cost differential for HDD is significant; additional costs that would be transferred to the electric customers. For a further discussion of the pluses and minuses of each construction method, please see Table 1 of the HDD Technical Report and the Conclusion Section.

Based on the technical review, Eversource has concluded that potential risks and technical challenges for HDD are significantly outweighed from its benefits for this Project.

Q. Does this conclude your supplemental pre-filed testimony on HDD?

A. Yes, it does.

Attachment A

Resume of Nicoles Strater

NICHOLAS H. STRATER, P.G.

TRENCHLESS PRACTICE LEADER

Mr. Strater has 25 years of geotechnical consulting experience, and has served as project and construction manager for a large variety of projects. His specialties include rock and soil tunnels, horizontal directional drilling, and trenchless technologies. Mr. Strater's experience covers a broad range of services areas including geotechnical site characterization; feasibility and design studies; detailed design; preparation of contract documents; construction phase services; and claims analysis and evaluation.

Mr. Strater is a member of the American Society of Civil Engineers Trenchless Installation of Pipelines (TIPS) Committee. He also serves on ASCE committees developing manuals of practice for pilot tube, auger boring, and the Direct Pipe™ methods.

Years of Experience: 25

Years with Brierley: 8

Education

M.S., Geology, University of Rhode Island, 1993

B.S., Geology, University of Rhode Island, 1993

Professional Registration

Licensed Professional Geologist

NH, WA, LA

Registered Professional Geologist

TN

Professional Societies

Society for Mining, Metallurgy and Exploration (SME)

North American Society for Trenchless Technology (NASTT)

Northeast Trenchless Association (NTA)

International Society of Explosive Engineers (ISEE)

Training

NASTT Short Course: *Pipe Bursting Good Practices* (Spring 2010)

Baroid/Halliburton HDD Drill Fluids Class (Spring 2009)

SME Short Course: *Underground Blasting Technology & Risk Management, 2008.*

ASFE Fundamentals of Professional Practice (*Magna Cum Laude*), 2005.

RELEVANT PROJECTS - HDD

Eversource Northern Pass Project, Central, Northern NH. Developed 90% design for 50 separate HDD installations for electric cable duct, ranging in length from 700 to 3,000 feet. Crossing locations includes roadways, streams, wetlands and rivers. Provided plan and profile geometries, pipe calculations, frac-out analyses, and permit support (NHDOT and NHDES permits).

HDD Design, Rehoboth Beach Outfall, Rehoboth Beach, Delaware. Developed design of 24-in diameter, 3,000-ft long HDPE ocean outfall completed by HDD. Provide pipe material analysis, prepared drawings, frac-out analysis and HDD specification. Managed oversight of HDD activities during construction. Construction completed Spring 2018.

Princeton University Electric Distribution, HDD Design Services – Carnegie Lake Crossing. Developed design of two separate, parallel HDD bores in bedrock, to install twin electric cable duct bundles consisting of eight (8) 6-in, and three (3) 4-in conduits (each). Provide duct design, prepared drawings, frac-out analysis and HDD specification. Construction completed Spring 2018. Bore paths approximately 1,950-ft long each.

HDD Feasibility Study, 69-kV Cable Replacement, Oceanside, CA. Developed 30% HDD design for a 69-kV cable duct system in the vicinity of Oceanside, California which will cross the San Luis Rey River. The alignment will pass in the vicinity of existing bridges, and will be approximately 1,100-ft in length.

Greater Augusta Utility District Kennebec River Crossing, Augusta, ME. Developed design of 16-in HDPE sewer siphon force main installation below the Kennebec River by horizontal directional drilling. Installation length is approximately 750 long, in glacial soils. Prepared fracout analysis, ACOE permit application, drawings, and supporting calculations.

Unitil Natural Gas Pipeline Installation, Squamscott River, Exeter/Stratham, NH. Provided design of 1,300-ft long HDD for installation of a 10-in steel natural gas pipeline installation below the Squamscott River. Developed drill geometries, completed pipe

BRIERLEY ASSOCIATES

Creating Space Underground

stress calculations, and provided frac-out analyses. Provided oversight of HDD installation.

MAYO RPS Force Main Trenchless Installations, Anne Arundel County, MD. Developed design of fourteen (14) separate HDD installations for new 20-in sewer force main. HDD installations range in plan length from 1,200 to 4,100 feet, and pass beneath roadways, parks, wetlands, and the South River. Developed drill geometries, completed pull force calculations, and provided frac-out analyses. Also developed performance specification and cost estimate for the HDD installations.

Cinder Cove Force Main Replacement Anne Arundel County, MD. Provided design review of three (3) separate HDD crossings for a 30-in fusible PVC force main. Developed revised drill geometries, completed pull force calculations, and provided frac-out analyses.

Exelon/BGE, 1500-103 BGE Russett to Tipton Duct Bank, Laurel, MD.
Project Manager responsible for design of five (5) trenchless crossings, each involving three (3) parallel HDD installations of electric cable duct bundle. Each bundle consisted of 5, 10-in HDPE duct. Drill paths range from about 1,200 to 2,200 feet in length, located below wetlands, and the Pawtuxtent River. Provided drill path geometry, pull force and annular pressure calculations, and construction oversight.

