HUBLINE/EAST TO WEST EXPANSION PROJECT

RESOURCE REPORT 11

Reliability and Safety

FERC Docket No. CP08-__-000

June 2008

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Filing Requirement	**Location in Environmental Report**
☐ Describe how the project facilities would be designed, constructed, operated, and maintained to minimize potential hazard to the public from the failure of project components as a result of accidents or natural catastrophes. (§ 380.12(m))	Section 11.2 to 11.4

ACRONYMS AND ABBREVIATIONS

Algonquin	Algonquin Gas Transmission, LLC
AC	alternating current
Certificate	Certificate of Public Convenience and Necessity
CFR	Code of Federal Regulations
E2W	HubLine/East to West Expansion Project
FERC	Federal Energy Regulatory Commission
HCA	High Consequence Areas
LNG	liquefied natural gas
MAOP	maximum allowable operating pressure
M&NE	Maritimes & Northeast Pipeline, L.L.C.
MP	milepost
NGA	Natural Gas Act
NSTAR	NSTAR Gas & Electric Corporation
Project	HubLine/East to West Expansion Project
RCV	Remote Control Valves
ROW	right-of-way
Spectra or Spectra Energy	Spectra Energy Corp
USDOT	U.S. Department of Transportation

11.0 RESOURCE REPORT 11 – RELIABILITY AND SAFETY

11.1 Introduction

Algonquin Gas Transmission, LLC ("Algonquin"), an indirect wholly owned subsidiary of Spectra Energy Corp ("Spectra" or "Spectra Energy"), is seeking a Certificate of Public Convenience and Necessity ("Certificate") from the Federal Energy Regulatory Commission ("FERC") pursuant to Section 7(c) of the Natural Gas Act ("NGA") authorizing the construction and operation of the HubLine/East to West Expansion Project ("E2W Project" or "Project") located in Massachusetts, Connecticut, Rhode Island, and New Jersey. The Project is designed to respond to significant interest from customers needing transportation capacity in order to accommodate increased receipts of natural gas from emerging natural gas supplies, including liquefied natural gas ("LNG"), at the east end of the Algonquin system, for redelivery to high growth markets in the Northeast Region.

The Project will consist of 31.4 miles of multi-diameter pipeline and associated pipeline support facilities, including compression facilities. Of this amount, 12.9 miles consists of new pipeline in Massachusetts and 18.5 miles consist of upgrades to existing pipeline in Massachusetts and Connecticut.

Massachusetts

- I-10 Extension – construct approximately 12.9 miles of new 36-inch-diameter pipeline from milepost ("MP") 0.0 in the Town of Weymouth to MP 12.9 in the Town of Canton, Norfolk County, Massachusetts; and
- Q-1 System – install approximately 7.5 miles of 36-inch-diameter pipeline that will replace a segment of an existing 24-inch-diameter pipeline from MP 12.2 in the Town of Sharon to MP 19.7 in Canton, Norfolk County, Massachusetts.

Connecticut

- E-3 System – install approximately 11.0 miles of 12-inch-diameter pipeline that will replace a segment of an existing 6- and 4-inch-diameter pipeline from MP 0.0 in the City of Norwich to MP 11.0 in the Town of North Stonington, New London County, Connecticut.

A significant portion of the 31.4 miles of the proposed pipeline facilities will be either within the existing Algonquin rights-of-way ("ROW") or adjacent to an existing powerline ROW.

New aboveground facilities in Massachusetts will include one compressor station as follows:

- Rehoboth Compressor Station – located near Algonquin's G-5 Tap at about MP 16.8 on the G-1 System in the Town of Rehoboth, Bristol County.

Modifications to three existing compressor stations to accommodate bi-directional flow along Algonquin's system will occur at the following facilities:

- Burrillville Compressor Station in Providence County, Rhode Island;
- Cromwell Compressor Station in Middlesex County, Connecticut; and
- Hanover Compressor Station in Morris County, New Jersey.

In addition, Algonquin will install aboveground over-pressure protection regulation at four locations along its ROW in Massachusetts.

Resource Report 11 provides a discussion of the reliability and safety aspects of the proposed Algonquin E2W Project. Algonquin will maintain and operate the E2W Project facilities pursuant to the procedures and policies of Spectra Energy. Algonquin has been in operation since 1953, when the major portion of its transmission system was constructed. As a result, the information in this Resource Report is based on the operating history of Algonquin.

