

*Safety and Reliability*  
*For the Underground Distribution System*

**IMPLEMENTATION PLAN**



January 10, 2006

# NSTAR Electric

*Safety and Reliability  
For the Underground Distribution System*

## Implementation Plan

### I. Introduction

In May 2005, the Department of Telecommunications and Energy (the “Department”) initiated two assessment processes relating to the underground electric distribution systems of NSTAR Electric<sup>1</sup> and other electric utilities operating in the Commonwealth. To perform the assessments, the Department retained the services of two independent consulting firms. The first independent assessment process was performed by Navigant Consulting, Inc. (“Navigant”) and related to the occurrence of stray voltage in underground distribution systems. The second independent assessment process was performed by Siemens Power Transmission & Distribution (“Siemens”) and related to dislodged manhole covers. On December 9, 2005, the Department issued the “Stray Voltage Final Report” prepared by Navigant and the “Manhole Safety Final Report” prepared by Siemens. Each of these reports sets forth a series of recommendations developed by Navigant and Siemens (respectively) based on their judgment as to the actions that could be taken by the Massachusetts electric companies “to ensure the safe operation” of their distribution systems. The Department directed each electric company to submit by January 10, 2006, its plan for implementation of the recommendations contained in the final reports.

In this filing, NSTAR Electric sets forth its plan for implementation of the Navigant and Siemens recommendations, as directed by the Department. However, there is one additional consideration involved with respect to new programs designed to address electrical safety and reliability issues on the NSTAR Electric system. On December 30, 2005, the Department approved a Settlement Agreement between NSTAR (a registered holding company), its operating affiliates, Boston Edison Company, Commonwealth Electric Company, Cambridge Electric Light Company, and NSTAR Gas Company, and the Attorney General of the Commonwealth of Massachusetts (the “Attorney General”), the Low-Income Energy Affordability Network and Associated Industries of Massachusetts. Petition of Boston Edison Company et al, D.T.E. 05-85 (2005). Under the terms of the Settlement Agreement,

---

<sup>1</sup> NSTAR Electric is composed on Boston Edison Company, Cambridge Electric Light Company and Commonwealth Electric Company.

NSTAR Electric is required to provide the Attorney General and the Department with a Capital Projects Scheduling List ("CPSL") covering activities to be performed in 2006 relating to (1) stray voltage inspection, survey and remediation; (2) manhole inspection, repair and upgrades; and (3) double-pole inspection, replacement/restoration and transfer and other projects relating to infrastructure improvement (see Settlement Agreement at Paragraph 2.25). The Settlement Agreement requires NSTAR Electric to spend not less than \$10 million in 2006 to complete activities included in the CPSL and also provides for cost recovery of incremental amounts incurred as a result of these programs. The Settlement Agreement requires NSTAR Electric to deliver the CPSL to the Attorney General and the Department by February 1, 2006.

As a result, NSTAR Electric's electrical safety and reliability plan must fulfill the dual mandate of the Department's directive to implement the recommendations of the independent consultants and the requirements of the Settlement Agreement approved by the Department in D.T.E. 05-85. Fulfillment of these obligations will require substantial commitment and attention by NSTAR Electric's senior management. These obligations will also have a significant impact on all aspects of NSTAR Electric's field operations including equipment and personnel resource allocations, work plans, work procedures, and information-system capabilities. Therefore, to implement these recommendations and requirements in a way that is operationally feasible, effective, and cost-efficient, NSTAR Electric must undertake a carefully planned and long-range approach, which will require some time to accomplish and implement. NSTAR Electric is currently engaged in this mobilization process and expects that the precise details of its work plans and schedules will take shape over the coming months. In that regard, the recommendations resulting from the independent assessments establish the parameters of NSTAR Electric's obligations in relation to electrical safety and reliability issues. Accordingly, this filing is designed to provide the Department with NSTAR Electric's initial plan to implement the recommendations of the independent assessments.

At the same time, the Settlement Agreement obligates NSTAR Electric to undertake a broader set of initiatives to address electrical safety than those recommended by the independent assessments. Under the Settlement Agreement, NSTAR Electric is obligated to file annual reports regarding the status of the projects and costs incurred for any programs that are implemented and for which NSTAR Electric receives cost recovery (see Paragraph 2.25). As a result, NSTAR Electric fully anticipates providing additional detailed information to both the Attorney General and the Department regarding its electrical-safety efforts as those programs are designed and implemented.

In Section II below, NSTAR Electric outlines its implementation plan relating to the recommendations set forth in the Stray Voltage Final Report. In Section III below, NSTAR Electric outlines its implementation plan relating to the recommendations set forth in the Manhole Safety Final Report.

## II. Recommendations Relating to the Stray Voltage Assessment

### A. Summary of NSTAR Electric Implementation Plan

-1-

NSTAR Electric will maintain a *stray voltage inspection and testing plan* to apply to NSTAR-owned or maintained low-voltage underground secondary equipment and underground facilities susceptible to the occurrence of stray voltage. NSTAR Electric will perform testing at levels exceeding 20 volts to the extent that technology rated to detect at that level or below is suitable and effective for use by NSTAR Electric's field employees. NSTAR Electric's inspection and testing plan takes into account that the sources of stray voltage, seasonal factors and the appropriate schedule for testing and inspection. NSTAR Electric's inspection and testing plan also includes mitigation, repair and remediation activities designed to protect the public safety.

