Secondary System Analysis

2006 Stray Voltage Detection and Electric Facility Inspection Report
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Introduction

On January 5, 2005, the New York Public Service Commission (PSC) issued its “Order Instituting Safety Standards” in Case No 04-M-0159. The Safety Standards require that electric utilities annually test for stray voltage all of their publicly accessible transmission and distribution facilities and metallic pole streetlights and traffic signals located on public thoroughfares (“streetlights”). A full round of stray voltage testing is to be completed by November 30, each year. The Safety Standards also require that electric utilities visually inspect all of their electric facilities on a five-year cycle. Additional requirements of the Safety Standards include:

1. Guard all stray voltage detected locations until made safe irrespective of whether the positive stray voltage conditions are the responsibilities of the utility Company or non-utility party. Permanent repairs must be made within 45 days, except in extraordinary circumstances.
2. Analyze stray voltage conditions and causes, and develop measures to prevent occurrences.
3. Develop a quality assurance (QA) program to ensure timely and proper compliance with the Safety Standards.
4. Track and maintain records of inspection and stray voltage testing dates and results for every facility inspected and tested. Records must be readily accessible and searchable, continuously updated, and subject to PSC audit.
5. Certify the completion and results of inspections and stray voltage tests and that all unsafe conditions are remedied.

The Safety Standards establish annual voltage testing and inspection targets and includes a performance mechanism to promote compliance with these targets. Failure to comply with the testing or inspection performance targets in any year will result in an earnings revenue adjustment equal to 75 basis points of return on common equity for each missed target.

This report describes Consolidated Edison of New York, Inc.’s (“Con Edison” or “the Company”) stray voltage detection program and equipment inspection program conducted in 2006 and addresses the following:

1. Results of the stray voltage testing program
2. Additional stray voltage detection programs
3. Results of the electrical facility inspection program
4. Adherence to PSC performance mechanism
5. Certification of stray voltage and inspection program
6. Analysis of results
7. Additional stray voltage related initiatives
8. Future improvements
Overview of Con Edison’s Electric System

Con Edison provides electricity in a 604-square mile encompassing New York City and most of Westchester County. Con Edison’s transmission and distribution systems provide a high level of reliability in a very dense urban environment. The transmission system is comprised of overhead and underground transmission feeders that transmit power from generating stations and transmission ties with neighboring utility systems to the Company’s substations. The distribution system is comprised of overhead and underground cables and transformers that deliver power from the Company’s substations to the Company’s 3.2 million electric customers.

Distribution
The Con Edison electric distribution system, which is located in the five boroughs of New York City and most of Westchester County, covers 604 square miles. As of January 1, 2005, Con Edison served 3,187,212 electric customers: 2,339,622 network and 847,590 non-network. Approximately 86 percent of the 24,693,178-kVA-distribution transformer capacity is underground, and 14 percent is overhead.

The distribution system is divided into four regions: Bronx/Westchester, Brooklyn/Queens, Manhattan, and Staten Island. There are 57 substations supplying 76 secondary networked and non-networked load areas. Stations are supplied through 267 miles of radial transmission feeders operating at 345 kV, 138 kV, or 69 kV. 2,044 distribution feeders, including 23 - 33 kV feeders, 308 - 27 kV feeders, 950 - 13 kV feeders, and 763 - 4 kV feeders, supply non-network and network load.

Underground
Con Edison’s underground electric distribution system serves approximately 2.3 million of Con Edison’s 3.2 million electric customers via 57 secondary, alternating current (“AC”) networks. Each network is supplied by primary 27kV or 13.8 kV distribution feeders that connect to network transformers that reduce the voltage to 120/208 volts. Each of the 57 networks is laid out in a grid of underground, low voltage, insulated secondary cables. The insulation on the cables is rated at 600 volts and provides insulation protection that is several times greater than the operating 120/208 voltage of the secondary cables.

These low-voltage insulated cables travel, for the most part, through concrete or metal underground ducts beneath roadways and eventually enter manholes and service boxes. From there, low-voltage, insulated service cables run underground to the individual buildings and homes served by Con Edison. The underground system has approximately 274,000 manholes, service boxes, and transformer vaults; 23,444 conduit miles of underground duct; 34,416 underground transformers; and 91,654 miles of underground cable including primary, secondary, and service cables. (Service cables run from service boxes to customer facilities.) The secondary distribution system also supplies direct current (DC) service in Manhattan. By the end of this 2006, the Distributed DC Network System will be eliminated. The remaining few customers will be fed radially.

Overhead
The overhead distribution system includes: 142 autoloops, seven 4 kV multi-bank and 230 - 4 kV unit substations, approximately 285,000 Con Edison or Verizon-owned poles, and 33,135 miles of overhead wires, including primary, secondary, and services. Cables operating at primary voltages of 33 kV, 27 kV, 13.8 kV, and 4 kV supply 46,435 overhead transformers that step the primary voltages down to 120/208/240v distribution voltages that are used by customers.

Streetlights
Con Edison does not own, install, or maintain streetlights within its service territory. The New York City Department of Transportation (NYCDOT) and the local Westchester municipalities own the streetlights in New York City and Westchester respectively. There are approximately 177,000 publicly accessible metal pole streetlights in the Company’s service territory. Con Edison cables and
structures directly supply approximately 119,000 of these streetlights. Municipally owned cables supply the remainder of the streetlights.

**Transmission**
The transmission system is comprised of overhead and underground transmission feeders that deliver power from generating stations and transmission ties with neighboring utilities to the Company’s substations.

**Underground**
Con Edison’s underground transmission system is located in all five boroughs of New York City and in Westchester County, delivering power at 69 kV, 138 kV, and 345 kV to various switching substations and area substations. The system consists of approximately 1,700 manholes and 600 circuit miles of cable. The cable system includes pipe-type cable, where cable is installed in steel pipes containing dielectric fluid and pressurized to a nominal value of 200 psig, low and medium pressure cable and solid dielectric cable, which is installed in concrete or fiberglass ducts or direct buried.

**Overhead**
The overhead transmission system consists of 138 kV and 345 kV high voltage cable supported on towers and poles on approximately 115 miles of right-of-way located for the most part north of New York City and terminating in Westchester County where the underground transmission system begins.

**Substations**
Con Edison has 18 – 345kV switching substations that provide interconnection points for:
- The 345kV transmission system within Con Edison
- The 345kV inter-ties with other utilities
- Ties to major generating facilities
- Ties to the 138kV transmission system

Con Edison has 19 – 138kV switching substations, and 1 - 69 kV substation which provide interconnection points for:
- The 138kV transmission system within Con Edison
- The 138kV inter-ties with other utilities
- Ties to major generating facilities
- Ties to supply power to area substations

Con Edison has 57 area substations each of which directly supplies one or two distribution load areas. The primary voltages at these stations are 69 kV, 138 kV or 345 kV. The distribution level voltages are 13.8 kV, 27 kV or 33 kV, depending on the region. In addition, there are 14 Public Utility Regulating Stations (PURS). These stations provide cooling/heat exchange for the pressurized dielectric fluid for selected 345 kV underground transmission pipe-type feeders. In summary, there are 37 transmission stations and 57 area stations, located at 61 sites. Some sites have more than one substation.

**Unit Substations**
There are 230 unit substations located throughout the Bronx, Brooklyn, Queens, Staten Island and Westchester in the Con Edison system. The unit substation power transformer converts primary 33 kV, 27 kV, and 13.8 kV to 4.33 kV. The 4 kV feeders that emanate from a unit station tie to 4 kV feeders from
other unit substations to create a 4 kV grid system. The 4 kV grid system supplies approximately 10 % of Con Edison’s total load.
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Part One – 2006 Stray Voltage Testing Program

2006 Stray Voltage Detection and Electric Facility Inspection Report
Introduction

The bulk of the Con Edison electrical facilities are components of the distribution system. There are approximately 274,000 underground and 285,000 overhead distribution structures and 177,000 metal pole streetlights supplied directly or indirectly from the distribution system. In comparison, there are approximately 3,200 transmission and substation facilities – including substations, PURS facilities, transmission towers, and transmission manholes.

Con Edison divided the testing and inspection programs into five components – underground distribution, overhead distribution, streetlights, transmission, and substation facilities.

In 2004, Con Edison created a new department, Secondary System Analysis (SSA), within its Distribution Engineering (DE) organization to manage the distribution facility stray voltage testing and facility inspection programs required by the Safety Standards. SSA manages the stray voltage testing and inspections for underground distribution, overhead distribution, and streetlights. Substations and Transmission Operations personnel, in conjunction with SSA, manage the stray voltage testing and inspections of substation and transmission facilities, respectively.

Distribution

Beginning in 2004, Distribution Engineering developed test devices and procedures for stray voltage testing and facility inspection programs. SSA managed the overhead distribution and underground distribution stray voltage testing and inspection programs from databases of the Company’s electric structures extracted from the corporate mapping system. SSA hired contractors to perform the stray voltage testing of all publicly accessible overhead and underground structures and streetlights and inspections of the overhead system. All publicly accessible underground and overhead distribution structures and streetlights were tested during January to October 2006. The entire overhead distribution system was inspected in 2005. Con Edison personnel began the inspection of underground facilities in December of 2004, and inspections are ongoing.

Con Edison does not own, install, or maintain streetlights within its service territory. The New York City Department of Transportation (NYCDOT) or Westchester municipalities own these streetlights. To manage stray voltage testing of streetlights, Con Edison directs its contractors to walk every street in the service territory and test all metallic streetlights.

Substations and Transmission

The departments responsible for maintaining substation and transmission facilities managed the stray voltage testing of these facilities. Substations Operations utilized substation personnel to conduct the stray voltage testing of the perimeters of switching and substations and PURS facilities. Substation Operations used its existing work management system, MAXIMO, to manage its testing program. Underground Transmission utilized qualified contractors to perform the stray voltage testing of underground transmission manholes and utilized a separate database to manage the stray voltage testing. Transmission Line Maintenance (Overhead Transmission) used transmission personnel to perform stray voltage testing of overhead transmission structures during routine spring inspections of those facilities. Con Edison personnel conducted stray voltage testing of unit substations as part of the Company’s existing bi-monthly inspection program and maintained a spreadsheet log of the stray voltage tests.

Repairs

SSA tracked all stray voltage conditions to ensure that all equipment was immediately made safe and permanently repaired within 45-days. SSA maintains a database to track each of the stray voltage conditions for which Con Edison was responsible and maintained ongoing communication with the Company organizations responsible for repairing these conditions.
Quality Assurance
The Safety Standards require electric companies to develop a quality assurance program to “ensure timely and proper compliance with these safety standards.” Con Edison has developed a comprehensive quality assurance program to address the stray voltage testing and facility inspections requirements. The quality assurance program includes:

1. Stray voltage testing of underground distribution structures including Underground Residential Distribution (URD).
2. Stray voltage testing of overhead distribution structures.
3. Stray voltage testing of municipality owned streetlights.
4. Stray voltage testing of transmission and substation facilities.
5. Facility inspections of underground distribution structures including URD.
6. Facility inspections of overhead distribution structures.
7. Facility inspections of transmission and substation facilities.

This report addresses Con Edison’s quality assurance program in the report section covering each of these activities.
Stray Voltage Testing of Underground Distribution Structures

Scope
The PSC’s Safety Standards require that electric utilities test for stray voltage “all electric facilities that are capable of conducting electricity and are publicly accessible.” There are approximately 274,000 underground distribution structures on Con Edison’s system. Underground distribution structures are considered publicly accessible except for underground structures that are:

1. On private property and behind a locked fence or gate
2. On Con Edison property and behind a locked fence or gate
3. Buried
4. Inaccessible due to long term construction
5. Inside a building in a restricted area, or
6. On a highway

Con Edison’s stray voltage testing procedure EO-10358 requires stray voltage testing of all publicly accessible underground Con Edison distribution structures through an annual testing program. In addition, procedure Bulletin 63 requires that underground structures be tested before working in an underground structure and again once the work for the day is completed.

The underground stray voltage-testing program is managed in an SQL Server Application. The application was created from an extract of the electric distribution structures recorded in the corporate mapping system and the 2005 stray voltage testing results. The database was then segregated by and provided to the contractors responsible for stray voltage testing in a given region. The contractors would test the structure, update the database to reflect the date of the stray voltage test and result, and upload the database to a Con Edison server. Con Edison then synchronized the database into one master database from which reports can be prepared, including:

1. Structures pending.
2. Structures complete.
4. Publicly inaccessible structures not tested.

Overall Program
The 2006 underground distribution stray voltage-testing program began in January and ended in October. The bulk of the testing was completed before the summer. Reconciliation of test data and quality assurance were conducted during the summer and fall. The 2006 Underground Distribution Stray Voltage Testing Program included an inventory of all Underground Distribution structures. The inventory included GPS coordinate collection of the underground structure, cover shape, and cover type.

Three contractors, directly supervised by Con Edison’s Construction Management organization, performed the stray voltage testing. SSA assigned a project manager and staff to manage the testing and data reconciliation for the entire program. The project manager was responsible for tracking contractor progress in accordance with Con Edison and contractor agreed milestones.

Stray voltage was found in 15 underground distribution structures. All 15 cases of stray voltage were immediately made safe, and permanent repairs were completed within 45-days. The 15 stray voltages were entered into a separate database that is used to identify root cause of the failures.
Stray Voltage Test Procedure
Con Edison developed a variety of specifications and procedures for the stray voltage-testing program. EO-5100, EO-100175, and EO-10129 govern the manufacture, purchase and operation of low voltage detectors. Bulletin 63 establishes the stray voltage testing procedure used by Con Edison personnel. EO-10358 covers the annual stray voltage-testing program that is conducted by contractors. In addition, EO-10360 was developed to troubleshoot streetlights correctly. The procedures described below are included in the Appendix.

EO-5100 (Low Voltage Detectors - Stray Voltage)
This specification details the requirements for the manufacture of low voltage detectors and associated test devices that are to be used for stray voltage testing, including materials, impact resistance, operating temperature range, voltage detection capabilities, and labeling.

EO-100175 (Purchase Recommendation - Low Voltage Detectors for Stray Voltage)
This purchase recommendation covers low voltage detectors and test devices for stray voltage testing. The specification currently identifies only the HD-LV-S-5 as an approved detector for AC stray voltage detection by Con Edison personnel or contractors.

EO-10129 (Operation and Maintenance of Low Voltage Detector for Stray Voltage)
This specification describes the step-by-step operation of the HD-LV-S-5 stray voltage detector. The specification includes pre-operational checks and prohibits using rubber gloves during testing.

B-63 (Stray Voltage Testing Of Company Structures and Streetlights)
This bulletin describes the equipment that must be tested in/on the overhead, underground, and URD systems including testing of streetlights. The bulletin requires Con Edison personnel to test a structure and streetlight before working in/on the structure and again when work is completed for the day. The bulletin addresses direct current testing for structures that have both alternating current and direct current facilities. The bulletin addresses voltmeter verification of a stray voltage indication from the HD device, stray voltage reporting, and guarding of any facility or streetlight found with stray voltage.

EO-10358 (Annual Contractor Stray Voltage Inspection Procedure)
This specification describes the annual stray voltage testing that is performed by contractors. It describes how to test a Con Edison structure or streetlight, when to test a streetlight, what pole attachments need to be tested, data transfer requirements, and notification procedures in case a stray voltage is identified, and guarding of any facility or streetlight found with stray voltage.

EO-10360 (Troubleshooting of Streetlights)
This step-by-step procedure governs troubleshooting of underground streetlight services. The specification also requires load testing of the Con Edison supply cables to all streetlights worked on by Con Edison. The load test is necessary to determine if the Con Edison neutral cable is defective.

Training
Con Edison developed training for both Company employees and contractors on how to conduct stray voltage tests. All contractors and employees were trained on map reading, conducting stray voltage tests, reporting of stray voltages, and guarding structures found with stray voltage.

Company Employees
Company employees received on-the-job training (OJT) course number ELE0004 covering the pre-operational check of the HD stray voltage tester, voltmeter verification, reporting mechanisms, and guarding of structures or streetlights found with stray voltages. These employees conducted post-work and work-in-progress quality assurance of the contractors performing the stray voltage testing.
**Contractors**

The management of the contractors was trained in a train-the-trainer format. The training included personal protective equipment, map reading, pre-operational check of the HD stray voltage tester, voltmeter verification, reporting mechanisms, and guarding of structures or streetlights found with stray voltage.

The contractor managers then trained their field personnel in personal protective equipment, map reading, pre-operational check of the HD stray voltage tester, voltmeter verification, reporting mechanisms, and guarding of structures or streetlights found with stray voltage.

**Results**

Con Edison’s contractors fielded 273,743 Con Edison underground distribution structures and found 15 stray voltage conditions. Table 1 displays the 15 underground stray voltages by Con Edison operating region.

<table>
<thead>
<tr>
<th>Borough</th>
<th>Stray Voltages Found</th>
<th>Detection Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brooklyn</td>
<td>1</td>
<td>0.001%</td>
</tr>
<tr>
<td>Queens</td>
<td>2</td>
<td>0.003%</td>
</tr>
<tr>
<td>Manhattan</td>
<td>9</td>
<td>0.015%</td>
</tr>
<tr>
<td>Bronx</td>
<td>3</td>
<td>0.010%</td>
</tr>
<tr>
<td>Westchester</td>
<td>0</td>
<td>0.000%</td>
</tr>
<tr>
<td>Staten Island</td>
<td>0</td>
<td>0.000%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td><strong>0.006%</strong></td>
</tr>
</tbody>
</table>

*Table 1 – Underground Distribution Stray Voltages by Region*

Table 2 displays the 15 underground distribution stray voltages by voltage level.

<table>
<thead>
<tr>
<th>Voltage Level</th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-8</td>
<td>1</td>
<td>6.7%</td>
</tr>
<tr>
<td>9-20</td>
<td>3</td>
<td>20.0%</td>
</tr>
<tr>
<td>21-50</td>
<td>5</td>
<td>33.3%</td>
</tr>
<tr>
<td>51+</td>
<td>6</td>
<td>40.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

*Table 2 – Underground Distribution Stray Voltages by Voltage Level*

In each of the 15 stray voltage cases, the contractor reported the condition to Con Edison, guarded the site, and waited on location until relieved by Con Edison. Con Edison made each location safe before leaving the location. Each of the 15 conditions was permanently repaired within 45 days.

There are 12,225 underground distribution structures that are not accessible to the public because they are located within fenced-Con Edison property, blocked by long-term construction, buried, located behind locked fences/gates, inside buildings, or located on highways. The contractors made at least two attempts to access each of these locations. In addition, Con Edison performed extensive quality assurance on these “No-access” categories. The details of the quality assurance are included in the next section of this report.
Quality Assurance Measures Instituted
There are 273,743 underground distribution structures within the Con Edison’s service territory. Con Edison developed a quality assurance plan to ensure that stray voltage testing was performed as specified. The reliability and error design parameters used were:

95% reliability within a ±10% relative precision level and satisfy established industry sample design criteria.

400 quality assurance checks are required to achieve a 95% confidence rate with a ±10% overall error that the stray voltage tests were conducted in accordance with Company specifications.

Stray voltage was not found during any of this quality assurance.

Specification EO-10315 (Quality Assurance of the Stray Voltage and Periodic Distribution Structure Safety Inspection Programs) calls for 400 quality assurance checks to be performed on the contractor stray voltage testing. The quality assurance checks are randomly selected from a database of all stray voltage tests. The audit consists of a field test for stray voltage. Con Edison performed 400 quality assurance checks and no stray voltage was found during this quality assurance. Fifty-four quality assurance checks had data issues due to items such as incorrect address, structure cover type, etc, but no stray voltages were identified during the quality assurance process.

Additional Quality Assurance Measures Instituted
In addition to the Random Quality Assurance, Con Edison also identified several areas for further investigation to ensure compliance with the Safety Standards. These are called “No Access – Construction/Dumpster,” “No Access – Private Property (Locked Fence or Gate),” “No Access – Highway,” “No Access – Con Ed Property,” “No Access – Inside Building,” and “No Access – Buried Box.” The scope and results of each of this quality assurance is discussed below.

Work-in-Progress
Con Edison performed 586 work-in-progress to ensure the contractor was able read the Company’s Mains and Services (“M&S”) plates (on which the Company’s structures are identified and mapped), identify the underground structures in the field, and test the structure in accordance with EO-10129 (Operation of Low Voltage Detectors), including the pre-operational checks. These work-in-progress checks found one deficiency.

Structures with No Access
Contractors make two attempts to locate and test all structures. The contractors categorize each of the “No Access” structures based on the field conditions such as long-term construction, dumpster on structure, behind a locked fence or gate, etc. If after two attempts, the structure is still “Not Found”, the contractors label the structure as “NF”. Con Edison personnel made a third and sometimes, fourth attempt to locate and test the structure. There are several types of “No Access” structures. Each condition and the quality assurance efforts involved are described below. There are a total of 12,225 structures in these categories.

No Access – Construction/Dumpster
The contractors make two attempts to access and test all structures that are found not accessible due to construction activity or dumpsters. If a structure is inaccessible due to Construction Activity or Dumpster, then the name of construction Company, contact person, phone number and duration of construction activity or dumpster removal schedule (as denoted on the permit or posting) is required so as to facilitate a re-field of the structure. Company forces fielded any structure that could not be verified via the 2005 stray voltage testing results. There are 120 structures in this category.
No Access – Private Property (Locked Fence or Gate)
The contractors make two attempts to access and test all structures that are found not accessible due to the structure being on private property and behind a locked fence or gate. Con Edison personnel then examined Company records to verify that each structure is located on private property and is publicly inaccessible due to restricted access. Company forces fielded any structure that could not be verified via Company records and the 2005 stray voltage testing results. Company forces then obtained the address and the name of the building owner for the Company’s records. There are 744 structures in this category.

No Access – Highway
The contractors make one attempt to access and test all structures that are found not accessible due to a location on a major city/state/national highway and requires a special permit for access. The structure was not tested if the structure is located on a major city/state/national highway and requires a special permit for access. Contractors record these structures as a No Access due to NA-Highway, and record the name of the highway. Con Edison personnel verified against Company mapping records and the 2005 stray voltage testing results that the structures that are considered to be “Not Accessible to the Public”. There are 391 structures in this category.

No Access – Con Ed Property
Contractors are not required to test structures on Con Edison property that are behind locked fences or gates. Any structure that was tested in 2005 and is now inaccessible due to being on Con Ed property is verified. In each case, the name of the Company facility was recorded. There are 831 structures in this category.

No Access – Inside Building
Contractors make one attempt to access and test structures that are found not accessible due to their location inside a restricted area inside a building. Only transformer vaults should be inside a building – no manholes or service boxes. Company personnel verified that the structure was within a building. In each case, the address and building owner was recorded. There are 836 structures in this category.

No Access – Buried Box
A buried box is a structure that is below grade and requires excavation to access the structure. These buried boxes are not publicly accessible and do not require a stray voltage test. Contractors made two attempts to access and test these structures. There are 9,303 structures in this category.
**Stray Voltage Testing of Overhead Distribution Structures**

**Scope**
The PSC’s Safety Standards require that electric utilities must test “all electric facilities that are capable of conducting electricity and are publicly accessible.” There are 284,865 wooden poles on Con Edison’s distribution system. Conductive metallic attachments seven feet or less above grade on wooden poles are considered publicly accessible except for poles that are:

1. On private property and behind a locked fence or gate,\(^1\)
2. On a railroad,
3. On Con Edison property and behind a locked fence or gate, or
4. Inaccessible due to long-term construction.

Con Edison’s stray voltage testing procedures, EO-10358 and B-63, require stray voltage testing of all publicly accessible metallic attachments (≤7ft from grade) to a wood distribution pole with Con Edison facilities. A publicly accessible metallic attachment can belong to any party using the pole for attachments, such as, Con Edison, Verizon, fire departments, local departments of transportation, cable television companies, etc. These attachments include ground wires, riser pipes, anchor guys, pedestrian walk/don’t walk signals, fire call boxes, etc.

The overhead distribution structure stray voltage-testing program is managed in a SQL Sever Application. The application was created from an extract of the wooden poles contained in the Company’s corporate mapping system and the 2005 overhead distribution inventory. The database was given to the contractors to perform stray voltage testing. To ensure that all poles were included in the database, the contractors were instructed to follow a pole line even when the corporate map indicated that the line ended. The contractors utilized hand held computers to record the time and date and results of the stray voltage test. The data from the handheld was then uploaded to the database. Once uploaded, reports can be run, including:

1. Structures pending.
2. Structures complete.

Simultaneously with stray voltage testing, the contractors conducted an inventory and inspected the poles and attached equipment in Queens and all new poles in the remaining service territory.

**Overall Program**
The overhead distribution structure stray voltage testing began in March of 2006 and was completed in October. Con Edison’s contractor visited every Con Edison-owned pole, every Verizon-owned pole with Con Edison attachments, and third-party-owned poles with Con Edison attachments. The contractor utilized handheld computers to record the stray voltage test result, and inventory information. The contractor was directed to follow the pole line to the end, including secondary cables.

**Stray Voltage Test Procedure**
Con Edison developed a variety of specifications and procedures for its stray voltage-testing program. Specifications EO-5100, EO-100175, and EO-10129 govern the manufacture, purchase and operation of low voltage detectors. Bulletin 63 contains the stray voltage testing procedure used by Con Edison personnel. EO-10358 addresses the annual stray voltage-testing program that is conducted by

\(^1\) This does not include rear yard poles. These poles are considered publicly accessible.
In addition, EO-10360 was developed to troubleshoot streetlights correctly. The procedures described below are included in the Appendix.

**EO-5100 (Low Voltage Detectors - Stray Voltage)**
This specification details the requirements for the manufacture of low voltage detectors and associated test devices that are to be used for stray voltage testing, including materials, impact resistance, operating temperature range, voltage detection capabilities, and labeling.

**EO-100175 (Purchase Recommendation - Low Voltage Detectors for Stray Voltage)**
This purchase recommendation covers low voltage detectors and test devices for stray voltage testing. The specification currently identifies only the HD-LV-S-5 as an approved detector for AC stray voltage detection by Con Edison personnel or contractors.

**EO-10129 (Operation and Maintenance of Low Voltage Detector for Stray Voltage)**
This specification describes the step-by-step operation of the HD-LV-S-5 stray voltage detector. The specification includes pre-operational checks and prohibits using rubber gloves during testing.

**B-63 (Stray Voltage Testing Of Company Structures and Streetlights)**
This bulletin describes the equipment that must be tested in/on the overhead, underground, and URD systems, including testing of streetlights. The bulletin requires Con Edison personnel to test a structure and streetlight before working in/on the structure and again when work is completed for the day. The bulletin addresses direct current testing for structures that have both alternating current and direct current facilities. The bulletin addresses voltmeter verification of a stray voltage indication from the HD device, stray voltage reporting, and guarding of any facility or streetlight found with stray voltage.

**EO-10358 (Annual Contractor Stray Voltage Inspection Procedure)**
This specification describes the annual stray voltage testing that is performed by contractors. It describes how to test a Con Edison structure or streetlight, when to test a streetlight, what pole attachments need to be tested, data transfer requirements, and notification procedures in case a stray voltage is identified, and guarding of any facility or streetlight found with stray voltage.

**EO-10360 (Troubleshooting of Streetlights)**
This step-by-step procedure governs troubleshooting of underground streetlight services. The specification also requires load testing of the Con Edison supply cables to all streetlights worked on by Con Edison. The load test is necessary to determine if the Con Edison neutral cable is defective.

**Shunt Resistor**
Overhead lines are not shielded and can induce voltages on metallic surfaces. These voltages are normally not harmful, and they do not involve a failed component of the distribution system.

The HD stray voltage indicator and a digital voltmeter can falsely indicate a potentially harmful stray voltage condition in the presence of induced voltage.

A digital voltmeter’s very high input impedance is designed not to affect the circuit being tested. The design has the disadvantage of being unable to distinguish a stray voltage capable of delivering a harmful electric shock from an induced voltage with no current carrying capacity. A shunt resistor can be used in conjunction with the voltmeter to determine whether the voltage is produced by current (presenting the possibility for harm) or is induced (harmless).

We have developed a shunt resistor to be used in combination with the Fluke voltmeter when a potential stray voltage has been identified on the overhead system. The step-by-step procedure is described in the Appendix.
Training
Con Edison developed training for both Company employees and contractors on how to conduct stray voltage testing. All contractors and employees were trained on map reading, conducting stray voltage tests, reporting of stray voltages, and guarding structures found with stray voltage.

Company Employees
Company employees received on-the-job training (OJT) course number ELE0004 covering map reading, the pre-operational check of the HD stray voltage tester, voltmeter verification, reporting mechanisms, and guarding of structures or streetlights found with stray voltage. These employees conducted post-work and work-in-progress quality assurance of the contractors stray voltage testing.

Contractors
The management of the contractors was trained in a train-the-trainer format. The training included personal protective equipment, map reading, data recording, pre-operational check of the HD stray voltage tester, voltmeter verification, reporting mechanisms, use of the shunt resistor, and guarding of structures or streetlights found with stray voltage. In the case of the overhead stray voltage testing, the training also included identification of metallic pole attachments such as guy wires, riser pipes, ground rods, traffic signal equipment, etc.

The contractor managers then trained their field personnel in personal protective equipment, map reading, data recording, pre-operational check of the HD stray voltage tester, voltmeter verification, reporting mechanisms, use of the shunt resistor, and guarding of structures or streetlights found with stray voltage. During the course of the program, Company forces regularly met with the contractors for training to address any required corrections.

Results
Con Edison visited 284,865 Con Edison, Verizon, and third party-owned poles to determine if the pole contained publicly accessible metallic attachments that required a stray voltage test. Not all of these poles had a publicly accessible metallic attachment that required a stray voltage test. Of the 284,865 poles visited, 22 had an attachment with a stray voltage. Table 3 displays the 22 overhead stray voltages by Con Edison operating region.

<table>
<thead>
<tr>
<th>Borough</th>
<th>Stray Voltages Found</th>
<th>Detection Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brooklyn</td>
<td>0</td>
<td>0.000%</td>
</tr>
<tr>
<td>Queens</td>
<td>2</td>
<td>0.003%</td>
</tr>
<tr>
<td>Bronx</td>
<td>2</td>
<td>0.009%</td>
</tr>
<tr>
<td>Westchester</td>
<td>3</td>
<td>0.002%</td>
</tr>
<tr>
<td>Staten Island</td>
<td>15</td>
<td>0.030%</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>0.007%</td>
</tr>
</tbody>
</table>

Table 3 – Overhead Stray Voltages by Region
Table 4 displays the 22 overhead stray voltages by voltage level.

<table>
<thead>
<tr>
<th>Voltage Level</th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-8</td>
<td>8</td>
<td>36%</td>
</tr>
<tr>
<td>9-20</td>
<td>5</td>
<td>23%</td>
</tr>
<tr>
<td>21-50</td>
<td>4</td>
<td>18%</td>
</tr>
<tr>
<td>51+</td>
<td>5</td>
<td>23%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 4 – Overhead Stray Voltages by Voltage Level

In each of the 22 cases, the contractor reported the condition to Con Edison, guarded the site, and waited on location until relieved by Con Edison. Con Edison made each location safe before leaving the location. Each of the conditions, where the Company was responsible, was permanently repaired within 45 days. Parties other than Con Edison were responsible for 45.4% of the stray voltages.

There are 1,578 overhead poles that are inaccessible to the public due to their location on railroads, on private limited access property such as factories, and in construction zones. Con Edison’s contractor made at least two attempts to access each of these locations. In addition, Con Edison performed extensive quality assurance on these no-access categories. The details of this quality assurance are included in the next section of this report.

**Quality Assurance Measures Instituted**

There are 284,865 wooden pole structures within the Con Edison service territory. Con Edison developed a quality assurance plan to ensure that stray voltage testing was performed as specified. The reliability and error design parameters used were:

- **95% reliability within a ±10% relative precision level and satisfy established industry sample design criteria.**

400 randomly selected quality assurance checks are required to achieve a 95% confidence rate with a ±10% overall error that the stray voltage tests were conducted in accordance with Company specifications. In total Con Edison performed 400 randomly selected Quality Assurance checks of the overhead distribution structure-testing program.

- **Stray voltage was not found during any of this quality assurance.**

The quality assurance audit included a field and office component to provide verification. The 400 poles for quality assurance were randomly pre-selected prior to the start of the testing program. The contractors would periodically transfer testing data to the Con Edison server. The SQL application would then compare the data received to the list of the 400 randomly pre-selected poles for quality assurance checks. The poles were then audited soon after the data was received.

The person conducting the quality assurance check verified that the pole did in fact require a stray voltage test, performed a stray voltage test, and verified that the contractor indicated on the pole record that a stray voltage test was required. Con Edison performed 400 randomly selected quality assurance checks.
Additional Quality Assurance Measures Instituted
In addition, Con Edison identified several areas in which there was potential for an overhead structure to be missed during the annual stray voltage-testing program. These are called “Fringe Plates,” “No Access Poles,” “Not Found Poles,” and “Zero Pole Plates.” The scope and results of each of this quality is discussed below.

Work-in-Progress
Con Edison personnel performed work-in-progress checks as part of the ongoing training process to ensure the contractor was able read the M&S plate and identify the poles with Con Edison attachments. The contractor was required to identify the pole attachments and state which attachments required testing. The contractor then tested the attachments with the approved device and in accordance with EO-10129 (Operation of Low Voltage Detectors), including the pre-operational checks.

Fringe Plates
A fringe plate is an M&S plate covering a border of one of Con Edison’s six geographic regions. The border could abut another utility’s service territory or a body of water or could be the border between regions. These border areas may have very few poles that possibly could be missed by the Company forces responsible for mapping or by the contractor conducting the stray voltage testing. There are 1,885 fringe plates on the Con Ed system. The number of fringe plates increased as compared to the 2005 testing program because the Company undertook an exhaustive process to identify all fringe plates.