The purpose of the report is to gauge the potential hazard risk to the public, which could result from an accident event occurring due to operational or natural causes. Procedures and design features that Algonquin utilize to avoid undue hazards and effects are included in this Resource Report.

A discussion of the key safety considerations associated with the natural gas pipeline industry is presented in Section 11.2 of the Resource Report. The material in Section 11.3 provides reviewers with a perspective of Algonquin's operating experience and corporate practices with industry-wide regulations and conditions. The procedures and design features to ensure operational reliability and safety are detailed in Section 11.4. A checklist showing the status of the FERC filing requirements for Resource Report 11 is included in the table of contents.

11.2 Natural Gas Pipeline Industry Safety Overview

The following information provides a perspective of Algonquin's experience with respect to safety and reliability compared to industry-wide operational data. The information presented also helps to define for the reviewer the key industry related safety issues.

11.2.1 Pipeline Safety

11.2.1.1 Hazards

The transportation of natural gas pipeline involves some degree of risk to the public in the event of an accident and subsequent release of gas. The greatest hazard is a fire or explosion following a major pipeline rupture.

Methane, the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic, but is classified as a simple asphyxiant, possessing only a slight inhalation hazard. If breathed in high concentration, oxygen deficiency can result in serious injury or death.

Methane has an ignition temperature of 1,000 degrees Fahrenheit and is flammable at concentrations between 5.0 percent and 15.0 percent in air. Unconfined mixtures of methane in air are not explosive. However, a flammable concentration within an enclosed space in the presence of an ignition source can explode. The specific gravity of methane is 0.55; therefore, it is buoyant at atmospheric temperatures.

11.2.1.2 Safety Standards

Under the Federal Pipeline Safety Act, (49 USC 601,101 et seq.) the USDOT is authorized to prop-promulgate pipeline safety standards. The proposed E2W Project facilities will be designed, constructed, operated, and maintained in accordance with the U.S. Department of Transportation ("USDOT") Minimum Federal Safety Standards in 49 Code of Federal Regulations ("CFR") Part 192. The regulations are intended to ensure adequate protection for the public from natural gas pipeline failures.

Part 192 specifies material selection and qualification, minimum design requirements, and protection from internal, external, and atmospheric corrosion.

Part 192 also defines area classifications, based on population density in the vicinity of the pipeline, which determine more rigorous safety requirements for populated areas. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1-mile length of pipeline. The four area classifications are defined as follows:

- Class 1 Location with 10 or fewer buildings intended for human occupancy.
- Class 2 Location with more than 10 but less than 46 buildings intended for human occupancy.
- Class 3 Location with 46 or more buildings intended for human occupancy or where pipeline lies within 100 yards of any building, or small, well-defined outside area occupied by 20 or more people during normal use.
- Class 4 Location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. Pipelines constructed in Class 1 locations must be installed with a minimum depth of cover of 30 inches in normal soil, and 18 inches in consolidated rock. Class 2, 3 and 4 locations, as well as drainage ditches of public roads and railroad crossings, require 36 inches in normal soil and 24 inches in consolidated rock. Class locations also specify the maximum distance to a sectionalizing block valve-10 miles in Class 1, 7.5 miles in Class 2, 4 miles in Class 3, and 2.5 miles in Class 4. Pipeline design pressures, hydrostatic test pressures, maximum allowable operating pressure, inspection and testing of welds, and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas. Table 11-1 shows the area classifications for the E2W Project.

TABLE 11-1

Area Classifications along the E2W Project

State Facility	Class Location (1, 2, 3, or 4)	Beginning and Ending MP	Length
Massachusetts			
I-10 Extension			
	3	0.0 to 12.9	12.9
Q-1 System			
	3	12.2 to 12.5	0.3
	1	12.5 to 14.4	1.9
	3	14.4 to 15.7	1.3
	1	15.7 to 16.1	0.4
	3	16.1 to 19.7	3.6
Connecticut			
E-3 System			
	3	0.0 to 4.3	4.3
	2	4.3 to 8.9	4.6
	1	8.9 to 10.7	1.8
	2	10.7 to 11.0	0.3

Part 192 prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Under Section 192.615, each pipeline operator must also establish an emergency plan that provides written procedures to minimize the hazards from a gas pipeline emergency. Key elements of the plan include procedures for:

1. Receiving, identifying, and classifying emergency events - gas leakage, fires, explosions, and natural disasters;

2. Establishing and maintaining communications with local fire, police, and public officials, and coordinating emergency response;

3. Making personnel, equipment, tools, and materials available at the scene of an emergency;

4. Protecting people first and then property, and making them safe from actual or potential hazards; and

5. Emergency shutdown of system and safely restore service.

Each operator must establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a gas pipeline emergency, and coordinate mutual assistance in responding to emergencies. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials.