-2-

NSTAR Electric will implement a *monitoring and tracking system* to record and document stray-voltage events. NSTAR Electric will record the equipment affected, pertinent system conditions, remediation and other relevant information designed to enable root-cause analysis and targeted inspections.

-3-

NSTAR Electric will submit *annual reports* to the Department that document and summarize information obtained in Recommendation 2.

-4-

NSTAR Electric will *monitor and assess alternate testing methods*, including new equipment that will improve inspection effectiveness and accuracy.

-5-

NSTAR Electric will continue the *public awareness campaign* put in place as part of the Joint Task Force activities to promote safety awareness via direct mail, bill stuffers, contractor bulletins and other public-interest communications.

-6-

NSTAR Electric will work with the other Massachusetts electric companies and the Department, as well as its equipment suppliers to explore and promote the *development of protective equipment* that can

differentiate and isolate stray voltage from normal customer electrical loads.

## **B. Specifics of NSTAR's Stray Voltage Implementation Plan**

### **Recommendation #1:**

#### **□ NCI RECOMMENDATION**

Prepare or update preventive maintenance plans, where needed or appropriate, to include inspection and testing of low-voltage secondary equipment and facilities susceptible to stray-voltage levels that exceed the thresholds described herein.

#### **□ ADDITIONAL NCI COMMENT**

The stray-voltage inspection and testing plan should include or consider the sources of stray voltage, the appropriate schedule and mitigation and remediation procedures, as follows:

#### Sources of Stray Voltage

- Identify and include likely sources of equipment susceptible to stray voltage, including exposed cable leads, exposed metal conduit and risers, metallic street light poles, padmounted devices, equipment enclosures, pedestals, and exposed grounds.
- At a minimum, utilities should inspect and test the following equipment where accessible by the general public:
  - Metallic street lights and fixtures;
  - Metallic risers, sweeps and conduits;
  - Manhole and handhole covers;
  - Secondary pedestals;
  - Padmount transformers and translosures;
  - Padmount switchgear, termination cabinets and junction boxes;
  - Control cabinets such as pole-mounted capacitor controls.

#### Schedule

- Prioritize inspection schedules based on susceptibility or prior history of recorded stray-voltage events by equipment type. Utilities should be permitted to propose inspection schedules and methods based on prior inspection results, equipment exposure, coordination with other inspection and preventive maintenance programs and locational factors.

- At a minimum, utilities should schedule voltage testing on a rolling five-year basis with voltage testing prioritized based on the following criteria, ranked from highest to lowest priority:
  - Areas of high exposure from prior inspections;
  - Equipment with the highest historical incident rate or with the highest known risk factors;
  - Equipment that is more susceptible to stray voltage during winter months when contamination or clearing increases the incident rate;
  - Equipment categories listed above that have not been inspected or tested in the past 5 to 10 years, or that have never been inspected;
  - Areas with a high density of equipment types listed above, such as residential and commercial subdivisions;
  - Rural areas where lines and equipment are located overhead and are generally inaccessible by the public may be assigned a lower priority.
- Inspections should be scheduled during periods where equipment may have greater susceptibility to stray voltage, such as during winter months when there is the potential for damage caused by clearing activities or lower ground resistance created by salt or contamination. Utilities should be provided an opportunity to gather factual information to identify seasonal impacts on equipment stray voltage susceptibility, and structure or modify programs based on this information.
- Utilities that propose to study the impact of seasonal factors should describe the methods they will employ to collect the factual information and how this information will be used to identify inspection schedules based on seasonal factors.

#### Mitigation and Remediation

- Utilities should immediately repair, replace or disconnect equipment with voltage readings of 20 volts or greater.
- All equipment with readings between 8 and 20 volts should be repaired within 24 hours.
- Equipment with readings below 8 volts should be addressed at the utilities' discretion.
- Utilities should cordon off the equipment or facilities with voltages between 8 and 20 volts if inspection personnel or repair crews are not present at the site at any time prior to repairs.
- Utilities should employ best efforts to contact and provide the customer or municipality a reasonable opportunity to correct the problem prior to disconnection.

- The communications protocol should be incorporated into each utility's preventive maintenance manuals, bulletins or notification procedures.

□ **NSTAR ELECTRIC IMPLEMENTATION**

As part of the Joint Task Force on Electrical Safety, NSTAR Electric committed to a periodic inspection and testing program for stray voltage that largely addresses the NCI recommendations. The uniform testing protocol established by the Joint Task Force requires NSTAR Electric: (1) to perform voltage-indication testing at 24 volts or less; (2) to test all above-grade electrical infrastructure within the City of Boston supplied by the underground distribution system on a rolling three-year cycle; (3) to target annual voltage-indication testing to the winter months and early spring (*i.e.*, the 1<sup>st</sup> and 4<sup>th</sup> quarters of each year); and (4) to test NSTAR Electric-owned or maintained streetlighting and other lighting equipment when it is energized or in use to detect the present of stray voltage (if necessary to detect the presence of stray current).