Appeal Landfill Utility Improvements, Calvert County, MD. Provided design of three (3) separate HDD 8-in fusible PVC force main installations below a stream and adjacent wetlands adjacent to the Appeal Landfill. Developed revised drill geometries, completed pull force calculations, and provided frac-out analyses. Also developed performance specification and cost estimate for the HDD installations.

Exelon/BGE, Russet East and Tipton 115 kV XLPE Cable Project, Baltimore, MD. Project Manager responsible for design of six parallel HDD installations of electric cable duct bundle. Each bundle consisted of 6, 8-in HDPE duct. Drill paths ranged from about 1,200 to 2,200 feet in length, located below wetlands. Provided drill path geometry, pull force and annular pressure calculations, and construction oversight.

Trenchless Feasibility Study, Entergy Red Gum 115kV Mississippi River, Crossing Replacement, Natchez, MS. Responsible for technical evaluation of trenchless alternatives for installation of four electric cables, each contained within 8-in duct. Installation to be completed below the Mississippi River, and unstable bank slopes. Total crossing length is approximately 7,500 feet. Methods evaluated included horizontal directional drilling (HDD) and the Direct Pipe Method.

ENMAX Downtown Calgary Transmission Reinforcement Project, Trenchless Duct Bank Installation Feasibility Evaluation, Calgary, Alberta. Provided feasibility assessment for trenchless installation of two 138kV cables (double circuit) or a single 240kV cable (single circuit) at four (4) locations, including 2 railroad crossings, and two river crossings. Methods considered included auger boring, microtunneling, and HDD. Provided cost estimates and work space requirements.

TransCanada Coastal GasLink Project Trenchless Feasibility Study, Multiple River Crossings, British Colombia. Project Manager responsible for technical evaluation of trenchless alternatives for installation of a 48-in steel pipeline across eight (8) rivers between Dawson Creek and Kitimat, B.C. Installation alternatives included HDD and microtunneling.

NOVA Gas Transmission North Montney Project Trenchless Feasibility Study, Peace River Crossing, Fort St. John, British Columbia. Evaluated feasibility of crossing the Peace River for installation of a 42-in steel high pressure gas main. Evaluated feasibility of HDD, microtunneling and the Direct Pipe method.

Raw Water Supply Elizabeth River Crossing, Norfolk Department of Utilities, VA.
The purpose of the project was to relocate the Norfolk raw water supply pipe between Norfolk and Portsmouth, Virginia as the utility relocation portions of a larger design build Midtown Tunnel project. A portion of the project included a 4,400 foot crossing of the Elizabeth River by means of Horizontal Directional Drilling (HDD) with a 36-in diameter steel pipe. Project Manager during design of the HDD crossing and associated pipe along with preparation of plans and specification technical sections for bidding.

Force Main, Elizabeth River Crossing, Hampton Roads Sewer District, VA. The purpose of the project was to relocate the force main pipe between Norfolk and Portsmouth, Virginia as the utility relocation portions of a larger design build Midtown Tunnel project. A portion of the project included a 3,620 foot crossing of the Elizabeth River by means of Horizontal Directional Drilling (HDD) with a 42-in diameter steel pipe. Project Manager during design of the HDD crossing and associated pipe along with preparation of plans and specification technical sections for bidding.

NStar Station 315 Trenchless Cable Duct Bank Installation Feasibility Study, Charles River Crossing, Watertown, Brighton, MA. Provided feasibility study for trenchless installation of two (2) two HDPE duct bundles below the Charles River. Each duct bundle will include nine (9) six-inch conduits. Methods evaluated included HDD and microtunneling. Provided risk and cost assessment, and develop method work space requirements.

Bangor Gas Penobscott River Crossing, Lincoln, ME. Project Manager for HDD design of 1,650-ft long installation of 6-in steel natural gas pipeline below Penobscott River. Completed pull force analysis, frac-out analysis, and prepared plans and profiles for permit submittals and bidding. Also provided pipe coating recommendations.

Annnisquam River Crossing, Gloucester, MA. Project Manager responsible for design of parallel HDD installations of fusible PVC pipes for potable water transmission. Drill paths cross below active marine channel, and are each approximately 1,200-ft in length. Provided drill path geometry, pull force and annular pressure calculations, and construction oversight.

Franklin Falls Potable Water Supply Crossings, Franklin, NH. Managed design, bid support, and construction management for trenchless installation of two (2), 12-in diameter HDPE potable water supply pipes across the Pemigiwasset River, to the east and downstream of the Franklin Falls Dam. Project included four (4) river crossings completed by HDD, each 1,200-ft long.

Exelon/BGE Gwynn's Falls Stream Crossing, Baltimore, MD. Project manager, responsible for trenchless feasibility study for installation of 10, 8-in HDPE electric cable ducts across Gwynn's Falls Stream. Methods evaluated included HDD and microtunneling.

Enfield Force Main Installation, Enfield, NH. Managed design, bid support, and construction management for installation of 14-in diameter, dual containment HDPE pipe for wastewater transmission. Installation was completed below potable water supply lake and wetlands, using 1,400 feet of horizontal directional drilling.

City of Middletown Sewer Force Main, Middletown, CT. Project Manager responsible for design of three (3) parallel, 30-in diameter fusible PVC pipes for use as sewer force main, by means of horizontal directional drilling (HDD). Drill paths located below active roadways and streams. Provided drill path geometry, pull force and annular pressure calculations.