Con Edison performed a quality assurance audit of 30 of the 1,885 M&S plates selected on a random basis. The scope of work included field inspecting the entire plate and marking on the plate with a highlighter, to indicate all the wood poles found in the field. Quality assurance personnel then compared the marked up plate to the data submittal by the contractor to ensure all poles were tested.

No Access Poles
Poles that are in the database, field, and/or on the secondary map, but cannot be accessed to perform a stray voltage test are considered not to be accessible to the public. The Company requires the contractor to make two attempts to test the poles. Con Edison quality assurance personnel then verified all of the No Access conditions. There are several types of “No Access” structures. Each condition and the quality assurance efforts involved are described below. There are a total of 1,590 publicly inaccessible poles in these categories.

No Access – Private Property and Behind a Locked Fence or Gate
The contractors make two attempts to access and test all poles that are found not accessible. If a structure located on commercial property and is inaccessible due to a locked gate, the name of customer and address is required so as to facilitate a re-field of the structure. Company forces then attempt to access the structure by displaying their Company identification. There are 536 poles that remain inaccessible in this category.

No Access – Con Edison Property
Contractors make two attempts to access and test all poles that are found not accessible to the public because they are located on Con Edison’s property. The Company verified that each of the poles was behind a Company fence that limited access to the structure to authorized personnel only. In each case, the name of the Company facility was recorded. The verification process included verifying the testing status against the 2005 testing data and arbitrarily reviewing the M&S plates to confirm Con Edison property names. There are 367 poles in this category.

No Access – Railroad
The contractors make two attempts to access and test all poles that are found not accessible. A number of poles were found to be inaccessible due to location on railroad property. The
Company performed a quality assurance audit on these poles by reviewing Company records, conducting field visits, and verifying the testing status against the 2005 database. A total of 675 poles are inaccessible due to location on railroad property.

**No Access – Construction**
The contractors make two attempts to access and test all poles that are found not accessible. If a pole is inaccessible due to construction, the name of construction company, customer and address is obtained so as to facilitate a re-field of the structure. Company forces then attempted to access the pole by displaying their Company identification. There are 12 poles in this category.

**Not Found Poles**
Poles that are in the database and/or on the corporate map, but cannot be located in the field require two attempts by the contractor. Company forces then conducted a quality assurance checks of 30 of these poles selected on a random basis. Any pole not found after two contractor passes and the random quality assurance was verified against the 2005 database to confirm data error. Con Edison performed 30 quality assurance checks.

**Zero Pole Plates**
Based on secondary mapping data, there are 3,744 M&S plates that do not have poles (this does not include M&S plates for Manhattan which has no poles). Quality Assurance randomly selected 30 samples – to determine if there were any poles with Con Edison facilities that have not been mapped. The scope of work included driving the entire area encompassed by the plate to verify that the M&S plate has no publicly accessible wood poles with Con Edison attachments.
Stray Voltage Testing of Municipality Owned Streetlights

Scope
The Safety Standards require that electric utilities test all publicly accessible metallic pole streetlights and traffic signals (“streetlights”). Con Edison does not own or maintain the streetlights in its service territory (New York City and the County of Westchester). Metal pole streetlights are considered publicly accessible as long as the pole is located on a public thoroughfare (roadway) and is not:

1. On private property,
2. On a highway,
3. On a pier,
4. Inside a park,
5. On Con Ed property, or
6. Inaccessible due to long term construction

Con Edison’s stray voltage testing procedures, EO-10358 and B-63, require stray voltage testing of all publicly accessible metal pole streetlights. The scope of work did not require stray voltage testing of streetlights located on highways, piers, on private property such as parking lots, or inside parks. Metal poles located on the perimeter of the park adjacent to a roadway were tested. The stray voltage testing on all streetlights was performed at night.

The streetlight stray voltage-testing program data is maintained in an SQL Server Application. Con Edison maps only the streetlights that are directly fed by Con Edison structures. In many cases, however, the NYCDOT and the Westchester municipalities supply multiple streetlights or traffic signals from a common Con Edison service point. Approximately 30% of all publicly accessible streetlights that require stray voltage testing are not on Con Edison maps.

Con Edison does not own, install, or maintain streetlights within its service territory. The New York City Department of Transportation (NYCDOT) or Westchester municipalities own these streetlights. To manage stray voltage testing of streetlights, Con Edison directs its contractors to walk every street in the service territory and test all metallic streetlights. In addition, in 2005, Con Edison instituted a system wide inventory of all publicly accessible streetlights in combination with a stray voltage-testing program. The inventory included capturing the Global Positioning System (GPS) coordinates and installing a barcode tag on each of the publicly accessible streetlights. The system-wide inventory created in 2005 was utilized to develop the SQL Server application that was used in 2006.

Overall Program
The 2006 streetlight stray voltage-testing program began in April and was completed in October. Con Edison hired contractors to test all streetlights for stray voltage and scan the barcode of all publicly accessible streetlights. All data was captured using handheld computers and uploaded to a Con Edison server into the SQL Server application built for the streetlight testing.

Test Procedure
Con Edison developed a variety of specifications and procedures for its stray voltage-testing program. Specifications EO-5100, EO-100175, and EO-10129 govern the manufacture, purchase and operation of low voltage detectors. Bulletin 63 contains the stray voltage testing procedure used by Con Edison personnel. EO-10358 addresses the annual stray voltage-testing program that is conducted by contractors. In addition, EO-10360 was developed to troubleshoot streetlights correctly. The procedures described below are included in the Appendix.
**EO-5100 (Low Voltage Detectors - Stray Voltage)**
This specification details the requirements for the manufacture of low voltage detectors and associated test devices that are to be used for stray voltage testing, including materials, impact resistance, operating temperature range, voltage detection capabilities, and labeling.

**EO-100175 (Purchase Recommendation - Low Voltage Detectors for Stray Voltage)**
This purchase recommendation covers low voltage detectors and test devices for stray voltage testing. The specification currently identifies only the HD-LV-S-5 as an approved detector for AC stray voltage detection by Con Edison personnel or contractors.

**EO-10129 (Operation and Maintenance of Low Voltage Detector for Stray Voltage)**
This specification describes the step-by-step operation of the HD-LV-S-5 stray voltage detector. The specification includes pre-operational checks and prohibits using rubber gloves during testing.

**B-63 (Stray Voltage Testing Of Company Structures and Streetlights)**
This bulletin describes the equipment that must be tested in on the overhead, underground, and URD systems, including testing of streetlights. The bulletin requires Con Edison personnel to test a structure and streetlight before working in/on the structure and again when work is completed for the day. The bulletin addresses direct current testing for structures that have both alternating current and direct current facilities. The bulletin addresses voltmeter verification of a stray voltage indication from the HD device, stray voltage reporting, and guarding of any facility or streetlight found with stray voltage.

**EO-10358 (Annual Contractor Stray Voltage Inspection Procedure)**
This specification describes the annual stray voltage testing that is performed by contractors. It describes how to test a Con Edison structure or streetlight, when to test a streetlight, what pole attachments need to be tested, data transfer requirements, and notification procedures in case a stray voltage is identified, and guarding of any facility or streetlight found with stray voltage.

**EO-10360 (Troubleshooting of Streetlights)**
This step-by-step procedure governs troubleshooting of underground streetlight services. The specification requires load testing of the Con Edison supply cables of all streetlights worked on by Con Edison. The load test is necessary to determine if the Con Edison neutral cable is defective.

**Training**
Con Edison developed training for both Company employees and contractors on how to conduct stray voltage testing. Company employees were trained on map reading, conducting stray voltage tests, reporting of stray voltages, and guarding structures found with stray voltage. These employees conducted post-work and work-in-progress quality assurance of the contractors performing streetlight stray voltage testing.

The management of the contractors was trained in a train-the-trainer format. The training included personal protective equipment, map reading, pre-operational check of the HD stray voltage tester, voltmeter verification, reporting mechanisms, and guarding of structures or streetlights found with stray voltages.

The contractor managers then trained their field personnel in personal protective equipment, map reading, pre-operational check of the HD stray voltage tester, voltmeter verification, reporting mechanisms, and guarding of structures or streetlights found with stray voltage.
Results
Con Edison visited 176,883 NYC-DOT and local municipally owned streetlights to perform a stray voltage test. Of the 176,883 poles tested, 877 were found with a stray voltage. Table 5 displays the 877 streetlights with stray voltage by Con Edison operating region.

<table>
<thead>
<tr>
<th>Borough</th>
<th>Stray Voltages Found</th>
<th>Detection Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brooklyn</td>
<td>350</td>
<td>0.66%</td>
</tr>
<tr>
<td>Queens</td>
<td>124</td>
<td>0.24%</td>
</tr>
<tr>
<td>Manhattan</td>
<td>287</td>
<td>1.01%</td>
</tr>
<tr>
<td>Bronx</td>
<td>22</td>
<td>0.10%</td>
</tr>
<tr>
<td>Westchester</td>
<td>21</td>
<td>0.13%</td>
</tr>
<tr>
<td>Staten Island</td>
<td>73</td>
<td>0.94%</td>
</tr>
<tr>
<td>Total</td>
<td>877</td>
<td>0.50%</td>
</tr>
</tbody>
</table>

Table 5 – Streetlight Stray Voltages by Region

Table 6 displays the 877 streetlights with stray voltage by level voltage.

<table>
<thead>
<tr>
<th>Voltage Level</th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-8</td>
<td>363</td>
<td>41.39%</td>
</tr>
<tr>
<td>9-20</td>
<td>298</td>
<td>33.98%</td>
</tr>
<tr>
<td>21-50</td>
<td>161</td>
<td>18.36%</td>
</tr>
<tr>
<td>51+</td>
<td>55</td>
<td>6.27%</td>
</tr>
<tr>
<td>Total</td>
<td>877</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 6 – Streetlight Stray Voltages by Voltage Level

In each of the 877 cases of streetlight stray voltage, the contractor reported the condition to Con Edison, guarded the site, and waited on location until relieved by Con Edison. Con Edison made each location safe before leaving the location.

There are 156 streetlights that are inaccessible to the public due to location in long-term construction zones or restricted access security zones such as around Wall Street. Con Edison made at least two attempts to access each of these locations. In addition, Con Edison performed extensive quality assurance on No-access categories. The details of this quality assurance are included in the next section of this report.

Quality Assurance Measures Instituted
There are approximately 177,000 publicly accessible streetlights within Con Edison’s service territory. Con Edison developed a quality assurance plan to ensure the stray voltage testing was performed as specified. The reliability and error design parameters used were:

95% reliability within a ±10% relative precision level and satisfy established industry sample design criteria.

400 quality assurance checks are required to achieve a 95% confidence rate with a ±10% overall error that the stray voltage tests were conducted in accordance with Company specifications.
Stray voltage was not found during any of this quality assurance.

Con Edison personnel performed 400 randomly selected post work checks to verify that the contractor visited the streetlight to perform a stray voltage test. Con Edison personnel observed that the information regarding the streetlight stray voltage testing was valid. Con Edison personnel also performed a stray voltage test. All 400 quality assurance checks passed the quality assurance audit.

**Additional Quality Assurance Measures Instituted**

In addition, Con Edison identified several areas in which there was potential for a streetlight to be missed during the annual stray voltage-testing program. These are called “No Access Streetlights”, “Plates with Mapped Streetlights” and “Zero Streetlight Plates.” The scope and results of each of these quality checks will be discussed below.

**Work-in-Progress**

Streetlights must be tested at night when the entire streetlight circuit is energized. Nighttime testing exposes neutral problems on the utility side of the streetlight circuit that would not be apparent during daytime testing when the circuit is not on. Con Edison conducted 219 work in progress checks to ensure the stray voltage contractor was testing the streetlights at night and in accordance with the testing specifications. In all cases, the contractor was found to be using the appropriate test device and testing after dark.

**No Access Streetlights**

Most streetlights can be accessed for stray voltage testing. The testing contractors identified 156 streetlights where they did not have access to test the structure due to construction or restricted access. These streetlights are also considered inaccessible to the public. Con Edison performed a 100% quality assurance audit on no access streetlights.

**No Access - Construction**

The contractors made two attempts to access and test all streetlights that were found not accessible due to construction activity. Con Edison performed a quality assurance audit on 100% of these no access streetlights to verify the streetlights were inaccessible due to construction. There are 55 streetlights in this category.

**No Access – Restricted Access**

The contractors made two attempts to access and test all streetlights that are found not accessible. If a streetlight is inaccessible due to restricted access, such as security zones placed around Wall Street, Con Edison performed a quality assurance audit on 100% of these streetlights to ensure the streetlights were inaccessible due to restricted access zones. There are 101 streetlights in this category.

**Verification of Streetlight Plates Tested**

The stray voltage-testing contractor is required to test the streetlights on every street in Con Edison’s service territory. Con Edison does not map approximately 30% of the streetlights because Con Edison does not directly supply the streetlights. Con Edison randomly selected 30 completed M&S plates to ensure the contractor tested all streetlights on the plate.

**Zero Streetlight Plates**

The stray voltage-testing contractor is required to drive 100% of all M&S Plates that had no metal pole streetlights previously mapped on the M&S Plate to ensure that no streetlights had been installed on the street since the previous year's testing program. Con Edison randomly selected 30 M&S Plates designated as ‘Zero-Pole Plates’ to verify the accuracy of the reporting by the contractor.
Stray Voltage Repairs
In each of the 877 cases of streetlight stray voltage, the contractor reported the condition to Con Edison, guarded the site, and waited on location until relieved by Con Edison. Con Edison made each location safe before leaving the location. All but seven of the 877 stray voltages were permanently repaired within 45 days. Repairs of the other seven were made within 46 to 74 days. The repair of these seven streetlights was delayed because of permit issues, D-Faults within the Con Edison structure, and a customer problem.
Stray Voltage Testing of Overhead Transmission Facilities

Scope
The vast majority of overhead transmission structures are lattice steel structures or wood and steel poles located on right-of-way (ROW) that is either owned by Con Edison or on easements granted to Con Edison. Stray voltage testing was performed on 1,188 steel structures and 31 wood poles and associated guy wires using voltmeters in accordance with Con Edison specification CE-ES-1043. Con Edison personnel conducted this stray voltage testing at each tower in conjunction with the periodic ground patrol of the overhead transmission system. Testing did not indicate the presence of stray voltage at any location.

Overall Program
Stray voltage testing began in March and was completed in May. Trained Con Edison Transmission Line Maintenance (TLM) personnel tested all towers for stray voltage. The stray voltage tests were documented in a database where the structure number, date tested, employee name/number, and the test result were recorded.

Test Procedure
Con Edison developed a stray voltage testing procedure CE-ES-1043 (Procedure to Measure Stray Voltage of Overhead Transmission Structures) (see Appendix) to address stray voltage testing of overhead transmission facilities. This specification stipulates that all transmission towers, any guy wires connected to transmission towers or poles, and fences that enclose any tower or pole shall be tested for stray voltage every year. In addition, Company personnel will conduct stray voltage testing on transmission structures that are actively worked on each day. Each stray voltage test shall be recorded on the daily work record (Daily Crew Activity Report). This data will be transferred to an electronic database. Voltmeters are used for all stray voltage testing.

Shunt Resistor
Overhead lines are not shielded and can induce voltages on metallic surfaces. These voltages are normally not harmful, and they do not involve a failed component of the distribution system.

A digital voltmeter’s very high input impedance is designed not to affect the circuit being tested. The design has the disadvantage of being unable to distinguish a stray voltage capable of delivering a harmful electric shock from an induced voltage with no current carrying capacity. A shunt resistor can be used in conjunction with the voltmeter to determine whether the voltage is produced by current (presenting the possibility for harm) or is induced (harmless).

We have developed a shunt resistor to be used in combination with the Fluke voltmeter when a potential stray voltage has been identified on the overhead system. The step-by-step procedure is described in the Appendix.

Training
Company employees assigned to the Transmission Line Maintenance Section of the Transmission Operations Department perform the testing of overhead transmission structures. These employees have significant knowledge of the overhead transmission system and normally work on the transmission right-of-way (ROW), performing inspections and maintenance work. They are also experienced in the use of voltmeters, which were used to perform stray voltage testing on the ROW. They received on-the-job training for stray voltage testing via course number ELE0004. They also reviewed OP-420-3, Con Edison’s Overhead Transmission Line Ground Patrol Standard.

Results
Initial testing was performed on 1,188 steel structures and 31 wood poles and associated guy wires using voltmeters in accordance with Con Edison specification CE-ES-1043. There were 13 steel structures, 1 wood pole, and 1 guy wire where measurements yielded greater than 1 volt. Measurements at these
locations ranged between 1.0 volts and 2.8 volts. Inspection of these locations did not reveal any improper conditions that could contribute to stray voltage; therefore no corrective action was required. The presence of voltage readings in the ranges referenced is considered to be induction consistent with the normal operation of the high voltage overhead transmission system.

**Quality Assurance Measures Instituted**

In accordance with CE-ES-1043, a planner in TLM, who has knowledge and expertise in overhead transmission, but who did not perform or directly supervise the stray voltage testing, conducted fifty QA inspections at locations on various transmission lines.

> Stray voltage was not found during any of this quality assurance.

The QA checks performed confirmed the accuracy of the results from the stray voltage-testing program.

**No Access Tower**

Of the 1,188 steel structures mentioned above, one tower exists in a major wetland and remained inaccessible after multiple attempts. This tower is considered inaccessible to the public.
Stray Voltage Testing of Underground Transmission Facilities

Scope
There are approximately 1,700 underground transmission facilities throughout the Con Edison service territory. Qualified contractors performed the stray voltage testing on publicly accessible transmission manhole covers in the five boroughs of New York City and Westchester County. Publicly inaccessible structures, defined as being behind a locked gate/fence or inside a substation, were not tested for stray voltage.

Overall Program
The underground transmission stray voltage testing began in August and was completed in November. The testing was performed primarily by qualified contractors, with Company personnel performing the stray voltage testing on those facilities that could not be located by the contractor. The contractors were provided with a list of all underground transmission structures. The list was generated by extracting data from Transmission Operations’ work management system (MAXIMO). The contractor fielded the structure location, tested the location for stray voltage, and documented the results of the test on the list for submission to Con Edison.

Test Procedure
Con Edison developed three specifications that govern the manufacture, purchase and operation of low voltage detectors – EO-5100, EO-100175, and EO-10129. Bulletin 63 was developed to address the stray voltage testing procedure by Con Edison personnel. EO-10358 covers the annual stray voltage-testing program that is conducted by contractors. The procedures described below are included in the Appendix.

EO-5100 (Low Voltage Detectors - Stray Voltage)
This specification details the requirements for the manufacture of low voltage detectors and associated test devices that are to be used for stray voltage testing.

EO-100175 (Purchase Recommendation - Low Voltage Detectors for Stray Voltage)
This purchase recommendation covers low voltage detectors and test devices for stray voltage testing. The specification approves only the HD-LV-S-5 as the approved detector for AC stray voltage detection.

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B-63 (Stray Voltage Testing Of Company Structures and Streetlights)
This bulletin describes the equipment that must be tested in on the overhead, underground, and URD systems.

EO-10358 (Annual Contractor Stray Voltage Inspection Procedure)
This specification describes the annual stray voltage testing performed by qualified contractors.

Training
Con Edison developed training for both Company employees and contractors on how to conduct stray voltage testing. Training topics included map reading, conducting stray voltage tests, reporting of stray voltage, and guarding of structures if stray voltage found.

Company Employees
Company employees received on the job training (OJT) developed by Transmission Operations. They received training in the pre-operational check of the HD stray voltage tester, voltmeter verification, reporting mechanisms, and guarding of structures found with stray voltages.
Contractors
The management of the contractors were trained in a train-the-trainer format by SSA and the EH&S section of Construction Management. The training included personal protective equipment, map reading, pre-operational check of the HD stray voltage tester, voltmeter verification, reporting mechanisms, and guarding of structures or streetlights found with stray voltages. The contractor managers then trained their field personnel in personal protective equipment, map reading, pre-operational check of the HD stray voltage tester, voltmeter verification, reporting mechanisms, and guarding of structures or streetlights found with stray voltages.

Results
There are 1,729 underground transmission facilities throughout the Con Edison territory. The test results did not indicate any presence of stray voltage on any of the underground transmission structures.

Quality Assurance Measures
Con Edison performed several types of quality assurance on the underground transmission stray voltage-testing program. Contractors performed the stray voltage testing of underground transmission facilities. These contractors, who also performed testing on underground distribution structures, were subject to field by Underground Transmission personnel to ensure the contractor was able read the Company’s maps (on which the Company’s structures are identified), identify the underground structures in the field, and test the structure in accordance with EO-10129 (Operation of Low Voltage Detectors), including the pre-operational checks. These work-in-progress checks found no deficiencies.

Underground Transmission personnel also performed checks at 30 locations following stray voltage testing. The QA checks performed confirmed the accuracy of the results from the stray voltage-testing program.

- Stray voltage was not found during any of this quality assurance.

Additional Quality Assurance Measures Instituted
Contractors make two separate attempts to locate and test all underground structures. If the contractor could not find the structure after the initial two attempts, Con Edison Construction Management personnel would then make a third attempt to locate that structure. Listed below are the categories for structures inaccessible to the public.

No Access – Private Property
There are a total of 8 structures in this category. These structures are considered inaccessible to the public.

No Access – Buried
There are a total of 3 structures in this category. These structures are considered inaccessible to the public.

No Access – Con Ed Property
There are a total of 402 structures in this category. While most of the structures are located on Con Edison property, some are located adjacent to Con Edison properties on streets that have been closed to the public for security reasons. All of these structures are secured from the public via fencing or other barriers and are inaccessible to the public.
Stray Voltage Testing of Substation Facilities

Scope
The PSC’s Safety Standards require that electric utilities test “all electric facilities that are capable of conducting electricity and are publicly accessible.” The PSC’s “Order Issuing Safety Standards,” issued January 5, 2005, requires that substation fences be tested for stray voltage. There are 92 transmission switching and area substations on 61 separate sites that require perimeter stray voltage testing. Three other substations are located within larger Con Edison properties, and the exterior fences of those substations are not publicly accessible. The perimeters of all 61 of these sites were tested for stray voltage. This section describes the stray voltage testing, quality assurance, and training for transmission and substation facilities.

Overall Program
Perimeter fencing including other electrical conductive materials accessible to the public, of sixty-one (61) substation sites in the five boroughs of New York City and Westchester were tested for stray voltages during the months of July through September 2005. Qualified substation mechanics and supervisors performed the stray voltage testing. All stray voltage tests were recorded in MAXIMO, the work management system that is used by Substation Operations to track tests, inspections and required repairs. Table 7 shows the count of substation and PURS facility sites by region. Some sites contain more than one substation.

<table>
<thead>
<tr>
<th>Region</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brooklyn</td>
<td>9</td>
</tr>
<tr>
<td>Queens</td>
<td>5</td>
</tr>
<tr>
<td>Manhattan</td>
<td>20</td>
</tr>
<tr>
<td>Bronx</td>
<td>4</td>
</tr>
<tr>
<td>Westchester</td>
<td>17</td>
</tr>
<tr>
<td>Staten Island</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
</tr>
</tbody>
</table>

*Table 7 – Substations Count by Region*

Test Procedure
Substations Operations Procedure 0800-0038/00 (Substations Stray Voltage Testing And Station Inspection) requires testing for electric potential (voltage testing) on steel, aluminum or other electrical conducting materials on substation perimeters where such materials are accessible to the general public. These materials include but are not limited to fences, doors, roll-up gates, metallic delivery boxes, dielectric fluid delivery ports, and Siamese connections that may become energized as a result of stray voltage.

Stray voltage testing is performed on perimeter fencing and other electrical conductive materials of substations where such materials are accessible to the general public. The surface of electrical conductive materials on all station perimeters will be tested annually using an approved tester (i.e., glow, no glow). The direct contact low voltage tester (HD LV-S-5) detects voltages above 5 volts (indicated by a glow of the device). If the device glows, a fluke meter will be used to obtain a numerical reading. If there is any voltage reading (above 0 volts), then the location shall be guarded until the voltage is eliminated (temporary grounding may be used). Permanent repairs will be made within 45 days. All fence lines, entrance doors, transformer vault enclosures and any metal exterior trimmings, which have the potential to conduct electricity and are accessible to the public, must be tested once during each 12-month period ending November 30. Qualified Con Edison personnel performed all stray voltage testing.

Con Edison developed three specifications that govern the manufacture, purchase and operation of low voltage detectors – EO-5100, EO-100175, and EO-10129. Bulletin 63 was developed to address the stray voltage testing procedure by Con Edison personnel. The procedures described below are included in the Appendix.
**EO-5100 (Low Voltage Detectors - Stray Voltage)**
This specification details the requirements for the manufacture of low voltage detectors and associated test devices that are to be used for stray voltage testing, such as materials, impact resistance, operating temperature range, voltage detection capabilities, and labeling.

**EO-100175 (Purchase Recommendation - Low Voltage Detectors for Stray Voltage)**
This purchase recommendation covers low voltage detectors and test devices for stray voltage testing. The specification approves only the HD-LV-S-5 as the approved detector for AC stray voltage detection by Con Edison personnel or contractors.

**EO-10129 (Operation and Maintenance of Low Voltage Detector for Stray Voltage)**
This specification describes the step-by-step operation of the HD-LV-S-5 stray voltage detector. The specification includes pre-operational checks and not using rubber gloves during testing.

**Training**
Employees are trained and demonstrate the ability to perform Stray Voltage Testing following Company specifications and safety procedures through training module CSG0020 (Stray Voltage Training & Testing SSO). The training includes the reasons for stray voltage tests, PSC Case 04-M-0159 information, safety concerns and conditions, personnel protective equipment, stray voltage testing, and program administration.

**Results**
There were no stray voltages on any of the 61 site perimeters.

**Quality Assurance Measures**
Substations Operations MAXIMO group performed quality assurance for the substation stray voltage-testing program. The quality assurance consisted of a documents search, records review, as well as physical stray voltage testing. Separate records were created for each quality assurance audit.

Stray voltage testing quality assurance was performed at 9 sites, consisting of two locations in the Bronx, one in Brooklyn, two in Manhattan, two in Queens and two in Westchester.

*Stray voltage was not found during any of this quality assurance.*

The QA checks performed confirmed the accuracy of the results from the stray voltage-testing program.
Stray Voltage Testing of Unit Substation Facilities

Scope
The PSC’s Safety Standards require that electric utilities must test “all electric facilities that are capable of conducting electricity and are publicly accessible.” There are 230 multi-bank and unit substations in the Con Edison service territory. All of these stations were tested for stray voltage. This section describes the stray voltage testing, quality assurance, and training for unit-substation facilities.

Overall Program
Metal fence and gates of 230 publicly accessible unit substations in the five boroughs of New York City (less Manhattan) and Westchester were tested for stray voltages during the months between August and October. The test results did not indicate any presence of stray voltages. Qualified Con Edison personnel performed all stray voltage testing. The stray voltage test date, result and employee number of the person who performed the test was recorded in an Access database.

Test Procedure
Every other fence post and the entire gate were tested with a HD Electric LV-S-5 direct contact low voltage detector. The tester shall make contact with the fence posts and gates to determine if stray voltage is present. If the tester light glows, indicating the presence of stray voltage, the stray voltage should be measured utilizing a Fluke 77/177 or equivalent multi-meter. The voltage reading is recorded in the database. The common lead of the multi-meter should be attached to a good ground source. The bare neutral bus or lead of the unit substation transformer can be considered a good ground source.

Con Edison developed three specifications that govern the manufacture, purchase and operation of low voltage detectors – EO-5100, EO-100175, and EO-10129. The procedures described below are included in the Appendix.

EO-5100 (Low Voltage Detectors - Stray Voltage)
This specification details the requirements for the manufacture of low voltage detectors and associated test devices that are to be used for stray voltage testing, such as materials, impact resistance, operating temperature range, voltage detection capabilities, and labeling.

EO-100175 (Purchase Recommendation - Low Voltage Detectors for Stray Voltage)
This purchase recommendation covers low voltage detectors and test devices for stray voltage testing. The specification approves only the HD-LV-S-5 as the approved detector for AC stray voltage detection by Con Edison personnel or contractors.

EO-10129 (Operation and Maintenance of Low Voltage Detector for Stray Voltage)
This specification describes the step-by-step operation of the HD-LV-S-5 stray voltage detector. The specification includes pre-operational checks and not using rubber gloves during testing.

Training
Con Edison developed training for Company employees on how to conduct stray voltage testing. All employees were trained on map reading, conducting stray voltage tests, reporting of stray voltages, and guarding stray voltages as part of their career path training or on the job training.

Company employees received on the job training (OJT). The Company employees received training in the pre-operational check of the HD stray voltage tester, voltmeter verification, reporting mechanisms, and guarding of structures or streetlights found with stray voltages.

Results
All 230 unit substations were tested for stray voltage, and no stray voltage was identified.
Quality Assurance Measures
Distribution Engineering performed a quality assurance on a randomly selected sample of 30 of the unit substations.

Stray voltage was not found during any of this quality assurance.

The QA checks performed confirmed the accuracy of the results from the stray voltage-testing program. These quality assurance checks were performed as post work.
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Part Two – Additional Stray Voltage Detection

2006 Stray Voltage Detection and Electric Facility Inspection Report
Additional Stray Voltage Detection

Mobile Stray Voltage Detector

The Mobile Stray Voltage Detector (SVD) is a former Research and Development project that has moved into full implementation. The SVD is a truck mounted device that employs a three dimensional antenna to sense unshielded sources of electricity from approximately 20 ft away. (See Figure 1) When the SVD alarms, the operator can rewind video on the onboard laptop that are connected to side mounted cameras. The operator can then identify potential stray voltage sources by comparing the video to the level of the alarm. The operator then performs manual testing on all objects in the vicinity of the potential stray voltage source to pinpoint the object with stray voltage.

The SVD enables Con Edison to perform multiple scans of geographic areas in much shorter time frames than manual testing. The SVD has the distinct advantage of not having to make direct contact with something to test it for stray voltage; therefore, the SVD has identified stray voltage on objects such as scaffolds that would not be tested in the manual testing program. Table 8 displays the number of stray voltage identified on objects that are not part of the manual testing program.

<table>
<thead>
<tr>
<th>Stray Voltage Location</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sidewalk</td>
<td>28</td>
</tr>
<tr>
<td>Scaffolding</td>
<td>27</td>
</tr>
<tr>
<td>Fence/Gate/Awning</td>
<td>16</td>
</tr>
<tr>
<td>Bus Shelter</td>
<td>16</td>
</tr>
<tr>
<td>Non Con Ed Structure</td>
<td>8</td>
</tr>
<tr>
<td>Fire Hydrant</td>
<td>6</td>
</tr>
<tr>
<td>Phone Booth</td>
<td>4</td>
</tr>
<tr>
<td>Customer Equipment</td>
<td>2</td>
</tr>
<tr>
<td>Standpipe/Water Pipe</td>
<td>2</td>
</tr>
<tr>
<td>Gas Pipe</td>
<td>1</td>
</tr>
<tr>
<td>Mail Box</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>111</strong></td>
</tr>
</tbody>
</table>

*Table 8 – SVD Stray Voltage Reports on Non Con Ed Equipment*

Con Edison has tripled its fleet and intends to perform multiple testing cycles per year with the SVD. In addition, Con Edison will increase mobile testing following winter storms.
Routine Work Stray Voltage Testing
Con Edison developed Bulletin 63 and revised Corporate Safety Procedure (CSP) 17.01 to address the stray voltage testing procedure by Con Edison personnel. Bulletin 63 describes the equipment that must be tested in on the overhead, underground, and URD systems. The specification also includes testing of streetlights. The bulletin requires Con Edison personnel to test a structure and streetlight before working in/on the structure and again when work is completed for the day. The bulletin addresses direct current testing for structures that have both alternating current and direct current facilities. The bulletin addresses voltmeter verification of a stray voltage indication from the HD device, stray voltage reporting, and guarding of any facility or streetlight found with stray voltage. Bulletin 63 and CSP 17.01 are included in the Appendix.

The stray voltage testing as part of routine work in an underground structure is entered onto the employee’s Daily Crew Activity Report. Con Edison clerical personnel then enter this information into the Stray Voltage Log. From 12/1/05 until 11/30/06, Con Edison personnel have performed 182,001 routine entry stray voltage tests, in addition to the annual testing program. Con Edison employees identified 138 stray voltages. These stray voltages are associated with routine entry and exit from a Con Edison structure or work on streetlights. Table 9 shows responsibility breakdown of each of the 138 energized equipment reports by Con Edison personnel. Con Edison does not electronically capture routine stray voltage tests of overhead distribution, overhead transmission, and substations at this time. Con Edison is currently developing an inspection system that is planned to begin rollout in 2007. This inspection system can capture routine stray voltage tests of overhead distribution facilities.

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Con Ed</td>
<td>106</td>
<td>76.81%</td>
</tr>
<tr>
<td>Non-Con Ed</td>
<td>32</td>
<td>23.19%</td>
</tr>
<tr>
<td>Total</td>
<td>138</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Table 9 – Stray Voltage Reports by Con Edison Personnel*

Reports from the Public
During the period of 12/1/05 through 11/30/06, Con Edison received 245 calls from the public of confirmed energized equipment and electric shocks. The breakdown appears in Table 10.

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Con Ed</td>
<td>124</td>
<td>50.61%</td>
</tr>
<tr>
<td>Non-Con Ed</td>
<td>121</td>
<td>49.39%</td>
</tr>
<tr>
<td>Total</td>
<td>245</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Table 10 – Stray Voltage Reports by the Public*
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Part Three – 2006 Facility Inspection Program

2006 Stray Voltage Detection and Electric Facility Inspection Report
Facility Inspection Procedures

Introduction
On January 5, 2005, the Public Service Commission (PSC) issued its “Order Instituting Safety Standards” in Case 04-M-0159. The Safety Standards require that electric utilities develop a program to inspect all of their electric facilities once every five years.