Although the three-year cycle adopted by NSTAR Electric for equipment in the City of Boston is within the five-year cycle recommended by NCI, the voltage-level threshold recommended by NCI is below the 24-volt level adopted by the Joint Task Force. The 24-volt level adopted by the Joint Task Force is well within the threshold recognized by the National Electric Code and the Occupational, Safety, Health Administration for human contact (50 volts). The 24-volt level set by the Joint Task Force also recognizes that the manufacturer ratings of equipment currently deployed by the electric distribution utilities are at this level.

However, consistent with the Department's directives, NSTAR Electric will work to implement a stray-voltage inspection and testing plan to detect the presence of stray voltage at levels exceeding 20 volts to the extent that technology rated to detect at that level or below is suitable and effective for use by field employees. In that regard, NSTAR Electric is currently in the process of evaluating a new technology reportedly able to detect stray voltage at 8 volts or higher. In particular, NSTAR Electric is evaluating whether it would be feasible and effective to use a technology with such a high sensitivity to the presence of voltage. NSTAR Electric would also like to gain an understanding of the impact of using this technology under varying environmental conditions and ground resistance levels. This evaluation is necessary because the use of highly sensitive voltage indicators has the potential to unduly complicate the inspection process given the potential for repeated "false positive" results. NSTAR Electric anticipates that it will conduct field testing of a small batch of these units over a three-month period and that, if the units function reasonably well in the field, it will purchase a number of these units for use by stray-voltage testing crews, as well as underground field crews and line crews as appropriate. The cost of these units is currently estimated to be in the range of \$600-\$700 per unit.

It should be noted that the changeover to the new technology may have an impact on NSTAR Electric's ability to meet scheduling commitments in the short run, but will

have the benefit of enabling testing at a much lower level in the long run. NSTAR Electric anticipates that procurement of these units and deployment in the field will be completed within six months.

As noted above, NSTAR Electric is currently testing all above-grade electrical infrastructure supplied by the underground distribution system and located within a 10-foot radius of NSTAR-owned manholes in the City of Boston (within a three-year rolling basis). To address the NCI recommendations, NSTAR Electric also plans to modify its testing protocol to include the full range of equipment referenced by NCI to the extent that this type of equipment is owned or maintained by NSTAR Electric and is accessible to the general public. This equipment will include metallic street lights and fixtures; metallic risers, sweeps and conduits; manhole and handhole covers; secondary pedestals; padmount transformers and transclosures; padmount switchgear, termination cabinets and junction boxes; and control cabinets such as pole-mounted capacitor controls. Although not required by the Joint Task Force, this additional equipment will be tested within the three-year testing cycle in the City of Boston. In addition, areas served by the NSTAR Electric underground distribution system beyond the City of Boston will be tested for stray voltage on a five-year cycle as recommended by NCI.

NSTAR Electric will target inspections and testing in the 1<sup>st</sup> and 4<sup>th</sup> quarters of each year to the areas most susceptible to the occurrence of stray voltage, such as urban areas or areas that tend to be particularly affected by environmental conditions that increase the potential for stray voltage to occur. As part of the rate settlement with the Attorney General, NSTAR Electric is also evaluating the possibility of completing inspections in these types of areas on a more frequent basis than the three-year rolling cycle, as appropriate.

NSTAR Electric applies, and will continue to apply, a strict policy of “making safe” any hazardous conditions leading to the creation and detection of stray voltage. Consistent with the NCI recommendation, mitigation, repair and remediation will involve a range of actions including equipment replacement and disconnection of service to a customer’s premise if the source or cause of the stray voltage is customer-related or if the stray voltage is present on or caused by municipal or other publicly owned facilities. NSTAR Electric also adheres to the protocol established by the Joint Task Force relating to the “temporary repairs” implemented to make the situation safe for the public.

## **Recommendation #2:**

### **□ NCI RECOMMENDATION**

The utilities should implement consistent monitoring and tracking systems that record and document stray-voltage events. These reporting systems should include equipment affected, system conditions, remediation, and other relevant information designed to enhance root-cause analysis and targeted inspections.

□ **ADDITIONAL NCI COMMENT**

At a minimum, the monitoring and tracking systems should include the following attributes and features:

- Links to trouble order or customer-information systems to ensure all stray-voltage events are recorded;
- Menu-based data entry and definitions;
- Established procedures to classify stray voltage events;
- Procedures or policies that document equipment that should be tested seasonally when the incident rate is highest
- Event data including:
  - Location of event;
  - Name of person reporting the event (if available);
  - Date and time event detected or reported;
  - Feeder and substation number;
  - Equipment impacted and damage report;
  - Equipment owner (utility, municipality, customer);
  - Equipment condition;
  - Voltage reading(s);
  - Inspection/testing/call out personnel/crews;
  - Type of mitigation employed;
  - Date of mitigation; Injuries (if any);
  - Date of report to Department ;
  - Tracking reports that list stray voltage events by equipment type, voltage readings, and location by area/region.