Enbridge Gas Pipeline Installation – Multiple Crossings, Massena, NY. Project Manager responsible for Contractor's design of four HDD crossings of rivers and wetlands to facilitate installation of 8-in natural gas pipeline. Crossings range in length from 1,000 to 2,500 feet in length.

Water Transmission Main, Bedford, NY. Trenchless subconsultant to Owner's Design Engineer, responsible for developing installation recommendations for 12-in water main below NYDOT Rte 22 and Rte. 35, and adjacent to Cross River. Installation methods included trenching and horizontal directional drilling.

PECO 130-42 Underground HPFF Transmission Line, Eddystone, PA. Developed trenchless design for installation of pipe cable below active Conrail tracks, and the adjacent Crum Creek. Trenchless installation below railway will be completed through pipe jacking; installation below Crum Creek will be completed through horizontal directional drilling (HDD). Provided technical assistance to Owner during construction.

Philadelphia Water Department Schuykill River Crossing, Philadelphia, PA.
Provided 60% HDD design of proposed trenchless crossing of the Schuykill River, for installation of dual, 8-in steel sewer force mains, within 24-in steel casing. Alignment approximately 1,400 feet in length.

New England East-West Solution (NEEWS), Central Connecticut and Massachusetts.
Evaluated the feasibility of installing 345-kVelectric cables through trenchless methods at over 150 locations throughout central Connecticut and Massachusetts. Proposed methods of installation include horizontal directional drilling, pipe ramming, auger boring, and microtunneling. Major crossing locations include rivers (Connecticut, Chicopee, Westfield), highways (I-84, I-90, and I-391), and wetlands.

MWRA Water Main Relocation – Section 26, Fox Hill Bridge Replacement, Saugus, MA.
Project Manager during development of a feasibility study to relocate a high pressure waterline under the Saugus River, to permit Replacement of the Fox Hill Bridge. Water main installation methods considered included horizontal directional drilling, microtunneling, and trenching.

Neptune Regional Transmission System Project, Long Island, NY and Sayreville, NJ.
Project Manager, responsible for design of 28 HDD bore paths for installation of AC and DC cables, bringing 600 megawatts of electricity from New Jersey to Long Island. HDD crossings ranged in length from 900 to 2,300 feet, and varied in depth from 33 to 95 feet. Purpose of crossings was to enable cable installation beneath fixed surface structures, wetlands, marine inlets, and public beaches. Project Owner was Prysmian (formerly Pirelli) Power Cable.

International Transmission Company Hickory Creek – Cardinal Bluffs, 345kV Transmission Line, Cassville, WI. Provided feasibility study for trenchless installation of underground cables below the Mississippi River and the abutting United States Fish and Wildlife Service (USFWS) Refuge in the vicinity of Cassville, Wisconsin. Methods evaluated included micrtounneling and HDD.

NAVTEC P499 Little Creek Cover Crossing, Portsmouth, VA. Provided contractor's HDD design for installation of twin 10-in steel casings for electric cable. Each installation was 2,970-ft in length. Completed pull force analysis, frac-out analysis, and prepared plans and profiles for submittals.

Dominion/ODEC Wildcat Point Water Intake Installation, Susquehanna River, PA. Project manager for design of 32-in water intake pipes, and one 8-in compressed air pipe below an active railroad, and the Susquehanna River. Installation will require three separate 36-in, 100-ft long microtunnels in mixed face conditions, and three separate, 1500-ft long HDD installations to intake structures on the river bottom. The project will also involves construction of a permanent, 35-ft deep shaft in bedrock, and a 45-ft deep cofferdam within the river.

Trenchless Installation Feasibility Study, PECO Frankfort Street Bridge Duct Bank Relocation, Philadelphia, PA. Evaluated feasibility of trenchless relocation of existing duct bank below Frankford Creek, consisting of twelve (12) 5-in HDPE ducts, to facilitate adjacent bridge demolition. Methods considered included microtunneling and HDD. Provided preliminary cost estimate comparison, and developed work space requirements.

Millennium Pipeline HDD, Various Locations, NY. Project involved six proposed HDD crossings across New York State, involving installation of 30-in. diameter high pressure natural gas main. The alignments crossed beneath various obstructions, including wetlands, creeks, New York State (NYS) Route 13, Interstate 84, and NYS Route 55. The HDD alignment lengths ranged from about 1,400 to 2,400 feet. Provided preliminary HDD paths for feasibility evaluation. Prepared geologic profile for each site, and assisted in the preparation of contract drawings for submittal to permitting agencies.

Malden River Malden River Crossing 13.8kV and 23kV Underground Distribution Project, Malden, MA.
Characterized subsurface conditions and prepared designs for two parallel, 1,200-ft long HDD drill paths beneath the Malden River, to facilitate installation of twelve 6-inch diameter PVC ducts. Project Owner was National Grid USA Service Company, Inc.

Tennessee Gas Pipeline/El Paso Gas Main Crossings, Saugus and Wakefield, MA.
Prepared design for two separate HDD drill paths; one approximately 1,700 feet long in bedrock, passing beneath a residential neighborhood, and one approximately 1,750 feet long in soil and bedrock, passing beneath a wetland and Interstate Route I-95. A 24-in. diameter natural gas main will be installed at each crossing.