To comply with the Safety Standards, Con Edison developed and implemented an inspection program for each of six systems that encompass all its electric distribution, transmission, and substation facilities. The six systems are underground distribution, overhead distribution, underground transmission, overhead transmission, unit substations, and large substations/PURS facilities. Each inspection program is described in detail in the following pages.

The Safety Standards require that electric utilities inspect all electric facilities over a five-year cycle. To achieve this goal, the Safety Standards provide for a ramp up of inspections over the four-year period from 2005 through 2009. The second year (12 months ended November 30, 2006) performance target is 90% of 1/5 of all electric structures. The Company has completed inspections of 100% of overhead distribution, 33% of underground distribution, 100% of overhead transmission, 66% of underground transmission, 43% of substations and PURS facilities, and 100% of unit substations. Overall, Con Edison has inspected 67% of its transmission, distribution, and substation facilities as of November 30, 2006. Table 11 displays the population and inspection status of each of the facility inspection programs.

<table>
<thead>
<tr>
<th>Facility Inspection Program</th>
<th>Facilities</th>
<th>Completed</th>
<th>Percent Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution – Underground</td>
<td>273,743</td>
<td>89,796</td>
<td>33%</td>
</tr>
<tr>
<td>Distribution – Overhead</td>
<td>284,865</td>
<td>284,865</td>
<td>100% - Completed in 2005</td>
</tr>
<tr>
<td>Transmission - Underground</td>
<td>1,729</td>
<td>1,135</td>
<td>66%</td>
</tr>
<tr>
<td>Transmission - Overhead</td>
<td>1,219</td>
<td>1,219</td>
<td>100% - Completed in 2005</td>
</tr>
<tr>
<td>Substations</td>
<td>95</td>
<td>41</td>
<td>43% SS and PURS</td>
</tr>
<tr>
<td>PURS facilities (see SS)</td>
<td>11</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Unit Substations</td>
<td>230</td>
<td>230</td>
<td>100% - Completed in 2005</td>
</tr>
<tr>
<td>Total</td>
<td>561,892</td>
<td>377,291</td>
<td>67%</td>
</tr>
</tbody>
</table>

Table 11 – All Facility Inspection Programs (to November 30, 2006)
Facility Inspections of Underground Distribution Structures Including URD

Scope
Underground distribution structures include manholes, service boxes, and transformer vaults associated with the network system. Underground distribution structures also include the splice boxes, pad mount transformers, and silo transformers of the underground residential distribution ("URD") system, and any manholes, service boxes and transformer vaults that are fed from the overhead system. There are about 274,000 underground distribution structures on the Con Edison system.

Company specification EO-10359 (see Appendix) outlines the scope of the inspection, inspection cycle, reporting and repairs associated with the underground inspection program. All structures will be inspected on a minimum of a five-year cycle. The inspections include stray voltage testing. Any stray voltage conditions and conditions that could support stray voltage, such as open secondary ends and cable contact with metallic covers or frames, are corrected immediately.

Procedure
Facility inspections are performed by qualified Con Edison field personnel that have been trained to perform inspections and have the operating experience required to make necessary repairs that are identified during the inspection. Specification EO-10359 requires that the employee inspect the outside of the structure for tripping hazards, such as, cover damage and variance from street grade. The employee then tests the cover for stray voltage, removes the cover, enters the structure, and visually inspects all cables and connections. The employee tests all lead sheath secondary and service conductors and all accessible metallic ducts for stray voltage. The results of the underground inspection are entered into a database to track the status of the inspections over the five-year cycle and to track the repairs that are identified.

Results

Tracking Inspections
There are approximately 274,000 underground distribution structures, including URD, in Con Edison’s distribution system. During the 12 months ended November 30, 2006, Con Edison has performed 163,206 inspections of 89,796 unique underground structures.

Company inspectors fill out an inspection form (see Figure 2) that is then entered into the Company’s Stray Voltage Log, a web-based inspection application to track the status of underground inspections.

---

2 Atmospheric testing is required for any entry into a subsurface structure.
3 The Inspection portion of the Stray Voltage Log will be replaced with a more advanced inspection system in 2007.
Repairs
Required repairs resulting from underground inspection are also recorded in the Stray Voltage Log. These repairs are classified in three categories:

- **Tier 1 – Repair immediately.**
- **Tier 1 – Schedule for follow-up repairs.**
- **Tier 2 – Replace as part of the Secondary Rebuild Program.**

The category “Tier 1 – Repair Immediately" includes stray voltage, cable in contact with cover, and open secondary ends. Each of these cases is a public safety concern and is repaired at the time of discovery.

The category “Tier 1 – Schedule for follow-up repairs" includes damaged neutral cables and connections, defective sump pumps, and damage to the structure cover. These repair items can be initiated at the time of discovery or scheduled for a follow-up repair.

The category “Tier 2 – Replace as part of the Secondary Rebuild Program” is used to identify items such as secondary main replacement, service replacement, and structure conductor upgrades (SCU). These items are capital improvements to the secondary system that will be scheduled and prioritized based on the overall performance of all structures on the associated M&S plate.

**Quality Assurance Measures Instituted**
SSA created a quality assurance program, EO-10315 (Quality Assurance of the Stray Voltage and Periodic Distribution Structure Safety Inspection Programs), to ensure that the underground structure inspections are performed in accordance with the Safety Standards and Con Edison’s specifications. The reliability and error design parameters used were:

- **95% reliability within a ±10% relative precision level and satisfy established industry sample design criteria.**

400 quality assurance checks are required to achieve a 95% confidence rate with a ±10% overall error that the inspections were conducted in accordance with Company specifications. In total, Con Edison performed 440 quality assurance checks of the underground inspections program, well above the 400 required for a 95% confidence rate.

**Random Quality Assurance – Underground Inspections**
The “Random Quality Assurance – Underground Inspections” are of completed inspections. Con Edison employees from the regional quality assurance sections conduct the quality assurance for each of the Company’s operating regions. These employees are experienced cable splicers and mechanics that have been trained in the facility inspection and the quality assurance specifications.

The completed inspections chosen for audit were randomly selected from facility inspections completed during the prior week. The quality assurance personnel performed a complete inspection of the selected facilities and compared the results to the inspection performed the previous week. Deficiencies identified during quality assurance have been communicated to field crew supervisors who have been required to reinforce inspection procedures with field crews.

**Work in Progress – Underground Inspections**
In addition to the 440 post-work checks, quality assurance personnel performed 31 work-in-progress quality assurance inspections for the underground structure inspection program. The scope of the audit includes meeting a field crew on location, having the crew demonstrate its understanding of the inspection requirements by performing the inspection and completing the inspection form (see Figure...
2.) The quality assurance personnel then give feedback to the employees on their performance and record keeping. Each of these work-in-progress checks is recorded as an on-the-job training session.

**Training**

Training for the underground structure inspection program began in December of 2004. The managers of the Secondary System Analysis section of Distribution Engineering conducted train-the-trainer sessions in each of the major workout locations. The participants included the managers, planners, and supervisors of the crews that would be performing the inspections. UG Inspection training continued through the 2006 UG Inspection program. The Secondary System Analysis Team conducted various training seminars at all of the major work out locations which included the following topics:

- The January 2004 stray voltage fatality
- The PSC Safety Standards
- Scope of the inspection
- Completing the inspection form
- Data Entry Process
- Status of inspections to annual goal
- Repairs pending
- Accounting of the inspection
- Performance mechanism
- Secondary rebuild program
- Visual Secondary Targeting (VST)
- Laptop Program (increases data entry efficiency)

The training process will continue as needed and various quality checks (field visits) were performed during 2006. This is to ensure consistency Company wide. Ongoing training presentations have included quality assurance inspection findings.
Facility Inspections of Overhead Distribution Structures

Scope
Overhead distribution structures, i.e., poles and pole-mounted equipment, are associated with both the non-network and network system. Con Edison or Verizon generally owns the poles, with a small subset owned by individual customers. In 2005, Con Edison has conducted a complete inventory of all poles and their corresponding attachments to facilitate stray voltage testing and facility inspections. There are 284,865 poles on the Con Edison system. All of these poles and attachments will be inspected on a minimum of a five-year cycle.

Procedure
The inspection of overhead distribution structures is detailed in the contractor request for proposal (RFP) and specification EO-10358. The RFP outlines the scope of the inspection, the five-year inspection cycle, reporting and repairs associated with the inspection.

Contractors performed the overhead facility inspections. The facility inspection is a visual inspection that is performed from the ground. The inspection entails observing the pole for obvious structural defects such as large cracks or splits. The contractor then observes the pole guys, the aerial cable and joints, and the pole equipment (crossarms, pin insulators, braces, transformers, reclosers, regulators, capacitor banks, sectionalizers, surge arresters and their connections, switches, tie wires, secondary racks, wildlife protectors, riser cable straps, tree molding, ground wire connections) for defects. The contractor also observes if there is limited vegetation clearance.

Results
The results of the overhead inspection are entered into a database to track the status of the inspections over the five-year cycle and to track the repairs required. There are 284,865 overhead distribution poles with Con Edison equipment attachments. Con Edison inspected 100% of its overhead distribution facilities in 2005.
Facility Inspections of Overhead Transmission Structures

Scope
Con Edison personnel from its Transmission Line Maintenance ("TLM") organization conducted inspections of the Company’s population of 1,219 overhead transmission towers and poles in accordance with Con Edison procedure OP-420-3, Con Edison’s Overhead Transmission Line Ground Patrol Standard (see Appendix). OP-420-3 defines the requirements of the ground patrol. All major components of the overhead system including right-of-way, structures, and conductors/shield wires were inspected during the ground patrol inspections. The towers and poles and their surrounding fences were tested for stray voltage during the ground patrols. Reported conditions are maintained in a database and addressed in accordance with Con Edison’s established maintenance programs.

Procedure
Con Edison procedure OP-420-3 was revised to meet the requirements of the Safety Standards. Overhead transmission towers are ordinarily inspected by ground patrol twice a year – once in the spring and a second time in the fall. The spring patrol assesses damage to facilities, rights-of-way, and access roads caused during the winter and spring runoff. The fall patrol ensures the lines are in proper condition to withstand winter storms. Con Edison transmission line maintenance employees perform these inspections.

The inspection consists of a visual evaluation from the ground to evaluate encroachment of the right-of-way, access roads damage, structural damage to the tower such as bent or broken supporting members, bird nests, defective grounding, damaged conductors, damaged insulators, vegetation clearance, etc.

Results
The results of the overhead transmission inspections are entered into a database to track the status of the inspections and required repairs. There are 1,219 overhead transmission facilities. Con Edison inspected 100% of its overhead transmission facilities in 2005.
Facility Inspections of Underground Transmission Structures

Scope
The 1,729 underground transmission manholes are inspected by Con Edison personnel in accordance with Company specification CE-SS-6830 (Low and Medium Feeder Pressure Periodic Inspection Procedure) and CE-SS-6045 (Inspection and Preventive Maintenance and Stray Voltage Testing of Pipe Type Cable Systems) depending on the type of facility being inspected. This specification outlines the scope of the inspection, inspection cycle, reporting and repairs associated with the inspection. Con Edison inspected 1,135 of the 1,729 underground transmission manholes by the year ended November 30, 2006.

Procedure
Facilities associated with pipe type cable system are inspected in accordance with Con Edison specification CE-SS-6045. This specification states the inspection criteria applicable to such facilities, and provides a summary of the inspection process. These inspections include, but are not limited to, the following facilities:

- Manholes (Splice, Diffusion Chamber and Clean Out etc.)
- Joints (Normal Joint, Semi-Stop joint, Full Stop Joint (including circulation line valve))
- Potheads
- Risers and exposed pipe sections on bridges
- Risers and exposed pipe sections in tunnels
- Valve Boxes, Vent Chambers, Freeze Pits and Thermal Probe Pits

Facilities associated with low and medium pressure fluid filled cable system are inspected in accordance with Con Edison specification CE-SS-6830. This specification states the inspection criteria applicable to such facilities, and provides a summary of the inspection process. These inspections include, but are not limited to, the following facilities:

- Manholes
- Joints
- Potheads
- Reservoirs
- Reservoir alarm relays
- Bonds

Results
Con Edison inspected 1,135 of the 1,729 underground transmission manholes by the year ended November 30, 2006. The results of the underground transmission inspection are entered into the work management system (MAXIMO) to track the status of the inspections and required repairs.

Tracking Inspections
Inspection results are recorded on a form detailed in the referenced specifications, and entered into the work management system (MAXIMO). Each MAXIMO record includes the date of the inspection, defects identified, and the inspector's name. This database is also used to track the required repairs.
Repairs
The repair work is prioritized and corrective maintenance is performed accordingly. For example, emergency work (e.g. leaking pipe) is performed immediately, and low priority work (e.g. missing feeder tag) is performed on a routine basis.

Quality Assurance Measures Instituted
Company specifications CE-SS-6830 (Low and Medium Feeder Pressure Periodic Inspection Procedure) and CE-SS-6045 (Inspection and Preventive Maintenance and Stray Voltage Testing of Pipe Type Cable Systems) require that quality assurance inspections of randomly selected transmission manholes be performed. These randomly selected manholes are re-inspected or re-tested by trained and knowledgeable employees who did not perform or directly supervise this work. In accordance with these specifications, five low/medium pressure cable system transmission manholes and 12 pipe type cable system transmission manholes were re-inspected in 2006, with results entered into the work management system (MAXIMO).

The quality assurance inspections yielded results indicating that the original inspections were performed in accordance with the applicable specifications.

Training
All Transmission Operations personnel who perform these inspections are familiar with the infrastructure and regularly perform tasks to install, maintain, and repair the underground transmission system. They are trained in the inspection protocols through career path training. This training is refreshed as required.
Facility Inspections of Substations

Scope
Inspections of Con Edison’s 95 substations and 14 public utility regulatory station (PURS) facilities are performed in accordance with the Company’s Substations Operations (SSO) procedure 0800-0038/00, Substations Stray Voltage Testing and Station Inspection (see Appendix). This procedure defines the requirements for substation and PURS facility inspections. (A PURS facility regulates the temperature of fluids used for cooling pipe-type transmission feeders.)

Procedure
The procedure entails a careful visual safety and reliability examination of substation and PURS cooling plant equipment for conditions that have the potential to cause or lead to safety hazards or failure of the equipment. Qualified substation personnel perform these inspections. All equipment in a substation or PURS cooling plant will be inspected by visual examination once every five years, and at least 20% of the substations and PURS cooling stations will be inspected each year. These inspections are separate and in addition to the periodic visual and/or maintenance functions that SSO performs on a periodic basis through compliance inspections such as battery room inspections, deluge room inspections, quarterly pump house, circulation plant and PURS inspections, pothead inspections, overhead tower inspections, and load board inspections.

Inspections are conducted according to inspection rounds for the “equipment categories” at each substation or PURS cooling plant as established in MAXIMO, SSO’s work management system. The equipment categories to be visually inspected are battery room, deluge room, pump house, circulation plant, PURS, pothead, overhead tower, load board, control rooms, relay cubicles (interior and exterior), alarm panels, circuit breaker cabinets (transmission and distribution voltage levels), transformers, station yards and interior switch rooms.

The individual equipment within each equipment category at each station will be visually inspected for any condition that has the potential to cause or lead to safety hazards or failure of the equipment. For example, all equipment within a relay cubicle will be visually inspected. Among the conditions to be identified are exposed conductors, corrosion, frayed/damaged insulation, foreign material intrusion, water leaks, and grounding connections.

Structures containing equipment, whether locked or not, must be opened and the equipment visually inspected. Disassembly of panels and cubicles is not required, only doors and openings normally designed to be accessible and operated during operations or maintenance are required to be opened. Sealed structures will not be opened.

Results
Con Edison inspected 41 substations of its 95 substations and 5 of its 11 PURS cooling facilities in 2005 & 2006. In total 43.4% of the substations and PURS facilities were inspected.

Tracking Inspections
The results of the inspection of each equipment category at a substation or PURS cooling plant are recorded in MAXIMO and each equipment deficiency is recorded. An associated Auto Tour round (job plan) is completed, identifying the inspection results.

All environmental or safety problems are immediately reported to the station operator who notifies the Control Center Shift Manager. All other items found during the inspection are recorded in MAXIMO. A new MAXIMO work order is generated to make the appropriate repairs.
Repairs
The inspection of the 41 substations of its 95 substations and 5 of its 11 PURS cooling facilities included 884 separate inspection groups. The required repairs include items such as replacing lighting, replacing covers on electrical junction boxes, and general station cleanup.

Quality Assurance Measures Instituted
Substation Operations’ quality assurance program consists of periodic document reviews and field observations to ensure that 100% of the required stray voltage tests and a minimum of 20% of the Safety and Reliability Inspections will be completed by November 30 of each year and that the testing and inspections are conducted properly.

The quality assurance was performed by members of the SSO MAXIMO group and consisted of a documents search, records review, as well as physical critical visual inspection. Critical visual inspection quality assurance was performed at two PURS locations and one substation facility in Queens. Separate inspection records were created for each quality assurance audit. The checks found no deficiencies in the original inspections. In addition, all inspection and follow-up work order documentation was reviewed. The audit indicated that follow-up work orders (to make repairs identified during the visual inspections) were not completed at five substations. These work orders were entered into our work management system and processed by appropriate personnel. In the remaining stations, work orders for repairs identified during the inspections had been completed. All personnel were retrained on proper reporting and referral of repairs identified during facility inspections.

Training
Employees are trained and demonstrate the ability to perform facility Inspections following Company specifications and safety procedures through training module CSG0020 (Stray Voltage Testing and Critical Visual Safety Inspections). The training includes the reasons for facility inspections, PSC Case 04-M-0159 Safety Standards requirements, safety concerns and conditions, personnel protective equipment, facility inspection criteria, and reporting.
Facility Inspections of Unit Substations

Scope
Existing Con Edison procedure EO-10790 (Inspection and Maintenance Schedule For 4kV Unit and Multi-Bank Substation Transformers and Switchgear) complies with the Safety Standards’ inspection requirements. The specification is a guide for 4 kV Unit Substation maintenance personnel who operate and maintain the 230 Multi-Bank and Unit Substations. It is formulated from industry standards, current Company practices, and equipment manufacturers’ recommendations with the objective of optimizing equipment operation.

Procedure
Qualified substation maintenance and operational personnel perform the facility inspections pursuant specification EO-10790. The inspections are performed every two months – more frequently than required by the Safety Standards. The inspection includes a visual inspection of circuit breakers, transformer and feeder circuit breakers, low voltage circuit breakers, tap changers, primary (de-energized tap changer), reactors, voltage regulators, cooling equipment, gauges and meters, control batteries, battery charger, nitrogen equipment and supply, transformer silica gel breathers, thermostat and heaters, station light and power, control wiring and circuits, protective relays, unit substation automation (USA), ground and test device, and environmental systems.

Results
In 2005, Con Edison inspected 100% of its 230 unit substations.
Part Four – Public Service Commission Performance Mechanism

2006 Stray Voltage Detection and Electric Facility Inspection Report
Public Service Commission Performance Mechanism

The Safety Standards provide for a 75 basis point revenue adjustment if the Company does not test 100% of its publicly accessible electrical structures and streetlights for stray voltage by November 30, 2006. The Safety Standards also provide for a 75 basis point revenue adjustment if the Company does not inspect at least 35% of its electrical facilities (90% of 1/5th of all electric facilities) over the two-year period ended November 30, 2006.

Stray Voltage Testing
By November 30, 2006, Con Edison completed the stray voltage testing of all its publicly accessible electric structures and streetlights as described previously in this report. Accordingly, a revenue adjustment is not applicable for 2006 stray voltage testing performance. Table 12 displays the results of Con Edison stray voltage testing programs.

<table>
<thead>
<tr>
<th>Stray Voltage Testing Program</th>
<th>Facilities</th>
<th>Completed(^5)</th>
<th>Percent Complete</th>
<th>Stray Voltages</th>
<th>Detection Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution – Underground</td>
<td>273,743</td>
<td>273,743</td>
<td>100%</td>
<td>15</td>
<td>0.005%</td>
</tr>
<tr>
<td>Distribution – Overhead</td>
<td>284,865</td>
<td>284,865</td>
<td>100%</td>
<td>22</td>
<td>0.008%</td>
</tr>
<tr>
<td>Streetlights</td>
<td>176,883</td>
<td>176,883</td>
<td>100%</td>
<td>877</td>
<td>0.496%</td>
</tr>
<tr>
<td>Transmission - Underground</td>
<td>1,729</td>
<td>1,729</td>
<td>100%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Transmission - Overhead</td>
<td>1,219</td>
<td>1,219</td>
<td>100%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Substations &amp; PURS Facilities</td>
<td>61 Site Perimeters</td>
<td>61 Site Perimeters</td>
<td>100%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Unit Substations</td>
<td>230 Site Perimeters</td>
<td>230 Site Perimeters</td>
<td>100%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>738,730</strong></td>
<td><strong>738,730</strong></td>
<td><strong>100%</strong></td>
<td><strong>914</strong></td>
<td><strong>0.124%</strong></td>
</tr>
</tbody>
</table>

*Table 12 – All Stray Voltage Testing Programs*

Facility Inspections
Con Edison inspected 67% of its overall transmission, distribution, and substation facilities over the two-year period ended November 30, 2006. The Company has completed inspections of 100% of overhead distribution, 33% of underground distribution, 100% of overhead transmission, 66% of underground transmission, 43% of substations and PURS facilities, and 100% of unit substations. Accordingly, a revenue adjustment is not applicable for 2006 inspection performance. Table 13 summarizes the status of Con Edison’s facility inspection program. The facility inspections of Overhead Distribution, Overhead Transmission, and Unit Substations were completed in 2005.

\(^4\) 35% is the cumulative total for 2005 and 2006. The 2005 requirement was 17% and the 2006 requirement is 18%.

\(^5\) Totals include sites that were inaccessible for testing as described in this report.
<table>
<thead>
<tr>
<th>Facility Inspection Program</th>
<th>Facilities</th>
<th>Completed</th>
<th>Percent Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution – Underground</td>
<td>273,743</td>
<td>89,796</td>
<td>33%</td>
</tr>
<tr>
<td>Distribution – Overhead</td>
<td>284,865</td>
<td>284,865</td>
<td>100% - Completed in 2005</td>
</tr>
<tr>
<td>Transmission - Underground</td>
<td>1,729</td>
<td>1,135</td>
<td>66%</td>
</tr>
<tr>
<td>Transmission - Overhead</td>
<td>1,219</td>
<td>1,219</td>
<td>100% - Completed in 2005</td>
</tr>
<tr>
<td>Substations</td>
<td>95</td>
<td>41</td>
<td>43% SS and PURS</td>
</tr>
<tr>
<td>PURS facilities (see SS)</td>
<td>11</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Unit Substations</td>
<td>230</td>
<td>230</td>
<td>100% - Completed in 2005</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>561,892</strong></td>
<td><strong>377,291</strong></td>
<td><strong>67%</strong></td>
</tr>
</tbody>
</table>

*Table 13 – All Facility Inspection Programs*
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Part Five – Certification of Stray Voltage Testing and Facility Inspection Programs

2006 Stray Voltage Detection and Electric Facility Inspection Report
Certification of Stray Voltage Testing and Facility Inspection Programs

The due diligence and test-completion certification of the Con Edison’s officer responsible for overseeing the Company’s Stray Voltage Testing Program is provided in the Appendix.

The due diligence and inspection-completion certification of the Con Edison’s officer responsible for overseeing the Company’s Facility Inspection Program is provided in the Appendix.
Analysis of Stray Voltage Testing Results

Weather Analysis of Energized Equipment (ENE) & Electric Shock Reports (ESR)

Con Edison has analyzed the correlation of weather affects on stray voltage detection and the incidence of electric shock. The analysis shows that weather does not affect stray voltage detection – stray voltage is not found at a greater rate when it rains or snows. The analysis does show that there is a greater rate of electric shock during rain or snow. Therefore, weather does not affect when you test for stray voltage.

Correlation between stray voltages found and weather data are weak. Electric Shock Report counts have a weak but clear negative correlation with maximum temperature (-0.25) and weak positive correlation with snow (0.29). The correlation increases when considering only confirmed reports where Company cable failure was responsible for the shock. In that case, correlation with max temp is -0.29 and correlation with snow is 0.32.

Similar comparisons of weather data and the results of ongoing testing programs are different. Correlations between found energized structures and weather variables are all extremely close to zero (See Table 14).

<table>
<thead>
<tr>
<th>Weather Data</th>
<th>Correlation of ENE and Weather Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>-0.05</td>
</tr>
<tr>
<td>Dew point</td>
<td>-0.12</td>
</tr>
<tr>
<td>Atmospheric Pressure @ Sea Level</td>
<td>0.16</td>
</tr>
<tr>
<td>STP</td>
<td>0.06</td>
</tr>
<tr>
<td>Max Temp</td>
<td>-0.05</td>
</tr>
<tr>
<td>Min Temp</td>
<td>-0.07</td>
</tr>
<tr>
<td>Temp Range</td>
<td>0.05</td>
</tr>
<tr>
<td>Precipitation</td>
<td>-0.07</td>
</tr>
<tr>
<td>Precipitation (Last 3 Days)</td>
<td>-0.11</td>
</tr>
<tr>
<td>Snow Depth</td>
<td>0.01</td>
</tr>
<tr>
<td>Fog</td>
<td>-0.07</td>
</tr>
<tr>
<td>Rain (Y/N)</td>
<td>-0.04</td>
</tr>
<tr>
<td>Snow (Y/N)</td>
<td>-0.10</td>
</tr>
<tr>
<td>Est. Snowfall</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Table 14 – Correlation of ENE and Weather Data

These relationships are extremely weak and day-to-day operations are not impacted by weather except as far as it impacts workers' efficiency during adverse conditions. In short, workers testing for stray voltage find stray voltage regardless of weather conditions.

Reasons for the disparity between these two results are not completely clear, but there are likely hypothetical causes. The most important difference is that testing programs find voltage only, while electric shocks require a hazardous voltage, a low impedance ground path, and person or animal in position to connect the two. Adverse weather must therefore increase the likelihood that all of these additional requirements are simultaneously present. People and animals are always present, so logically
the weather must have an effect on availability of a low impedance path to ground or the impedance of
the available grounds in the field. Lab studies of soil resistivity are currently being done by Distribution
Engineering to understand the path of current to the surface from a buried energized duct.

Simulation Study – Mitigation through Detection
Con Edison conducted a study to determine the most effective method for mitigating Stray Voltage in
Urban Environments. The study evaluated the different types of stray voltage found in 2004 and 2005. The results showed that although there are many different causes and sources of stray voltage, the
mitigation can be addressed in a common method.

The key to mitigating Stray Voltage conditions is to test, locate, and repair problems with the system that are causing the Stray Voltage conditions.

The scope of the testing program was evaluated based on the most effective use of testing resources.

- It was found that testing is most effective when it is evenly spaced throughout the year. This prevents the SVC (stray voltage conditions) from accumulating at any period of time on the system.
- Multiple scans conducted during the year will help reduce the duration of time that SVC is on the system. As a SVC is created by failed equipment, it will be identified sooner and repaired.
- The multiple scans increase the chance of identifying temporary conditions that can cause a SVC. A temporary condition could be caused by environmental conditions such as water level in a vault. These conditions can change more frequently than an insulation breakdown failure.

The model created to demonstrate the effectiveness of multiple scans spread out throughout the year demonstrated that testing up to 10 times per year will reduce the number of SVC on the system. Additional testing after this point will not significantly reduce the active SVC. The expected results of the study appear in Figure 3.

![Figure 3 – Average Stray Voltage on System vs. Search Frequency](image)

Con Edison has started a program that will demonstrate this theory and reduce the active SVC. Con Edison has planned to test the underground network system four times using the mobile stray voltage detection vehicles. In addition to the planned scanning, Con Edison will test the system following snow
storms. We are anticipating snow storms an average of 3-5 times per year. In addition to the mobile testing, Con Edison will conduct one hand test of the entire system.

Observations
Con Edison has completed four complete stray voltage testing cycles of the underground distribution structures, three complete testing cycles of the metal streetlights and two complete testing cycles of wood distribution poles. Each successive testing cycle has resulted in a steady reduction of stray voltages. The detection rates observed appears in Figure 4.

![Figure 4 – Stray Voltage Testing Detection Rate](image)

Table 15 reflects all stray voltages identified through manual testing.

<table>
<thead>
<tr>
<th>Stray Voltage Testing Program</th>
<th>Facilities</th>
<th>Stray Voltages</th>
<th>Detection Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution – Underground</td>
<td>273,743 (Annual Testing) 182,001 (Routine Testing)</td>
<td>15 138</td>
<td>0.005% 0.076%</td>
</tr>
<tr>
<td>Distribution – Overhead</td>
<td>284,865</td>
<td>22</td>
<td>0.008%</td>
</tr>
<tr>
<td>Streetlights</td>
<td>176,883</td>
<td>877</td>
<td>0.496%</td>
</tr>
<tr>
<td>Transmission - Underground</td>
<td>1,729</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Transmission - Overhead</td>
<td>1,219</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Substations &amp; PURS Facilities</td>
<td>61 Site Perimeters 0 Site Perimeters</td>
<td>0 Site Perimeters</td>
<td>0%</td>
</tr>
<tr>
<td>Unit Substations</td>
<td>230 Site Perimeters</td>
<td>0 Site Perimeters</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>920,731</td>
<td>899</td>
<td>0.098%</td>
</tr>
</tbody>
</table>

*Table 15 – All Stray Voltage Testing Programs*
Stray Voltage Initiatives

Research and Development
Con Edison’s Research and Development (R&D) department is involved in initiatives that may lead to a reduction in stray voltage or better detection techniques. This section describes several of the more promising programs.

Mobile Stray Voltage Detector
The project has developed a vehicular sensor/system for detecting the presence of stray voltages on manhole covers, gratings, service boxes, light poles and other structures while driving over roadways. The development includes a three-axis version, optimization of detector sensitivity for field conditions, improved design of the capture, analysis and alarm electronics and prototype testing in field conditions. Con Edison has procured 15 mobile stray voltage detection (SVD) systems from Sarnoff Corporation. These SVD’s employ three-dimensional electric field sensors to detect stray voltages or unshielded electric cables. The Company has moved to full scale implementation of the Mobile Stray Voltage Detector.

Con Edison has tripled its fleet and intends to perform multiple testing cycles per year with the SVD. In addition, Con Edison will increase mobile testing following winter storms. Con Edison is evaluating the effectiveness of mobile SVD testing relative to manual stray voltage testing.

Composite Covers
If a low voltage cable comes in contact with the metallic cover of a distribution structure, a stray voltage can be created if the cable insulation fails. A composite or non-metallic structure cover can provide additional electrical insulation to prevent an insulation failure within the structure from becoming a stray voltage on the surface.

There are several prototypes that have passed initial load testing and blast testing. These covers have been installed in field locations and the performance will be evaluated in 2007 for possible widespread field use.

Structure Cover Monitoring System
This project seeks to develop a sensor/system for real time detection of the presence of stray voltages on manhole covers, gratings, service boxes, light poles and other structures. The system will have RF communication capabilities.

The project has developed a prototype sensor system and communication channel for detecting the presence of stray voltages on transformer gratings. The prototype sensor design unfortunately can cause a significant voltage rise occur on the grating during a primary cable fault. The sensor is being redesigned to account for this voltage rise. The redesigned sensor will be tested and based on positive results, a pilot installation will be initiated.

Arcing Signature
Electrification events may be associated with arcing faults on the secondary network mains and / or services. Prior work sought a method of detecting such faults by staging arcing faults, measuring the resultant voltage and current waveforms, and determining if microprocessor network protector relays could detect and discriminate the event. The results showed some signature that could be recognized by an enhanced relay, but locating the source and discriminating from other electrical events proved problematic. The current project follows up on the prior work and seeks to take advantage of advances in technology.

The Canadian Electric Association (CEA) is leading a project that is limited to the detection and interruption of secondary voltage arcing faults. Secondary voltages to be considered range from 120/240V to 347/600V and include both single phase and three-phase secondary voltage distribution.
The objective is to identify the technical performance parameters required for secondary voltage arcing fault detection and interruption device(s) that could be applied to overhead and underground secondary service wires, and utility secondary distribution networks. (In the case of utility secondary networks, the requirement may be for detection only.)

The Electric Power Research Institute (EPRI) is managing a project that seeks to develop a design spec for several “low cost” monitoring or injection devices that could be used to detect arcing fault on underground secondary distribution systems. If successful, a second phase will seek to develop the mechanism for arcing fault localization and communication.

Testing in Pittsburgh by Eaton of low current cable faults has begun as well as the start of the third phase, which includes in-conduit testing. Field visits, data collection, and oscillograph comparisons are being conducted to study the electrical signatures of arc faults and to determine if this is a feasible means of arc fault detection.

**Acuity Streetlight Pilot**

At Con Edison, stray voltage appears on metal pole streetlights at a much greater rate than any other electrical facility. Presently, the Company conducts manual stray voltage testing on streetlights once a year as part of the annual testing program. In addition, Con Edison crews test a streetlight for stray voltage before working on a streetlight and again when the work is complete. Unfortunately, a stray voltage could appear on a streetlight soon after the testing is complete. Con Edison is working with a vendor to develop a stray voltage monitor that fits into the photocell socket of the streetlight. The monitor in development will contain a stray voltage detector and a communication system that would send an alarm to alert repair crews. Presently, the Company has a pilot installation within the Con Edison facility in Astoria. The pilot installation is testing the communication system. The stray voltage detector for this monitor is still in development.