11.2.1.3 High Consequence Areas

The USDOT Pipeline and Hazardous Materials Safety Administration has promulgated a rule for Pipeline Integrity Management in High Consequence Areas ("HCAs") for Gas Transmission, which requires that a facility-specific Integrity Management Plan be developed to document procedures under which pipeline integrity will be monitored and maintained for those areas where the pipeline traverses lands or facilities that are considered HCAs (49 CFR Part 192 Subpart O). HCAs are identified as an area established by one of the methods described below:

- Class 3 and 4 Locations;
- Class 1 or 2 Locations where the potential impact radius is greater than 660 feet and the area within a potential impact circle contains 20 or more buildings intended for human occupancy; or
- The area within a potential impact circle containing 20 or more buildings intended for human occupancy, or an identified site (i.e. [1] an outside area or open structure that is occupied by 20 or more persons for at least 50 days in any 12-month period; [2] a building that is occupied by 20 or more persons for at least five days a week for 10 weeks in a 12-month period; or [3] a facility occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate).

The potential impact radius means the radius of a circle within which the potential failure of a pipeline could have significant impact on people or property. The potential impact radius is determined by the formula $r = 0.69 \times (\text{square root of } (p \times d^2))$, where 'r' is the radius of a circular area surrounding the point of failure, 'p' is the maximum allowable operating pressure ("MAOP") in the pipeline segment in pounds per square inch, and 'd' is the nominal diameter of the pipeline in inches.

Table 11-2 shows the potential HCAs along the proposed E2W Project facilities.

TABLE 11-2

Location of High Consequence Areas along the E2W Project

State Facility	Beginning MP	Ending MP	Length
Massachusetts			
I-10 Extension			
	0.0	12.9	12.9
Q-1 System			
	12.2	12.6	0.4
	14.4	15.9	1.5
	16.3	19.6	3.3
Connecticut			
E-3 System			
	2.4	2.6	0.2
	3.0	3.4	0.4
Total	**---**	**---**	**18.7**

As discussed in Section 11.2.1.2 above, the E2W Project facilities will be designed, constructed, operated, and maintained in accordance with the USDOT Minimum Federal Safety Standards in 49 CFR Part 192.

11.2.2 Pipeline Accident Data

Since February 9, 1970, 49 CFR Part 191 required all operators of transmission and gathering systems to notify USDOT of any reportable incident, and to submit a written report on form F7100.2 within 20 days. USDOT changed reporting requirements after June 1984 to manage the amount of data collected. After that date, operators must report only incidents that involve property damage valued at more than $50,000, injury, death, release of gas, or incidents that are otherwise considered significant by the operator. The filing date was also extended to 30 days. To avoid combining dissimilar data sets, only incidents reported during the period from 1987 through 2006 are used in this report.

Table 11-3 summarizes national gas transmission incidents and accidents by category from 1987 to 2006. As seen in Table 11-3, the categories accounting for the highest percentage of pipeline incidents are caused by damage from excavations (12 percent) and corrosion (12 percent). Excavation damage includes operator or third-party excavation and corrosion includes internal and external corrosion. The population of pipelines included in the data set varies widely in terms of age, pipe diameter, and level of corrosion control. Each of these variables influences the incident frequency that may be expected for a specific segment of pipeline.