Lofton's Island Utility Crossing, Fort Myers, Florida. Evaluated site geologic conditions, and assisting with the horizontal directional drilling design for the installation of electric, water, and fiber optic utilities between Fort Myers and Lofton's Island. Installation was approximately 1,800 feet long, beneath the Caloosahatchee River.

Conoco-Phillips Sheep Creek Crossing, Grande Cache, Alberta. Managed site investigation and geotechnical design for a 6,100-ft long petroleum pipeline to be installed beneath Sheep Creek, through horizontal directional drilling.

Encana Horizontal Directional Drill, Fort Nelson River, British Columbia.
Managed remote, helicopter access site exploration for a 5,700-ft long natural gas line installation beneath the Fort Nelson River. Provided site soil and bedrock characterization, and assisted with the HDD design.

Chelsea Creek Natural Gas Main Crossing, Chelsea, MA. Provided summary of soil and bedrock conditions for installation of proposed 12-in. natural gas main beneath Chelsea Creek using horizontal directional drilling (HDD) methods. Developed geologic profiles, and authored portions of geotechnical design memo summarizing anticipated ground conditions and construction considerations.

Emergency Potable Water Main Replacement, Matlacha Pass Crossing, Pine Island, FL.
Project Manager during design of 2,915 foot long installation of a 16-in. diameter HDPE potable water main beneath Matlacha Pass (marine crossing) by means of Horizontal Directional Drilling (HDD). Previous water supply main was

destroyed by Hurricane Andrew. Provided geologic profiles, developed drill fluid annular pressure curves, and assisted in development of Contract Documents.

Progress Energy Utility Installation, St. Petersburg, FL. Provided field oversight during pilot hole drilling for 1,550-ft long horizontal directional drill beneath State Route 275. Monitored drill path geometry and depth for conformance with Contract requirements. Hole was reamed to allow installation of 42-in. diameter steel carrier pipe for installation of electric cables.

PR-2/22A, PR-2/22B PREPA HDD Crossing, San Juan, Puerto Rico
Project Manager for trenchless design of two crossings to allow installation of new 115kV electric cables beneath highways PR-2/22A and PR-2/22B, and the Margarita Creek Canal. Each crossing involved seven separate HDD drill paths, ranging in length from 567 to 880 feet. Developed geologic profiles, HDD drill paths, and HDD design recommendations.

False Creek (English Bay) Crossing, Vancouver, British Colombia
In support of differing site conditions claim, evaluated and summarized subsurface conditions encountered by a 1,200-ft long horizontal directional drill completed below False Creek, at the mouth of English Bay.

Hudson River Gas Pipeline Crossing, Poughkeepsie, New York
Developed conceptual geologic profile and drill path for potential HDD replacement of gas line damaged by barge anchors.

PAPERS & PUBLICATIONS

- “HDPE in for the Long Haul via HDD”, with T Young, *Trenchless Technology,* 2016
- “Geotechnical Baseline Reports: Understanding Them And How They Can Be Used Successfully On Trenchless Projects”, with H. Stewart and R. Brock, *NASTT Rocky Mountain Trenchless Journal*, 2016

- “Warning: Do Not Bid on This Project!”, with B. Dorwart, *North American Society for Trenchless Technologies (NASTT) 2015 No-Dig Proceedings,* 2015 (speaker).
- “Problems Realized with Contractor-Proposed Pilot Tube Auger Boring”, with R. Brock and B. Zeitlow, *North American Society for Trenchless Technologies (NASTT) 2015 No-Dig Proceedings,* 2015 (speaker).
- “The Perfect Storm HDD Crossing, Blynman Canal, Gloucester, MA”, with Gould, J., Sequino, M., Durkin, L., Boeh, M, *North American Society for Trenchless Technologies (NASTT) 2014 No-Dig Proceedings,* 2014 (speaker).
- “Trenchless Risk Reduction During Project Planning and Design”, with T. Pullen, *North American Society for Trenchless Technologies (NASTT) 2013 No-Dig Proceedings,* 2013 (speaker).
- “Challenges And Lessons Learned With Pilot Tube Guided Auger Boring Utility Crossings Of The Little River”, with J. Struzziery, *North American Society for Trenchless Technologies (NASTT) 2012 No-Dig Proceedings,* 2012, (speaker).
- “Franklin Falls – The Toughest Trenchless Crossing In New Hampshire”, with T. Pullen, J. Martin, P. Cote. *North American Society for Trenchless Technologies (NASTT) 2012 No-Dig Proceedings,* 2012.
- "Pilot Tube Guided Auger Boring Takes on Horizontal Directional Drilling." D. Paster (Icon Tunnel Systems), N. Strater (Brierley Associates, LLC), J. Struzziery (Kleinfelder/SEA). Trenchless Technology, November, 2011.
- *“*Team Approach Leads to Success in Complicated HDD Installation”, with B. Dorwart, T. Pullen, B. Fenoff, E. Neilsen, B. Hoffman, and J. Bristow*: North American Society for Trenchless Technologies (NASTT) 2011 No-Dig Proceedings,* 2011, (speaker).
- *“*Powering New York State”, with L. Puls, B. Dorwart, and T. Crofts, 2010, *Trenchless International, Issue 7.*