**Isolation Transformers**

An isolation transformer (IT) provides electrical separation between line and load side of a streetlight circuit. The only electrical connection present is the coupling of the primary and secondary coils via a magnetic field. As the use of an IT requires the existing grounding bond between the lamp neutral and ground to be removed, there is no direct path or circuit present unless an internal transformer fault was to occur. An isolated closed loop provides the benefit of no return path for stray voltage from bad connections or shorted phase conductors. Therefore stray current will not flow, as no circuit is present.

With regard to streetlights, failures of either the phase conductor or neutral wires (or associated connectors) may occur in the body of the lamp, service conduit, or service box. Isolation transformers reduce the hazard of these occurrences by providing an isolated loop that prevents the flow of current from an energized structure through an individual to ground.

Isolation transformers are in widespread use for medical equipment, swimming pools, and desk lamps. However, based on an Edison Electric Institute member survey, no US utilities are currently using isolation transformers to protect streetlights from stray voltage. One application concerning the use of isolation transformers in Israeli wetland areas was reported to Distribution Engineering by an Ambient Corporation consultant.

Isolation transformer tests were performed on a lamppost at Con Edison’s Learning Center to confirm the theoretical safety and practicality of the isolation transformer. Three scenarios were considered: the basic case without an isolation transformer, the isolation transformer in the base and the isolation transformer in the service box. The basic case showed that under certain conditions the current going through the base could be hazardous. The isolation transformer in the base and in the service box each performed as expected with only minuscule amounts of current flowing through the streetlamp base.
Installation of isolation transformers would provide a number of substantial benefits. Public and animal safety would improve due to the elimination of shocks. Based on an analysis of 2,170 past stray voltage events, it is expected that the units installed in streetlight bases would provide a 78% improvement in safety while the units in the service boxes would provide a 93% improvement. Other benefits include reduced adverse media coverage, reduced liability, and an improved working relationship with the NYCDOT. Fewer shock reports would improve productivity by avoiding the need for emergency crews responding to shock incidents and making the areas safe. It is expected that 504 fewer events would occur per year based on past data resulting in a savings of $2.1 million per year.

Con Edison has partnered with the NYCDOT to purchase and install 5,000 isolation transformers on streetlight services in the bases of underground fed, metallic streetlights. As of 12/18/06, 2,966 units have been installed. Both Con Edison and NYCDOT will continue to install the units in the course of normal streetlight maintenance work in 2007.

“Experimental Investigation of Secondary Cable Degradation as Related to Stray Voltage and Manhole Events” (University of Connecticut)
The objective of this research proposal is to understand the conditions which lead to the phenomena that occur as a result of the degradation of the cable insulation due to thermo mechanical stresses. These phenomena include stray voltage and a potential explosion. Stray Voltage is suspected to occur once the insulation has cracked and leakage from the conductor to the surface happens because of a sufficiently low resistance from the exposed conductor to the surface. An explosion is suspected to occur if the resistance from the exposed conductor to ground is low enough to allow current to flow causing a carbonized track across the insulation, which if in a confined space (such as a duct) would consume the oxygen rapidly and the decomposition of the insulation would happen anaerobically generating gases such as hydrogen, carbon monoxide and a range of hydrocarbons which are all combustible.

This research proposal will attempt to:

- Determine the degree of thermal aging as a function of temperature and time for each cable insulation material and determine if any characteristic substances are evolved from the insulation which might be used to determine that the insulation is overheated.
- Determine the current and other conditions required to initiate anaerobic decomposition of the cable insulation, along with the combustible gases and the rate of gas generation as a function of the impedance to ground.
- Determine the conditions under which common insulating materials between the conductor and the surface will promote stray voltage conditions at the surface. (E.g. under which conditions does concrete become sufficiently conductive that when energized to a certain potential it would pose a safety hazard)

“Proposal for Data Analysis and Modeling to Assist in Optimizing Stray Voltage Mitigation Programs” (The Risk Research Group, Inc.)
The objective of this proposal is to further clarify the events or conditions that cause, or are associated with, stray voltages and to develop a framework of methodology with which to use this knowledge to ascertain how best to address the problem.

This project will be split into four tasks:

- Review Data and Analysis – Studies generated by the SSA and the data they use will be reviewed to determine whether additional conclusions or new insights can be gained.
- Establish Relationships Between Stray Voltage Events and Weather and Other Factors for Modeling Purposes – The intended output of this task is a relationship between the contents
of an electrical structure, other measures of reliability problems within the area, inspections and tests performed on electrical structures and the likelihood of a stray voltage event originating from within the structure.

- **Task 3**
  - Risk Measure – a good measure of the likelihood of a stray voltage resulting in an electric shock to a pedestrian in an area would be the product of the number of electrical structures and streetlights in the area, the likelihood of a stray voltage event occurring in a given structure, and the pedestrian density in that area.
  - Apply Measure of Risk to Evaluate Alternative Strategies for Risk Reduction
  - Identify “Best” Strategies for Risk Reduction.

- **Meetings, Reports, Training and Deliverables**

**“Stray Voltage, Manhole Events and Secondary System Machine Learning Project, Phase 1 and 2” (Columbia University)**

The overall goal of this project is to identify the most vulnerable secondary structures in Manhattan, Brooklyn/Queens and the Bronx based on a time-to-event modeling approach which predicts for each structure the expected time until the next event.

- Create the complete, cleaned and unified database that will support this analysis
- Derive rankings of the most vulnerable structures, M&S Plates, networks, etc.
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Part Eight – Future Recommendations

2006 Stray Voltage Detection and Electric Facility Inspection Report
Future Recommendations

Con Edison has initiated several programs and work practices to enhance stray voltage detection and data management, and maximize the number of facility inspections. This section reviews these improvements.

Mobile Stray Voltage Detector (SVD)
The most significant future improvement is the use of the mobile stray voltage detector. Con Edison has tripled its fleet and intends to perform multiple testing cycles per year with the SVD. In addition, Con Edison will increase mobile testing following winter storms. Con Edison is evaluating the effectiveness of mobile SVD testing relative to manual stray voltage testing.

Shunt Resistor
Overhead lines are not shielded and can induce voltages on metallic surfaces. These voltages are normally not harmful, and they do not involve a failed component of the distribution system.

The HD stray voltage indicator and a digital voltmeter can falsely indicate a stray voltage condition in the presence of induced voltage.

A digital voltmeter's very high input impedance is designed not to affect the circuit being tested. The design has the disadvantage of being unable to distinguish a stray voltage capable of delivering an electric shock, from an induced voltage with no current-carrying capacity. A shunt resistor can be used in conjunction with the Fluke voltmeter to determine whether the voltage is produced by current (presenting the possibility of electric shock) or is induced (harmless).

We have developed a shunt resistor to be used in combination with the Fluke voltmeter when a potential stray voltage has been identified on the overhead system. The step-by-step procedure is described in the Appendix. The shunt resistor was implemented in the middle of the 2005 Overhead Transmission and Distribution testing program and was used for the entire Overhead Transmission and Distribution Testing Program in 2006.

Transmission and Substation Testing
Con Edison has completed two testing cycles of overhead transmission, underground transmission, and substations. No stray voltage was found on these facilities. Con Edison proposes to eliminate stray voltage testing of transmission and substation facilities. The stray voltage detection should instead focus on distribution facilities.
Appendix

2006 Stray Voltage Detection and Electric Facility Inspection Report
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A: EO-5,100 (Low Voltage Detectors - Stray Voltage)
1. **SCOPE**

   This specification details the requirements for low voltage detectors and associated test devices that are to be used for stray voltage testing.

2. **APPLICATION**

   This specification applies to all Customer Service Regions.

3. **GENERAL**

   Detectors covered under this specification are used to detect the presence of low voltage on various structures and components associated with the Con Edison distribution system. A separate test device shall be provided to verify the proper operation of the detector.

4. **PURCHASE RECOMMENDATION**

   Approved manufacturer’s products for Low Voltage Detectors /Test Devices are listed in Purchase Recommendation EO-100175.

5. **REQUIREMENTS**

   5.1 **Enclosure**

   Materials used for the enclosures of both the low voltage detector and the associated test device shall be impact resistant and durable under the anticipated operating conditions of the devices. The assembled devices shall be constructed so as to preclude the entry of foreign material or moisture. Low voltage detector and test device enclosures shall be constructed to meet the requirements for NEMA 4 enclosures in accordance with NEMA Standards Publication 250 – 2003.
5.2.1 Mechanical Requirements

5.2.1.1 Impact resistance

Detectors and tester devices supplied under this specification shall be capable of being dropped 30 times from a height of 12 feet on the center of a bed of loose sand at least 2 feet by 2 feet by 6 inches deep. The exposed surface of the sand shall be smoothed to a horizontal plane prior to each drop. The detector shall be dropped 10 times at an angle of 45° (probe/test plate end down), 10 times in a vertical position upon the probe/test plate end of the detector/tester, and 10 times in the vertical position upon the base of the detector/tester. These tests shall be performed with the normal batteries installed. Parts shall not be tightened once the test has begun. There shall be no damage to any part, which could render the detector/tester inoperable. The lens of the detector shall not break, chip or crack. After the completion of the drop tests, each device shall be checked for normal operation in accordance with operating instructions. Non-conformance to the above shall constitute a failure of this test.

5.2.1.2 Operating Temperature

Detectors and test devices shall operate over a temperature range of –13 degrees Fahrenheit (-25 degrees Centigrade) to +131 degrees Fahrenheit (+55 degrees Centigrade).

5.2.2 Electrical Requirements

5.2.2.a Voltage detection capabilities

Detectors shall visually indicate the presence of voltage at a level of 5 volts (+/- 0.5 volts) through 600 volts AC when placed into direct contact with the surface of a metallic object. The detectors shall have a maximum use voltage of 600 volts AC. The detector shall incorporate a monitoring circuit that will render the detector inoperative when the battery voltage drops below a specified voltage that would preclude accurate functioning of the detector.

5.2.2.b Test device functionality

Test devices shall verify the proper operation of the detector. The test device shall provide a visual indication of that the test device is functioning properly and shall have a monitoring circuit that will render the device inoperative when the battery voltage drops below a specified voltage that would preclude accurate functioning of the test device.
5.3 **Serial Number**

Each detector and test device shall be assigned a unique, traceable, serial number. The serial number shall contain information on the date of manufacture.

5.4 **Labeling**

Detectors and testers shall be permanently, and legibly labeled with the following information: manufacturer, model number, serial number, and notation that the device operated within the specified design parameters.

5.5 **Packing Slip Documentation**

Each detector / test device shall come with a packing slip. The packing slip shall list the following information:

1. Serial Number
2. Date The Unit Passed The Test
3. Test Operator

5.6 **Certified Test Report**

A certified test report for each shipment of detectors / test devices shall be sent to the Distribution Engineering Environmental Health and Safety Manager listing the serial numbers of each detector and /or tester in the shipment and their “turn on voltage or output voltage” respectively. The Product Manager for these products or an officer of the company shall sign the report.

J.R. Martin
J. Schneider

Joseph R Martin(signature on file)
Joseph R. Martin
Manager
Environmental Health and Safety
Distribution Engineering

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B: EO-100,175 (Purchase Recommendation - Low Voltage Detectors for Stray Voltage)
PURCHASE RECOMMENDATION
LOW VOLTAGE DETECTORS FOR STRAY VOLTAGE

1.0 SCOPE

This purchase recommendation covers low voltage detectors and test devices for stray voltage testing.

2.0 APPLICATION

This purchase recommendation applies to all Customer Service Regions.

3.0 GENERAL

Low Voltage detectors and test devices covered under this recommendation shall meet all of the requirements specified in Purchase and Test specification EO 5100 "Low Voltage Detectors - Stray Voltage".

4.0 APPROVED PRODUCTS - Approved manufacturers products and their catalog numbers are listed below:

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<th>Manufacturer</th>
<th>Class and Stock Number</th>
<th>Catalog Number</th>
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<td>HD Electric Company</td>
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<tr>
<td>Low Voltage Detector</td>
<td>456 5693</td>
<td>Catalog Number LV-S-5</td>
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<tr>
<td>Proof Tester</td>
<td>456 5701</td>
<td>Catalog Number PT-LV -5</td>
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<tr>
<td>Accessory Bag</td>
<td>059 5348</td>
<td>Catalog Number LV-S BAG</td>
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5.0 ALTERNATE MANUFACTURERS

Low voltage detectors produced by manufacturers other than those listed in paragraph 4 may be submitted to the Distribution Engineering Environmental Health and Safety Manager for evaluation. Products found acceptable will be included in subsequent revisions of this purchase recommendation.

J. Schneider

Joseph R Martin (signature on file)
Joseph R. Martin
Manager
Environmental Health and Safety
Distribution Engineering

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C: EO-10,129 (Operation and Maintenance of Low Voltage Detector for Stray Voltage)
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
4 IRVING PLACE
NEW YORK, NY 10003

DISTRIBUTION ENGINEERING DEPARTMENT
ENVIRONMENTAL HEALTH AND SAFETY

SPECIFICATION EO–10129
REVISION 2
MAY 2005

OPERATION AND MAINTENANCE OF LOW VOLTAGE DETECTOR FOR STRAY VOLTAGE

FILE: OPERATION AND MAINTENANCE OF EQUIPMENT
MANUAL NO. 1, SECTION NO. 15

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1.0 SCOPE

This specification details the operation, maintenance and application of the HD Electric LV-S-5 low voltage detector and the associated PT-L-5 proof test device. The LV-S-5 detector is used to test for stray voltage on various structures and components that are not normally energized.

2.0 APPLICATION

This specification applies to all Customer Service Regions.

3.0 GENERAL

3.1 Theory Of Operation

The LV-S-5 low voltage detector operates by matching a factory-preset voltage (threshold voltage) to a voltage that is present at the tip of the detector. When the voltage at the detector tip equals or exceeds this preset voltage, the detector will provide a visual indication. Proper operation of the detector is verified prior to use by means of a proof test device. The proof test device simulates contact with an energized surface by generating a "test voltage" that is slightly greater than the detectors preset (threshold) voltage.

3.2 Operational Conditions

The LV-S-5 potential detector is designed to operate under all normally encountered weather conditions. The device can be used in precipitation, but is not designed to be submerged in liquid.

The LV-S-5 potential detector and the PT-LV-5 proof test device are, designed to operate over a temperature range of -13° Fahrenheit (-25° Centigrade) to +131° Fahrenheit (+ 55° Centigrade).

3.3 Voltage Detection Capabilities

The LV-S-5 voltage detectors shall be used to detect AC voltages only. The LV-S-5 voltage detector will visually indicate the presence of voltage over an operating range of 8 – 600 volts AC when placed into direct contact with the surface of a metallic object. The maximum use voltage of the LV-S-5 detector is 600 volts AC. The detector incorporates a monitoring circuit that will render the detector inoperative when the battery voltage drops below a specified voltage that would preclude accurate functioning of the detector.
3.4 Proof Test Device

The PT-LV-5 proof test device verifies the proper operation of the detector by providing a voltage source to activate the detector. The proof tester has a monitoring circuit that will render the device inoperative when the battery voltage drops below a specified voltage that would preclude accurate functioning of the proof test device.

4.0 PURCHASE RECOMMENDATION

Purchase Recommendation EO-100175 lists the approved manufacturers and catalog numbers for the low voltage detector, proof test device, and protective case.

5.0 OPERATING INSTRUCTIONS

5.1 The LV-S-5 voltage detectors shall be used on the not normally energized surface(s) of metallic objects to detect AC voltages only. The LV-S-5 voltage detector shall not be used to test for the presence of DC voltage. Measurement for the presence of DC voltages shall be performed using an approved multimeter.

5.2 Potential detector(s) shall be used without gloves and only as indicated in this specification.

5.3 The preliminary test specified in paragraph 6.0 must be performed prior to performing any tests for the presence of voltage on surfaces or equipment.

5.4 Use or applications other than specified in this specification must conform to existing work rules and be approved by the Environmental Health and Safety Manager of the Distribution Engineering Department.

5.5 The voltage detector shall be held as close to perpendicular to the component being tested as possible when checking for the presence of voltage.

5.6 Detectors must contact the component being tested.

5.7 The detector shall be kept in a protective case, class and stock number 059 5348 when not in use.
6.0 PRELIMINARY DEVICE TESTS

6.1 Proof Test Device - Verify the operation of the PT-LV-5 proof test device by performing the following actions. Press the test button on the top of the PT-LV-5 proof test device. The test light shall illuminate. If the test light does not illuminate, the 9 volt battery in the device shall be replaced. This is accomplished by sliding the battery compartment cover on the back of the tester open, and inserting a new 9-volt alkaline battery. The initial check operations shall then be repeated. If the test light does not illuminate after the battery has been replaced, the proof test device shall be replaced.

6.2 Detector - Verify the operation of the LV-S-5 detector by performing the following actions. Touch the probe tip of the LV-S-5 voltage detector to the metallic plate located on the end of the PT-LV-5 proof test device (figure 1). The test button on the PT-LV-5 shall be depressed, the test lamp of the PT-LV-5 shall illuminate, and the indicator on the LV-S-5 detector shall illuminate. If the indicator on the detector does not illuminate, the batteries for the LV-S-5 detector shall be replaced. This can be accomplished by unscrewing the back of the test device barrel (hand grip) and replacing the two AAA batteries. The initial check operations shall then be repeated. If the detector indicator does not illuminate as indicated above, the detector shall be removed from service.

FIGURE 1
7.0  **VOLTAGE TEST**

7.1  Perform the preliminary tests detailed in paragraph 6.0.

7.2  Clean an area on the surface of the structure to be tested removing all dirt and rust. Touch the probe tip to the bare metal surface. If stray voltage is present, the probe tip will illuminate.

J.R. Martin
J. Schneider

Joseph R Martin(signature on file)
Joseph R. Martin
Manager
Environmental Health and Safety
Distribution Engineering
D: B-63 (Stray Voltage Testing Of Company Structures and Streetlights)
Bulletin # 63: Secondary System Analysis

Distribution Engineering Department Bulletin

Subject: Stray Voltage Testing of Company Structures and Streetlights (OJT0063)

Metal pole streetlights and company structures including, poles, manholes, service boxes, vaults, and Underground Residential Distribution (URD) that contain or support primary or secondary cables or equipment shall be tested for stray voltage before and after working in or on the structure. The paragraphs below describe what should be tested, DC testing, what to do if a stray voltage is found and the required reporting. All AC stray voltage tests shall be conducted in accordance with EO-10129 (Operation And Maintenance Of Low Voltage Detector For Stray Voltage)

WHAT SHOULD BE TESTED?

UNDERGROUND STRUCTURES - Test the metallic frame and cover. If the cover has multiple gratings or covers, each piece shall be tested.

PADMOUNTS - Test the exterior surface of the Padmounted equipment.

SILOS - Test the metallic frame and cover.

POLES - Test all metallic surfaces on the pole from grade to a height of seven feet above grade. Surfaces to be tested include ground wires, anchor guys, and riser pipes of any company attached to the pole. Accessible traffic control equipment shall also be tested. Con Ed or other companies, such as Verizon, may own the pole.

STREETLIGHTS - Test the metallic frame and cover of metal pole streetlights. Streetlights on wood poles do not need to be tested.

STRUCTURES WITH DC

All DC required stray voltage tests shall be conducted as follows:

- All measurements shall be taken on bare metal surfaces.

- Verify the proper operation of the approved DC voltage detector (Fluke model 77/177) by touching the tip of the “live” lead of the device to a known energized voltage source while the tip of the “common” lead is connected to a neutral or ground location. The device shall indicate a voltage reading. Devices that fail to provide a proper voltage reading/indication shall be removed from service.

- Measurements for DC voltage shall be made with portable AC/DC voltmeters. When using these devices, connect to a good neutral or ground with the common (black) AC/DC voltmeter. Measure the voltage between the object (cover, frame, or casting) being tested and a good neutral or ground point. Examples of good ground points are the system neutral, metal water pipes, hydrants, steel faced curbs, street lamp
neutral or ground. When using curbs as the reference point for measurements, only curbs that have a full steel facing extending from the sidewalk to below the pavement and a minimum continuous length of 10 feet may be utilized. When using these reference points, connect to bare metal surfaces. In locations where the neutral or ground point is longer than the voltmeter lead length, connect to the neutral/ground with an extension lead wire. Secure the other end of the extension lead to the negative (black) probe of the voltmeter. Use care when using extension leads so as to not create a hazard to workers, pedestrian or vehicular traffic.

- The “live” meter probe lead shall then be placed into contact with the cover/frame under inspection.
- If measurements for voltage are being taken with an AC/DC voltmeter the voltage present will be indicated on the meter display. Readings shall be taken on both the AC and DC scales.

**WHAT TO DO IF A STRAY VOLTAGE IS FOUND?**

- When a stray voltage condition is identified with a SV detector, verify the condition with a voltmeter. If one volt or more (AC or DC) is found, the location will be manned continually and reported to the appropriate Control Center for the creation of an Energized Equipment (ENE) ECS Ticket, unless the crew is investigating an electric shock report. Electric shock reports shall be recorded on ECS tickets with a trouble type of ESR.
- The crew shall make necessary repairs to eliminate the source of the stray voltage.
- Report the identified defects to the local Control Center through the normal ECS procedures (See OJT ECC0100 for reporting the results of stray voltage inspections). The Control Center then updates the ECS to reflect the status of the stray voltage, repair work done to eliminate the stray voltage, and any remaining repair work.

**REPORTING**

The Stray Voltage Log intranet application is the repository for all underground stray voltage tests whether a stray voltage is found or not. Stray voltage tests on poles shall be recorded on the DCAR only when no stray voltage is identified. If a stray voltage is discovered on a pole it shall be immediately reported to the Control Center.

L. Scally

Won Choe (Signature on File)
Won Choe
Department Manager
Distribution Engineering Department
Secondary System Analysis
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E: EO-10,358 (Annual Contractor Stray Voltage Inspection Procedure)
ANNUAL CONTRACTOR STRAY VOLTAGE TESTING PROCEDURE

FILE: OPERATION AND MAINTENANCE OF EQUIPMENT
MANUAL NO. 1, SECTION 13.

TARGET AUDIENCE

ELECTRIC OPERATIONS
CENTRAL OPERATIONS
MAINTENANCE & CONSTRUCTION SERVICES

NESC REFERENCE

SECTIONS 214 A 2, 4, 5
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1.0 PURPOSE
The purpose of this specification is to describe the annual stray voltage testing to be performed by a contractor, operation of the required testing devices, the facilities required to be tested, notifications of facilities found with stray voltages, and data transfer process between the contractor and Con Edison. Stray voltage testing is mandated by the PSC and is Con Edison’s responsibility to test all company electric facilities to ensure the public safety. This specification lists the structures by Mains and Service Plates that shall be tested, and a contractor is required to report any exceptions or deficiencies detected when performing the stray voltage testing.

On January 5, 2005, the New York State Public Service Commission issued its Case No. 04-M-0159 - “Order Instituting Safety Standards” to examine the safety of electric transmission and distribution systems. The safety standards include requirements that electric utilities test all of their publicly accessible distribution facilities for stray voltage and inspect all of their electric facilities once every five years. A full round of stray voltage testing is to be completed by November 30, each year.

2.0 APPLICATION
This specification applies to all Operating Regions.

3.0 TERRITORY COVERAGE
The stray voltage testing will cover the entire Con Edison electric distribution territory. That is Brooklyn, Manhattan, Staten Island, the Bronx, a major portion of Queens up to Jamaica Bay including Broad Channel, and a major portion of Westchester County excluding Somers, Pound Ridge, North Castle, Lewisboro, North Salem, Bedford and part of Yorktown.

4.0 DEFINITIONS

4.1 Alternating Current (AC)
An alternating current (AC) is an electrical current, where electrical charge oscillates (i.e., moves back and forth), rather than flowing continuously in one direction, as is the case with direct current.

4.2 Customer Property
Customer property as used throughout the specification is defined as the property of a residential or a commercial customer.

4.3 Direct Current (DC)
Direct current (DC) is the continuous flow of electricity through a conductor such as a wire from high to low potential. In DC, the electric charges flow always in the same direction, which distinguishes it from AC.
4.4 **Ground Rod**  
An electrode placed in the earth and attached to a ground wire.

4.5 **Ground Wire**  
A conductor that is attached to a ground rod, continues vertically up the pole and is attached to an overhead cable or equipment.

4.6 **Guy Wire**  
A galvanized steel wire attached to the pole at an elevation well above the reach of a person at grade to an anchor placed in the ground approximately 12 feet laterally from the pole. (See Figure 2 in Exhibit E)

4.7 **Low Voltage**  
A nominal voltage under 600 volts is considered low voltage in the Con Edison system.

4.8 **Mains**  
The low voltage (under 600 volts) AC or DC cables that run between Con Edison structures.

4.9 **Mains & Services (M&S) Plate**  
A map that details the locations and types of manholes, service boxes, mains, services, poles, streetlights, and traffic lights in a geographic area.

4.10 **Manhole**  
A subsurface structure that contains secondary and/or primary conductors. This structure may have rectangular or circular covers.

4.11 **Pad Mount**  
Examples of the pad mounted equipment are transformer, T-Tap, or switchgear where normally mounted above the ground. A metal box normally protects the equipment.

4.12 **Poles**  
A wooden structure owned by Con Edison or Verizon for the purpose of attaching overhead cables and equipment.

4.13 **Riser**  
A metallic pipe attached to a pole containing cables transitioning from Overhead to Underground or vise versa.

4.14 **Service**  
Electric cables that supply Con Edison customers.
4.15 **Service Box**
A subsurface structure that contains low voltage conductors. This structure may have rectangular or circular covers.

4.16 **Stray Voltage**
An unintentional voltage that manifests on a surface.

4.17 **Streetlight**
A metallic pole owned by the New York City Department of Transportation (NYC-DOT) or local municipality for the purpose of illuminating an area.

4.18 **Structure**
A Con Edison Service Box, Manhole, Transformer Vault, or Pole.

4.19 **T-Tap Box**
A cable junction point with three directions.

4.20 **Traffic Signal**
A metallic pole owned by the NYC-DOT or local municipality for the purpose of traffic control.

4.21 **Transformer Vault**
A subsurface structure that contains a transformer. This structure normally has an open grating type cover.

4.22 **Underground Structure or Subsurface Structure**
A service box, manhole or transformer vault.

4.23 **Underground System**
Underground system consists of subsurface structures, equipment and structures associated with pad mount and the URD system.

4.24 **URD (Underground Residential Distribution) System**
URD System usually consists of a solo type of underground transformer, T-Tap box, or switchgear.

5.0 **TESTING CYCLE**

5.1 **Testing Cycle**
Stray voltage testing is an annual requirement. Ideally, the testing should start on December 1\(^{st}\) and complete by November 30\(^{th}\) in the subsequent year. Contractor shall abide by the contractual agreement that set forth at the beginning of the program.
5.2 **Overhead Electric Facility Inspection Cycle**

All of the overhead electric facilities require a visual inspection once every five years. In other word, twenty percent (20%) or one fifth (1/5) of the overhead facilities specified by Con Edison shall be inspected each year.
6.0 UNDERGROUND SUBSURFACE STRUCTURE AND URD STRAY VOLTAGE TESTING PROCEDURE

Underground testing comprised of subsurface structures of the network secondary and URD including the above ground pad-mounted structures. A subsurface structure is defined as any manholes (MH), service boxes (SB), transformer vaults (V, VS), transformer manhole (TM), customer boxes (CB), buried boxes (BB), injunction boxes (IJ), P-Boxes (PB), and T-Tap boxes and switchgears specifically associated with the URD.

6.1 Structures Requiring Stray Voltage Test

Test criteria include all Con Edison owned subsurface structures located on both public thoroughfare and customer property.

All covers and frames of subsurface and URD structures shall be tested for stray voltages. In locations where a series of structures involve multiple covers, normally transformer vaults, each cover must be tested for stray voltage individually. Typical covers and frames are shown in Exhibit B.

All the above ground metal housing of pad-mounted structures, all sides of the metal compartment, shall be tested for stray voltage.

Certain Con Edison owned structures are exempt from the annual stray voltage testing by the contractor if the following criteria are met:

- The structure is located inside a building
- The structure is located on an expressway or highway
- The structure is located or fenced inside a Con Edison Property

In these instances, refer to Exhibit A for the table of exception codes.

6.2 Test Procedure

6.2.1 AC Tests

Majority of the electric facilities throughout the Con Edison system only require AC stray voltage testing. However, there are structures in Manhattan, where there are secondary AC and/or DC facilities present. These structures require DC or both AC and DC stray voltage tests. Refer to the DC Test (Section 6.2.2) for details.

All stray voltage tests must be conducted using Con Edison approved and specified tools and equipment. Refer to Exhibit J for details regarding the testing devices and the proper method of taking voltage measurement.
All AC stray voltages identified with a stray voltage indicator will be verified with a Fluke 77/177 multi-meter from the metal attachment in question to a suitable neutral or ground point. Measurements for voltage shall be taken between the attachment being tested and a suitable neutral or ground point (e.g. metal water pipe, hydrant, steel-faced curb, sewer grating, ground rod, or driven ground). When using roadway curbs as the reference point for measurements, only curbs that have a full steel facing extending from the sidewalk to below the pavement and a minimum continuous length of 10 feet may be utilized. When using these reference points, connections shall be made to clean bare metal surfaces. In locations where the neutral or ground point is at a distance in excess of the voltmeter lead length, the connection to the neutral/ground shall be made with suitable gauge/length lead wire, the opposite end of which shall be securely connected to the negative (black) probe of the meter or voltage continuity tester. When using such “extension leads” appropriate care shall be taken in the placement of such leads so as not to create a hazard to workers, pedestrian or vehicular traffic.

If a stray voltage condition is detected, the Safety Notification Procedure must be followed to report the condition to Con Edison. Refer to Exhibit K for details.

6.2.2 DC Tests

All measurements shall be taken on clean bare metal surfaces. Verify the proper operation of the approved DC voltage detector (Fluke model 77/177) by touching the tip of the “live” lead of the device to a known energized voltage source while the tip of the “common” lead is connected to a neutral or ground location. The device shall indicate a voltage reading. Devices that fail to provide a proper voltage reading/indication shall be removed from service.

Measurements for DC voltage shall be made with portable AC/DC voltmeters. When using these devices, connection shall be made to suitable neutral or ground source with the common (black) AC/DC voltmeter or voltage continuity tester lead. Measurements for voltage shall be taken between the object (cover, frame, or casting) being surveyed and a suitable neutral or ground point (e.g. metal water pipe, hydrant, steel-faced curb, sewer grating, ground rod, or driven ground). When using roadway curbs as the reference point for measurements, only curbs that have a full steel facing extending from the sidewalk to below the pavement and a minimum continuous length of 10 feet may be utilized. When using these reference points, connections shall be made to clean bare metal surfaces. In locations where the neutral or ground point is at a distance in excess of the voltmeter lead length, the connection to the neutral/ground shall be made with suitable gauge/length lead wire, the other end of which shall be securely connected to the negative (black) probe of the meter or voltage continuity tester. When using such “extension leads”
appropriate care shall be taken in the placement of such leads so as not to create a hazard to workers, pedestrian or vehicular traffic.

The “live” meter probe lead shall then be placed into contact with the cover/frame under inspection.

If measurements for voltage are being taken with an AC/DC voltmeter, the voltage present will be indicated on the meter display. Readings shall be taken on both the AC and DC scales.

6.2.3 Exceptions

Each structure must be located and tested for stray voltage unless exception applies. All stray voltage testing exceptions must be clearly documented.

If a steel plate is found to be covering the underground structure, the steel plate itself shall be tested for stray voltage, the date of the test shall be recorded and remarks shall be denoted such as steel plate over structure in the comments field.

If a structure cover is partially obstructed, stray voltage test shall be conducted on the partial exposed cover or frame. The actual test conducted must be clearly documented. However, under circumstances when a structure cover is found to be totally obstructed by a dumpster or construction activity, revisiting the location to access the structure is required.

If a structure cannot be tested in the field, an exception code shall be used to report the testing status of the structure. Please refer to Exhibit A for the table of exception codes

6.2.4 No Access Procedure for UG Structures

In an event of no access to a structure the contractor shall attempt access and record additional information as follows:

a. No Access – Data

(1) NA-Construction / NA-Dumpster: If a structure is inaccessible due to Construction Activity or Dumpster then the Name of Construction Company, Contact Person, Phone Number & Duration of Construction Activity or Dumpster Removal Schedule (as denoted on the permit or posting) are required in addition to the location information.

(2) NA-Locked Gate / Fence: It is visibly located on private property (not inside building) but cannot be tested due to being locked or fenced in then the location of the structure is required. Only one attempt is
required. The record of the attempt shall be reported to Con Edison.

b. No Access – Field Visit (NA-Construction and NA-Dumpster)

(1) If unsuccessful in accessing and testing a structure at the first visit then a second field attempt is required, no early than two weeks after the first attempt and no later than four weeks after the first attempt to access the structure. On the second attempt, the contractor shall use the location information provided by Con Edison in order to locate the structure, such as the on-street, cross-street, and front-of address. If there is no access after the second attempt then the structure shall be reported to Con Edison with the updated contact & location information and the date of two field attempts.

(2) If the structure cannot be accessed due to permanent construction activity or dumpster on location within the specified two weeks of first attempt, then the contractor shall make the second attempt to access as per the construction activity schedule or dumpster removal schedule recorded on first attempt. The second attempt must be made before the program end date.

(3) In the event of No Access structures found in the last three weeks before the program end date, due diligence would be exercised to get the detailed contact & location information on the first attempt as well as make the second field attempt to locate and test the structure before the program end date.

6.2.5 UG Structures covered by snow/garbage
If a structure cannot be tested due to snow/garbage on the first attempt, no additional information is required. However, another attempt shall be made to the location after thaw or garbage removal to ensure all structures are tested for stray voltages. Under this circumstance, the structure cannot be reported as No Access due to snow/garbage.