TABLE 11-3

Office of Pipeline Safety – 1987 through 2006 Incident Summary

Year	Number of Incidents	Excavation Damage	Other Outside Force Damage	Corrosion	Material Failure	Fatalities/ Injuries
1987	70	7	0	6	1	0/15
1988	89	12	0	6	6	2/11
1989	103	15	0	7	5	22/28
1990	89	14	0	10	8	0/17

TABLE 11-3

Office of Pipeline Safety – 1987 through 2006 Incident Summary

Year	Number of Incidents	Excavation Damage	Other Outside Force Damage	Corrosion	Material Failure	Fatalities/ Injuries
1991	71	12	0	7	2	0/12
1992	74	12	0	6	5	3/15
1993	95	6	0	10	9	1/17
1994	81	12	0	16	4	0/22
1995	64	8	0	2	7	2/10
1996	77	19	0	8	6	1/5
1997	73	11	0	9	3	1/5
1998	99	12	0	13	11	1/11
1999	54	11	0	8	6	2/8
2000	80	11	0	21	3	15/18
2001	87	15	0	10	8	2/5
2002	82	7	4	17	17	1/5
2003	97	11	7	16	19	1/8
2004	123	13	5	18	14	0/3
2005	181	10	9	14	20	0/7
2006	143	9	8	15	23	3/5
Totals	**1,832**	**227 (12%)**	**33 (2%)**	**219 (12%)**	**177 (10%)**	**61/227**

Source: U.S. Department of Transportation. Office of Pipeline Safety internet site: http://ops.dot.gov/stats/stats.htm

The breakdown of outside force incidents in Table 11-4 shows that human error in equipment usage was responsible for approximately 75 percent of outside force incidents. Since April 1982, operators have been required to participate in "one call" public utility programs in populated areas to minimize unauthorized excavation activities in the vicinity of pipelines.

The frequency of reportable incidents is strongly dependent on pipeline age. While pipelines installed since 1950 exhibit a fairly constant level of incident frequency, pipelines installed prior to that time have a significantly higher rate, partially due to corrosion. Older pipelines have a higher frequency of corrosion incidents, since corrosion is a time dependent process. Further, new pipes generally use more advanced coatings and cathodic protection.

TABLE 11-4

Outside Force Incidents by Cause

Cause	Percentage
Third Party Damage	73.5
Earth Movement	5.7
Weather	19.4
Other	1.4
Total	**100.0**

Older pipelines have a higher frequency of outside force incidents partly because the location of older pipelines may be less well known and less well marked than newer pipelines. In addition, the population of older pipelines contains a disproportionate number of smaller diameter pipelines. Small diameter pipelines are more easily crushed or broken by mechanical equipment or earth movement.

Table 11-5 clearly demonstrates the effectiveness of corrosion control and cathodic protection in reducing the incidence of failures caused by external corrosion. The use of both an external protective coating and a cathodic protection system, required on all pipelines installed after July 1971, significantly reduces the rate of failure over unprotected or partially protected pipe.

TABLE 11-5

External Corrosion Incidents by Level of Control

Corrosion Control	Incidents/ 1,000 mi./yr
Bare but not cathodically protected	0.05
Bare and cathodically protected	0.14
Coated but not cathodically protected	0.71
Coated and cathodically protected	0.02
Total	**0.92**

11.2.3 Impact on Public Safety

The reportable incident data summarized in Table 11-3 above includes pipeline failures of all magnitudes with widely varying consequences. Approximately one-third of the incidents were classified as a leak, one-third classified as a rupture, and the remaining one-third classified as other.

A fatality occurred in two percent of incidents and an injury occurred in 10 percent of incidents during the 13-year period. Table 11-6 presents the annual fatalities and injuries which occurred on natural gas transmission and gathering lines from 1985 through 1997.

TABLE 11-6

Natural Gas Transmission and Gathering Systems Fatalities and Injuries

Year	Fatalities	Injuries
1985	6	12
1986	5	20
1987	0	15
1988	2	11
1989	22	28
1990	0	17
1991	0	12
1992	3	15
1993	0	18
1994	0	21
1995	2	10
1996	1	5
1997	1	5

The nationwide totals of accidental fatalities due to various manmade and natural hazards are listed in Table 11-7 in order to provide a relative measure of the industry-wide safety of natural gas pipelines. Direct comparisons between accident categories should be made cautiously since individual exposures to hazards are not uniform among all categories. Nevertheless, the average number of fatalities resulting from natural gas transmission and gathering pipelines is relatively small considering the more than

310,000 miles of transmission and gathering lines in service nationwide. Furthermore, the fatality rate for pipelines is approximately one-fiftieth the fatality rate from natural hazards such as lightening, tornadoes, and floods.