- “Rock Mass Characterization for the WSSC B-County Water Tunnel”, w/P. Headland, D. Dobbels, and M. Younis: Society for Mining, Metallurgy and Exploration (SME) North American Tunneling Conference 2008 Proceedings, 2008 (speaker).
- “Design and Risk Management for a Multiple Crossing Project”, with P. Ambrosio, and B. Dorwart: North American Society for Trenchless Technologies (NASTT) 2007 No-Dig Proceedings, 2007, (speaker).
- "Recommended Site and Subsurface Characterization Methods for a Successful Directional Drilling Project ", with B. Dorwart and M. Brownstein, in North American Society for Trenchless Technologies (NASTT) 2006 No-Dig Proceedings, 2006, (speaker).
- *“*Use of Optically Guided, Large Diameter Downhole Hammers to Complete Trenchless Installation of Electric Cables”, with L. Puls, B. Dorwart, T. Crofts, and D. Dobbels, *International Society for Trenchless Technology (ISTT) 2009 International No-Dig Proceedings,* 2009 (speaker).
- “Roadheader Design for Mining Cemented Placer Gold Deposits”, with J. Rostami, W. Del’Orfano, B. Dorwart, and A. Tenbusch, *Society for Mining, Metallurgy and Exploration (SME) National Conference 2011 Proceedings,* 2011 (speaker).
- “Engineering Geology of Narragansett Bay, Rhode Island, and Implications for Bridge Foundation Design and Construction”, with S. Bamford, M. Sherrill, and D. Gifford, in *Association of Engineering and Environmental Geologists (AEG) National Meeting Abstracts with Programs*, 2006, (speaker).
- “Engineering Geology, Young Faults and Seismicity of the Northern Narragansett Bay (Rhode Island)” with P.J. Barosh, J. Kaplin, M. Carnavale, T. Davidson., and W. Kiker, *in Association of Engineering and Environmental Geologists (AEG) National Meeting (Boston) Field Trip Guide, Field Trip #4,* 2006.
- “Design of Passive Dowel Systems and Perimeter Control Blasting Measures for Stabilization of Excavated Rock Slopes,” with Van Roosendaal, D.J., and McKown, A.F., proceedings for the 54th Highway Geology Symposium, Burlington, Vermont, September 2003, pp.276-287.

INVITED SPEAKER

- *“Trenchless Risk and Safety”* – National Grid Annual Contractor’s Safety Seminar, Fall, 2015
- *“Planning and Design Considerations for Pilot Tube Guided Auger Boring (PTAB)”* - Colorado School of Mines Microtunneling Short Course, 2014
- *Trenchless Risk Reduction”* - 2013 ASCE Mohawk-Hudson Section Geotechnical Symposium
- *Pilot Tube Guided Auger Boring Utility Installation, Cambridgepark Drive Drainage Improvements Project,* Colorado School of Mines Microtunneling Short Course, 2013
- *“*Geotechnical Reports for Trenchless Projects” – Northeast Trenchless Association (NTA) Annual Meeting, 2010.
- *“*Interpretation of Geotechnical Reports” – Northeast Trenchless Association (NTA) Annual Meeting, 2009.

Attachment B

Resume of Marc Dodeman

Marc A Dodeman – Project Director, Submarine Cable Projects at LS Cable America

Education

May, 1996 **Richard Stockton College**, Pomona, NJ

Bachelor of Science, Biology; Marine Ecosystems Core Studies

Undergraduate studies included extensive field research of wetland and salt marsh environments, advanced marine sampling techniques, and a comprehensive survey of the wetlands surrounding the Mullica river culminating in a formal report submittal to the NJDEP (via Marine Fisheries.) Internship at Stone Harbor Wetlands institute as field scientist. Studied abroad in Costa Rica.

May, 1995 **Richard Stockton College**, Pomona, NJ

Bachelor of Science, Environmental Science; Oceanography Core Studies

Undergraduate studies included DGPS training, extensive mapping and charting exercises, seafloor survey and sampling, oceanography (theoretical and applied), geomorphology, and marine dynamics. Internship at Hoechst-Celanese included technical writing and formal microscopy training.

Professional Experience

August, 2017 – Present **LS Cable America, Inc.**

Employed as Director, Submarine Cable Projects

Responsibilities include overseeing Submarine Cable Projects, directing Project Management and field personnel during projects, while acting as the day-to-day contact for the Customer's Project Management Team. Duties include finding and developing project leads, and bids and proposals support, focusing on submarine cable supply and installation.

October, 2008 – August,2017 **Caldwell Marine International, LLC., Farmingdale, NJ**

Employed as Director of Business Development / Project Manager, Submarine Cable Division. Responsibilities include the acquisition of market intelligence and development of business opportunities and coordination of commercial sales. Responsible for maintaining strong business relationships with major clients such as ABB, Prysmian, LS Cable, Nexans, Sumitomo, J-Power, Viscas, Hellenic, and ZTT among others. Also liaise directly with primary contract issuers from Eversource, Hess Energy, Duke Energy, National Grid, PSNH, LIPA[PSE&G], Neptune, Cross Sound Cable, Cross Hudson Cable, Pepco, Atlantic City Electric, Dong Energy and others. Secondary tasks include marketing and marine project management.