The monitoring and tracking system should include the ability to query data and produce interim reports via menu-based systems.

Utilities should be encouraged to jointly discuss development and use of a common tracking and recording system.

□ **NSTAR ELECTRIC IMPLEMENTATION**

As a result of the efforts of the Joint Task Force, NSTAR Electric has made significant strides in developing database information to assist in the tracking and monitoring of stray-voltage events. Currently NSTAR Electric obtains information regarding stray-voltage events from two main sources, which are: (1) stray voltage events detected through the inspection and testing program; and (2) stray voltage

detected as a result of “area energized” calls made to NSTAR Electric’s call center. In the past, stray voltage events detected through the inspection and testing process were logged into a database, while “area energized” calls were tracked in NSTAR Electric’s M3i customer system. However, NSTAR Electric recently implemented a process change linking these two sources of information by requiring stray voltage occurrences detected through the testing process to be relayed to the dispatch center and recorded in the M3i system. This initiative will enhance the tracking and reporting of stray voltage events on the NSTAR Electric system.

NSTAR Electric records data relating to stray voltage events (whether known to NSTAR Electric as a result of voltage-indication testing or “area energized” calls) on a standardized form, with the exception of voltage readings. As noted by NCI in the Stray Voltage Final Report, as well as the Joint Task Force Report, voltage levels associated with “stray voltage” vary considerably in response to environmental conditions and ground-reference potential. As a result, readings may differ at points along the current path and even at the same location at different points in time. This phenomenon greatly diminishes the value of voltage readings because it makes the readings difficult to capture and inherently unreliable and inaccurate for tracking purposes. Therefore, NSTAR Electric does not find it necessary or helpful to attempt to pinpoint and record a voltage level. It should also be noted that, NSTAR Electric’s testing program involves the use of voltage indicators that detect only the *presence* of current and do not provide a voltage-level reading. NSTAR Electric’s field protocol is to eliminate the source of stray voltage once it is detected by the voltage indicator regardless of the voltage level.

### **Recommendation #3:**

#### **❑ NCI RECOMMENDATION**

The utilities should submit reports to the Department that document and summarize information obtained in Recommendation 2.

#### **❑ ADDITIONAL NCI COMMENT**

At a minimum, these reports should include:

- Annual reports that list inspection and testing data, including number of inspections conducted by equipment type;
- Number of stray voltage events detected by inspection personnel versus calls-ins or notification by third parties.
- Variance reports on current year inspection targets
- Stray voltage events detected on equipment that is not included in stray voltage equipment inspection schedules (which will enable the Department to determine if the company is inspecting and testing the correct equipment)
- Number of exceptional or non-routine events that required reporting to OSHA or other governmental organizations due to injuries or other substantive impacts.

- All exceptional and non-routine events described above should be submitted to the Department within one to three days. Events involving a fatality or injury (human or domestic animal) should be reported immediately.

In addition, utilities should consider reporting the following information:

- Clear and concise tables and charts that track the data listed in Recommendation 2;
- Proposed schedules that summarize inspections scheduled for the following year;
- Cost of inspections and mitigation activities
- Results of internal studies or industry activities involving stray voltage testing and detection methods, or stray voltage phenomena
- Results of investigation of new testing devices or methods, particularly those that offer cost-effective alternatives

Utilities should consider assigning individual(s) who are responsible for issuing these reports and responding to questions regarding the company's stray voltage program.

#### □ **NSTAR ELECTRIC IMPLEMENTATION**

As part of its participation in the Joint Task Force, NSTAR Electric must record instances in which stray voltage is detected through the inspection process and report those instances to the City of Boston, Inspectional Services Department on an annual basis. These annual reports must include the date of detection, the location, the known or suspected cause of the stray voltage, identification of the entity that owns and/or maintains the equipment, and the method used to make the situation safe. To implement the NCI recommendation, NSTAR Electric will augment this report with data resulting from "area energized" calls and will provide a comprehensive report to the Department on an annual basis. NSTAR Electric will continue to notify the Department of any events resulting in injury to humans or domestic animals within 24 hours of the event.

NSTAR Electric is also obligated to update the Joint Task Force on a semi-annual basis in relation to its efforts to implement the Joint Task Force recommendations (many of which were also recommended by NCI) and to review any developments in technology, industry practices or other factors that would benefit the public safety. NSTAR Electric will include information regarding any technological or industry developments of note in its annual reports of stray voltage events to the Department.

#### **Recommendation #4:**

#### □ **NCI RECOMMENDATION**

The utilities should monitor and assess alternate testing methods, including new equipment that will improve inspection efficiency and cost.

□ **NSTAR ELECTRIC IMPLEMENTATION**

NSTAR Electric will continue to monitor and assess alternate testing methods and technologies that have the potential to improve inspection effectiveness and/or reduce costs. An example of NSTAR Electric's efforts in this regard is the prototype mobile-unit detection device currently under evaluation for potential field use by NSTAR Electric. NSTAR Electric representatives have visited the laboratory where the equipment is under development and is preparing for a second round of field testing. In addition, NSTAR Electric is assessing whether the investment required to implement and maintain this technology would provide effective assistance in expediting the inspection process during critical winter months or perhaps enabling repeat tests in susceptible areas during that time period. If NSTAR Electric determines that operation of the unit would be feasible and effective from a practical perspective, NSTAR Electric anticipates that it will consider including it in the program to be developed consistent with the Settlement Agreement.