TABLE 11-7

Nationwide Accidental Deaths

Type of Accident	Fatalities
All accidents	101,500
Motor vehicles	44,800
Falls	16,200
Poisoning	13,900
Drowning	2,900
Fires, flames and smoke	2,600
Suffocation	1,200
Agriculture	710
Natural gas transmission and gathering pipeline reportable incidents (1986-2005 annual average)	3.2

All data, except where noted, reflects 2003 statistics from the National Safety Council, "Injury Facts 2004 Edition."

11.3 Algonquin's Safety Overview

The E2W Project Facilities constructed by Algonquin will fully adhere to USDOT regulatory requirements pertaining to pipeline safety. These safety regulations will be reinforced by the comprehensive and strictly enforced corporate practices of Algonquin. The effectiveness of the federal and corporate requirements in ensuring reliability and safety is illustrated by the following operating experience profile of Algonquin. The empirical information presented illustrates the low potential for public hazard from accidents associated with the operation of the proposed project facilities.

11.3.1 System Overview

Algonquin owns and operates a natural gas transmission system consisting of approximately 1,100 miles of transmission pipeline, six compressor stations and numerous delivery points to its customers. Algonquin is one of five interstate natural gas transmission companies currently providing service to the New England area. Algonquin has provided this service since 1953, when the major portion of its transmission system was constructed.

The Algonquin transmission facilities are located in New Jersey, New York, Connecticut, Rhode Island and Massachusetts. Portions of the Algonquin pipeline system traverse through densely populated regions of these states in close proximity to many population centers.

11.3.2 Historical Operating Record

Generally, the natural gas transmission industry has an excellent record of public safety. Pipelines and related facilities are designed and maintained with strict adherence to USDOT standards to ensure public safety, reliability, and to minimize the opportunity for system failure.

Algonquin, in particular, has an excellent record of public safety since operations began in 1953. No pipeline or equipment failures have occurred that resulted in significant property damage or serious personal injury since operations began. Algonquin will continue to employ similar system design, construction, operation, and maintenance practices to ensure this excellent record is maintained.

Portions of Algonquin's pipelines are located in areas that have experienced significant growth and development since these systems were originally installed. This growth and development has resulted in increased activity adjacent to the pipeline facilities, and an increased potential for accidents involving the pipeline from adjacent land use development and activity. Such accidents would primarily be associated with excavations that might compromise the pipeline's integrity and result in a failure. Based on recent history and due to the implementation of the measures described within this Resource Report, the probability of future accidents is low.

11.4 Algonquin's Measures to Protect the Public and Utilities

11.4.1 Public Protection

Public safety is Algonquin's top priority and will be paramount during all phases of the E2W Project (e.g., construction, operation, and maintenance). During construction, special care will be taken in residential areas to minimize neighborhood and traffic disruption, to control noise and dust to the extent practicable, and to protect the public at large. Measures to be implemented in residential areas include, but are not limited to: fencing the construction work area boundary to ensure construction equipment, materials, and spoil remain in the construction ROW; ensuring piping is welded and installed as quickly as reasonably possible consistent with prudent pipeline construction practices to minimize construction time affecting a neighborhood; backfilling the trench as soon as the pipe is laid or temporarily steel plate the trench; and completing final cleanup and installation of permanent erosion control measures within 10 days after the trench is backfilled, weather conditions permitting. In addition, Algonquin will develop site-specific construction plans where residential dwellings are within 25 feet of construction workspace and the plans will be filed with the FERC prior to construction.

According to National Transportation Safety Board statistics, the interstate natural gas pipeline system is the safest energy delivery system in the nation. The E2W pipeline and associated aboveground facilities, including the Rehoboth Compressor Station, will be designed, constructed and operated to meet or exceed the safety requirements exclusively governed by the USDOT. Pipelines and related facilities are designed and maintained with strict adherence to USDOT standards to ensure public safety, reliability, and to minimize the opportunity for system failure. Normally, pipeline facilities do not explode. Leakage surveys are conducted on the pipeline at prescribed intervals to identify leakage, as required by the USDOT. Additional surveys are conducted periodically to identify any anomalies in the pipeline. See Section 11.4.3.2 below for additional discussion on Algonquin's equipment features that are designed to increase the overall safety of its system and protect the public from a potential failure of the system due to accidents or natural catastrophes.