6.2.6 UG structures located on Private Property
If a Con Edison owned structure is located on private property but is not locked behind a gate/fence it is considered accessible. The contractor shall attempt to test the structure using their “Con Edison Contractor Identification Card.” If refused access, the second attempt shall only be made with the Construction Management Inspector. The On-Call Construction Management inspector / supervisor must be notified daily or weekly of all locations where the contractor has been refused access to test structures located on private property. Under this circumstance, the structure cannot be reported as No
Access due to location on Private Property. *Structures on school property must be tested unless the structure is enclosed in a locked gate/fence inside the property.*

6.3 UG Structure Asset Inventory
A field inventory shall be conducted for all new structures located in the field, and shall include recording the information for each UG structure, as well as GPS coordinate collection. Refer to Exhibit C for a list of the required information. Additionally, all the data shall be electronically collected in the field using a handheld device. Refer to Exhibit M for details.

6.4 GPS Coordinates
Exhibit M details recommended GPS hardware and software requirement, GPS Technical Specifications, GPS coordinates deliverables including GPS quality assurance (QA) compliance.
7.0 OVERHEAD STRAY VOLTAGE TESTING PROCEDURE
Wooden Pole Stray Voltage Testing and Inspections includes all Con Edison owned on joint used wooden poles in the Con Edison distribution system with Con Edison attachments.

7.1 Structures Requiring Stray Voltage Test
Test criteria include all Con Edison owned or joint use wooden poles with metallic attachments located on both public thoroughfare and customer property including backyard or alley. Stray voltage test shall be performed on all wooden poles with metallic attachments such as ground wires, ground rods, anchor guy wires, riser pipes or other metallic attachments accessible at grade level to a maximum height of seven feet. Refer to Exhibit E for typical symbols of overhead pole or riser displayed on an M&S Plate.

7.2 Testing Procedure

7.2.1 Procedure
Stray voltage testing will be performed on all Con Edison owned or joint use poles with metallic attachments accessible at grade level to a maximum height of seven feet. If a stray voltage condition is detected, the Safety Notification Procedure must be followed to report the condition to Con Edison as per Exhibit K.

All wooden Con Edison or Verizon poles will be tested provided they have a ground wire, ground rod, guy wire, riser pipe, or other metallic attachment accessible from grade to a maximum height of seven feet. These attachments need not belong to Con Edison. The stray voltage test will be performed on each of the guy wires, ground wires, riser pipes, or other metallic attachment accessible at ground level. In the case of guy wires, the test will be performed on the metallic portion of the guy wire that is located approximately 12 feet laterally from the pole (see Figure 2 in Exhibit E). A pole that does not have ground wire, guy wire, riser pipe, or other metallic attachment accessible from grade to a maximum height of seven feet will not be tested for stray voltage and will be indicated by the contractor as not requiring a stray voltage inspection.

Wooden poles requiring Stray Voltage testing will be conducted using the approved voltage detectors in EO-100175.

All required stray voltage tests should be in accordance with EO-10129. All AC stray voltages identified with a stray voltage indicator will be verified with a Fluke 77/177 multi-meter from the metal attachment in question to a suitable neutral or ground point. Measurements for voltage shall be taken between the attachment being tested and a suitable ground point (e.g. metal water pipe, hydrant, steel-faced curb, sewer grating, ground rod, or driven ground).
When using roadway curbs as the reference point for measurements, only curbs that have a full steel facing extending from the sidewalk to below the pavement and a minimum continuous length of 10 feet may be utilized. When using these reference points, connections shall be made to clean bare metal surfaces. In locations where the neutral or ground point is at a distance in excess of the voltmeter lead length, the connection to the neutral/ground shall be made with suitable gauge/length lead wire, the opposite end of which shall be securely connected to the negative (black) probe of the meter or voltage continuity tester. When using such “extension leads” appropriate care shall be taken in the placement of such leads so as not to create a hazard to workers, pedestrian or vehicular traffic.

7.2.2 Exceptions
Each pole must be located and tested for stray voltage unless an exception applies. All stray voltage testing exceptions must be clearly documented.

a. Structure Not Tested
If a structure cannot be tested in the field, an exception code shall be used to report the testing status of the structure. Please refer to Exhibit D for the table of exception codes.

b. Structures Tested
If a Con Edison owned wooden pole or Verizon owned wooden pole with Con Edison attachments is found in the field but is not provided in the data extract to the contractor AND is not mapped on the M&S Plate, it shall be tested for stray voltage and in addition the pole inventory and safety inspection must be conducted.

7.2.3 No Access Procedure for Wooden Poles
In the event of no access on a wood pole the contractor shall report the testing status as No Access structure as per the following steps:

  c. No Access – Data

    (1) NA-Construction: If a pole is inaccessible due to Construction Activity then the Name of Construction Company, Contact Person, Phone Number & Duration of Construction Activity (as denoted on the permit or posting) are required in addition to the location information.

    (2) NA-Locked Gate/Fence: If a wood pole is located behind a locked gate/fence on a public or a commercial private property (Note: It does not include Residential) then the Contact Person Name & Phone Number such as building / store owner / maintenance manager are required in addition to the location information.
b. No Access – Field Visit (NA-Construction / NA-Locked Gate/Fence)

(1) If unsuccessful in accessing and testing a structure at the first visit then a second field attempt is required, no earlier than two weeks after the first attempt, and no later than four weeks after the first attempt to access the structure. On the second attempt, the contractor shall use the location information provided by Con Edison in order to locate the structure, such as the on-street, cross-street, and front-of address. If there is no access after the second attempt then the structure shall be reported to Con Edison with the updated contact & location information and the date of two field attempts.

(2) If the structure cannot be accessed due to construction activity on location within the specified two weeks of first attempt, then the contractor shall make the second attempt to access as per the construction activity schedule recorded on first attempt. The second attempt must be made before the program end date.

(3) In the event of No Access structures found in the last three weeks before the program end date, due diligence would be exercised to get the detailed contact & location information on the first attempt as well as make the second field attempt to locate and test the structure before the program end date.

7.2.4 Wooden Poles Located on Residential Property

If a wood pole with Con Edison attachments is located on a RESIDENTIAL private property and is locked behind a gate/fence, it is considered accessible. The contractor shall attempt to test the structure using their “Con Edison Contractor Identification Card.” If refused access by the customer, the second attempt shall be made by the contractor only with a Construction Management Inspector. The On-Call Construction Management supervisor must be notified of all locations where the contractor has been refused access to test structures located on private property. **A wood pole cannot be reported as No Access due to location on a RESIDENTIAL Private Property.**

7.3 Overhead Pole Inspection Procedure

The wooden pole inspection includes visually inspecting and identifying poles with physical, hardware, equipment, insulator and cable damage or oil leaks. Poles should also be inspected for tree and branch encroachment on wires. Contractors are also required to inspect for minimum primary wire clearances of 7-1/2 feet from nearest phase on pole to customers building. If any inspection damages, tree on wire, insufficient clearances or oil leaks from overhead
equipment or cable joints are discovered, contractors must follow the Safety Notification Procedure.

7.3.1 Procedure
The pole visual inspection includes the following parts:

a. Pole Condition
   - Fair – pole looks to be in acceptable and stable condition.
   - Immediate Attention Required – pole has sustained significant physical damage. Pole requires immediate attention and could be hazardous to the public. The contractor shall standby and safeguard the area until relieved by Con Edison. Refer to Exhibit K for details.

b. Tree Condition
   A tree condition would be a tree branch on a primary wire or a vine on the pole that has grown around primary or secondary wires. This does not include service wires.

c. Equipment Oil Leaking
   Signs of leaking oil are stains on the side of the equipment and a wet stain below the equipment on the ground.

d. Aerial Joint Leaking
   Signs of leaking oil are stains on the bottom of the joint as well as a wet stain below the joint on the ground. This includes all joints within visual range of the pole.

e. Cross Arm, Tri-mount and Bi-wing Bracket Damaged
   It includes any sign of cracked or failing hardware. This includes the hardware pulling away from the pole.

f. CE Primary / Secondary Riser Damaged
   This should capture a riser pipe that is heavily rusted with holes in it or pulling away from the pole, and any damage below the 7 feet from the sidewalk surface that could be dangerous for pedestrians.

g. CE Secondary / Service Wire Damaged
   If wire shows signs of being pulled away from the pole or visual signs of wire strands damaged.

h. Secondary Rack damaged
   Rack shows signs of being bent or pulled away from the pole.
i. **Insulators damaged**
   Insulators on primary or secondary are visually cracked, missing, or broken off of pins.

j. **Tie wires damaged**
   Plastic tie wires are visually broken. Wire is pulled away from pole or into the secondary rack.

k. **CE ground rod damaged**
   Ground rod out of ground and away from pole. Any condition could cause a tripping hazard.

l. **CE anchor Guy Wire damaged**
   Guy wire is slack or broken.

m. **CE arm guy wire damaged**
   Guy wire is slack or broken.

n. **CE head guy wire damaged**
   Guy wire is slack or broken.

o. **CE messenger guy wire damaged**
   Guy wire is slack or broken.

p. **Other damaged guy wire, CATV or Telephone**
   (Does not include broken wires that were made safe.)

q. **CE wire down (Primary, Secondary, or Service)**
   Wire is broken and hanging off of pole.

r. **Insufficient wire clearance**
   Primary wire are at least 7'6" from a building or antenna for 4 and 13 kV and 10'0" for 27 and 33 kV.

s. **Non-CE wire down**
   Telephone, CATV or FD.

t. **Surge Arrestors Blown**
   Surge arrestors show visual signs such as burnt connections and or disconnected arrestor lead.

u. **Wires Down**
   Con Edison overhead wires are down. The contractor shall standby and safeguard the area until relieved by Con Edison. Refer to Exhibit K for details.

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**Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult Distribution Engineering Intranet Site Distribution Engineering or http://distribution, for the current version prior to use.**
v. Oil Leak
Oil leak from Con Edison equipment on the pole. The contractor shall standby and safeguard the area until relieved by Con Edison. Refer to Exhibit K for details.

w. Other
Any situation that could be immediately dangerous to the public. The contractor shall standby and safeguard the area until relieved by Con Edison. Refer to Exhibit K for details.

Key information must be provided and safety measures must be taken to restrict access to the public. Contractors must secure the area and remain at the location until relieved by Con Edison personnel. Refer to Exhibit K for reporting procedures.

7.3.2 Visual Inspection Damages – Notify Only
When a Visual Safety Inspection reveals abnormal pole conditions such as tree on wire or insufficient wire clearances involving Con Edison attachments, Contractors must immediately notify Con Edison’s Call Center and provide key information. The contractor is not required to standby on the location. An ECS Ticket will be generated and routed to the appropriate department for follow-up repairs. Refer to Exhibit K for reporting additional inspection damages.

7.4 Overhead Asset Inventory Program
A field inventory shall include recording pole information such as pole type, location, hardware, equipment, badge ID, ground area type, Osmose tag, and Con Edison or foreign attachments as listed in the database provided by Con Edison at the beginning of the program. Refer to Exhibit F for the required information to be collected for the asset inventory.

7.5 GPS Coordinates
Contractors are required to record the N.Y.S Plane GPS coordinates at each new pole location. Exhibit M details recommended GPS hardware and software requirement, GPS Technical Specifications, GPS coordinates deliverables including GPS quality assurance (QA) compliance.
8.0 METAL POLE STRAY VOLTAGE TESTING PROCEDURE

Metal Pole Streetlight & Stray Voltage testing includes testing at night all metal poles streetlights and traffic signals located on public roadways.

8.1 Structures Requiring Stray Voltage Test

Test criteria includes all publicly accessible metal pole streetlight and traffic signals located on public roadways such as public streets, sidewalks off public streets and center medians on public streets. Testing is not required on metal pole streetlight and traffic signals located on highways, parks, piers and private property including private streets, walkways and sidewalk off private streets. The program requires that all the public roadways in the Company’s service territory are fielded for publicly accessible metal poles and 100% of the M&S plates given to the contractor are tested for stray voltage.

Stray voltage test shall be performed at night on the base, shaft and on the outside of any electrical attachments on the metal pole streetlight and traffic signals, which are accessible at grade level to a maximum height of seven feet.

8.2 Testing Procedure

8.2.1 Procedure

Stray voltage testing will be performed on all publicly accessible metal pole streetlights and traffic signals at nighttime. If a stray voltage condition is detected, the Safety Notification Procedure must be followed to report the condition to Con Edison.

Stray Voltage testing will be conducted using the approved voltage detectors in EO-100175. All required stray voltage tests should be in accordance with EO-10129. The barcode tag shall be scanned using Con Edison approved scanners after the stray voltage test has been conducted. The technical specifications of the barcode scanner shall be provided before the start of the program.

All AC stray voltages identified with a stray voltage indicator will be verified with a Fluke 77/177 multi-meter from the metal attachment in question to a suitable neutral or ground point. Measurements for voltage shall be taken between the attachment being tested and a suitable neutral or ground point (e.g. metal water pipe, hydrant, steel-faced curb, sewer grating, ground rod, or driven ground). When using roadway curbs as the reference point for measurements, only curbs that have a full steel facing extending from the sidewalk to below the pavement and a minimum continuous length of 10 feet may be utilized. When using these reference points, connections shall be made to clean bare metal surfaces. In locations where the neutral or ground point is at a distance in excess of the voltmeter lead length, the connection to the neutral/ground shall be made with suitable gauge/length lead wire, the
opposite end of which shall be securely connected to the negative (black) probe of the meter or voltage continuity tester. When using such “extension leads” appropriate care shall be taken in the placement of such leads so as not to create a hazard to workers, pedestrian or vehicular traffic.

8.2.2 Exceptions

a. Structures Not Tested
   If a structure cannot be tested in the field, an exception code shall be used to report the testing status of the structure. Please refer to Exhibit G for the table of exception codes.

b. New Structures Tested
   If a publicly accessible metal pole streetlight or traffic signal is found in the field but is not provided in the data extract to the contractor and is not mapped on the Landbase Plate, the structure shall be tested for stray voltage and the inventory and GPS information shall be collected. The contractor shall designate the pole as unmapped/new per the database data dictionary. Please refer to Section 8.3 for inventory information, and Exhibit M for GPS collection information.

8.2.3 No Access Process for Metal Poles
   In the event of no access to a facility the contractor shall report the testing status as No Access and capture the detailed contact & location information during the first field attempt as per following information.

a. No Access – Data

   (1) NA-Construction: If a metal pole is inaccessible due to construction activity then in addition to the location information such as front of building (F/O), on street, cross street 1 & cross street 2, the Name of Construction Company, Contact Person, Phone Number & Duration of Construction Activity (as denoted on the permit or posting) is required.

   (2) NA-Locked Gate/Fence: If a metal pole is located behind a temporary locked gate/fence on a public roadway then the location information is required. If the pole is located in a residential gated community and cannot be accessed, the community name, contact person, and contact number is required. Only one attempt is required to access the structure.
b. No Access – Field Visits (NA-Construction)

(1) If a metal pole located on a roadway is inaccessible due to construction at the first attempt then a second field attempt is required, no early than two weeks after the first attempt and no later than four weeks to access the metal pole. If no access then the pole shall be reported to Con Edison with the updated contact & location information and the date of both field attempts.

(2) If the pole cannot be accessed due to construction activity within the specified four weeks of first attempt, then the contractor shall conduct a third and final attempt at access as per the construction activity schedule captured on first attempt before the end of the program.

(3) In the event of No Access poles found in the last three weeks of the Program, Contractors should exercise due diligence to get the detailed contact & location information on the first attempt as well as make the second field attempt to locate and test the structure by the end of the program.

8.2.4 Metal Poles on Roadways with Restricted Access
If a publicly accessible metal pole streetlight or traffic signal is located on a roadway with restricted access (NA-Locked Gate/Fence), e.g. metal pole streetlights F/O NYSE on Wall Street, Forest Hills Garden Community, Queens, the metal pole shall be tested by Con Edison. Only one attempt is required by the contractor. The record of the attempt shall be reported to Con Edison. If the pole is located in a residential gated community and cannot be accessed, the community name, contact person, and contact number is required.

8.2.5 Base-Only Metal Poles
If a metal pole streetlight is found in the field with only a base at the location, the base of the lamp shall be tested for stray voltage. The contractor is not required to revisit the pole location and shall mark the pole as base only on the Landbase Map.

In the event the base only pole appears to be new and is not mapped on the Landbase Map, the contractor shall revisit the location no earlier than two weeks and no later than four weeks to record the inventory and GPS location for the pole. The inventory and GPS location shall only be recorded if there is a pole shaft.
8.3 **Metal Pole Asset Inventory Program**

Metal pole asset inventory shall only be conducted on new metal poles in the field. A field inventory shall include recording metal pole information such as pole type, location and electrical attachment as listed in the database provided by Con Edison at the beginning of the program. Additionally, GPS coordinates shall be recorded at all new pole locations. Refer to Exhibit I for the required information to be collected for the asset inventory.

8.4 **Metal Pole Badging Procedure**

All new publicly accessible metal poles found in the field shall be badged by the contractor as per the following guidelines:

The aluminum badge shall be installed horizontally with ¾” steel banding on the metal pole at a height of seven feet to eight feet from grade level.

The steel banding shall be fastened to the metal pole with a fastener using a banding tool. The barcode tag shall be installed facing the sidewalk where it can be safely scanned.

The badging of metal poles shall be performed according to Con Edison’s Standards, Specifications and Procedures. The installation specification for the metal pole badges will be furnished to award contractor(s).

If the contractor(s) detects stray voltage on a metal pole, the contractor(s) shall complete all the items listed under the metal pole asset inventory section with the exception of installing the tag on the pole. The contractor shall revisit the pole to install a tag within 48 hours from the time of initial attempt.

8.5 **GPS Coordinates**

Exhibit M details recommended GPS hardware and software requirement, GPS Technical Specifications, GPS coordinates deliverables including GPS quality assurance (QA) compliance.
9.0 STRAY VOLTAGE TEST DEVICE AND OPERATING PROCEDURE

9.1 Test Device Requirement
Con Edison approved and specified test equipment shall be used. Refer to Exhibit J for details.

9.2 Test Device Operating Procedure
All AC stray voltages detected by the Stray Voltage Test Device must be verified with a voltmeter, and voltage readings must be measured accurately to substantiate stray voltages. Refer to Exhibit J for details.

10.0 SAFETY SETUP AND NOTIFICATION PROCEDURE
Once the stray voltage is confirmed to be greater than one volt, a series of safety setup and notification procedure shall be followed. That is the surrounding area must be safeguarded for public safety, and immediately followed by calling Con Edison personnel to report findings. Refer to Exhibit K for details.

While conducting visual inspection on wooden poles, certain abnormal conditions observed are required to report to Con Edison. The same safety setup and/or notification procedure shall be followed. Refer to Exhibit K for details.

11.0 QUALITY ASSURANCE REQUIREMENTS

11.1 Internal quality control (QC) processes and quality assurance (QA) audit procedures shall be implemented by the contractor for each program to ensure the accuracy of data collected in the field, as well as transferring the collected data to Con Edison.

11.2 In addition, the Company shall mandate external 2% quality control audits. Refer to the QA/QC Requirements in Exhibit L.

11.3 Supplemental QA auditing is required for GPS coordinates collection. Refer to Exhibit L for details.

12.0 GPS COORDINATE SPECIFICATION

12.1 GPS Technical Specifications
Exhibit M details recommended GPS hardware and software requirement, and technical specification requirement.

12.2 Electronic Landbase Map
One-hundred percent (100%) of the GPS coordinates shall be plotted on the electronic Landbase Map, and all associated electronic ‘shape’ files shall be submitted to Con Edison as part of the deliverables. Refer to Exhibit M for details.
12.3 GPS Quality Assurance Audit
GPS QA audit is required for GPS coordinates collection. Refer to Exhibit M for details.

13.0 MARK UP INSTRUCTIONS

13.1 Marking Up M&S Plates or Landbases
Paper M&S Plates or Landbase Maps shall be marked up according to Con Edison’s specification, and returned to Con Edison on a weekly basis. Refer to Exhibit N for details.

13.2 Marking Up with a Paint Dot
A paint dot about one inch in diameter must be marked on each underground subsurface structure cover that tested for stray voltage or at the base\(^1\) of each wooden pole that tested for stray voltage. Refer to the color scheme listed below for the paint dot associated with the testing year:

- 2006 Blue (Aervoe 209)
- 2007 Red (Aervoe 281)
- 2008 Yellow (Aervoe 282)
- 2009 Orange (Aervoe 205)
- Start cycle over with the color in Blue

A ‘white’ (Aervoe 207) paint dot about one inch in diameter should be placed on QA audited structures with the exception of metal poles.

14.0 INFORMATION RESOURCES REQUIREMENTS

14.1 General
Con Edison requires the contractor to carefully manage the distribution and disposition of printed and plotted maps due to the sensitive nature of the information they contain. Contractor shall maintain a daily record of the employees to whom they are distributed and shall ensure that all copies are destroyed by the end of each workday.

The contractor shall have secured access to all Company M&S plates. The awarded contractor must sign and be in compliance with Con Edison’s non-disclosure / confidentiality agreements regarding accessing, controlling, and

\(^1\) At the base of a wooden pole is defined as ‘just above the sidewalk’ or ‘as close to the sidewalk surface as possible.’
safeguarding of facility maps, plates, drawings, etc. used for the purpose of satisfying its contractual obligations in advance of award of a contract.

14.2 **VPN Connection**

The awarded contractor will be provided remote access via Virtual Private Network (VPN) connection to Con Edison M&S plates. An access database will also be available via VPN connection for transmittal of inspection information.

The contractor is responsible for remotely printing all M&S plates. The Company will not provide printed plates to the contractor.

The contractor shall update the master inspection database through a secured VPN connection on a weekly basis.

14.3 **IT Hardware and Software**

The contractor is responsible for hiring IT staff to administer the hardware and software installation, operation and maintenance. The contractor shall have the following:

14.3.1 Recommended: Dell GX Business Class Desktop PC or equivalent

14.3.2 Plotter to print M&S plates. Recommended: Xerox 510 Copy System.

14.3.3 Broadband Internet connection (DSL, Cable, or T1)

14.3.4 PC’s with the following minimum configuration and software:

   b. Office XP Professional
   c. CGM Viewer, provided by Con Edison at no additional cost to the contractor
   d. Firewall software to be acquired by the contractor at its cost. Black Ice Software is recommended.

14.4 **Competent IT Manager and Staff**

The contracting firm is responsible for employing its own Information Technology (IT) staff to administer the computer hardware and software installation, system operation and maintenance.

The contractor is responsible for assigning a dedicated Information Technology and/or Data Manager who shall be responsible for administering the hardware/software installation, operation, maintenance, and VPN connection requirements. The responsibilities shall include identifying and supporting
14.5 Con Edison Data Deliverables

The contractor will use Con Edison’s M&S plates and data records to identify structures during a field inspection. Street, and Cross streets. The UFID/MSLINK number is a unique number in the mapping database used to identify each structure across the Con Edison distribution area. These four items must be used together with the M&S plates during a field inspection to verify each structure location. It is essential that each location be identified correctly to match the structure number with the UFID/MSLINK number in order to avoid improper recording.

Con Edison will provide Intranet access to M&S plates through a secured VPN connection. Once on the Intranet site, the contractor will have access to the most up-to-date copies of Con Edison maps. Contractor staff will be able to produce printed or plotted copies on hardware described below, using functions available on the Intranet site. Use of VPN and other necessary training will be provided as necessary.

Con Edison will provide Intranet access through VPN connection to electronic data files (in MS Access database format) that contains the structures and equipment for testing. The data files shall be saved in the Distribution Engineering Server.

15.0 CONTRACTOR DELIVERABLES

The following reporting requirements shall be sent to Con Edison unless notified specifically by the stray voltage testing program manager:

15.1 Daily Requirements

15.1.1 Daily Crew Route Report: By 7am daily or otherwise specified, email the crews’ itinerary report for the day. The crew itinerary report should include the following information, hours of operation if different daily, number of crews, crew routes, crew Name with specific M&S Plates assigned for that day. The contractor(s) shall provide the crew itinerary report for each shift.

15.1.2 For the Metal Streetlight and Traffic Signal Pole Stray Voltage Testing Program: The contractor(s) shall also summarize on the Daily Progress Report any residential gated communities which could not be accessed. A separate section for the report will be reserved for this purpose, and will include borough, on-street, cross-street, M&S Plate, name of the community, and the contact information for either the property manager or real estate manager for the community.
15.2 **Weekly Requirements**

15.2.1 Weekly Progress Report: The daily inspection progress report summarizing the number of inspections completed, stray voltage found & reported with the corresponding B-Ticket number, number of no access facilities and the number of not mapped facilities inspected and tested. The daily inspection progress report shall have a cumulative progress section with a histogram comparing the progress against the milestone schedule. A detailed format of the report shall be provided at the start of the Program.

15.3 **Bi-Weekly Requirements**

15.3.1 Not-Found Report: The bi-weekly Not-Found report shall list all structures that could not be found by the contractor(s) field inspectors within the prior two weeks. This listing will have each structure’s unique identifier listed, along with the M&S Plate / Landbase Map the structure is located on, and the date of visit by the field inspector.

15.3.2 QA/QC Audits Progress Report: The weekly QA inspection progress report shall summarize the total number of work in progress QA inspections and post work completion QA inspections completed. The report shall also list the total number of failed inspections.

15.4 **Monthly Requirements**

15.4.1 Testing Data Upload: All data must be uploaded within one month from the date the test is conducted on a structure. Data for the passes that are considered ’Exceptions’ (i.e. No Access) are also required to be uploaded within one month from the date of the attempt of access. Each M&S Plate or Landbase Map reported must be fully completed within a month from the date of data upload.

15.4.2 QA/QC Data Upload: The data for the completed QA inspections shall be uploaded monthly to the QA Inspections database created for the contractor(s) in their respective folder. The contractor(s) shall compare the results for the random post work completion QA inspections against the original data and report the total number of failed inspections along with the errors.

15.4.3 Quality Control Inspection Results Report: The contractor shall provide a detailed Quality Control Inspection Results Report on a monthly basis. The report shall classify the failed inspections errors by type and submit a pie chart / histogram on the total errors observed. Any work in progress errors observed shall be corrected in the field. The details on the corrective action implemented shall be included in the report. The data manager shall submit
16.0 TRAINING REQUIREMENT

The awarded contractor(s), specifically the field supervisor / foreman level, must attend a Contractor Orientation Session (or Train-the-Trainer Orientation) provided by Con Edison prior to performing any stray voltage test or overhead inspection. The Orientation will cover personal safety issues such as PPE, hazards assessment of work area including traffic controls; instructions on reviewing M&S Plates, overview of Con Edison’s distribution systems, use of voltage detectors and testing procedures and reporting and recording procedures.

The awarded contractor(s) are responsible for other additional training requirement. Once the Trainer of the contracting company has trained its own employees of eHASP (Environment Health and Safety Plan), a list of trained employees’ names and their Social Security Numbers must be submitted to Con Edison before work shall commence.

Con Edison is not responsible for any training on electronic data collection and recording or the use of hardware or software required for the program. Also, Con Edison shall not provide any technical support or training on any hand-held device and data collection software selected by the contractor(s). The awarded contractor(s) is responsible for internal training and technical resources for using the hand held data collector/logger, GPS receiver, and stray voltage tester. The contractor shall elaborate on their proposed training methods selected to train the field inspectors to operate the specified hardware/software requirements in their technical proposal.

At a minimum, the contractor personnel conducting these tests should have knowledge and training in the following topics:

- Use of Proper Personal Protective Equipment
- Work Area Protection
- Hazard Communication
- First Aid CPR (This is required only on multi-person crews)
- The proper use of the Approved Voltage Detector and Meter
- Contractors shall not enter subsurface structures.
- Content and Implementation of Contractor eHASP
17.0 COMMUNICATION REQUIREMENT
The following information, at a minimum, needs to be communicated to all personnel, at the beginning of each shift, for Stray Voltage Detection Work.

- No cover or frame is to be touched with a bare hand or any part of the body; only the voltage detector or meter is to be used to make contact with the facilities.
- Each individual needs to be aware of his/her surroundings at all times.
- Always make sure to observe all traffic before entering a street, either at intersections or any other point. A flag person should be used to control the traffic flow when needed.
- Always wear a traffic safety vest (DOT Compliant Class II).
- Be aware that when bending down, the visibility benefits of the traffic safety vest are diminished.
- Always obey all traffic control devices.
- When finding a facility with stray voltage located in traffic, the contractor shall stand by and safeguard the facility at a distance.
- If at all possible, stand facing oncoming traffic when in the street.

18.0 PRIOR TO COMMENCEMENT
Prior to the commencement of any work in the field the contractor shall train all the field employees on the environmental health and safety plan (eHASP). A list of all the contractor employees along with their Social Security numbers must be submitted to Con Edison before the start of any work.

19.0 REFERENCE SPECIFICATIONS
The following specifications and documents are referenced in this specification:

EO-100175  Purchase Recommendation – Low Voltage Detectors for Stray Voltage
EO-10129  Operation & Maintenance of Low Voltage Detectors – Stray Voltage
EO-5100  Low Voltage Detectors – Stray Voltage
EO-13233-B  Pole Identification Tag and Voltage Badge
350129  44 INCH MB RING For Use with Q-8 Manhole Cover
20.0 **ATTACHMENTS**
The following exhibits are attached.