**Recommendation #5:**

□ **NCI RECOMMENDATION**

The utilities should promote safety awareness via mail, bill stuffers and contractor bulletins to the extent these processes are not already in place.

□ **NSTAR ELECTRIC IMPLEMENTATION**

Through the Joint Task Force, NSTAR Electric has committed to, and commenced, a comprehensive outreach campaign to build public awareness as to the need to report damage to outdoor electrical equipment on an expedited basis to facilitate remediation by the equipment owner. Specifically, NSTAR Electric included a bill insert in customer bills in September 2005 and a direct mail to large property owners in December 2005. Copies of these communications are included herewith as Appendix 1.

**Recommendation #6:**

□ **NCI RECOMMENDATION**

The electric utilities should explore and promote the development of protective equipment with electric equipment suppliers that can differentiate and isolate stray voltage from normal customer electrical loads.

□ **NSTAR ELECTRIC IMPLEMENTATION**

NSTAR Electric will explore and promote the development of protective equipment for use on secondary systems with its equipment suppliers to the extent practical.

The Working Group to be established among the electric utilities in relation to manhole covers may also serve as a forum for discussion regarding research and development of protective equipment and related funding of those efforts. NSTAR Electric believes that, although the development of ground-fault protection systems for secondary equipment would be beneficial in terms of detecting stray current on these systems, these types of technology advancements are generally achievable only as the result of significant investment in research and development projects on an industry-wide basis. Therefore, the Working Group may provide a platform for these efforts in Massachusetts

### III. Recommendations Relating to the Manhole Safety Assessment

#### A. Summary of NSTAR Electric Implementation Plan

-1-

For purposes of data tracking and monitoring activities relating to “manhole events,” NSTAR Electric will participate in a Working Group with the other Massachusetts electric companies to establish *uniform definitions* to categorize manhole events occurring on the underground system consistent with industry practice.

-2-

NSTAR Electric will implement a *manhole inspection program* targeted at developing a baseline assessment of manhole conditions on the NSTAR Electric system over the five-year period beginning January 1, 2006. NSTAR Electric will create a database of manhole inspections and required repairs resulting from those inspections. NSTAR Electric will use the resulting data to prioritize future manhole inspections and/or determine an appropriate periodic re-inspection cycle. NSTAR Electric will prioritize the resulting corrective-maintenance repairs and monitor and track those repairs by priority level.

-3-

NSTAR Electric will work with the utility working group to develop a *splice log* or an alternative approach that would facilitate the identification of workmanship issues on spliced, underground cables.

-4-

NSTAR Electric will provide supplemental training to its troubleshooters in the collection of forensic information relating to field failures on the underground system and will take the steps necessary to ensure a sufficient level of resources are available to perform root cause analyses, as appropriate. Failure reports and root-cause analyses will be compiled and assessed each year and a report will be prepared and submitted to the Department .

-5-

NSTAR Electric will employ standardized manhole inspection forms that maximize the use of checklists and minimize the need for free-form comments. NSTAR Electric will prepare and submit annual manhole inspection and manhole event reports with a summary analysis to the Department. NSTAR Electric will report all manhole events resulting in property damage, personal injury or media coverage to the Department within 24 hours.

-6-

NSTAR Electric will participate in a Working Group composed of representatives from the four companies and Department staff to meet semi-annually to share information on manhole event trends, root-cause analyses, research studies, results of pilot programs, new technologies, and lessons learned. The Working Group may also address broader issues related to electric distribution reliability and safety, as appropriate.

-7-

*Recommendation to the Department/not applicable to NSTAR Electric*

## **B. Specifics of NSTAR Electric's Manhole Implementation Plan**

### **Recommendation #1:**

#### **□ SIEMENS RECOMMENDATION – DEFINITION OF MANHOLE EVENTS**

The following definitions should be adopted for manhole events:

- *Smoking Manhole* – A manhole event in which smoke is visible, but no visible flame is escaping from the edge of the manhole cover or from holes in the cover.
- *Manhole Fire* – A manhole event in which the cover remains seated in its frame and there is visible flame escaping from the cover's edge or from holes in the cover.
- *Manhole Explosion* – A manhole event in which a release of energy from the manhole occurs and the manhole cover is dislodged from its frame, or debris such as cement and dirt is projected into the air although the manhole cover remains seated.