May, 2005 – October, 2008 **Tyco Telecommunications (US) Inc. Morristown, NJ**

Employed (through promotion) as a Senior Project Coordinator in the Marine Services Group. Position included in-situ Project Management including schedule management and management of associated marine construction activities. The Sr. Project Coordinator position involved the management of personnel, vessels, equipment, logistics, and high profile customer interface.

April, 2001 – May, 2005 **Tyco Telecommunications (Tycom,) Morristown, NJ**

Cable Engineer; Shore Ends Group. Primary responsibilities included all phases of installation, both marine and terrestrial, from the shore end demarcation to the cable terminal. Certified Raychem and Type-"C" jointer. Proficient in the use of various HV test equipment as well as various fusion splicing machines and optical test equipment. Due to prior experience, secondary responsibilities evolved into "Engineer in Charge" position for various shallow and deep water PLIB (ROV) projects.

May, 1996 – April, 2001 **Margus Co. Inc. Edison, NJ**

Cable and Environmental Impact Engineer. Responsibilities included cable route design including all geodetic calculations, desk top study support, marine route survey analysis, landing site surveys, ROV PLIB(project manager and pilot,) PLIB (ROV) data assessment, shore end installation (ship-board project manager,) field operations management, cable fault locating (analog and digital,) 25Hz tone injection for ROV PLIB and cable locating, cable locating and charting, cable patrol, quality assurance during cable installation, ship-board representation and field reporting for all phases of cable installation and PLIB, and providing technical support for proposals.

1989 – May, 1996 **Margus Co. Inc. Edison, NJ**

Part time employment as a Field Technician. Assisted in cable locating projects utilizing 25Hz tone injection and fault locating projects utilizing a TDR or OTDR. Oversaw diver burial of CANUS off Manasquan, NJ. Completed High Voltage Safe Practices Training.

Additional Information

Quoted in the front page Wall Street Journal Article "In Digital Age, U.S. Spy Agency Fights to Keep From Going Deaf" by Neil King. (May 25, 2001)

Certifications

Harvard Course on Business Negotiation, Certificate of Completion 2016
CPR, AED, Supplemental Oxygen, Current, 2016
Basic First Aid, Current, 2016
Hazcom / GHS Training, January 2013
OSHA 30 Certificate, March 2011
NASBLA Safe Boating Course and Certificate, February 2011
Tyco Telecom: Cable Systems Design and Engineering Process Refresher (Process-8), August 2006
Tyco Compliance: Responsible Business Communications, June 2005
Tyco Compliance: Diversity at Work, June 2005
Tyco Compliance: Financial Reporting, June 2005
Tyco Compliance: Foreign Corrupt Practices Act, June 2005
Tyco Compliance: Global Health and Safety, June 2005
Tyco Compliance: Business Ethics, June 2005
International Construction, Operations and Maintenance: Integrity Training, October 2004
Docs Open Controlled Library Training, March 2004
ICOM ISO 9001-2000, February 2004
ICOM Cable Laying Fundamentals, February 2004
POTB Railroad: EIC, Watchman / Lookout, RMM Operator, November 2002
Site Survey Course Completion, May 2002
Power Safety Officer Offshore Designation, February 2002
Agilent OTDR Training, 2001
HP OTDR Training, 2001
Lucent / Avaya OTDR Training, 2001
HiPotronics HV DC Training, 2001
Star-Spellman HV DC Power Supply Training, 2001
Shore End Cable Installation (Plow Ops) + Type "C" End Seal, October 2001
Post Lay Inspection and Burial (ROV) + TerraWave Grounded End Seal, March 2001
AT&T High Voltage Safe Practices Training, December 1996
AT&T Inside Plant Installers Course, December 1996
Bell Labs: General-Radio / HP 1308A High Output Tone Generator Training, 1989

Registrations

IEEE Member, IEEE PES Member, IEEE Standards Voting Member
Registered Tyco, Type-C Jointing Certified for Powered Submarine and OSP Systems, March 2001; Refresher November 2004
ASCE, SSTT Trenchless Technology, SSES / Buried Asset Management, December 2011
ABB Contractor OHS Project Manager, December 2010
Registered RayChem Jointing Certified for Submarine and OSP Systems, June 2001
Registered AT&T Inside Plant High Voltage Certified for DC Powered Systems, May 1995

Notable Projects

October 2008 – August 2017

- NYPA Velco Submarine Cable Project (LS Cable / New York Power Authority, Vermont Electric) (8xHDDs)
- Block Island Wind Farm HDD Project (LS Cable / Deepwater Wind, National Grid) (3xHDDs)
- Little Bay Crossing Project (Public Service of New Hampshire [PSNH])
- Falmouth to Martha's Vineyard Submarine Cable Replacement Project (Prysmian / Northeast Utilities [Eversource]) (2xHDDs)
- Martha's Vineyard Submarine Cable Repair (Prysmian / Northeast Utilities [Eversource])
- Long Island Sound Submarine Cable Repair (Prysmian / LIPA [PSE&G])
- Bayonne Energy Center 345kV Brooklyn to Bayonne Submarine Cable Project, (ABB, Bayonne Energy / Newark Energy Center / Hess Energy) (6xHDDs)
- Vancouver Island Transmission Reinforcement Project (Mitsubishi Americas, Viscas, J-Power / BC Hydro,)