Algonquin maintains operating policies and procedures that are periodically reviewed by USDOT. All operating personnel are thoroughly trained to perform their activities in accordance with these policies and procedures. These policies provide specific directions in preventive maintenance and vigilant patrols of facilities, as well as procedures to be followed in the event of accident or natural catastrophe.

Periodic training sessions and review of operating and emergency procedures are conducted for affected operations employees. This training includes safe operation of pipeline valves and equipment; facilities, including meter stations and compressor stations; hazardous material handling procedures; public liaison

programs and general operating procedures. The proposed E2W Project facilities will be operated and maintained in accordance with these procedures.

11.4.1.1 Liaison Procedures with Local Authorities

Liaison with public authorities and local utilities is maintained in all locations along the pipeline. A current list of those to be contacted is maintained and includes the Area Manager at Algonquin's Westwood Office, the Area Supervisor at its Dighton Office in Massachusetts, the Area Manager at Algonquin's Cromwell Office in Connecticut, and the Area Supervisor its Burrillville Office in Rhode Island. Key components of the liaison program consist of:

1. Periodic fire fighting demonstrations conducted in each district.

2. Periodic visits with municipal safety officials to inform them of the nature and operating pressure of Algonquin facilities and to coordinate emergency response in the event of an accident.

3. Special informational meetings and training at the initiation of the municipality.

4. Periodic literature distribution listing emergency telephone numbers and other pertinent data.

Excerpts of the Algonquin Liaison Program which will be used for the E2W Project are as follows:

I. Contact is made with the police and fire departments and/or public officials of all communities that contain Algonquin facilities in order to accomplish the following:

A. Ascertain how the officials may be able to assist Algonquin during an emergency, including the determination of the jurisdiction and/or responsibility with resources that may be involved in a response to an emergency.

B. Acquaint the officials with how Algonquin responds to an emergency on its pipeline system.

C. Notify the officials of the types of pipeline emergencies for which they will be contacted.

D. Inform them how Algonquin, in working with their departments, will cooperate in mutually assisting in protecting life or property during an emergency.

II. Police and fire departments and public officials are given maps that show the location of Algonquin's pipelines within the boundaries of their towns.

III. In order to enable Algonquin to quickly establish contact with police or fire departments and public officials in the event of an emergency at any location on the pipeline system, a current listing of their telephone numbers is maintained. This listing is reviewed on a periodic basis and necessary revisions are made.

IV. Algonquin invites fire companies to participate in its periodic fire demonstrations. Emphasis is placed in the following areas:

A. When and when <u>not</u> to extinguish a natural gas fire during an emergency.

B. How to extinguish different types of natural gas fires.

C. Conduct periodic emergency simulation exercises.

V. Algonquin will continue to participate, on an invitational basis, in meetings with fire department in communities in which the Algonquin facilities are located. The following subjects will be emphasized at these meetings:

A. The Algonquin role in emergencies on their respective pipeline system.

B. The properties of natural gas and precautionary measures around an emergency.

C. The local fire company's participation during an emergency on the Algonquin system.

VI. Liaison with Gas Distribution Companies and Other Customers

Because Algonquin will not be performing direct education to the public in areas franchised to gas distribution companies or other customers, liaison will be maintained with these companies. The purpose of this liaison is to afford them ready contact when they recognize the occurrence of a real or potential emergency on an Algonquin facility. In order to maintain such liaison, the following steps are taken on a periodic basis:

A. All gas distribution companies having franchise areas in which an Algonquin pipeline is located, or Algonquin end use customers, are supplied maps showing the location of the Algonquin pipeline in their area. The maps, showing the Algonquin emergency telephone numbers, are transmitted to the person in charge of the distribution company's or end user's operations.

B. A current listing of each distribution or end use customer company's emergency telephone numbers and key personnel is maintained by Algonquin.

11.4.2 Utility Protection

The majority of the proposed pipeline segments for the E2W Project are located within or adjacent to the existing Algonquin pipeline ROW (i.e., Q-1 and E-3 Systems) and/or the NSTAR Gas & Electric Corporation ("NSTAR") powerline ROWs (i.e. Q-1 System and I-10 Extension). Some portions of the pipeline segments deviate from existing ROWs, generally to avoid specific construction constraints, provide adequate separation from existing residences, or to reduce impacts to sensitive resources.