- **Exhibit A** – Underground Testing Exception Codes
- **Exhibit B** – Underground Structure Covers and Symbols
- **Exhibit C** – Underground Asset Inventory Requirements
- **Exhibit D** – Wooden Pole Testing Exception Codes
- **Exhibit E** – Wooden Pole Pictures, Diagrams, and Symbols
- **Exhibit F** – Wooden Pole Asset Inventory Requirements
- **Exhibit G** – Metal Pole Testing Exception Codes
- **Exhibit H** – Metal Pole Pictures, Symbols, and Diagrams
- **Exhibit I** – Metal Pole Asset Inventory Requirements
- **Exhibit J** – Stray Voltage Testing Device
- **Exhibit K** – Safety Notification Procedure
- **Exhibit L** – QA/QC Requirement
- **Exhibit M** – GPS Coordinate Specifications
- **Exhibit N** – Mark-Up Instructions for Maps

 Won Choe (Signature on File)
Won Choe
Department Manager
Secondary Systems Analysis
Distribution Engineering

Brian Marks
Matthew Glasser
Aseem Kapur
Richard Luong
Winnie Yueh
REVISION 2:
- Reformatted the specification to align with the Specification Writer’s Guide issued on May 2006
- Reorganized the specification by moving testing programs to main body and moving tables, pictures, and diagrams to various Exhibits
- Expanded or added materials on QA/QC Requirements and GPS Coordinate Specifications from the previous revision
- Modified the Safety Notification Procedure to conform to current practices
- Modified Exception Codes for all testing programs to reflect changes in categorization
- Removed embedded files and added tables for asset inventories in Exhibits
- Added PBoxes and Injunction Boxes to UG Structures
- Removed ‘NM’ testing code from all programs
- Clarified ‘Private Property’ classification for all three programs
- Added Biweekly reporting requirement for Not Founds
- Changed frequency of multiple reporting requirements
- Modified number of required visits for ‘No Access’ categories

FILE:
## EXHIBIT A

### UNDERGROUND TESTING EXCEPTION CODES

<table>
<thead>
<tr>
<th>Exception Code</th>
<th>Location of Structure (Default Location is Street)</th>
<th>Definition of Exception Code</th>
<th>Procedure to be followed by Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>NF</td>
<td>Unknown</td>
<td>Structure could not be located in the field, but is mapped on the M&amp;S Plate.</td>
<td>Provide the location as per M&amp;S plate.</td>
</tr>
<tr>
<td>NA-Construction</td>
<td>Sidewalk / Intersection / Median / Private Property</td>
<td>A structure is defined as No Access under the following conditions:</td>
<td>The contractor shall re-attempt to access and test the structures. Refer to Section 3.4 in the Exhibit. The contractor shall re-attempt to access and test the structures. Refer to Section 3.4 in the Exhibit.</td>
</tr>
<tr>
<td>NA-Dumpster</td>
<td>Sidewalk / Intersection / Median / Private Property</td>
<td>It is verified to be located in a publicly accessible area but cannot be tested due to construction activity.</td>
<td>The contractor shall re-attempt to access and test the structures. Refer to Section 3.4 in the Exhibit.</td>
</tr>
<tr>
<td>CP</td>
<td>Con Edison Property</td>
<td>A structure cannot be tested, as it is located inside Con Edison property.</td>
<td>Provide the name and location of the Con Edison Property.</td>
</tr>
<tr>
<td>IB</td>
<td>Inside Building</td>
<td>A Structure is defined as Inside Building when it is not visible in the field and is located in the basement or high-rise floor etc. <strong>This only pertains to Transformer Vaults inside buildings.</strong></td>
<td>Provide the location of the building and building name (if available).</td>
</tr>
<tr>
<td>NA-Highway</td>
<td>Highway</td>
<td>It is located on major city/state/national highway and requires a special permit for access.</td>
<td>Provide the Highway Name</td>
</tr>
<tr>
<td>DP</td>
<td>Duplicate Structure</td>
<td>A structure cannot be tested, as a duplicate structure with same type and number is located on the same M&amp;S plate. <strong>Note: Duplicate structures may exist across different M&amp;S Plates but not on the same M&amp;S Plate.</strong></td>
<td>Provide the location information for the structure duplicated to.</td>
</tr>
</tbody>
</table>
EXHIBIT B

SAMPLE OF UG STRUCTURE COVERS AND SYMBOLS

Figure 1 – Manhole Cover

Figure 2 – Manhole Cover
Figure 3 – Manhole Cover

Figure 4 – Service Box Cover
Figure 5 – Vault Gratings

Figure 6 - URD / Padmount Structure
Figure 7 - UG Structure Symbols
EXHIBIT C

UNDERGROUND ASSET INVENTORY REQUIREMENTS

- GPS X and GPS Y
- Structure Location: Front of Address, On Street, Cross Street 1, Cross Street 2, etc.
- Structure Type: SB, MH, T-Tap, Transformer Vault, etc.
- Location of Structure: Street, Sidewalk
- Cover Type: Solid or Vented
- Cover Shape: Square, Rectangle, or Round
- Cover Ring: 44 Inch MB Ring
### EXHIBIT D

**WOODEN POLE TESTING EXCEPTION CODES**

<table>
<thead>
<tr>
<th>Exception Code</th>
<th>Location of Structure (Default Location is Sidewalk)</th>
<th>Definition of Exception Code</th>
<th>Procedure to be followed by Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>NF</td>
<td>Unknown</td>
<td>Pole could not be located in the field but is mapped and is in the database.</td>
<td>Provide location information for the pole as per the M&amp;S plate.</td>
</tr>
<tr>
<td>NF Tested Area</td>
<td>Unknown</td>
<td>Riser Pole could not be located in the field but is mapped and is in the database.</td>
<td>The contractor shall test ground at the approximate location as shown on the map, as well as all metallic structures within a 10’ radius of the location. The contractor shall re-attempt to access and test the structure. Refer to Section 7.2.3.</td>
</tr>
<tr>
<td>NA-Construction</td>
<td>Backyard / curb / private property / alley COMMERCIAL Private Property</td>
<td>It is verified to be located in a publicly accessible area but cannot be tested due to construction activity etc. It is visibly located on a public or COMMERCIAL private property but locked or fenced in resulting in no access. It does NOT include RESIDENTIAL private property (e.g. backyards, gated communities).</td>
<td>The contractor shall report the name and contact information of the commercial property owner (if available).</td>
</tr>
<tr>
<td>CP</td>
<td>Con Edison Property</td>
<td>Wood Pole is located inside Con Edison property</td>
<td>Provide the name and location of the Con Edison Property.</td>
</tr>
<tr>
<td>NA-RR</td>
<td>Railroad Right-of-way</td>
<td>It is located along a Railroad right-of-way</td>
<td>Provide the Railroad Name (e.g. LIRR or SIRT)</td>
</tr>
<tr>
<td>NA-Highway</td>
<td>Highway</td>
<td>It is located on major city/state/national highway and requires a special permit for access.</td>
<td>Provide the Highway Name</td>
</tr>
</tbody>
</table>
Figure 1 – Wooden Poles with Metal Attachments
**Figure 2 – Guy Wire Diagram**

**Figure 3 - Overhead Pole Symbols**
Figure 4 – Wooden Pole Attachments (4-kV)

Figure 5 – Wooden Pole Attachments (13 / 27-kV)
## EXHIBIT F

### WOODEN POLE ASSET INVENTORY REQUIREMENTS

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FrontOfAddress</td>
<td>CATVCompanies</td>
</tr>
<tr>
<td>OnStreet</td>
<td>CATVPowerSupply</td>
</tr>
<tr>
<td>OnStAlias</td>
<td>FireAlarmWires</td>
</tr>
<tr>
<td>CrossStreet1</td>
<td>FireAlarmPullBox</td>
</tr>
<tr>
<td>CrossStreet2</td>
<td>FireAlarmLEDLight</td>
</tr>
<tr>
<td>MuniCode</td>
<td>FireAlarmIncandesantLight</td>
</tr>
<tr>
<td>MuniName</td>
<td>FireAlarmRiser</td>
</tr>
<tr>
<td>GPSX</td>
<td>Floodlights</td>
</tr>
<tr>
<td>GPSY</td>
<td>FiberOpticAttachments</td>
</tr>
<tr>
<td>PoleHeight</td>
<td>OtherPowerSupply</td>
</tr>
<tr>
<td>PoleHeightClassEstimated</td>
<td>StLights0Watt</td>
</tr>
<tr>
<td>YearStencil</td>
<td>StLights150Watt</td>
</tr>
<tr>
<td>VoltageIDTag</td>
<td>StLights250Watt</td>
</tr>
<tr>
<td>InventoryDone</td>
<td>StLights175Watt</td>
</tr>
<tr>
<td>SafetyInspectionDone</td>
<td>TwoWayTrafficSignals</td>
</tr>
<tr>
<td>EquipmentOnPole</td>
<td>ThreeWayTrafficSignals</td>
</tr>
<tr>
<td>ForeignAttachmentsOnPole</td>
<td>FourWayTrafficSignals</td>
</tr>
<tr>
<td>OSMOSETagPresent</td>
<td>FiveWayTrafficSignals</td>
</tr>
<tr>
<td>OSMOSETagYear</td>
<td>UnknownTrafficSignals</td>
</tr>
<tr>
<td>OSMOSETagType</td>
<td>PedWalkTrafficSignals</td>
</tr>
<tr>
<td>OSMOSETreatmentType</td>
<td>StreetOrTrafficLightRisers</td>
</tr>
<tr>
<td>OSMOSECorDblCTrussPresent</td>
<td>CATVAnchorGuyWires</td>
</tr>
<tr>
<td>PoleType</td>
<td>CATVHeadGuyWires</td>
</tr>
<tr>
<td>GPSManual</td>
<td>CATVRisers</td>
</tr>
<tr>
<td>VisInspInvDate</td>
<td>CATVGroundRods</td>
</tr>
<tr>
<td>VisInspector</td>
<td>CATVGroundWires</td>
</tr>
<tr>
<td>VisInspOrganization</td>
<td>TelWires</td>
</tr>
<tr>
<td>CATVVWires</td>
<td>TelAnchorGuyWires</td>
</tr>
</tbody>
</table>

### Notes
- Paper copies of procedures and instructions are uncontrolled and therefore may be outdated. Please consult Distribution Engineering Intranet Site Distribution Engineering or http://distribution, for the current version prior to use.
## EXHIBIT G

### METAL POLE TESTING EXCEPTION CODES

<table>
<thead>
<tr>
<th>Exception Code</th>
<th>Location of Structure</th>
<th>Definition of Exception Code</th>
<th>Procedure to be followed by Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>NF Tested Area</td>
<td>Unknown</td>
<td>Metal Pole could not be located in the field at the specified location.</td>
<td>The contractor shall test ground at the approximate location as shown on the map, as well as all metallic structures within a 10’ radius of the location.</td>
</tr>
<tr>
<td>NA-Construction</td>
<td>Sidewalk / Intersection / Median</td>
<td>It is verified to be located in a publicly accessible area but cannot be tested due to construction activity etc.</td>
<td>The contractor shall re-attempt to access and test the structure as per the No Access procedure for Metal Poles listed in Section 8.2.3</td>
</tr>
<tr>
<td>NA-Locked Gate/Fence</td>
<td>Sidewalk / Intersection / Median</td>
<td>It is visibly located on a publicly accessible street but is behind a locked gate/fence. This also applies to Metal Poles located on a street in a residential gated community and that could not be accessed</td>
<td>Provide the location information of the light. If the light is in a residential gated community, provide the name and contact information for the community</td>
</tr>
<tr>
<td>NA-Highway</td>
<td>Highway</td>
<td>Metal Pole is located on major city/state/national highway and requires a special permit for access.</td>
<td>Provide the name of the Highway</td>
</tr>
<tr>
<td>DP</td>
<td>Duplicate Record</td>
<td>The pole is a duplicate record of another metal pole and was not located at the specified location</td>
<td>Provide the Metal Pole Barcode Badge number of the pole that is found in the field at the specified location</td>
</tr>
<tr>
<td>NMP</td>
<td>Primarily residential communities</td>
<td>Non-metal pole – Pole on the Landbase / M&amp;S Plate that does not have a metal housing, such as a fiberglass / plastic pole</td>
<td>Provide the location information of the light. If the light is in a residential community, provide the name of the community</td>
</tr>
<tr>
<td>CL</td>
<td>Customer Light on private property</td>
<td>Metal Pole is a privately owned metal pole located on private property and is not owned by the NYC DOT or Municipality.</td>
<td>Provide the location information of the light</td>
</tr>
</tbody>
</table>
EXHIBIT H

SAMPLE OF METAL POLE PICTURES, SYMBOLS AND DIAGRAMS

Figure 1 – Metal Pole Streetlights and Traffic Signals
Figure 2 – Landbase Map with Metal Pole Symbols

Figure 3 – Traffic Signal & Streetlight Metal Pole Attachments
Figure 4 - Stand Alone Traffic Signal and Attachments

Figure 5 - Metal Pole Barcode Tag
## EXHIBIT I

**METAL POLE ASSET INVENTORY REQUIREMENTS**

<table>
<thead>
<tr>
<th>SLUniqueID</th>
<th>Region</th>
<th>StreetlightType</th>
<th>StructureType</th>
</tr>
</thead>
<tbody>
<tr>
<td>StructureNumber</td>
<td>MSPlate</td>
<td>GPSPlate</td>
<td>LocationType</td>
</tr>
<tr>
<td>GPSX</td>
<td>GPSY</td>
<td>Address</td>
<td>BID</td>
</tr>
<tr>
<td>DirectionLocationID</td>
<td>OnStreet</td>
<td>OnStAlias</td>
<td>CrossStreet1</td>
</tr>
<tr>
<td>CrossStreet2</td>
<td>MuniCode</td>
<td>MuniName</td>
<td>MSStructureMapped</td>
</tr>
<tr>
<td>Comments</td>
<td>PoleAttachmentsInventoryDate</td>
<td>PoleAttachmentsInspector</td>
<td>PoleAttachmentsInspOrganization</td>
</tr>
<tr>
<td>StLuminaires</td>
<td>WattStickerNumStLum1</td>
<td>WattStickerNumStLum2</td>
<td>PedLuminares</td>
</tr>
<tr>
<td>WattStickerNumPedLum1</td>
<td>WattStickerNumPedLum2</td>
<td>LEDFireAlarms</td>
<td>LEDFireAlarmOn</td>
</tr>
<tr>
<td>IncandescentFireAlarms</td>
<td>IncandescentFireAlarmOn</td>
<td>TwoWayTrafficSignals</td>
<td>ThreeWayTrafficSignals</td>
</tr>
<tr>
<td>PedWalkTrafficSignals</td>
<td>AuxControlBoxes</td>
<td>TrafficControlBoxes</td>
<td>FireAlarmPullBoxes</td>
</tr>
<tr>
<td>PedPushButton</td>
<td>FloodLights</td>
<td>SpotLights</td>
<td>Cameras</td>
</tr>
<tr>
<td>MicrowaveSensors</td>
<td>VariableMessageSigns</td>
<td>CommunicationAntennae</td>
<td>LEDStSigns</td>
</tr>
<tr>
<td>IlluminatedTrafficSigns</td>
<td>ForeignAttachments</td>
<td>ForeignAttachmentType</td>
<td></td>
</tr>
</tbody>
</table>

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EXHIBIT J

STRAY VOLTAGE TESTING DEVICE

1.0 REQUIREMENT
Contractors must use the following Con Edison approved and specified tools and equipment to perform stray voltage testing:


- Fluke 77/177 Multi-meter shall be used to take voltage measurement when the HD low voltage detector has indicated possible stray voltage detected on a structure.

The contractor is responsible for purchasing the required number of voltage detectors, proof tester, multi-meter and the accessory bag as per EO-100175 in order to perform the testing. A proof tester has to be purchased for every voltage detector used for field-testing. **Field inspectors must test the device once every hour during the course of the inspectors’ work.** The periodic testing of the detector is necessary to maintain the integrity of the stray voltage testing results.

2.0 PROCEDURE
All AC stray voltages identified with a stray voltage indicator will be verified with a Fluke 77/177 multi-meter from the structure in question to a suitable neutral or ground point. Measurements for voltage shall be taken between the object (base, shaft or metal attachments) being surveyed and a suitable neutral or ground point (e.g. metal water pipe, hydrant, steel faced curb, sewer grating, ground rod, or driven ground). When using roadway curbs as the reference point for measurements, only curbs that have a full steel facing extending from the sidewalk to below the pavement and a minimum continuous length of 10 feet may be utilized. When using these reference points, connections shall be made to clean bare metal surfaces. In locations where the neutral or ground point is at a distance in excess of the voltmeter lead length, the connection to the neutral/ground shall be made with suitable gauge/length lead wire, the opposite end of which shall be securely connected to the negative (black) probe of the meter or voltage continuity tester. When using such “extension leads” appropriate care shall be taken in the placement of such leads so as not to create a hazard to workers, pedestrian or vehicular traffic.
EXHIBIT K

SAFETY NOTIFICATION PROCEDURE

1.0 NOTIFICATION AND STANDBY
If one of the following conditions is detected on any structure (UG or OH or SL) in the field then the contractor must immediately notify Con Edison’s Call Center at 718-222-7175, and standby for Con Edison and/or NYC DOT personnel:

1.1 Stray Voltage
On UG Structures, OH Wood Pole Metal Attachments & Metal Pole Streetlights & Traffic Signals (Note: Applies to all Structure Types)

1.2 Pole Condition – Immediate Attention Required
Pole has sustained significant physical damage and requires immediate attention (Note: Applies to OH Poles only)

1.3 Oil Leak(s)
Oil Leaking on OH Wood Pole Equipment (Note: Applies to OH Poles only)

1.4 Wire(s) Down
Con Edison Wires Down, on OH Wood Poles (Note: Applies to OH Poles only)

1.5 Wires Exposed
Wires Exposed due to a missing base on Metal Pole Streetlights & Traffic Signals (Note: Applies to Metal Poles only)

2.0 SAFETY SETUP REQUIREMENT
In instances of Stray Voltage (greater than one volt), Oil Leaks, Wires Down, and Wires Exposed, the surrounding area must be safeguarded for public safety. The field crew must immediately take measures such as barricade tape or barricades to restrict public access. If the structure is in a traffic lane, the contractor shall protect the structure from the curbside.

3.0 NOTIFICATION REQUIREMENT
Key information must be provided and safety measures must be taken to restrict access to the public. Contractors must secure the area and remain at the location until relieved by Con Edison personnel.

When testing indicates the presence of voltage on a structure, the field crew shall verify the voltage reading with the multi-meter. If the reading is greater than one volt the field crews or supervisor will immediately notify the Call Center (contact phone number shall be furnished at the Contractor Orientation session) and report the following information:
CSA:  (e.g., Brooklyn, Queens, Staten Island, Bronx, Westchester, or Manhattan)

Company Name:  (e.g., ABC Company)

Employee Name:  (e.g., John Doe)

Testing Program:  Specify one of the following:
(Current Year)  UG Manual Stray Voltage Testing Program
(Current Year)  OH Manual Stray Voltage Testing Program
(Current Year)  SL Manual Stray Voltage Testing Program

Streetlight Badge Number:  (If Applicable)

Structure Type:  (e.g., manhole, service box, vault, pole, streetlight, etc.)

Structure Number:  (e.g., #12345)

Location:  (e.g., 409 East 90th Street, Manhattan)

Nearest Cross Street:  (e.g., York Ave)

M&S Plate Number:  (e.g., 41-L)

Voltage Reading:  (e.g., only voltage readings > 1V shall be reported)

Foreign ground used:  (e.g., fire hydrant, steel curb, etc)

Call back number:  (e.g., phone number of person calling in stray voltage)

Standing By:  Yes

The survey crews will stand-by the structure until relieved by a Con Edison employee.

4.0 NOTIFICATION ONLY
When a Visual Safety Inspection reveals abnormal pole conditions, Contractors must immediately notify Con Edison’s Call Center and provide key information. The following instances will NOT require standby:

4.1 Insufficient Wire Clearance
When a Visual Safety Inspection reveals abnormal pole conditions such as OH pole condition – immediate attention and insufficient wire clearances involving Con Edison attachments
4.2 Wires Exposed
When the wires and/or conduit is exposed at a Metal Pole Streetlight/Traffic Signal location that and the metal pole and base are missing, and no stray voltage is detected on the wires, conduit, bolts, and metal structures within a 10’ radius.

In such cases, the contractor is not required to standby on the location. The following information shall be provided upon notification:

CSA: (e.g. - Brooklyn, Queens, Staten Island, Bronx, Westchester, or Manhattan)

Company Name: (e.g. ABC Company)

Employee Name: (e.g.- John Doe)

Structure Type: (e.g. – manhole, service box, vault, pole, streetlight, etc.)

Structure Number: (e.g.- #12345)

Location: (e.g. 409 East 90th Street, Manhattan)

Nearest Cross Street: York Ave.

M&S Plate Number: (e.g.- 41-L)

Call back number: (e.g. phone number of person calling in stray voltage)

Also, for wires exposed at a Metal Pole Streetlight/Traffic Signal location with no stray voltage, the contractor will notify the Con Edison control center that the B-Ticket should be classified as an ‘SLP’ ticket.

5.0 RECORDKEEPING
The contractor shall record and report the following information for each standby location:

- B-Ticket Number
- Unique Structure ID
- Date and Time of Notification
- Date and Time of Contractor Relief
- Name of Caller
- Type of Problem (e.g. Stray Voltage, Oil Leak)
5.1 In cases where the ‘Type of Problem’ is Stray Voltage, the following additional information is required:

- Voltage Reading
- Grounding Source

6.0 NOTIFICATION GUIDELINES

6.1 First Notification by Testing Contractor
The testing contractor shall notify the Con Edison control center and notify the stray voltage and/or visual safety inspection condition. The Contractor must notify the control center whether they are standing by on location or not.

6.2 Second Notification by Testing Contractor (Traffic Signals & Pedestrian Walk Don’t Walk Signals Only)
Prior to calling a Stray Voltage incident on Traffic Signals and Pedestrian Walk/Don’t Walk signs to the Con Edison Call Center, the testing contractor must notify the NYC DOT Communication Center and report the energized metal pole location along with the voltage reading and get a DOT Confirmation Number.

The DOT Communication Center number is 718-433-3340, the caller is to confirm that the work ticket is coded a "20 Louie" (02 20L), and the call confirmation number is to be recorded on the B-ticket generated by the Con Edison call center. After the confirmation number has been received the contractor shall notify the Con Edison Call Center as per First Notification listed above and provide the Confirmation Number in addition to the fields listed above.

6.3 Third Notification by Testing Contractor Supervisor or Field Manager
Upon relief at each standby location by Con Edison or the DOT contractor the Stray Voltage Testing Contractor shall notify the Call Center of the time of Relief as well as the ON CALL Construction Management Inspector. The contractor shall be responsible for notifying the Call Center of the time of their relief.

6.4 Fourth Notification by Testing Contractor Supervisor or Field Manager
At the end of each daily or nightly shift, the Stray Voltage Testing Contractor Supervisor or Field Manager shall notify the Construction Management personnel on-duty with a list of all notification incidents that occurred during the shift, and shall provide the associated B-Ticket numbers, Structure ID’s, Date/Time of Notification, Date/Time of Relief, Type of Problem, and Voltage Reading.
EXHIBIT L

QA/QC REQUIREMENT

1.0 PROCEDURE
Contractor(s) shall implement the following quality control procedures to ensure that the accuracy of data collected in the field. The contractor(s) shall have designated quality control technicians who will be responsible to meet the following requirements:

1.1 Internal Audits
The contractor(s) shall conduct random field inspections including work in progress and post work audits on all work done by the field inspectors. Any work in progress discrepancies will be addressed at the time of identification and the corrections will be made to ensure the quality of inspections. The work in progress quality and post work quality control inspections shall be performed for the duration of the program. The Company mandates that the contractor shall conduct random internal QA/QC audits on a minimum of 2% of all the work completed by them. Refer to the reporting section for reporting the results to Con Edison.

1.2 External Audits
The Company shall randomly select 2% of the entire population completed by the contractor on a monthly basis for the contractor to re-field and re-test. During the audit the contractor quality control technician shall complete the entire applicable scope of work including: attachment inventory, visual inspection GPS coordinates and stray voltage testing. The random audit inspections shall be performed throughout the duration of the program. The contractor shall compare the audit data with the initial inspection and correct any deficiencies. The contractor shall spray paint every facility with a white dot where the Company mandated external audit is completed.

1.3 GPS QA/QC
All the GPS coordinates collected by the contractor shall be plotted on the Landbase Maps. The contractors shall randomly print 2% of the Landbase Maps and submit to Con Edison for verification of accuracy.

1.4 Data Checks & Control
Before submitting the data to Con Edison the contractor(s) shall check the data for accuracy to remove all erroneous entries. The contractor(s) is responsible to set up customized lists and data entry fields in the tailored to meet Con Edison’s specific requirements listed in scope of work for each program. The contractor(s) is responsible for making corrections to incorrect data.
2.0 RECORDKEEPING & REPORTING

2.1 QA Records
The Company shall provide a separate database for the 2% external QA/QC audits. The data shall be collected and maintained independently from the master inspections and submitted to Con Edison regularly. At the end of the program the contractor shall identify all the 2% records where an internal audit was conducted. Each audit completed by the contractor (internal or external) must accompany the name of the quality control inspector and the date of audit.

2.2 QA/QC Reports
The contractor shall submit internal quality control reports on all the internal work in progress and post work audits completed. The report shall include the number of audits completed delineated into total number of pass and failed inspections. All the failed audits shall be classified by failure types such as incorrect inventory, incorrect badging etc. The contract field manager shall certify each quality control report for completion and accuracy. At the end of the program the project manager shall submit a detailed QA/QC report including the total number of audits completed, the failures observed and the corrections made.

3.0 RESOURCES AND STAFFING
The contractor shall maintain a dedicated quality control staff based on the total staffing levels to meet the internal and external quality control requirements. The field manager shall directly supervise the quality control technicians. The contractor shall submit the milestones to meet the internal/external audit requirements with the corresponding staffing levels for the quality control technicians in the technical proposal. The quality control technicians shall be provided with all the tools and equipment required for completing all the items in the scope of work for each program.

4.0 QA/QC FOLLOWUP
Con Edison shall be conducting random audits on all the work completed by the contractor. Any deficiencies or inaccuracies observed in the data collection shall be returned to the contractor for correction and recollection. The Company shall audit all facilities for stray voltage and in the event that a facility is found where the stray voltage test was not done, the contractor shall retest the entire M&S plate.
EXHIBIT M

GPS COORDINATE SPECIFICATIONS

5.0 GPS EQUIPMENT
Contractor(s) shall record the N.Y.S Plane GPS coordinates at each facility with sub meter precision. The contractor is required to use the Trimble GPS Pathfinder Pro XR or Pro XH receiver to record the GPS coordinates. The contractor(s) shall record the GPS coordinates and all the attributes listed in the scope of work for each program using a handheld device. The contractor(s) is responsible for purchasing the following hardware and software:

- TRIMBLE GPS Pathfinder Pro XR or PRO XH Field Kit
- TRIMBLE Pathfinder Office Software Kit
  Please note that the contractor(s) is only required to purchase one copy of the Pathfinder Office Software Kit.
- TRIMBLE Recon Standalone Including PC2003 (OS) Option (2) for Data Collector – Handheld Device for Data Collection *
- TRIMBLE TerraSync Pro software for Handheld *
  Each handheld requires a separate license.

*Con Edison recommends the purchase of this handheld and the software for electronic data collection. The contractor may use any comparable handheld and software that is compatible with Pathfinder Office software and the Trimble GPS receiver. The contractor shall submit the details on the alternative handheld type and the data collection software in the technical proposal. The Company must approve the hand-held type and data collection software selected by the contractor before the start of the program.

Feature and attribute data should be inputted with the TerraSync™ software running on the Trimble Recon™ handheld, or an existing/new data collection software at the contractor(s) discretion. The GPS coordinates and all the additional attributes of each facility specified in the Scope of Work for each program shall be electronically recorded using a hand-held device. A list of all the hand-held devices compatible with the TerraSync™ software can be found on their website.

6.0 TECHNICAL SPECIFICATIONS
The contractor is responsible for training field inspectors to operate the GPS device to meet or exceed the following operating parameters.
6.1 **Differential Correction (Horizontal)**
50 cm + 1ppm on a second by second basis (horizontal)

6.2 **Differential Correction (Vertical)**
Submeter + 2ppm on a second-by-second basis (vertical)

6.3 **Maximum acceptable PDOP**
Less than or equal to 6.

6.4 **Minimum Signal-to-noise ratio**
Greater than or equal to 6

6.5 **Satellite Elevation**
Mask at 15 degrees

6.6 **Carrier Phase Processing**
20 cm + 5 ppm with 10 minutes tracking satellites.

6.7 **Minimum satellites**
Minimum 4 satellites are required to record the GPS coordinates.

6.8 **GPS Pathfinder Office software**
Must be used to develop a data dictionary for the field assessment using customized data entry fields as listed in the worksheet on the Scope of Work for each program.

6.9 **Utilize Electronic Landbase File**
If the GPS unit does not acquire 4 satellites to calculate a GPS coordinate due to documented limitations of GPS, the contractor(s) shall utilize an Electronic Landbase file to create New York State Plane Coordinate for that facility by a relative to the previous location positioned via GPS using 4 or more satellites.

7.0 **REPORTING**
The GPS data shall be submitted using the following guidelines:

7.1 GPS Data delivered to the Company will identify the facilities that were positioned using the Electronic Landbase.

7.2 The contractor shall submit the ESRI shape file(s) containing GPS coordinates and attributes for each facility inspected. In addition, the electronic landbase files for the entire city shall be submitted at the end of the program.

7.3 For facilities positioned using the Electronic Landbase the contractor is required to submit the Electronic Landbase file with the matching shape file for each pole location.
7.4 The contractor is responsible for recollecting the GPS coordinates for any location not meeting these operating specifications. The Company shall review the Shape Files periodically and at the end of the program. All unacceptable GPS data shall be returned to the contractor for recollection.

7.5 The contractor shall convert all the GPS coordinates into the NYS Plane coordinates and upload them to the database.

7.6 The contractor shall submit the electronic shape (.shp) files for the GPS coordinates. The coordinates shall include all the attribute information included in the asset inventory section for each program.

7.7 The contractor(s) shall plot 100% of the GPS coordinates on the NYC Planometric Landbase.

7.8 The contractor shall return NYCMAP Base maps to the Company at the end of the program.

7.9 The contractor shall be recollecting incorrect/inaccurate GPS coordinates.

8.0 GPS QA/QC
All the GPS coordinates collected by the contractor shall be plotted on the Landbase Maps. The contractors shall randomly print 2% of the Landbase Maps and submit to Con Edison for verification of accuracy.
EXHIBIT N

MARK UP INSTRUCTIONS FOR MAPS

The contractor shall use the following color scheme to mark up each M&S or Landbase plate completed. The contractor shall be responsible for accounting for 100% of the marked up plates at the end of the program.

- Green Highlighter for PASS (No stray voltage detected on a facility)
- Pink Highlighter for FAIL (Stray voltage detected on a facility)
- Yellow Highlighter for a metal pole NF (not found)
- Orange Highlighter for a structure with no access (NA)
- Draw a Red Dot using a Red Pen (not a Highlighter) for a facility found in the field but not mapped on the M&S plate. The red dot should be placed on the map in close proximity to the actual field location.

For the new metal poles and OH wood poles found in the field the contractor is responsible for writing the wood pole number on the pole adjacent to the red dot and incase of metal pole the unique badge number installed by the contractor on the metal pole.

The Metal Pole Streetlight & Traffic Signal Stray voltage testing requires that 100% of the M&S plates are printed, marked up and submitted at the end of the program.

- Facility PASSED Stray Voltage Test
- Facility FAILED Stray Voltage Test
- Facility NOT MAPPED, Identify Unique Badge Number
- Facility NOT FOUND
- Facility with NO ACCESS
F: EO-10,360 (Troubleshooting Of Streetlights)
TROUBLESHOOTING OF STREETLIGHTS

FILE:  ENGINEERING MANUAL NO. 1, SECTION13
       FIELD MANUAL NO. 1, SECTION 11
       FIELD MANUAL NO. 3, SECTION 1
       FIELD MANUAL NO. 9, SECTION 15
       FIELD MANUAL NO.23, SECTION 6.1

TARGET AUDIENCE  ELECTRIC OPERATIONS
NESC REFERENCE   011. ITEM C
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1.0 Purpose
This specification governs troubleshooting of streetlight services.

2.0 Application
This specification applies to all Operating Regions.

3.0 Troubleshooting Streetlights – No Light Or Stray Voltage
All streetlight no-lights and stray voltages will be investigated and the below procedure will be followed.

3.1 Verify Location And Stop Tag
Verify the location of the streetlight that needs to be investigated for stray voltage or a no-light condition. If a stop tag is present, verify the stop tag number with the provided paperwork. A stop tag may not be present at all streetlight locations.

3.2 Service Check At S/L Base
Check the fuse and remove or replace if necessary. If the problem still exists, utilize marking tape to distinguish between the live conductor and neutral conductor. The neutral conductor will be connected to the streetlight base at the ground stud and incoming conduit. Disconnect and protect the ends on the service and internal wiring. Verify the service cable is alive with an approved low voltage tester such as test-lamps. If incoming cables have the correct polarity continue to next step. If incoming polarity is incorrect, check the cable in the structure and continue troubleshooting. If incoming cables are de-energized, check connections within the Con Ed structure.

3.3 Load Test Cable
Once the service has been checked alive at the streetlight base, separate the Con Ed service cable from the DOT cable. The service cable will be load tested with an approved load test device. For load testing the incoming service conductors, use the PORTA-SAFE MODEL #15LB/86064, The Super Beast Load Tester (Catalog #3HJA-469-D) or a portable electric heater. This shall be done while the hot leg and neutral leg are disconnected. The current should hold at 6 amps for approximately 3 minutes. When using the Super beast, verify the service is good by the voltage read out on the top of the super beast. It has to hold steady at 120 volts, and with a hand held you have to measure the current. If the service does not pass the load test, check connections within the Con Ed structure (see EO-5403). Check the continuity of the cable from the base to the structure. If repairs cannot be made then the cable will be replaced (URD Direct buried cable – locate the trouble and make repairs). If the service passes the load test, then continue with paragraph 3.6. If the service does not pass the load test, then the cable will be replaced – see paragraph 3.5.
3.4 Install New Cable
New cable and the required connections at the Con Ed structure shall be installed in accordance with the appropriate specifications, depending whether the streetlight has an overhead, underground or riser supply. If the streetlight service is obstructed, Con Ed will clear and repair Con Ed ducts only. If the duct is obstructed in the DOT elbow, Con Ed crews will attempt to clear the obstruction with methods such as an air lance. Use a roding tool from the streetlight base to check for the obstruction. If it is within the first 36 inches of the streetlight base it is to be reported to the DOT or local municipality. If the obstruction is beyond 36 inches, it is in the Con Edison duct and should be handled appropriately. Con Ed crews should not break the streetlight foundation. Greenfield conduit should not be installed in the streetlight base. Once the obstruction is clear, Con Ed will install the new service cable. If Con Ed crews cannot clear the DOT obstruction, then the obstruction will be referred to the DOT for repair. Once the DOT has completed repairs then Con Ed will replace the service.

3.5 Reconnect Cable and Lamp
Temporally reconnect the streetlight and observe if the light turns on.

3.6 Check For Stray Voltage
Most photocell controlled streetlights reset and turn on for approximately one minute after being connected. During this one-minute period the lamp structure shall be checked for stray voltage with an approved tester (see EO-100175 and EO-10129). If a streetlight is found with stray voltage, the service will be cut and capped (LEC) in the streetlight base after all the previous steps have been taken. After the lamp is cut, the employee or contractor shall install 3 horizontal bands of black tape one inch apart on the metal pole at a height of six feet from grade level. This is required for the DOT to identify the lamp as a stray voltage lamp. The streetlight will be reported to the local municipality or DOT for repair. If the light does not turn on during this one-minute period, the streetlight will not be connected. The service will be cut and capped (LEC) in the streetlight base in accordance with EO-2509-C or EO-13118-B and reported to Regional Engineering and the DOT or local municipality via the Stop Tag Data Base. If no stray voltage is observed and the required grounding and bonding can be connected, then permanently reconnect the streetlight. If the grounding and bonding cannot be repaired then the streetlight service will be cut and capped (LEC) in the streetlight base in accordance with EO-2509-C or EO-13118-B and reported to Regional Engineering, Distribution Engineering and the DOT or local municipality via the Stop Tag Data Base.

3.7 Completion of work
If the crew has repaired the streetlight they shall clean the area, document the work and secure the cover to the base.

4.0 Streetlight Cover
Con Edison has informed the New York City Department of Transportation, Street Lighting Division, that Company personnel will not damage streetlight bases or covers when using streetlights for temporary purposes and will not leave them uncovered after completion of their work. Therefore, field crews are required to close and secure streetlight covers that they have opened. If a Company crew finds a lamppost cover missing, they will promptly make it safe with a Lamp Post Skirt (EO-11286-C) or dated rubber sheeting and inform their designated liaison employee or organization within their customer service region. The designated employee will take appropriate steps (call the Control Center) to inform the Department of Transportation in New York City or local municipality in Westchester County to replace the missing covers and make permanent repairs.

5.0 Reference Specifications

<table>
<thead>
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<td>Methods of Grounding Lamp Post for Multiple Street Lighting</td>
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<td>Operation and Maintenance of Low Voltage Detector for Stray Voltage</td>
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<td>Application for Heat shrinkable Tubing on Copper or Aluminum, Rubber Insulated, Non-leaded, 600V Mains and service Cables</td>
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<td>Live End Seals for Rubber Insulated Leaded and Non-Leaded Cables A.C. and D.C. Mains and Services</td>
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Leo A. Scally (Signature on File)
Leo Scally
Section Manager
Secondary System Analysis
Distribution Engineering

Peter Mulholland

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</table>
6.0 **Appendix A: Flowchart For Troubleshooting Of Streetlights with Stray Voltage.**

![Flowchart for troubleshooting of streetlights with stray voltage]
G: Shunt Resistor Brochure
5.0 Measure the voltage between the same two points as in step 2.0

5.1 If the voltage is less than one volt, the condition is an induced voltage and not a stray voltage. The testing can continue with the next pole.