#### **□ NSTAR ELECTRIC IMPLEMENTATION**

NSTAR Electric agrees with Siemen's comment that the current definition of "manhole event" is focused on manhole events causing the dislodgment of a manhole cover and that this definition may exclude a more comprehensive view of notable events occurring on the underground distribution system. In addition, NSTAR Electric supports the concept of establishing uniform definitions of "manhole events" for the purpose of data tracking and monitoring activities by the electric companies. NSTAR Electric recognizes that the use of common terms by the Massachusetts electric companies will facilitate the Department's efforts to ensure the public safety through informed oversight. NSTAR Electric proposes to work with the other Massachusetts electric companies through a Utility Working Group (discussed in Recommendation 6, below) to develop these uniform definitions. To

that end, NSTAR Electric recommends that the definitions developed by ConEdison Electric Company, which operates a large underground distribution system in New York City, be used as a starting point for uniform definitions in Massachusetts. The ConEd definitions are as follows:

- *Smoking Manhole* – A manhole event in which smoke, but no visible flame is escaping from holes in the cover or around the cover's edge and the cover remains seated in its frame.
- *Manhole Fire* – A manhole event in which flame is visible at holes in the manhole cover or around the cover's edge and the cover remains seated in its frame.
- *Manhole Open* – A manhole event in which a release of energy from the manhole occurs and one or more manhole covers are dislodged from their respective frames. There is no reported injury or damage.
- *Manhole Explosion* – A manhole event in which a release of energy from the manhole is accompanied by physical injury to people and/or damage to vehicles or surrounding structures, including windows.

The ConEd Model provides a more precise and appropriate definition of the types of events that have the potential to occur on an underground distribution system and, if adopted by all the Massachusetts utilities, will facilitate the Department's review and tracking of these types of events.

## **Recommendation #2:**

### **□ SIEMENS RECOMMENDATION – INSPECTION AND MAINTENANCE PRACTICES**

Electric companies should implement a program designed to inspect all manholes over the five-year period beginning January 1, 2006 and create a database of manhole conditions and required repairs. The resulting data should be used to prioritize future manhole inspections and/or determine an appropriate periodic re-inspection cycle for each individual company. Required repairs should be prioritized in accordance with a standardized repair priority schedule, and the resulting manhole inspection repair backlog should be monitored and tracked by priority level. (Abnormal conditions found during the manhole inspections should be recorded and reported per Recommendation 5, below.)

### **□ NSTAR ELECTRIC IMPLEMENTATION**

NSTAR Electric is in the process of developing a mobilization plan aimed at generating a baseline assessment of the condition of NSTAR-owned manholes and prioritizing necessary corrective-maintenance repairs relating to the inspection process. On the NSTAR Electric underground distribution system, there are approximately 38,000 manholes using duct-manhole construction, which are the types of manholes within the scope of the Siemens' report (Manhole Safety Final Report at A-1).

Completion of an initial round of 38,000 manhole inspections within a five-year period poses a substantial challenge for NSTAR Electric, mainly in terms of the sheer number of qualified personnel that would be required and the obstacles inherent in accessing manholes in congested urban areas. In fact, implementation of the manhole assessment project will have a substantial impact on all aspects of NSTAR Electric's field operations including equipment and personnel resource allocations, work plans, work procedures, and information-system capabilities. As a result, NSTAR Electric recognizes that its process will need to be structured with flexibility to ensure that issues such as emerging system conditions, reliability requirements and workforce availability can be addressed within the context of the development of a baseline assessment of NSTAR-owned manholes. Therefore, NSTAR Electric's mobilization plan will commence in 2006 and will be completed on a year-to-year basis with consideration of operational constraints and reliability priorities on NSTAR Electric's distribution system.

In that regard, there are a number of considerations that must be factored into the NSTAR Electric-specific implementation of Siemens' recommendations. First, it should be noted that all manholes do not have the same probability of experiencing an underground failure. Inspection priorities should take into account the number of primary circuits in a manhole, the proximity of the manhole to its source station, equipment (such as transformers or switches) within the manhole and the number of previous failures (if any) within the manhole, among other factors. For example, manholes that house only one or two primary circuits have a very low probability of experiencing an event, and therefore, should not take priority over other efforts directed to reliability improvement. Conversely, manholes that contain secondary network limiters or locations requiring cutoff verification of services to demolished buildings may be appropriate for prioritization.

In addition, inspection times are directly affected by a number of factors including the accessibility of manholes, requirements to obtain municipal permits for manhole openings and OSHA work area and manhole entry requirements. In particular, NSTAR Electric is required to obtain street occupancy permits to enter manholes within the City of Boston on a non-emergency basis. On heavily traveled streets within the City of Boston, access may be allowed only at night. In addition, police details are typically mandated at the state and municipal level for work performed in the public way. Moreover, there are extensive work procedures and testing protocols that NSTAR Electric field technicians must adhere to prior to entering a manhole and environmental consultants may be needed on site to pump out and clean the manholes to prepare for entry by NSTAR Electric field technicians. NSTAR Electric also confronts the unusual problem that many manholes in City of Boston are "tidal manholes," which means that they are susceptible to daily flooding associated with ocean tides on the waterfront. Given the significant amount of preparation required prior to manhole entry in urban and/or tidal areas, NSTAR Electric must devote the time and resources to perform corrective maintenance

relating to the inspection while the manhole is available in order to avoid the costs and delay associated with a new manhole entry.