Prior to construction, existing utility lines and other sensitive resources, identified in easement agreements or by federal and state agencies, will be located and marked to prevent accidental damage during pipeline construction. Algonquin's contractors will contact the "Call Before You Dig" or "One Call" system, or state or local utility operators, to verify and mark all utilities along the Project workspaces to minimize the potential for damage to other buried facilities in the area. Where there is a question as to the location of utilities, such as water, cable, gas, and sewer lines, they will be located by field instrumentation and test pits.

11.4.2.1 NSTAR Powerline ROW

Between MP 0.0 and MP 1.1 in the Town of Weymouth, the I-10 Extension will be installed using the horizontal directional drill ("HDD") method. The majority of the remaining I-10 Extension (approximately 88 percent) was sited adjacent to the existing NSTAR powerline ROW from the proposed HDD exit point at MP 1.1 to MP 10.3, where it leaves the NSTAR powerline ROW to reach its interconnect with the existing Q-1 System in the Town of Canton. The existing Q-1 pipeline is located parallel and adjacent to the NSTAR powerline ROW. There are also some short segments of the I-10 Extension between MP 1.1 and MP 10.3 that required deviations from the existing NSTAR powerline ROW (approximately 12 percent) to avoid specific construction constraints and maintain a safe working distance between Algonquin's construction equipment and existing overhead electric transmission lines and structures.

It is not uncommon for natural gas pipeline facilities to parallel existing utility ROWs, including electric transmissions ROWs. Algonquin will comply with all federal, state, and local regulations applying to construction with regard to structures and underground utilities. Algonquin has held and continues to hold meetings with NSTAR to discuss the proposed location of its pipeline in proximity to NSTAR's existing overhead electric transmission lines and structures. As part of Algonquin's assessment of the reliability and safety of constructing and maintaining its proposed pipeline in proximity to NSTAR's overhead facilities, it considered the following:

Algonquin's Use of Heavy Construction Equipment in the Vicinity of High Voltage Powerlines

Algonquin has and continues to meet with NSTAR to obtain information on its requirements for construction activities within the vicinity of its overhead electric transmission lines and structures. Algonquin has conducted surveys and collected information on the location and size of existing powerline structures within the proposed E2W construction corridor, tower footing location and dimensions, and wire heights (lowest point between towers). Based on its consultations with NSTAR, and construction experience within and adjacent to existing overhead electric transmission lines and structures, Algonquin has designed or will modify its construction technique on the E2W Project with sufficient offsets to eliminate the risk of heavy construction equipment interfering with NSTAR's overhead high voltage electric transmission lines during construction and operation of the E2W Project.

Potential Structural Impacts to Electric Transmission Towers Due to Nearby Blasting

Where possible Algonquin has offset its pipeline trench by 50 feet to avoid any potential damage to NSTAR's electric transmission towers, in those areas that this could not be achieved the construction technique will be modified. Algonquin has extensive experience in blasting near structures including other underground pipelines and overhead powerlines. Algonquin will use a licensed blasting engineer and will follow the E2W Project Blasting Plan (refer to Resource Report 6) to avoid damage to NSTAR's overhead electric transmission lines and structures from blasting.

Effects on the Pipeline Resulting from Lighting Strikes to the Electric Transmission Towers

Algonquin will consult with an electrical engineer that specializes in developing alternating current ("AC") mitigation systems for pipeline utility companies. An AC mitigation system will be designed and installed to mitigate the steady state induced AC on the pipeline and deal with any fault current should they occur. Typically lightning arrestors along with decoupling devices are employed on the pipeline to protect against any electrical surges.

Effects on the Pipeline Resulting from a Direct Ground Fault Current by a nearby 345 kV Electric Transmission Line

It is not uncommon for natural gas pipelines to share ROWs with electric transmission and other utilities. Since pipelines and electric transmission lines often share ROWs, there is a need to ground the pipeline to dissipate electrical interference. In these situations, AC voltages are transmitted to the pipeline by conductive or inductive interference. Magnetic induction acts along the pipeline or pipeline segment that is approximately parallel to the powerline and can cause significant pipeline potentials even at relatively large separation distances.

Consideration must be given to safety of personnel and the public who may come into contact with aboveground portions of the pipeline such as valves and test stations. These exposed structures can be a potential shock hazard when touched while the soil is at a significantly different potential.