5.2 If the voltage is one volt or more, report the condition as a stray voltage, begin troubleshooting or stand by until relieved by appropriate personnel.

Questions? Call
917-567-5460

Con Edison
Matthew Glasser
Senior Engineer
Secondary System Analysis
4 Irving Place – Room 1138
New York, NY 10003
Phone (212) 460-3423
Cell (917) 567-5460
Email mailto:glasserm@coned.com
http://www.coned.com/

SHUNT RESISTOR DESIGN
1. The shunt resistor shall consist of five 100Ω resistors wired in series.

2. Each resistor shall be a minimum of 10 watts (Radio Shack Part #271-135)

3. The case shall be a 4 AA battery holder (Radio Shack Part #270-409)

4. The leads shall be banana leads (Radio Shack Part #278-713)

5. All connections shall be soldered, taped securely and confined within the shunt resistor housing.

CON EDISON
UTILIZING SHUNT RESISTORS TO PREVENT FALSE STRAY VOLTAGE DETECTIONS ON THE OVERHEAD SYSTEM
BACKGROUND

Overhead lines are not shielded and can induce voltages on metallic surfaces. These voltages are normally not harmful and they do not involve a failed component of the distribution system.

A stray voltage indicator (Figure 1) and a digital voltmeter (Figure 2) can falsely indicate a potentially harmful stray voltage condition in the presence of induced voltage.

A digital voltmeter's very high input impedance is designed not to affect the circuit being tested. The design has the disadvantage of being unable to distinguish a stray voltage capable of delivering a harmful electric shock, from an induced voltage with no current carrying capacity.

We have developed a shunt resistor to be used in combination with the Fluke voltmeter when a potential stray voltage has been identified on the overhead system. Utilize this procedure to determine if a voltage identified is a stray voltage or an induced voltage. A shunt resistor can be used in conjunction with the Fluke meter to determine whether the voltage is produced by current (presenting the possibility for harm) or is induced (harmless).

PROCEDURE

1.0 Utilize HD LV-S-5 to test metallic attachments on pole for stray voltage. (Figure 1)

2.0 If the HD device indicates a potential (lights up), take a voltage reading with the Fluke meter from the item in question to a good ground. (Figure 2)

3.0 Remove Fluke meter leads from voltmeter and install the shunt resistor leads. **The shunt resistor should**

4.0 To test that the shunt resistor is functioning properly: With the shunt resistor installed on the fluke meter, turn the dial to the resistance (Ω) position. In this position with the leads separated, the reading should be between 450 and 550 ohms. (Figure 4)
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H: Overhead Transmission Stray Voltage Testing Specification
ENGINEERING SPECIFICATION
CE-ES-1043
TEST SPECIFICATION

SPECIFICATION FOR THE PROCEDURE TO MEASURE STRAY VOLTAGE OF OVERHEAD TRANSMISSION STRUCTURES

SECTION I – GENERAL AND TECHNICAL REQUIREMENTS

REVISION 1

JUNE, 2005

Prepared By:  
Project Manager, Transmission Feeders Engineering / Date

Concurrence By:  
Section Manager, Transmission Feeders Engineering / Date

Approved By:  
Chief Engineer, Electrical Engineering / Date

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Paper copies of the Engineering Operations Manual are uncontrolled and therefore may be outdated. Please verify that you have the current version prior to use by viewing the Central Engineering website (http://ceng/).
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SECTION I – GENERAL AND TECHNICAL REQUIREMENTS

1.0 SCOPE

1.1 This specification establishes procedures to test overhead transmission towers, guy wires connected to transmission towers or poles, and fences that enclose transmission towers or poles as required by the New York Public Service Commission (PSC) Safety Standards.

2.0 APPLICABLE STANDARDS AND REFERENCES

2.1 Safety Standards, issued January 5, 2005 by the PSC. See PSC Case 04-M-0159 – Proceeding on Motion of the Commission to Examine the Safety of Electric Transmission and Distribution Systems.

2.2 National Electrical Safety Code (NESC).

2.3 CE-PS-1062 Quality Assurance Requirements For Stray Voltage Testing and Safety and Reliability Inspections.

3.0 QUALITY ASSURANCE

3.1 The Transmission Line Maintenance section is responsible for implementing the quality assurance process for the voltage testing defined in this section. The Transmission Feeders Engineering section shall provide oversight and guidance as required.

3.2 A minimum of 50 quality assurance inspections shall be conducted after the stray voltage testing is completed to ensure that the stray voltage testing is being performed as specified herein. These randomly selected structures shall be re-tested by trained and knowledgeable employees who did not perform or directly supervise the testing. All voltage measurements made under the quality assurance inspection will be documented on the inspection form. All necessary corrective action will be addressed in accordance with section 8.0 of this specification. Re-testing will be performed after corrective action has been completed. Retest measurements shall be documented on the inspection form.

3.3 A report documenting the quality assurance inspection shall be prepared. The report shall list the location of each quality assurance inspection, the date of the inspection, the voltage reading obtained during the quality assurance inspection, the date of the stray voltage program inspection, and the voltage reading obtained during the stray voltage program inspection. In addition, a report in compliance with CE-PS-4304, Section 10 must be updated on a monthly basis.

4.0 GENERAL SAFETY AND ENVIRONMENTAL CONSIDERATIONS

4.1 For Company forces:

4.1.1 Applicable corporate safety policies and programs as required.

4.1.2 Applicable corporate environmental policies and programs as required.
4.2 For Contract forces:

4.2.1 Applicable federal, state, and local regulations for safety requirements and additional Company policies as required.

4.2.2 Applicable federal, state, and local regulations for environmental requirements and additional Company policies as required.

5.0 TEST AND INSPECTION EQUIPMENT AND CALIBRATION CRITERIA

5.1 Fluke 77, Fluke 179 or an approved equal Testing Meter shall be used for stray voltage measurement.

5.2 The Testing Meter shall be calibrated as per manufacturer’s instructions.

5.3 Appendix A of the PSC Order requires “All equipment used for stray voltage testing must be certified by an independent test laboratory as being able to reliably detect voltages of 8 to 600 volts.”

6.0 SPECIAL TOOLS AND EQUIPMENT

6.1 None

7.0 FREQUENCY

7.1 All transmission towers, any guy wires connected to transmission towers or poles, and fences that enclose any tower or pole shall be tested for stray voltage every year.

7.2 All annual stray voltage testing must be completed by November 30 each year.

7.3 In addition, Company personnel will conduct stray voltage testing on transmission structures that are actively worked on at the beginning and end of each workday. If work is concluded at a particular structure during the workday, stray voltage testing will be done before the personnel leave the site, rather than at the end of the workday. Each stray voltage test shall be recorded on the daily work record (Daily Crew Activity Report). This data will be transferred to an electronic database.

7.3.1 Readings shall not be taken when difficult natural conditions exist, such as significant snow cover or ground frost.

8.0 PRECAUTIONS

8.1 None

9.0 ACCEPTABLE METHODS

9.1 The stray voltage shall be measured from the tower steel, guy wire or tower fence to ground. Where a system ground is not available a metal rod shall be driven into the earth to an approximate depth of 1 foot for a ground point.
9.2 The Testing Meter shall be operated in accordance with the manufacturer's instructions.

10.0 DOCUMENTATION

10.1 Test crews shall complete appropriate test forms, which enumerates each item to be tested. The voltage reading shall be recorded on the appropriate form.

10.2 The Transmission Line Maintenance section shall process and maintain the completed forms and ensure that all structures have been tested each year and corrective repairs have been made. The Transmission Feeders Engineering section shall review the test results and recommend corrective action for locations that do not meet the acceptance criteria defined herein.

11.0 ACCEPTANCE CRITERIA AND CORRECTIVE ACTION

11.1 Measured stray voltage from tower steel, guy wire or tower fence to ground exceeding 8 volts is not acceptable.

11.2 Corrective action shall be taken on the facility where stray voltage is measured greater than 8 volts. If the condition causing the voltage cannot be repaired immediately, the structure must be made safe, for example, by use of a temporary ground rod, or continuously guarded by personnel to prevent access by the public until the structure can be made safe or permanently repaired. Permanent repair shall be made within 45 days.

12.0 RESTORATION

12.1 After completion of work, all temporary grounds and associated equipment or connections shall be removed.

13.0 ANALYSIS

13.1 None
Maintenance and Inspection Specification

SECTION II – TEST DATA AND ACCEPTANCE REQUIREMENTS AND SUPPLEMENTAL SPECIFICATIONS

PART 0 – (Data Sheets, Tables and Lists)

1.0 Not Applicable.

PART 1 – (Supplemental Specifications)

1.0 Not Applicable.
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I: Overhead Transmission Facility Inspection Specification
1.0 **PURPOSE** — To establish a procedure for conducting ground patrols to visually inspect Con Edison’s overhead transmission system.

2.0 **APPLICATION** — This operating procedure applies to all overhead transmission lines in Westchester, Putnam, Dutchess, Orange, Rockland and Richmond counties. For lines in Westchester, Putnam, Dutchess, and Richmond this work shall be performed by Con Edison’s Transmission Line Maintenance (TLM) section. Orange and Rockland Utilities’ (O&R) EHV Dept. shall perform the work for the lines in Orange and Rockland counties, which are maintained by O&R under inter-utility agreements. For the purposes of clarity the remainder of this procedure refers to the Con Edison organization, but it shall be understood to apply to the O&R organization with respect to the appropriate lines.

3.0 **PROCEDURE**

3.1 **Patrol Schedule** — Two patrols, one in the Spring, and one in the Fall shall be scheduled. The Fall Patrol will ensure that the lines are in proper condition to withstand winter storms. The Spring Patrol will be conducted to assess damage to facilities, rights-of-way and access roads caused during the winter and spring runoff so that damage can be corrected during the Summer months. Whenever practical, the ground patrol shall be combined with other work to be performed. Overhead Transmission lines must be inspected at least every five years as required by the New York State Public Service Commission’s (PSC) Safety Standards.
3.2 Organization - The patrol shall be conducted by a crew of one or two employees, depending on the conditions of the section being patrolled. At the discretion of TLM management the crew may be directed to perform minor maintenance during the patrol, some of which is referenced in paragraph 3.5. Company personnel who are familiar with the inspection criteria and capable of identifying the deficiencies that may be indicated by such criteria will conduct such patrols and inspections. The inspectors will be trained in the procedure for conducting and recording inspections.

3.3 Equipment And Tools - Each patrol crew shall be equipped as follows:

3.3.1 Equipment - One four-wheel drive, all terrain, or tracked vehicle, equipped with a cellular phone, spare tire, and safety equipment required for the work assignment.

3.3.2 Tools - Lineman's tools, including climbing tools, binoculars, first aid kit, gloves, hard hat, safety harness, chain saw, flashlight or safety beam, plus those tools required to perform the work identified in paragraph 3.5.

3.4 Inspection - The following items shall be observed. The conditions found shall be reported in accordance with article 3.6.

3.4.1 Right-Of-Way
(1) Right-of-way encroachment

(2) Unauthorized use of access roads
(3) Activity on or near the right-of-way, which could damage the facilities

(4) Note location of unauthorized Dumping of debris, garbage, and abandoned vehicles

(5) General height of trees and brush in each section.

(6) New roads to or on the right-of-way

(7) New locked gates across the road

(8) New utilities constructed on, over or across the right-of-way

(9) Streams that might cause erosion near structures.

(10) Earth slides.

(11) Erosion and other unstable conditions.

3.4.2 Roads-Bridges-Culverts-Gates-Fences

(1) Condition of road.

(2) Condition of culverts.

(3) Condition of bridges.

(4) Condition cross drains.
(5) Condition of drainage ditches, swales, and water bars.

(6) Erosion.

(7) Condition of gates - note type and dimensions if replacement is required.

(8) Fences.

(9) Miscellaneous conditions, which, require work that cannot be performed by the patrol.

3.4.3 Towers and Poles

(1) Loose, bent or broken steel

(2) Missing or severely rusted bolts, nuts, pulleys

(3) Cracked or deteriorating foundations

(4) Rusted steel - special attention is to be given to steel, where it enters the ground or concrete.

(5) Misalignment and/or leaning of towers and poles

(6) Backfill - erosion around foundations and bases

(7) Bird or insect nests on towers or poles
SUBJECT: OVERHEAD TRANSMISSION LINES
GROUND PATROL STANDARD

(8) Miscellaneous conditions such as missing bolts.

(9) Condition of exposed grounding connections attached to poles or tower legs.

3.4.4 Aircraft Warning Equipment -

(1) All lights and associated equipment operating properly.

3.4.5 Conductors and Accessories
(1) Note conductor clearances to ground line, other lines, overhead shield wire, etc., which appear less than normal for the line being inspected.

(2) Note jumper clearances to structures, which appear less than normal. Check for burn marks.

(3) Check conductor for broken or separated strands.

(4) Corona Rings.

(5) Dampers.

(6) Counterpoise - exposed, broken, or loose connections.

(7) Insulators - broken, flashed, or contaminated.
(8) Miscellaneous conditions which might require further inspection and/or repair.

(9) Fiber optic cable, associated attachments, and integrity of cable jacket.

3.4.6 Vegetation

(1) Generally check proximity of trees and brush to conductors. Where clearance appears to fall within categories listed in the latest revision of EO-10323, closer measurements shall be made. If emergency conditions are found, the crew shall notify TLM management of the situation immediately, and clear the problem, if they have the proper equipment and it is safe to do so.

(2) Inspection personnel shall pay particular attention to vegetation in upland knolls and in swamps. Knolls in upland areas where conductors are relatively close to the ground should be clear of all woody vegetation. In swamps, every effort shall be made to detect undesirable woody species growing up through the phragmites canopy. Species such as ailanthus and swamp maple will grow quickly as they break through the canopy. One of the most effective methods of detecting this situation is to
scan the entire swamp from a high point using binoculars.

(4) Report side trees that appear to be unhealthy, damaged, uprooted, etc., and appear more likely to fall into the conductor than healthy trees.

3.5 Work Items - At the discretion of TLM management the following types of work may be performed during ground patrols.

(1) Remove downed trees or brush obstructing the access roads.

(2) Remove or trim danger trees growing on the side of the conductors in the border zone. (See latest revision of EO-10323, Classification of Troubles Reported on Overhead Transmission Lines and EO-10351, Vegetation Treatment Along Overhead Transmission Line Rights-Of-Way.

(3) Remove undesirable vegetation under the conductors in the wire zone. (See latest revision of EO-10323 and EO-10351).

(4) Remove boulders where possible from access roads.

(5) Erect or replace signs.

(5) Clean out debris from bridges and culverts.
3.6 Reports

3.6.1 Emergency Conditions - Emergency conditions as defined in the latest revision of EO-10323 shall be reported immediately to TLM supervision.

Reports - The crew shall record findings on the appropriate paper or electronic inspection forms as the patrol in each span is completed. Completed forms shall be submitted to TLM supervision no later than the next business day. A sample form is attached to this operating procedure as Exhibit A.

3.6.2 Patrol Data - Data from the patrol shall be maintained in a work management system which shall be used to identify, plan, and prioritize maintenance work, especially work that must be performed during feeder outages.

3.7 Public Relations - The following practices shall be followed during the course of the patrol:

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Transmission Operations Procedure

SUBJECT: OVERHEAD TRANSMISSION LINES
GROUND PATROL STANDARD

(1) Leave non-company gates open or closed as found.

(2) Leave Company gates closed and locked.

(3) Do not enter private property without securing the owner’s permission.

(4) Any damage to private property will be reported immediately to TLM supervision. Be courteous to the public and record their requests and complaints.

3.8 Quality Assurance

3.8.1 A minimum of 50 quality assurance inspections shall be conducted after spring patrol is completed to ensure that the patrol is being performed as specified herein. These randomly selected structures will be re-inspected by trained and knowledgeable employees who did not perform or directly supervise this work. All deficiencies observed during the quality assurance inspection will be documented on the inspection form.

3.8.2 A report in compliance with CE-PS-4304 Section 10 must be updated on a monthly basis.
4.0 **RESPONSIBILITIES** -- The Section Manager, Transmission Line Maintenance is responsible for the implementation of the ground patrols and inspections in accordance with the schedule stated in section 3.1, and the scheduling of corrective actions as required from the information gathered by the patrols.

5.0 **REFERENCES**

5.1 **EO-10323** - Classification of Troubles Reported on Overhead Transmission Lines.

5.2 **EO-10351** - Vegetation Treatment Along Overhead Transmission Line Rights-Of-Way

5.3 **CE-PS-4304** - Quality Assurance Requirements for Stray Voltage Testing and Safety and Reliability Testing

6.0 **Exhibits** -- Exhibit A - Sample Ground Patrol Inspection Form

7.0 **ADVICE & COUNSEL** -- The General Manager, Transmission Operations, shall provide advice and counsel on this Operating Procedure.
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J: Substations Stray Voltage Testing and Inspection Procedure
1.0 PURPOSE

1.1 To establish a procedure for Substation Operations’ compliance with Public Service Commission Electric Safety Standards that require (1) annual voltage testing of publicly accessible structures that may become energized as a result of stray voltage and (2) five-year visual inspection of electric equipment for safety and reliability. This procedure requires testing for electric potential (voltage testing) on steel, aluminum or other electrical conducting materials on substations where such materials are accessible to the general public. These include but are not limited to fences, doors, roll-up gates, metallic delivery boxes, dielectric fluid delivery ports and Siamese connections that may become energized as a result of stray voltage. This procedure also requires visual inspection of all equipment in substations and cooling plants on a five-year cycle.

2.0 APPLICATION

2.1 This procedure applies to all transmission and sub-transmission substations and cable-cooling plants.

3.0 DEFINITIONS and REQUIREMENTS

3.1 Substation Testing – Stray voltage testing of perimeter fencing and other electrical conductive materials of substations where such materials are accessible to the general public. The surface of electrical conductive materials on all station perimeters will be tested annually using an approved tester (i.e., glow, no glow). The direct contact low voltage tester (LV-S-5) detects voltages above 5 volts (indicated by a glow of the device). Since the Public Service Commission’s standards require testing for voltage of 8 volts and higher, if the device does not glow, no further testing is required at a test point. If the device glows, a fluke meter will be used to obtain a numerical reading. If there is any voltage reading (above 0 volts), then the location shall be guarded until the voltage is eliminated (temporary grounding may be used). Permanent repairs will be made within 45 days. All fence lines, entrance doors, transformer vault enclosures and any metal exterior trimmings, which have the potential to conduct electricity and are accessible to the public, must be tested once during each 12-month period ending November 30.

3.2 Station Inspection – A careful visual safety and reliability examination of substation and cooling plant equipment for conditions that have the potential to cause or lead to safety hazards or failure of the equipment. All equipment in a substation or cooling plants will be inspected by visual examination once
every five years, and at least 20% of the substations and cooling stations will be inspected each year. These inspections are separate and in addition to the periodic visual and/or maintenance functions that SSO performs on a periodic basis through compliance inspections such as battery room inspections, deluge room inspections, quarterly pump house, circulation plant and PURS inspections, pothead inspections, overhead tower inspections, and load board inspections.

4.0 STRAY VOLTAGE PROCEDURE

4.1 Required Permits and Training.

a. Authorized personnel who conduct stray voltage testing on equipment described in section 1.1 are not required to obtain an Area Work Permit. But must be familiar with the workings and procedures of a substation.

b. Authorized personnel prior to conducting the stray voltage testing and station inspections as described in section 1.1 are required to take the OJT training listed as CSG0020 STRAY VOLTAGE TRAINING & TESTING SSO under the Learning Center courses.

4.2 Proper PPE

a. In addition to other station-required PPE, no additional PPE is required for personnel that conduct stray voltage testing.

4.3 Testing Devices & Equipment:

a. All substation perimeters will be tested annually using the Low Voltage Tester Device (LV-S-5).

b. The test device should be checked for proper operation prior to the start of testing, periodically during the day, and at the end of the test day.

c. A fluke meter will be used to obtain a numerical reading when the Low Voltage Tester detects voltage.

d. A 50’ length of 12 AWG insulated wire (with alligator clips) will be needed in order to connect the ground lead of the Fluke device to a ground source. (Note: obtain a length of 12 AWG necessary to accommodate a proper ground reference)

e. Fluke Meter Device Settings:

(1) The black lead on the meter should be connected to the terminal marked (Com) and the red lead should be connected to the terminal marked (V).

(2) The Multi-Meter dial indicator should be set in the A/C Voltage measurement setting, with a sensitivity that can detect 1V to 500V.
4.4 Conducting Stray Voltage Testing:

a. Stray voltage testing at each station will be conducted according to stray voltage testing rounds that are established in Maximo. The results of the stray voltage test at each testing point shall be recorded in Maximo.

b. Whenever possible, exterior substation structures that are accessible to the public will be tested from the interior of the substation. For example, a roll-up gate will be tested by applying the test device to a test point on the interior of the door, and a metal chain link fence will be tested by applying the test device to fence test points while standing on the interior side of the fence.

c. All continuous structures that comprise conductive materials shall be tested at 40’ intervals (i.e. perimeter fencing).

d. Touch the approved Test Device (Glow / No Glow) to substation exterior structures made of materials that can conduct electricity and are accessible to the public. These structures include but are not limited to fences, doors, roll-up gates, metallic delivery boxes, dielectric fluid delivery ports and Siamese connections that may become energized as a result of stray voltage. If at any point the device glows when in contact with a conducting or non-conducting section, follow the procedures stated in item 4.5 “POSITIVE TEST RESULTS”. If a no glow condition exists then proceed to next test point.

4.5 Positive Test Results of a Stray Voltage Test:

a. If at any time the test device indicates a voltage (glows), a Fluke Meter reading will be taken to confirm and identify the severity of the stray voltage condition.

b. Connect a 12 AWG insulated wire to a Substation ground cable or OSHA ball stud. A fire hydrant may also be used as a ground reference for tests conducted on the exterior of the Station beyond the reach of a ground cable or OSHA ball stud.

(1) Attach the black lead from a Fluke Meter to the free end of the 12 AWG insulated wire.

(2) Set the Fluke Meter multi-meter to test continuity and touch the ground source that the 12 AWG insulated wire is attached to with the tip of the red lead. If the integrity of the 12 AWG wire has not been compromised the reading should be zero.

(3) In the event continuity in the lead cannot be established by the required method, obtain another 12 AWG insulated wire or Fluke Multi-Meter if necessary.

(4) Once continuity has been established, move the selector to the AC voltage setting and use the tip of
the red lead connected to the multi-meter to test the exposed portion of the potential conductor.

(5) Obtain an accurate reading of the measured stray voltage. Record the location and the reading.

(6) When a stray voltage condition is found the station operator will be informed immediately. The station operator will contact the Control Center Shift manager immediately.

c. Temporary safety measures will require the application of portable grounds to the affected area.

d. Following the application of the portable grounds, the area will be tested again to ensure that no stray voltage is detected.

e. In the event that a stray voltage condition cannot be resolved, means shall be implemented to shield the public from the condition until it can be resolved.

4.6 Repairs of a Stray Voltage Condition:

a. Repairs shall be made in accordance with EI 2002-10, latest revision that discusses the means and material required to properly address deficiencies in the station ground grid.

b. Stray Voltage conditions that can be resolved (i.e. tighten a strap, etc.) do not require further action. If the condition cannot be resolved, it shall be recorded in Maximo, temporary measures applied (i.e. temporary/portable ground) and permanent repairs made within 45 days.

4.7 Tracking of an Exterior Stray Voltage Test:

a. The conduct of each stray voltage testing Auto Tour round shall be recorded in Maximo. An associated Auto Tour round or job plan shall be completed identifying the test results – either negative (no stray voltage) or test failure. Any positive reading that can’t be resolved constitutes a test failure.

(1) A test failure requires personnel to record a positive reading along with its location in Maximo.

(2) A new Maximo Work Order shall be created with a work type of SVTR (Stray Voltage Testing Repair). A Maximo tag will be used to reference the affected area when follow-up work is required.

5.0 Station Inspection:

5.1 All equipment in each substation and cable cooling plants will be visually inspected once every five years.
5.2 Inspections will be conducted according to inspection rounds for the “equipment categories” at each station or plant as established in Maximo. The equipment categories to be visually inspected are battery room, deluge room, pump house, circulation plant, PURS, pothead, overhead tower, load board, control rooms, relay cubicles (interior and exterior), alarm panels, circuit breaker cabinets (transmission and distribution voltage levels), transformers, station yards and interior switch rooms.

5.3 The individual equipment within each equipment category at each station will be visually inspected for any condition that has the potential to cause or lead to safety hazards or failure of the equipment. Among the conditions to be identified are exposed conductors, corrosion, frayed/damaged insulation, foreign material intrusion, water leaks, and grounding connections. For example, all equipment within a relay cubicle will be visually inspected.

5.4 The results of the inspection of each equipment category at a station shall be recorded in Maximo and each equipment deficiency will be recorded. An associated Auto Tour round or job plan will be completed, identifying the inspection results.

5.5 Structures containing equipment, whether locked or not, must be opened and the equipment visually inspected. Disassembly of panels and cubicles is not required, only doors and openings normally meant to be accessible and operated during operations or maintenance are required to be opened. Sealed structures will not be opened.

5.6 All environmental or safety problems shall be immediately reported to the station operator. They will notify the Control Center Shift Manager. All other items found during the inspection will be recorded in Maximo. A new Maximo Work order will be generated to make the appropriate repairs.

6.0 **Quality Assurance**

6.1 Substation Operations shall use this procedure and Maximo as the record keeping and tracking mechanism to implement the required testing and inspections.

6.2 Substation Operations will implement a quality assurance program and responsibilities to ensure that actions mandated under the above referenced PSC Electric Safety Standards are completed.

6.3 Substation Operations’ quality assurance program will conduct periodic document reviews and field observations throughout the year to ensure that 100% of the required stray voltage tests and a minimum of 20% of the Safety and Reliability Inspections will be completed by November 30 of each year and that 100% of substation and cooling plant equipment is inspected every five years.

6.4 Substation Operations will assess annually the causes of stray voltage in substations and cooling plants, identify preventative and remedial measures, and establish a plan to implement such measures.
6.5 Substation Operations shall prepare an annual report summarizing:
   a. The status of their test and inspection programs, including test and inspection results.
   b. The activities required by section 6.4
   c. This report will be available to the Law Department by December 15th in support of the Company’s January 15th annual report to the PSC addressing the Company-wide testing and inspection program.

6.6 The elements to be reviewed as part of the quality assurance program are noted in Section 4.0 and 5.0 of this procedure. The periodic reviews are not intended to cover every element and item of the program, but over the period of the year all elements should be reviewed. A minimum of 10% of the SV Testing and Station Inspections completed should be checked yearly.

7.0 RESPONSIBILITIES

7.1 The MAXIMO Manager will be responsible for establishing and updating, as necessary, Auto Tour rounds in Maximo to implement the stray voltage testing and inspection programs.

7.2 The MAXIMO Manager in the interim, until the Quality Assurance Group is developed will be responsible for developing, updating, as necessary, and implementing the annual Quality Assurance Program.

7.3 The MAXIMO Manager will be responsible for conducting the assessment and planning required by section 6.4.

7.4 Area Managers will be responsible for the completion of the annual stray voltage tests and required critical visual inspections.

7.5 Central Engineering will act as the Subject Matter Expert (SME) in the installation and/or repair of the Stations ground grid.

7.6 The Control Center Shift Manager will serve as the information coordinator and default contact in the case where Engineering is not readily available.

7.7 The Station Operator will serve to contact the necessary required individuals and to perform temporary safety measures to protect or isolate the affected area.

8.0 EXHIBITS

8.1 Exhibit A – Stray Voltage Test Device.

9.0 REFERENCES

9.1 PSC Case 04-M-0159 – Proceeding on Motion of the Commission to Examine the Safety of Electric Transmission and Distribution


9.3 SSO OJT Training CSG0020 “STRAY VOLTAGE TRAINING & TESTING SSO”.

SSO SV OJT Presentation
Exhibit A

Stray Voltage Test Device
INSPECTION AND MAINTENANCE SCHEDULE FOR 4 KV UNIT AND MULTI-BANK SUBSTATION TRANSFORMERS AND SWITCHGEAR
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## 4.0 EQUIPMENT

- 4.1 Unit Substation and Multi-Bank Transformers
- 4.2 Circuit Breakers
- 4.3 Tap Changers
- 4.4 Reactors
- 4.5 Voltage Regulators
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## 5.0 AUXILLARIES

- 5.1 Cooling Equipment
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- 5.8 Station Lights and Power
- 5.9 Control Wiring and Circuits
- 5.10 Protective Relays
- 5.11 Unit Substation Automation

## 8.0 ATTACHMENT

Appendix A- Unit Substation and Equipment Section Inspection Report.
INSPECTION AND MAINTENANCE SCHEDULE FOR 4 KV UNIT AND MULTI-BANK
SUBSTATION TRANSFORMERS AND SWITCHGEAR

1.0 SCOPE

This inspection maintenance schedule covers the recommended periodic inspection and maintenance intervals of all electrical equipments for Con Edison’s 4 kV Unit and Multi-Bank substation transformers, associated switchgear and ancillary equipment.

2.0 GENERAL

This document is compiled as a guide for 4 kV Unit Substation maintenance personnel who operate and maintain the Multi-Bank and Unit Substation transformers and associated switchgear. It is formulated from industry standards, current Company practices and equipment manufacturers’ recommendations with the objective of optimizing equipment operation. The Company’s or manufacturer’s recommendations may prevail where more stringent maintenance schedules are required for critical or specialized equipment.

3.0 LOCATION

The equipment listed in the following pages is located on Company-owned or leased-properties, high-tension customers’ premises and in areas where the Company has direct-access and responsibility to operate and maintain such equipment. Equipment may also be mounted on Company owned vehicles.

The following list covers the recommended maintenance/inspection intervals for various equipment installed at 4 kV Unit and Multi-Bank Substations.

4.0 EQUIPMENT

4.1 Unit Substation and Multi-Bank Transformers

4.1.1 Acceptance Inspection - Inspect transformers to ensure that no damage has occurred in transit to the substation or during installation and commissioning. Tests letters are issued by Distribution Engineering detailing additional requirements during installation.
4.1.2 **Warranty Inspection** - All equipment is to be checked within 12 months after energization, or for an extended period agreed upon between Con Edison and the manufacturer for defects or damage which may be covered by warranty.

4.1.3 **Periodic inspection** - Periodic inspection of all Unit and Multi-Bank Substations for general station conditions shall be completed every two months. Items to be checked are included in Appendix A. Completed form (Unit Substation And Equipment Section Inspection Report) should be submitted to and retained by the local Supervisor.

4.1.4 **Oil Samples** - Oil samples are to be taken annually from all oil filled compartments and sent to the Chemical Lab for DGOA and dielectric strength.

4.2 **Circuit Breakers**

4.2.1 **Transformer and Feeder Circuit Breakers** - Periodic maintenance of transformer and feeder circuit breakers is required every 500 operations or every three years. If required, the operating mechanism should be overhauled and all worn parts replaced. Refer to the manufacturer’s instruction manuals/EI Specification for detailed installation and maintenance tests guidelines for each breaker type.

Note: In addition to the inspection requirements listed above, all breakers which experience an open auto that results in a lockout coupled with an instantaneous relay operation should have a visual inspection performed prior to being returned to service.

4.2.3 **Low Voltage Circuit Breakers** - During periodic inspections of associated equipment the 120V or 240V breakers should be inspected and switched to the ON/OFF positions to ensure that they work.

4.3 **Tap Changers**

4.3.1 **Primary (De-energized Tap Changer)** - Whenever the de-energized tap changer is repositioned a transformer turns ratio test shall be performed.

4.3.2 **Secondary (LTC)** - Periodic inspections shall be carried out at the end of first year of operation and every three years thereafter.
4.4 **Reactors** - Oil samples are to be taken annually and sent to the Chemical Lab for DGOA and dielectric strength.

4.5 **Voltage Regulators** - Operational checks shall be performed during the Stations periodic inspections every two months.

5.0 **AUXILIARIES**

5.1 **Cooling Equipment** – See Appendix A.

5.2 **Gauges and Meters** - See Appendix A.

5.3 **Control Batteries** - Physical inspection of batteries shall be carried out each month to check the electrolyte levels. A complete inspection shall be carried out every 12 weeks and on an annual basis in accordance with the latest revision of Specification EI-1034.

5.4 **Battery Charger** - Charger voltages shall be checked every time batteries are checked to insure that the charger voltage values are in accordance with the latest revision of Specification EI-1034.

5.5 **Nitrogen Equipment and Supply** - See Appendix A.

5.6 **Transformer Silica Gel Breathers** - During every periodic station inspection, silica gel breathers are to be checked for color changes, which indicate moisture. When the color change is approximately 75% the silica gel shall be replaced.

5.7 **Thermostat and Heaters** - Check annually prior to winter to verify that they are operating.

5.8 **Station Light and Power** – Check for availability of all supplies during each periodic inspection every two months accordingly.

5.9 **Control Wiring and Circuits** - During each maintenance inspection on each piece of equipment, its associated control wiring should be checked for loose connections and frayed or damaged insulation.

5.10 **Protective Relays** - Frequency of inspection and maintenance schedule is determined by the Protective System Testing (PST). However, during station inspections, if found, relay targets are to be reset manually and logged accordingly in the station log book.
5.11 **Unit Substation Automation (USA)** – Perform the following checks at the time of the Periodic Inspection, from the Station Control Node (SCN) to verify that the system is operating satisfactorily:

5.11.1 Power check - Press any button on the SCN to activate the SCN from Screen Server mode. Scroll the screen to where the breaker status is displayed. Carry out the following:

a- check the actual status of the transformer and feeder breakers and compare with the status displayed on the SCN (Open/Closed). If a discrepancy exists, check with the station log and the local Control Center. If the local Control Center is unaware of the discrepancy, contact the local maintenance supervisor.