October 2006 – October, 2008

Trans-Pacific Express (TPE) Senior Project Coordinator *SPC and sole Marine Coordinator for the entire Marine Installation program. Responsibilities included coordination of up to twelve main-lay, shore end, freighting, route clearance, and PLGR vessels simultaneously for the duration of the project. Was the sole Tyco Marine representative at all CCM meetings in China, Taiwan, Korea and the US, presenting status summary on a six-weekly basis and closing any contractual issues raised by the TPE consortium composed of delegates from Verizon Business, Korea Telecom, China Telecom, Chunghwa Telecom and the China Network Communications Group (CNC.) Reported on a daily basis to the Directors of Marine Services and Project Management, and submitted financial and budgetary tracking information monthly. Managed subcontractors from Alcatel, SBSS(China,) Hitachi Cable, and NEC/OCC cable. Acted as direct support to the Vice-President of Sales during the bidding of Phase 1 and Phase 2 contracts, both of which were awarded to Tyco Telecommunications.*

November 2005 – January, 2006

Bahamas Domestic Cable Network (BDSN) Project Coordinator *Shore End EIC at Eleuthera, Bahamas. Responsible for the excavation of the land cable route and installation of the land cable. Included management of the excavation and installation sub-contractors and final splicing of the land cable at the BMH and cable terminal.*

February 2005 – July, 2005

(SMW-4) Engineer in Charge *Shore End EIC aboard the Swissco 12. Responsible for the mobilization of the Swissco 12 lay barge and GATOR 2 trenching spread at Labroy Shipyard, Batam, Indonesia. EIC of the Swissco 12 for the lay / burial of Segment S1.6 at Cox's Bazar, Bangladesh.*

December, 2004 – January, 2005

Sea-Me-We IV (SMW-4) Engineer in Charge *Load EIC aboard the C/S Tyco Durable at Hitachi Cable Factory, Japan. Responsible for loading 3000+ km of fiber cable, repeaters, and branching units aboard the main lay vessel for the "Durable Load B" program. Responsibilities included the management of factory and vessel personnel, shipboard splicing and testing personnel, and client interface.*

April, 2004 – August, 2004

Tata Indicom, India – Singapore (TIISCS) Engineer in Charge *Engineer in Charge aboard the C/B Cable Networker off Singapore overseeing the deep injector burial of the Tanah Merah Shore End. Responsible for all reporting activities, and data production and submittal to the onboard client representatives. Provided technical assistance in the process of obtaining MPA operational clearances. Responsible for all cable crossing notifications. (1xHDD)*

October 2003 – April 2004

Venezuela Domestic (VenDom) Engineer in Charge *Shore end Cable Engineer in charge of restoring the exposed section of the Venezuela Domestic Cable System(at the behest of CANTV, under ACMA approval) landing at Carúpano, Estado Sucre. Solely responsible for managing entire project from contract acceptance, through budgeting phase, project coordination, contractor bidding and acceptance, permitting, completion of actual operations, ACMA final approval, final reporting, and payment of contractors. Solely responsible for all installation team selection and personnel management. Project completed on time and on budget.*

August 2003 – October 2003

SCP PLIB Engineer in Charge *Engineer in Charge aboard the M/V Wave Sentinel overseeing PLIB of SCP Segments 1W and 2E. ROV used for both segments was the Atlas - 2 (SMD) operated by Global Marine Systems. Responsible for all reporting activities, schedule planning activities, and data production and submittal to the onboard client representatives. Provided technical assistance in the set-up and troubleshooting of Star Spellman 25Hz tone generator module at Svalbard.*

May 2003 – August 2003

Svalbard Cable Project (SCP, Norway) Cable Engineer *Shore end cable engineer responsible for purchasing and shipping tools to Norwegian landing sites. Responsible for fabrication of hybrid power bus bar and enclosure units for Svalbard(Spitsbergen) beach structure. Responsible for assisting with the installation of shore ends at Andenes (Breivika.) Assisted with inside plant installation of power and fiber cables to terminal equipment in Breivika. Assisted with land jointing and Ground Bed installation at Breivika. Assisted with inside plant installation at Breivika. (1xHDD)*

May 2002 – April 2003

TGN Pacific Terrestrial Works (TGTP) Inspector / Installer *Oversaw installation of entire land route between Nedonna Beach and Hillsboro Cable Terminal in Oregon. Responsible for maintaining contract specification standards for all duct and manhole installation and proofing between Nedonna and Hillsboro. Responsible for maintaining contract specification standards for installation of terrestrial fiber cable between Nedonna and Hillsboro. Responsible for terminating and splicing land cable at various regeneration station points along the TGTP routes between Nedonna and Portland, Oregon, as well as managing multiple installation teams. (1xHDD)*

November 2001 – May 2002

C2C PLIB Engineer in Charge *Engineer in Charge aboard the M/V Adams Challenge and then the Tyco Responder for C2C Segments 6S2, 7S, and 7Smid in the South China Sea. ROV used for all segments aboard both vessels was the ST-210 (Perry) operated by Canyon Offshore. Responsible for all personnel selection and crewing logistics, reporting activities, schedule planning activities, and data production and submittal to the onboard client representatives. Responsible for all cable and pipeline crossing notifications.*