Given these operational constraints, NSTAR Electric is confronted with a considerable challenge in completing inspections of its 38,000 duct-bank construction manholes within a five-year period. Although NSTAR Electric will endeavor to complete these inspections, NSTAR Electric does not believe that it is necessary to conduct inspections of all of these manholes in order to develop a baseline assessment of the condition of the underground system or to determine the appropriate periodicity of a new manhole inspection program. Therefore, NSTAR plans to undertake the inspections necessary and appropriate to establish a baseline assessment of the condition of NSTAR Electric-owned manholes and to establish a going-forward periodic manhole-inspection program. As indicated below, NSTAR Electric will review the data collected and report its findings to the Department on an annual basis. Based on these findings, NSTAR Electric may recommend appropriate changes in the scope and frequency of the inspection program to the Department.

NSTAR Electric will use a prioritization approach targeting critical manholes based on the following factors:

- Service disconnect verification for demolished buildings (potential source of stray voltage);
- Secondary network manholes, particularly those with current limiters;
- Number and type of cables in the manhole;
- Proximity to the source station;
- General work or logistical priorities;
- Other factors indicating a need for priority inspection.

It should also be noted that NSTAR Electric does not intend to repeat inspections of manholes that have been inspected, repaired or upgraded within the past three years. Because these manholes have been the subject of recent and comprehensive maintenance and/or construction activity, NSTAR Electric does not need to revisit these manholes within such a short time period to determine their condition. NSTAR Electric will compile and maintain a list of these manholes for reference in any later assessment of the program.

In terms of documentation, NSTAR Electric will require its field technicians to complete a Manhole Inspection Form for each inspection performed. NSTAR Electric is currently developing a new format for use in the baseline assessment process. A draft of the pending NSTAR Electric Manhole Inspection Form is provided in Appendix 2. NSTAR Electric will also maintain a corrective-maintenance log listing repairs made necessary by those inspections. Corrective maintenance activities will be prioritized, monitored and completed in accordance with the

definitions set forth in Appendix 3. As noted above, NSTAR Electric will file an annual report with the Department summarizing the status of its manhole inspection program and assessing the results.

On an additional note, NSTAR Electric does not believe that the cost estimates for manhole inspections set forth on Page 2-3 of the Manhole Safety Final Report are representative of the costs that would be incurred on the manhole system. During its investigation, NSTAR Electric provided comment to Siemens' regarding its representations of the cost of manhole inspections. As indicated to Siemens, these cost estimates fall far short of what the actual cost will be to the electric distribution systems. For example, these cost estimates do not include the cost of police details, travel time, manhole inaccessibility due to cars parked over holes, set-up time at the job site and costs involved with working around day-time prohibitions on manhole entry imposed by the City of Boston or other municipalities. Set-up time is necessary for setting cones, a manhole guardrail, performing gas detection, pumping and vactoring the manhole as necessary. In addition, there are significant setup costs associated with pumping and cleaning tidal manholes, which require special attention.

### **Recommendation #3:**

#### **❑ SIEMENS RECOMMENDATION – SPLICING LOGS**

Each company should maintain a database of new and repair splices made by employees and contractor crews in order to determine possible workmanship issues and related splicing training needs.

#### **❑ NSTAR ELECTRIC IMPLEMENTATION**

NSTAR Electric currently maintains sufficient information in its Work Management System and other business processes to determine whether workmanship issues are occurring in relation to the installation or repair of splices. In particular, NSTAR Electric maintains data to distinguish work performed by NSTAR Electric crews from work performed by and among outside contractors. However, NSTAR Electric will work with the Utility Working Group to consider the development of a splice log or an alternative approach that would facilitate the identification of workmanship issues on spliced, underground cables.

It should be noted that splicing logs were of more importance in the past, when the splices were lead-wipe and required a considerable amount of craft expertise to install successfully. This is no longer the case. Splices are now completed as cold splices or using heat-shrink technology. These splices are routinely performed using much less craft expertise, and therefore, NSTAR Electric (like most other utilities) no longer finds it of value to maintain detailed splicing logs tracking the level of information suggested by Siemens. The splicing data recorded and maintained by NSTAR Electric will provide the level of information necessary to evaluate the work

performed by NSTAR Electric crews versus outside contractors without imposing an undue administrative burden on NSTAR Electric. Moreover, the Utility Working Group will provide a forum for the consideration of alternative approaches that will coincide with the systems and operational practices of the companies.

#### **Recommendation #4:**

##### **❑ SIEMENS RECOMMENDATION – FAILURE ANALYSIS AND TRENDS**

Each company should train a sufficient number of employees in forensic failure analysis so that a field failure analysis is performed and a report generated for all manhole events in order to determine the root cause of the event. Additionally, the failure analyses reports should be compiled and assessed each year and a report of annual trends should be prepared and submitted to the Department.