As stated above, Algonquin will consult with an electrical engineer that specializes in developing AC mitigation systems for pipeline utility companies. Typically zinc ribbon is used to mitigate AC voltages to industry acceptable levels. The control method consists of one or more bare zinc conductors buried parallel to and near the pipeline and are regularly connected to it through decoupling devices. The zinc ribbon used in this way is very effective in mitigating excessive pipeline potentials due to both inductive and conductive interference.

NSTAR's Use of Heavy Construction Equipment and Cranes Directly Above Algonquin's Pipeline

Algonquin typically works with electric utilities to ensure that the design of its pipeline is compatible with their needs for construction and maintenance of their facilities. This is usually accomplished by separation of the facilities to the extent practicable, increased burial depth of the pipeline, and use of heavier wall pipe in certain areas.

Cumulative Need for ROW access by NSTAR and Algonquin during Emergencies that Would Require Simultaneous Occupancy

Algonquin currently operates its existing pipeline system in shared ROWs with NSTAR, and other electric transmission companies. Typically, access points to the ROW are shared and used for normal and routine access to the ROW for maintenance and operation.

11.4.3 Other Protection Measures

11.4.3.1 Surveys

Ordinarily, weekly aerial and monthly vehicle patrols of all pipeline facilities are performed along with scheduled preventive maintenance. Any unusual situation or condition is reported and investigated immediately. Algonquin performs annual leak detection surveys of their pipeline facilities. The leak surveys are instrumental in early detection of leaks and can reduce the likelihood for pipeline failure. The E2W Project facilities constructed by Algonquin will use similar field survey procedures.

Algonquin is also a member of "Call Before You Dig" or "One Call" and related pre-excavation notification organizations in the states in which they operate. Through "Call Before You Dig" or "One Call," contractors provide notification to a central agency of proposed excavation that in turn notifies Algonquin of the excavation locations. If Algonquin's facilities are located in the area of proposed

contractor activity, they will be marked in the field and a representative of Algonquin will be present during excavation to ensure that the facility is not compromised.

11.4.3.2 Equipment

The Algonquin transmission system includes many equipment features that are designed to increase the overall safety of the system and protect the public from a potential failure of the system due to accidents or natural catastrophes.

Cathodic protection systems are installed at various points along the pipelines to mitigate corrosion of the pipeline facilities. The cathodic protection system impresses a low voltage current to the pipeline to off-set natural soil and groundwater corrosion potential. The functional capability of cathodic protection systems are inspected frequently to ensure proper operating conditions for corrosion mitigation.

Algonquin's pipeline will be built according to USDOT safety standards. Since the pipeline is buried a minimum of 3 feet underground, it is relatively immune from direct lightning strikes. Specific site conditions, including earthquake forces, are considered in the design criteria for pipelines. A welded steel pipeline is highly resistant to earthquake forces because of its configuration and design. In fact, studies have been made on the performance of natural gas pipelines in Southern California, the major earthquake area in the United States. Those studies reported that there is no known case of a buried, modern, welded steel pipeline that has experienced a break or a leak as a result of earthquake-shaking forces or ground deformation.

A gas control center is maintained in Houston, Texas. The gas control center monitors system pressures, flows, and customer deliveries. Further, the gas control center is manned 24 hours a day, 365 days a year. Algonquin also operates area and sub-area offices along the pipeline route whose personnel can provide the appropriate response to emergency situations and direct safety operations as necessary.

Algonquin's pipeline systems are equipped with Remote Control Valves ("RCVs"). This allows the valves to be operated remotely by Gas Control in the event of an emergency, usually evidenced by a sudden loss of pressure on the pipeline. Remotely closing the valve allows the section of pipeline to be isolated from the rest of the pipeline system.

Data acquisition systems are present at all meter stations along the system. If system pressures fall outside a predetermined range, an alarm is activated and notice is transmitted to the Houston Gas Control Center. The alarm provides notice that pressures at the station are not within an acceptable range.

A list of contractors who are available to respond to Algonquin's needs in the event of an emergency is available in the Emergency Procedures Manual. Algonquin employs well qualified and licensed field personnel, whose credentials are in accordance with Massachusetts and Connecticut safety standards, and who can be immediately dispatched to the scene of an emergency if the need should arise.