April 2001 – November 2001

C2C Shore End Installation Cable Engineer / Engineer in Charge *Shore end cable engineer responsible for purchasing and shipping tools to various SE Asian landing sites. Responsible for assisting with the installation of shore ends at Chung Hum Kok, Hong Kong, and Nasugbu, Philippines. Responsible for inside plant installation of power and fiber cables to terminal equipment in Hong Kong and the Philippines. Engineer in Charge aboard the Smit Borneo off Hong Kong overseeing the sled burial of Segments 1A and 2B. Responsible for all reporting activities, and data production and submittal to the onboard client representatives. Responsible for all cable and pipeline crossing notifications.*

December 2000 – January 2001

ST-200 Series ROV (Global Marine Systems) ROV Pilot / Tech *Two month pilot / technician contract aboard the C/S Wave Mercury at Kobe, Japan. Attained Japanese seaman's book.*

October 2000 – December 2000

FLAG ATLANTIC Survey Party Chief / Project Manager *Field project manager coordinating route clearance operations and installation team manager while serving as Nav party chief utilizing a Win-Frog survey suite. Responsible for all data submittal to the onboard client representatives.*

February 2000 – October 2000

TAT-14 Senior Ship-board Representative *Senior Representative for Sprint during the Route Clearance operations for segments K, L, and G and subsequent installation of these segments with Otter aboard the M/V Maersk Forwarder. Senior Representative during the installation of the segment K and L shore ends at Manasquan, later overseeing operations for Sprint during ensuing diver burial operations on segment K. Senior Representative aboard M/V Toisa Crest overseeing MAKO PLIB of segment K1(N.) Senior Representative aboard C/S Fresnel for segment K3 and L main-lay. Witnessed and approved all on-board Fiber, Conductor, and Dielectric Testing as performed by KDD. Senior Representative aboard M/V Hondo River overseeing HECTOR PLIB of segments L and G. Senior Representative aboard M/V Normand Carrier overseeing PLIB operations using Spencer. Senior Representative aboard the C/S Subaru for Segment K deep water main-lay. Witnessed and assessed fiber faulting issue on behalf of the RWG. Responsible for providing cable and pipeline crossing notifications throughout all phases of the project. (4xHDDs)*

August 1999 – November 1999

TAT-14 Project Manager *Project Manager during the additional archaeological survey to satisfy requirements of the NJ Historical Preservation Society. This allowed Sprint and AT&T to finalize the permitting process for the New Jersey landings of segments K and L at Manasquan, and L and G at Tuckerton. When directional drilling of the conduits was undertaken at Manasquan, responsible for sending a daily QA report to Sprint, as well as providing positional calculations for the drilling team. Then acted as the marine QA representative for Sprint, and located, marked, and guarded the PTAT and Gemini cables during pipe installation.*

November 1998 – July 1999

SMW-3 (S5) Project Manager / ROV Superintendent *Onboard Project Manager and ROV Superintendent continuously through all PLIB segments in Mumbai, Karachi, Fujairah, and Muscat aboard the M/V Ghareb. Responsible for all reporting and data production for submittal to the onboard client representatives.*

September 1998 – November 1998

SMW-3 (S3) Shore End Operations Manager O*perations manager during the cable landing at Jaya Ancol in Jakarta. Located all other area cables and charted them before SMW-3 installation and prepared the manhole for cable entry. Once landing was completed, took over as Project Manager and Installation Team Superintendent aboard M/V Ibis for the remainder of jet sled operations. Approved final Fiber Acceptance Tests.*

May 1998 – July 1998

TAT-14 On-board Representative *Representative for Sprint during the inshore Marine Route Survey for Segments K,L, and G aboard the S/V Atlantic Twin. When inshore work was completed, acted as an onboard representative for Sprint during the deep water survey to the continental shelf break for Segments K and G aboard the R/V Jean Charcot. (4xHDDs)*

February 1998 – April 1998 *

Sea-Me-We III (SMW-3) Tone injection specialist *Solely responsible for 25Hz tone injection into capped, buried ends of SMW-3 shore ends at Pantai Cermin (Medan)Indonesia, (Satun)Thailand, and (Penang)Malaysia. This allowed the MAKO aboard M/V Kendrick to locate and bury the cable before the PFE's were installed. *Flew from Indonesia to US in March 1998 on an emergency basis to locate the* ***CANUS*** *cable break off Manasquan, NJ and prepare the faulted cable ends for recovery by the C/V Sir Eric Sharp. After successful recovery of both ends, returned directly to Indonesia.*

January 1997-May 1997

FLAG Ship-board Representative *Representative for AT&T/SSI aboard M/V British Viking. On board for Segments N1-N1/8 (Thailand – Singapore,) Segments G1,FW,E1-6, D2/1-6. (Djibouti, Red Sea, Safaga, Alexandria, Algeciras) Responsible for all cable and pipeline crossing notifications.*

1996-1998

H2O Project Manager *Conversion of the out of service HAW-2 SD telephone cable into scientific use cable for the IRIS consortium in association with Woods Hole Oceanographic Institute. Responsible for converting a tube-type analog High Frequency line bay into a solid state amplifier bay. Assisted with reversing the polarity of the PFE at Makaha. Responsible for all logistics and inside plant installation of all components to Bell spec.*