##### **❑ NSTAR ELECTRIC IMPLEMENTATION**

NSTAR Electric conducts field failure analysis using experienced underground workers and has in-house personnel trained in cable/joint failure analysis. If the failure is considered out of the ordinary, NSTAR Electric preserves and analyzes samples of the damaged equipment. If there is any sign of damage due to overloads, load readings are taken. If a new joint or cable is involved, it is saved and analyzed formally with the splicer, supervisor and training school personnel involved. NSTAR also tests new cable and splices prior to placing them in service for quality assurance purposes during the construction process. NSTAR employs on-site inspectors and pre-approved contractors who have demonstrated quality work in the utility construction field. If the contractor does not do quality work as identified by the on-site inspector or through cable/splice failures during testing, they are removed from NSTAR Electric's approved vendor's list.

NSTAR Electric has, in the past, conducted formal analyses on many cable and joint failures with little value generated in terms of providing insight into the reasons for cable failure. The majority of failures are usually determined to be due to moisture ingress resulting from cracks in the insulation due to cable movement or corrosion of lead sheaths. Therefore, a program to conduct forensic analysis needs to be focused on areas where information of value to NSTAR Electric's reliability efforts is most likely to be obtained.

Accordingly, NSTAR Electric will perform forensic analysis consistent with the circumstances surrounding the event. To accomplish this objective, NSTAR Electric will provide supplemental training to its troubleshooters in the collection of forensic information relating to field failures on the underground system. NSTAR Electric will also take the steps necessary to ensure a sufficient level of resources are available to perform root-cause analyses on events involving a dislodged cover and/or personal injury or property damage. Failure reports and root-cause analyses will be

compiled and assessed each year and a report will be prepared and submitted to the Department.

NSTAR Electric will maintain its records relating to forensic analyses of manhole events for review by the Department, as appropriate. NSTAR Electric is also evaluating the possible benefits of participating in the Cable Splicing Center of Excellence, which is coordinated by ConEd, and may propose to join this group as part of the program to be developed under the Settlement Agreement. As part of NSTAR Electric's membership in this organization, NSTAR Electric is able to perform up to 18 comprehensive forensic analyses per year using the facility.

#### **Recommendation #5:**

##### **□ SIEMENS RECOMMENDATION – DATA COLLECTION AND REPORTING**

The companies should employ standardized manhole inspection and manhole event data collection forms that maximize checklists and minimize the need for free-form comments. Quarterly and annual manhole inspection and manhole event reports with a prescribed summary analysis should be prepared and submitted to the Department. Additionally, individual standardized reports on all events involving dislodged covers should be submitted to the Department as soon after the event as possible.

##### **□ NSTAR ELECTRIC IMPLEMENTATION**

NSTAR Electric will utilize a new Manhole Inspection Form discussed in response to Recommendation 2. NSTAR Electric will also maintain Manhole Event data consistent with the definitions set forth in response to Recommendation 1. These two forms will make maximum use of checklists and will require only minimal free-form comments, if any. NSTAR Electric will provide the Department with summary information on the Manhole Inspection Program on an annual basis. NSTAR Electric will provide the Department with summary information on manhole events (as defined in response to Recommendation 1) on a monthly basis. In addition, NSTAR will report all manhole events resulting in property damage, personal injury or media coverage to the Department within 24 hours.

#### **Recommendation #6:**

##### **□ SIEMENS RECOMMENDATION – INTERCOMPANY COOPERATION**

Siemens recommends the creation of a Working Group comprised of representatives from the four electric companies and Department Staff to meet quarterly for sharing information on manhole event trends, root cause analyses, research studies, results of pilot programs, new technologies, and lessons learned. The Working Group could also address broader issues related to electric distribution reliability and safety, as appropriate.

□ **NSTAR ELECTRIC IMPLEMENTATION**

NSTAR Electric will participate in a Working Group composed of representatives from the four electric companies and Department Staff. NSTAR Electric recommends that this Working Group meet on a semi-annual basis so that there is time to collect and analyze data on a meaningful basis for sharing within the group.

**Recommendation #7:**

□ **SIEMENS RECOMMENDATION – OUTREACH**

Siemens recommends a survey be taken of non-jurisdictional operators of underground electric distribution systems in Massachusetts. The survey should consist of questions regarding manhole events and manhole inspection practices, and determine the responding municipalities/organizations interest in participating in the Working Group (see Recommendation 6).

□ **NSTAR ELECTRIC IMPLEMENTATION**

NSTAR Electric believes that this type of effort could be beneficial, but would need to be undertaken by the Department in accordance with its jurisdiction under G.L. c. 164.

**IV. Conclusion**

NSTAR Electric's safety and reliability plan must fulfill the dual mandate of the Department's directive to implement the recommendations of the independent consultants and the requirements of the Settlement Agreement approved by the Department in D.T.E. 05-85. However, the recommendations resulting from the independent assessments establish the parameters of NSTAR Electric's obligations in relation to electrical safety and reliability issues on the electric distribution system. Accordingly, this filing is designed to provide the Department with NSTAR Electric's initial plan to address these issues on the NSTAR Electric system in a comprehensive and effective manner.

As noted above, the Settlement Agreement obligates NSTAR Electric to undertake a broader set of initiatives to address safety and reliability issues than those recommended by the independent assessments. Therefore, NSTAR Electric anticipates that it will provide additional detail to both the Attorney General and the Department regarding its safety and reliability efforts as those programs are designed and implemented.