Note: If an “OFF LINE” status is displayed for any transformer or feeder breaker or reclosure, report it immediately to the maintenance supervisor for service.

b – check the Automatic Reclosure Switch (ARS) at the SCN. Determine if the status is in the “Auto” position. If it is not in the “Auto” position, but in the “N/R” (Non-Reclose) position, check the station log and call the local Control Center to ascertain if this is the correct status. Inform the local maintenance supervisor if Control Center is unaware of the status.

c – check the Local/Remote status of the transformer at the SCN. Determine if the status is in the “Local” position. If it is not in “Local”, check the station log and call the local Control Center to ascertain if this is the correct status. Inform the local maintenance supervisor if Control Center is unaware of the status.

6.0 **GROUND AND TEST DEVICE**

Inspect annually.
7.0 ENVIRONMENTAL SYSTEMS

During each periodic inspection the station is to be checked for conformance to established Company procedures. In particular, the transformer moats or containment areas are to be checked for spillage of oil and to assure proper drainage of water. All oil spills are to be reported to the proper authority. Check the moat pit and remove build-up of sludge and debris. Observe environmental procedures as per Spill Prevention and Control Countermeasures (S.P.C.C.) protocol. Where a solidification product is used to prevent oil from reaching the environment, it must be replaced every five years, or if it cakes up due to contact with oil, the solidification product shall be replaced as soon as possible and every five years thereafter.

8.0 ATTACHMENT

Appendix A: Unit Substation and Equipment Section Inspection Report.

Ralph J. Mauro (Signature on File)

Ralph J. Mauro
Manager, Distribution Substation and Equipment
Distribution Engineering Department

Ebrima S. Cham

REVISION 1:

Added items 37 & 38 to Appendix A of attachment.
Review date: As required.

FILE:

Inspection and Maintenance Manual No. 1
# Unit Substation And Equipment Section Inspection Report

**Electric Operation Organization:** Substation:

**Substation Operator:** Employee ID #:

**Inspection Date:** Print # :

---

**FOLLOW GUIDELINES ON REVERSE SIDE TO COMPLETE INSPECTION**

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<th>U = UNSATISFACTORY</th>
<th>T = NOTIFIED DISPATCHER</th>
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**OPERATIONAL CHECKS - Cubicle #**

Jan., 4  May 8  Sept., 5  
Feb., 5  June 4  Oct., 6  
Mar., 6  July None  Nov., 7  
Apr., 7  Aug., None  Dec., 8  

**Feeders**

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**TRANSFORMER OIL LEVELS AND TEMP. READINGS**

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<th>MAX TEMP.</th>
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**RECTIFIER**

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<th>As Found</th>
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**D.C. VOLTAGE**

**D.C. AMP**

---

**NITRO PRESSURE:**

CONSERVATOR PRESSURE: NITRO PRESSURE (To Transformer):  

**REMARKS:**

---

Operator's Signature ____________________________  Supervisor's Signature ____________________________
**UNIT INSPECTION GUIDELINES**

1. **BATTERIES**
   - Check water levels, corrosion and housekeeping.
   - Check D.C. voltage to spec. as marked on rectifier and adjust if required.
   - Check Ammeter for reading and fluctuation & housekeeping.
   - Does rectifier require cleaning? - Indicate readings

2. **RECTIFIER**
   - System drop check. Pressure in bottle, pressure on system [2lbs.]
   - Conservator tank pressure - Indicate readings

3. **NITRO SYSTEM**
   - General - Check transformer and report.
   - Main body, capaciformer, tap changer and primary. Indicate readings

4. **OIL LEVELS**
   - Indicate readings

5. **OIL LEAKS**
   - General - Check transformer and report.

6. **FIRE EXTINGUISHERS**
   - Expiration date? - Signed inspection tags

7-8. **LIGHTING**
   - Check circuit, replace bulbs.

9. **HEATER**
   - Check if operational

10. **TELEPHONE LINES**
    - Are they operational?
    - Check all meters and note load reading. Reset indicators
    - Indicate readings

11. **FEEDER AMMETER**
    - Check and replace as required

12. **FEEDER CONTROL LTS.**
    - Check setting - indicate counter reading

13. **TRANSFORMER GRDS.**
    - Assure cable is attached. Using an ohmmeter, check the resistance between the transformer ground/fence ground to the water pipe.

14. **FENCE GROUNDS**
    - Is system operational? Are any heads clogged? Check piping

15. **WATER SPRINKLER SYS.**
    - Check incoming water lines. Check general condition of pit (enclosure/doors)

16. **WATER PIT**
    - Check overall condition of the cable and lugs

17. **TRANSF. COOLING KIT**
    - Is kit in station and complete?

18. **GAUGES [OIL]**
    - Does gauge function properly? Record oil levels.

19. **GROUND & TEST DEVICE**
    - Operate G&T at the test station. Is G&T ref tagged? Check physical condition.

20. **STATION LADDERS**
    - Check ladder. Are there any splits, missing rungs or dry rot?
    - **IF ANY OF THESE CONDITIONS ARE FOUND, RED TAG & NOTIFY SUPERVISOR.**

21. **ONE LINE DIAGRAM**
    - Check the One Line Diagram. Is it up to date? Check with desk Supervisor.

22. **STATION PORT. GRDS.**
    - Check overall condition of the cable and lugs

23. **PCB KIT**
    - Check contents as complete

24. **SIGNS HV, "No Smoking" on battery door, phone signage, etc.**
    - Are signs in good condition?

25. **HOUSEKEEPING**
    - Check - general yard status and sidewalks

26. **LOCKS [SECURITY]**
    - Overall station security

27. **ADEMCO**
    - Send a signal to office and confirm with Supervisor

28. **TAPE CHANGER**
    - Check setting. Check compartment housekeeping.

29. **BREAKER DOLLIE**
    - Check overall condition

30. **USA**
    - Check SCN for power, Main Menu appears, Transformer ARS and Feeder ARS are in "Auto"

31. **SELICA GEL**
    - Check for color change and replace when 75% of glass has changed color.

32. **WHITE HARD HAT SIGN**
    - Is the "White Hard Hat" sign present and in good condition?

33. **WHITE HARD HAT**
    - Is the "White Hard Hat" in the proper location and in good condition?
L: HD Test Reports
TEST REPORT

Electrical Testing of Voltage Testers

for

Consolidated Edison Cooper Station

Purchase Order No. 519117

Prepared by: Jeremy M. Spratt, Project Engineer
NTS Power Products

Date: 2-3-2005

Reviewed and Approved by: Independent Reviewer
NTS Power Products

Date: 2-3-2005

Reviewed and Approved by: Quality Management Representative
NTS Power Products

Date: 2-3-05
<table>
<thead>
<tr>
<th>SECTION</th>
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<tr>
<td>1.0 PROGRAM SCOPE</td>
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<tr>
<td>2.0 APPLICABLE REFERENCE DOCUMENTS</td>
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<tr>
<td>3.0 DESCRIPTION OF EQUIPMENT</td>
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<tr>
<td>4.0 ELECTRICAL TESTING</td>
<td>4-1 to 4-2</td>
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<td>5.0 TEST EQUIPMENT</td>
<td>5-1 to 5-2</td>
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<td>APPENDIX A DATA REPORT</td>
<td>A-1 to A-3</td>
</tr>
<tr>
<td>APPENDIX B TEST SET-UP DRAWING</td>
<td>B-1 to B-3</td>
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1.0 PROGRAM SCOPE

The purpose of this Test Report is to present the methods and results of electrical tests on equipment identified within Section 3.0 of this Test Report, in accordance with Consolidated Edison Purchase Order No. 519117. The purpose of this program was to evaluate the performance of the voltage detectors described in Section 3.0.

The items described in Section 3.0 were supplied by Consolidated Edison.

All work conducted for this program was performed in accordance with the requirements of NTS Corporate Quality Policy Manual, Revision 3, dated September 21, 2004.
2.0 **APPLICABLE REFERENCE DOCUMENTS**

2.1 Consolidated Edison. Purchase Order No. 519117, dated 01/20/05.


2.4 NTS Test Program 39600-04E.
3.0 DESCRIPTION OF EQUIPMENT

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<th>Test Item</th>
<th>Part Number</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>HD Electric Company Low Voltage Detector</td>
<td>LV-S-5</td>
<td>20</td>
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</tbody>
</table>

Note: The items above were supplied by Consolidated Edison.
4.0 Electrical Testing

In accordance with Consolidated Edison Purchase Order 519117, dated 01/20/05, testing was performed on the HD Electric Company Low Voltage Detector as supplied by Consolidated Edison. The detectors are identified in Section 3.0 of this report. Testing included Turn-On Voltage measurement to determine the minimum voltage levels required to activate the detectors and Maximum Voltage Exposure testing to evaluate each detector’s ability to withstand exposure to voltages up to 600 VAC. Detailed test data can be viewed in Appendix A of this report and the Test Set-Up drawing can be viewed in Appendix B.

4.1 Turn-On Voltage Testing

Turn-On Voltage testing was performed using the Consolidated Edison supplied fixture depicted in Appendix B. The tip of the detector was placed in contact with the surface of the electrode. Then voltage to the electrode was slowly increased until the device indicated voltage presence. The voltage at which the detector illuminated was recorded. This process was repeated three times for each detector. The following summarizes the Turn-On Voltage Testing for the detectors.

- **HD Electric Company Low Voltage Detector, p/n LV-S-5**
  No sensitivity adjustment
  Turn-on voltage summary data:
  4.21 (min), 5.03 (max), 4.44 (avg), 4.35 (median), 4.33 (mode), 0.2302 (std dev), 0.06 (con)
  This device has a 95% confidence of detecting voltages of 4.44 +/- 0.06.

In summary, the Turn-on Voltage tests were performed three times on each detector. The three readings were recorded and the statistics calculated.
4.2 **Maximum Voltage Exposure Testing**

Each detector was exposed to AC voltage up to 600 volts. Voltage was ramped from 0 to 600 in approximately 5 seconds. If the device continued to operate up to 600 volts it passed the maximum voltage test. If the device stopped operating, the voltage at which it failed was recorded.

All detectors were exposed to a Maximum Voltage of 600 VAC without suffering detectable damage or degradation of performance.
5.0 TEST EQUIPMENT

All test equipment used for this program had calibration certification traceable to the National Institute of Standards and Technology (NIST). A list of all equipment used during this program is included on the following page.
<table>
<thead>
<tr>
<th>Inv#</th>
<th>Description/Manufacturer</th>
<th>Model #:Serial #</th>
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Calibration Abbreviations
- UWCE - use with calibrated equipment
- CBU - calibrate before use
- NQM - not used for quantitative measurement
- CAL - calibrated
- NCR - no calibration required
APPENDIX A

DATA REPORT
The device shall be installed in the customer supplied test fixture (PT-LV-5). The tip of the device shall be in contact with the surface of the electrode. The voltage through the electrode shall be slowly increased until the device indicates voltage presence. The value at which the device indicates voltage shall be recorded. This process shall be repeated three times for each device.

![Data Sheet](image)

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**Overall**

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Device is exposed to AC voltage up to 600 volts. Voltage is ramped from 0 to 600 in approximately 5 seconds. If the device continues to operate up to 600 volts it passes the maximum voltage test. If the device stops operating, the voltage at which it fails shall be recorded.

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APPENDIX B

TEST SET-UP PHOTOS
M: Corporate Safety Procedure 17.01
1.0 PURPOSE

This procedure discusses entry into electrical enclosed spaces, including requirements for testing the atmosphere, training, ventilation, and monitoring.

2.0 APPLICABILITY

This procedure applies to all con Edison employees and contractors working under con Edison oversight (defined as "contractors" for this CSP), who work in electrical enclosed spaces used for the operation and maintenance of electric power generation, transmission, and distribution lines and equipment, including fiber-optic equipment associated with these electrical systems.

For outside agencies such as public improvement, that are not under contract with con Edison, the con Edison organization serving as the primary contact shall inform the agency’s project supervision of the relevant safety precautions to be taken when working in con Edison facilities meeting the OSHA definition of an electrical enclosed spaces. The hazard communication shall be documented.
3.0 INTRODUCTION

This document identifies the procedures for inspection, entry and work in electrical enclosed spaces. Spaces that are not designed for entry under normal operating conditions are not considered to be electrical enclosed spaces for the purposes of this procedure. In addition, spaces that are expected to contain a hazardous atmosphere are not considered to be electrical enclosed spaces. These spaces are addressed as permit-required confined spaces.

This procedure does not address practices in permit-required confined spaces, gas enclosed spaces (working spaces such as gas manholes) and similar structures not associated with electric power generation, transmission, and distribution. Entry into these spaces must be performed in accordance with applicable Corporate Safety Procedures (CSPs). Permit-required confined spaces are addressed in CSP 16.00 - Permit-Required Confined Space Program, and gas enclosed spaces are addressed in CSP 17.02 - Gas Enclosed Spaces.

4.0 COMPLIANCE REQUIREMENTS

4.1 ENTRY PROCEDURE

4.1.1 Job Briefings

The employee in charge shall conduct a job briefing with the employees involved before they start the job. The briefing shall cover: the hazards associated with the job; work procedures involved; special precautions; energy source controls; and personal protective equipment requirements. Additional briefings shall be held if significant changes, which might affect the safety of the employees, occur during the course of the work. Completion of a job briefing shall be documented.

4.1.2 Vehicular or Pedestrian Traffic

Prior to the performance of work, protection of enclosed space entry work areas shall be planned, using the Con Edison Work Area Protection and Traffic Control Field Manual, to avoid vehicular and pedestrian traffic hazards.

4.1.3 Pre-Entry Inspection

4.1.3.1 Evaluation of Potential Hazards

Before an entrance cover to an enclosed space is removed, it shall be determined that removal can be done safely and if the condition of the electrical facilities contained therein is sufficient to allow unrestricted access. A qualified Con Edison employee must conduct this initial inspection. The initial inspection shall include:

1) Testing for stray voltage on the frame, cover, or grating, in accordance with OJT ELE0020.

2) Checking whether the cover is above “normal”, expected temperature.

3) Gradually loosening the cover if it is fastened in place, to release any residual pressure.
4) Determining whether there might be a hazardous atmosphere in the space, or whether conditions at the site could cause a hazardous atmosphere, such as an oxygen deficient or flammable atmosphere to develop within the space. This includes the oxygen level, presence of a flammable atmosphere, carbon monoxide levels, and if applicable, other toxic contaminants. Where vented manholes are present, the vent holes shall be used to test the atmosphere. If an atmosphere is potentially in the flammable range or above the upper explosive limit, if it is determined that the cover should be removed, it should be done without creating a spark.

Any conditions making it unsafe to remove the cover shall be eliminated before the cover is removed (that is, reduced to the extent that it is no longer unsafe).

### 4.1.3.2 Removal/Opening of the Cover

Before attempting to remove covers from subsurface structures, appropriate (manhole hooks, bars, etc.) tools shall be used to remove covers from subsurface structures. When covers are removed from electrical enclosed spaces, a railing shall promptly guard the opening with appropriate toe guards, temporary cover, or other barrier to prevent an accidental fall through the opening and to protect employees working in the space.

### 4.1.3.3 Burnouts or Electrical Failure

Only Con Edison qualified employees shall complete the work identified in this paragraph. If evidence is present of cable or component failure, fire, smoke, explosion, or other abnormalities, additional PPE in the form of protective hood (C/S 684-0755) and goggles (C/S 689-3952) shall be worn prior to approaching the cover. Employees responding to burnouts may remove the cover if it can be done safely. After removal of the cover, the employees shall remain at a safe distance away for a period of 10 minutes in the absence of a flare-up. If a flare-up occurs, the employee shall remain at a safe distance until the burning stops. The hose of a power ventilator may be directed into the opening if the hose can be placed safely. After a burnout is cleared (burnt apart or cut), the structure shall be ventilated to remove gases and odors created by the burnout.

### 4.1.3.4 Con Edison Initial Entry and Visual Inspection

Once the structure is initially entered, a visual inspection shall be conducted for exposed live conductors, improperly sealed cable ends, visual burnouts, structural damage, D-Fault tags, environmental tags, and cable ends cut excessively long where the cable-end could contact the structure cover/grating or metal frame. The visual inspection shall be documented. In addition, abnormalities, such as oil or compound leaking from cable or joints, broken cable sheaths or joint sleeves, hot localized surface temperatures of cables or joints, or joints that are swollen beyond normal tolerance are presumed to lead to or to be an indication of an impending fault. EO-1184, Identifying Cable And Splice Abnormalities On Distribution Feeders or CE-TI-6832, Procedure For A Quick Visual Inspection (QVI) on the 69 KV and 138 KV Low and Medium Pressure Insulating Fluid Filled Cable Systems, shall be followed to determine when a cable must be de-energized for work in a manhole. If a “D” Fault is noted, it must be reported and the structure shall be exited immediately. If a D-Fault tag, environmental tag, or any unsafe condition is found further steps shall only be taken with consent and advice of the control center and/or field supervisor. Cable inspections are not required for enclosed spaces where electrical equipment has not been previously tied into the system, or service boxes with no primary cable.
4.1.4 Entry by Con Edison Personnel not qualified for Electrical Work, Contractors, or Public Improvement Personnel

If entry takes place immediately after the initial inspection (see Section 4.1.3.4), a follow-up inspection is not required provided that the con Edison Inspector or the contractor foreman were on location during the initial inspection by the qualified electrical worker. If entry by non-qualified personnel (i.e., con Edison employees not qualified for electrical work, contractors, and Public Improvement personnel) is not immediate but takes place within 72 hours of the initial inspection, a “follow-up inspection” shall be conducted prior to each entry. The follow-up inspection shall be conducted by a qualified person (con Edison or contractor trained by con Edison) involved in the work and include:

1) Verification that the initial inspection was performed in the specified time frame.

2) Testing for stray voltage by a qualified con Edison employee or qualified contractor.

3) Completion of atmospheric testing as outlined in Section 4.2

4) Determination that it is safe to enter the space.

5) A visual inspection for abnormalities such as faults or non-capped cable.

6) Communication of inspection results and hazards to the con Edison inspectors and the contractor foreman.

If entry is delayed past the 72 hours, the initial inspection shall be repeated per Section 4.1.3.4. Con Edison personnel not qualified for electrical work may only enter after the “follow-up” inspection is conducted by qualified personnel. Follow-up inspections shall be documented. Service boxes without primary service are exempt from the initial inspection (Section 4.1.3.4), however shall have the equivalent of the “follow-up inspection”. This section does not apply for enclosed spaces where electrical equipment has not been previously tied into the system.

4.1.5 Defective Primary and/or Secondary Cable

Where a cable in a manhole has one or more abnormalities that could lead to or that could be an indication of an impending fault, the defective cable shall be de-energized before an employee may work in the manhole. Abnormalities, such as oil or compound leaking from cables or joints, broken cable sheaths or joint sleeves, hot localized surface temperatures of cables or joints, or joints that are swollen beyond normal tolerance are presumed to lead to or be an indication of an impending fault. The latest version of EO-1184, Identifying Cable And Splice Abnormalities On Distribution Feeders or CE-TI-6832, Procedure For A Quick Visual Inspection (QVI) on the 69 KV and 138 KV Low and Medium Pressure Insulating Fluid Filled Cable Systems, shall be followed in all cases involving D-Faults.

4.1.6 Attendants

While work is performed in an electrical enclosed space, an attendant shall be available in the immediate vicinity to render emergency assistance. The attendant shall not be distracted from the duty such as speaking on a cell phone. Occasionally, the attendant may briefly enter a manhole to provide assistance other than in an emergency. This person is not precluded from performing other duties outside the electrical enclosed space if these duties do not distract the
attendant from monitoring employees within the space. Manhole attendants shall be trained in first aid, cardiopulmonary resuscitation (CPR), and rescue.

4.1.7 Hazardous Atmosphere

Employees shall not enter any enclosed space that contains a hazardous atmosphere, unless the entry is performed as required by CSP 16.00 - Permit-Required Confined Space Program.

4.1.8 Personal Protective Equipment

The minimum personal protective equipment for con Edison employees, contractors, and visitors for work covered in the scope of this procedure are safety shoes, hardhat, eye protection, and FR clothing (where electrical flash hazards exist, or hot work operations are conducted). The FR clothing requirements are outlined in CSP 5.03 Personal Protective Equipment: Protective Clothing.

4.2 ATMOSPHERIC TESTING

Atmospheric testing is required prior to space entry for the following reasons:

- To evaluate the hazards and to verify that acceptable conditions for entry exist.
- To ensure that acceptable conditions are maintained during the entry work.

4.2.1 Order of Testing

All structures must be tested according to Attachment 1 prior to entry.

The internal atmosphere shall be tested using an approved, properly calibrated Atmospheric Testing Device, in the following sequence:

- Oxygen (acceptable criteria between 19.5 and 23.0%). Oxygen monitoring equipment shall be set to alarm if the oxygen content falls below 19.5 percent.
- Flammable gases and vapors (acceptable criteria less than 10% of the lower explosive limit (LEL), i.e., a reading of 0.5% methane).
- Carbon monoxide (CO) (acceptable criteria less than 35 parts per million [ppm]).
- Tests for toxic vapors and gases, if necessary. Entry level for toxic substances shall not exceed the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL), regardless of the anticipated length of entry.

The readings will be documented including the time and results.

For entry into pipe type feeder manholes that are connected to SF6 equipment, the Chem Lab is to be contacted to do the monitoring (see GSIs 17.01.03 and 17.01.04).

Where hazardous atmospheres are suspected, it is permissible to “pre-test” the space with an instrument not approved under 4.2.4 below for one or more concerns. This is desirable to minimize potential damage to a space entry gas detector through overexposure. Regardless of the results and actions of any such pretest, proper testing for all concerns using an approved instrument must be performed prior to actual space entry.
4.2.2 Stratified Atmospheres

When monitoring for entries involving descent into atmospheres, which may be stratified, the atmosphere should be tested a distance of approximately four feet in the direction of travel and to each side. If a sampling probe is used, the entrant’s rate of progress should be slowed to accommodate the sampling speed and detector response.

4.2.3 Space Entry Gas Detector Requirements

Pre-entry atmospheric testing, and any required during-entry atmospheric testing, shall only be performed using a gas detector approved by Safety & Industrial Hygiene for space entry testing in accordance with CSP 9.03. Approved instruments shall be initially calibrated by Technical Services, and shall be recalibrated at least every 90 days. Instruments with remote calibration procedures accepted by Safety & Industrial Hygiene and Technical Services can be calibrated locally; Technical Services shall calibrate all other instruments. Each instrument shall either have the next calibration due date attached on a sticker by Technical Services or displayed on the instrument’s screen where possible. No space entry gas detector shall be used in the field past the calibration due date. All gas detectors shall have their calibration due date clearly indicated and shall not be used if this date is not clearly visible.

Only personnel who have current training on the use of space entry gas detectors shall use them in the field or shall be assigned duties, which may require their use in emergency situations. Contractors shall use instrumentation that meets the OSHA requirements.

4.2.4 Approved Equipment

The Industrial Scientific CMX-270, Bascom-Turner 512A, and Draeger Miniwarn/Multiwarn units are the only approved space entry gas detectors for compliance with the testing requirements of this CSP. Only the Draeger units have approved remote calibration procedures. Contractors may use equipment not specifically listed provided it is appropriate for meeting the testing requirements, is in working order and properly calibrated.

Any approved space entry gas detector that is used for survey purposes shall not be used for space entry until it has been recalibrated and serviced by Technical Services and/or the manufacturer. Organizations that do not use different model detectors for survey than for space entry shall clearly label each instrument as “SURVEY” or “SPACE ENTRY”. “Survey” is defined as (1) prolonged or extended testing of potentially contaminated areas that are not the intended subject of space entry (including but not limited to boreholes, curb lines, basements, etc.) or (2) prolonged or extended monitoring any area at unacceptable (alarm) levels beyond the period of time required to:

- Confirm the required response action,
- Safely exit an unacceptable atmosphere,
- Determine the usefulness and/or appropriate respiratory protection, and/or
- Confirm the effectiveness of space ventilation actions.

Any space entry unit, which is used for survey activities, either by accident or in an emergency, shall be immediately tagged “out-of-service” or “survey-only” until recalibrated and/or serviced.
Currently the only approved exceptions to the survey restriction are the Draeger Miniwarn and Multiwarn.

4.3 MONITORING AND VENTILATION

4.3.1 Monitoring

If flammable gases or vapors or CO are detected or if an oxygen deficiency is found, forced-air ventilation shall be used to maintain oxygen at a safe level (between 19.5% and 23.0% oxygen), and to ensure that the concentration of combustible gases and vapors is less than 10% of the LEL (0.5% methane) and that concentrations of CO are less than 35 ppm.

If continuous forced-air ventilation is **not** used, continuous monitoring shall be conducted to ensure that no increase in the concentration of flammable gases or vapors and/or CO occurs.

If continuous forced-air ventilation is used, monitoring must be conducted periodically according to the following schedule:

- If no problems were found during the initial check of the structure, monitoring will be conducted at least every two hours.
- If a contaminant was found during the initial check of the structure, monitoring will be conducted at least every hour.

All monitoring shall be documented, including time and results.

Structures required to be de-watered, must be tested for safe atmosphere prior to entry/re-entry.

Continuous forced-air ventilation is required during hot work and work with lead cable splicing. For additional information on Con Edison procedures for addressing these hazards, refer to CSP 10.00 Lead Management Program, and CSP 15.00 Welding, Cutting And Other Hot Work Operations.

4.3.2 Ventilation

Ventilation with forced air may be necessary to eliminate or control hazardous gases or fumes that may be present in electrical enclosed spaces, and to maintain an adequate supply of oxygen. The use of power ventilation, however, does not eliminate the need to check concentrations of oxygen and combustible gas prior to and during any entry. Personnel who enter electrical enclosed spaces for cable identification, inspection, or other minimal time periods shall continue to use gas and oxygen detectors to determine that an enclosed atmosphere is safe.

If at any time a test indicates an unsatisfactory atmosphere, leave the manhole or vault at once. Operate the power ventilator for 10 minutes and then take a second test. (For more guidance on proper ventilation techniques refer to ELE1010). Take this test away from the output of the power ventilator. If this test indicates a satisfactory condition, the subsurface enclosure may be entered. If the unsatisfactory condition persists, report the matter to the supervisor. Only Con Edison-approved power ventilation equipment shall be used.
4.3.2.1 Specific Ventilation Requirements

If continuous forced-air ventilation is used, operation of the system shall begin before entry is made, and operation shall be maintained to ensure that a safe atmosphere exists before employees are allowed to enter the work area. The forced-air ventilation shall be directed to ventilate the immediate area where employees are present within the electrical enclosed space and shall continue until all employees leave the enclosed space.

4.3.2.2 Air Supply

The air for the continuous forced-air ventilation shall be supplied from a clean source and shall not increase the hazards in the electrical enclosed space.

4.4 OPEN FLAMES

If open flames are used in electrical enclosed spaces, a test for flammable gases and vapors shall be made immediately before the open flame device is used and at least once per hour while the device is used in the space. Testing shall be conducted more frequently if conditions present in the electrical enclosed space indicate that once per hour is insufficient to detect hazardous accumulations of flammable gases or vapors. A certificate of fitness is required as outlined in CSP 14.03.

4.5 ACCESS

Employees shall not climb into or out of manholes or vaults by stepping on cable or hangers. Only approved ladders that extend three feet above the surface shall be used.

4.6 COMMUNICATIONS

Reliable communications (visual, voice, signal line, or two-way radio) shall be maintained among all employees involved in the job.

4.7 LOWERING EQUIPMENT

Equipment used to lower materials and tools into manholes or vaults shall be capable of supporting the weight to be lowered and shall be checked for defects before use. Before tools or materials are lowered into a manhole or vault, employees working in the space shall be clear of the area directly under the opening.

4.8 DUCT RODS

If duct rods are used, they shall be installed in the direction presenting the least hazard to employees. An employee shall be stationed at the far end of the duct line being rodded to ensure that the required minimal approach distances are maintained from exposed energized parts.

4.9 CABLES

Energized cables that are to be moved shall be carefully inspected for defects before they are moved. Energized primary cable shall only be inspected/handled/moved by qualified con Edison employees or qualified contractors. Energized joints shall only be handled by con Edison
personnel or contractors fully qualified by 1910.269. Energized secondary cable shall only be inspected/handled/moved by or under the direction of qualified con Edison employees, or qualified contractors. Refer to EO-10130 (distribution cable) or CE-TI-6832 (transmission cable) for cable moving procedures.

When multiple cables are present in a work area, the cable to be worked shall be identified by electrical means, unless its identity is obvious by reasons of distinctive appearance or location or by other readily apparent means of identification. Cables other than the one being worked shall be protected from damage.

When work is performed on buried cable or on cable in manholes, metallic sheath bonding shall be maintained or the cable sheath shall be treated as energized.

4.10 USE OF EQUIPMENT BY CON EDISON EMPLOYEES AND/OR CONTRACTORS

Con Edison employees may use the contractor’s ladders or rescue device, if visually inspected before use, and found to be in proper working order. Atmospheric monitoring equipment used by or for con Edison employees shall be con Edison equipment only. Contractors may use con Edison equipment with prior approval from con Edison personnel supervising the work.

4.11 TRAINING

Con Edison employees and contractors who enter electrical enclosed spaces for the purpose of conducting physical work, or who serve as attendants, shall be trained as required for the reason for entry, including the following:

- Applicable work procedures
- First aid/CPR (SAF 0021)
- Electrical enclosed space entry procedure
- Electrical enclosed space rescue
- The hazards of electrical enclosed space entry
- The proper use of forced-air ventilation for manholes, vaults, or similar structures
- Procedures for clearing underground structures of flammable gas and vapors

All of the above topics (except First aid/CPR) are covered in OJT ELE1010, Enclosed Space Entry and Rescue and in various skill courses.

Employees subject to entering manholes where SF₆ may be present shall receive the following additional training (see GSI 17.01.01):

- Properties of SF₆
- Nature and composition of the solid and gaseous decomposition products
- Appropriate precautions to be taken

4.12 ELECTRICAL ENCLOSED SPACE RESCUE

Examples of situations that may require rescue or resuscitation include but are not limited to:
• Illness (of a degree to preclude self-rescue).
• Injury (burns or fractures).
• Unconsciousness (physical blow, electric shock, or heart attack).

The time period in the space is not to be used as a guide, rather the type of work being done is the determining factor. Rescue equipment shall consist of a harness, a lifeline, and a self-supporting extraction device.

4.12.1 Work Requiring Rescue Device Set-Up

For work tasks with significant equipment interface, for example, splicing operations; network protector repairs; replacing fuses; test box inspections; bus table construction; cable pulling and moving operations; or flush work over 50ppm PCB, rescue equipment shall be set up at the job site prior to the start of work. Prior to entry, the entrant assigned to work in the electrical enclosed space shall put on a retrieval harness. The entrant does not have to be attached to the retrieval line. Transformer vault cages must be removed before performing tasks with significant equipment interface.

4.12.2 Work not Requiring Rescue Device Set-Up

For work tasks with minimal equipment interface/low hazard potential such as blocking open or closing a network protector; identifying cable and equipment; performing phase checks and phase identification; removing and applying grounds; applying ground switch; visual inspection with no work ongoing, work in service boxes under 48", or pre-inspection for scheduled work, rescue equipment shall be available on the truck adjacent to the work area. The entrant is required to wear a retrieval harness. If however, in the opinion of the lead mechanic or competent person, rescue equipment is required for entry, it shall be set up. The lead mechanic shall make this decision based on circumstances in the electrical enclosed space, or if the time period for the entry may become extended.

5.0 DEFINITIONS

Attendant: An individual authorized by the management of his/her department, who is stationed outside an enclosed or other space to monitor the authorized entrants and to perform all duties assigned in this program, including providing assistance to employees inside the space.

Confined Space: A space that:

• Is large enough and so configured that an employee can bodily enter and perform assigned work, and

• Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry), and

• Is not designed for continuous employee occupancy.

Confined spaces include, but are not limited to pits, sumps, sewers, manholes, wells, tanks/tankers, boilers and pressure vessels, other vessels, and equipment.
**Electrical Enclosed Space:** A working space, such as a manhole, vault, tunnel, service box, or shaft, used for the operation and maintenance of electric power generation, transmission, and distribution lines and equipment. An electrical enclosed space has a limited means of egress or entry, and is designed for periodic employee entry under normal operating conditions. Under normal conditions, an electrical enclosed space does not contain a hazardous atmosphere, but may contain a hazardous atmosphere under abnormal conditions.

**Gas Enclosed Space:** A working space used solely for the maintenance and distribution of natural gas lines and equipment, such as a manhole, vault, tunnel, or shaft. A gas-enclosed space has a limited means of egress or entry, and is designed for periodic employee entry under normal operating conditions. Under normal conditions, a gas-enclosed space does not contain a hazardous atmosphere, but may contain a hazardous atmosphere under abnormal conditions.

**Guarded:** Covered, fenced, enclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, mats, or platforms, and designed to minimize the possibility, under normal conditions, of dangerous approach or accidental contact by persons or objects.

**Hazardous Atmosphere:** An atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, unaided from an enclosed space), injury, or acute illness from one or more of the following causes:

- Flammable gas, vapor, or mist in excess of 10% of its lower explosive limit [LEL] (0.5% methane).
- Atmospheric oxygen concentration below 19.5% or above 23.0%.
- Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in The Occupational Safety and Health Administration General Industry Standard (29 Code of Federal Regulations [CFR] 1910.1000) and which could result in employee exposure in excess of its dose or permissible exposure limit.
- Any other atmospheric condition that is immediately dangerous to life or health (IDLH).

**Immediately Dangerous to Life or Health (IDLH):** Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual’s ability to escape unaided from a dangerous atmosphere.

**Lower Explosive Limit (LEL):** The lower limit of flammability of a gas or vapor at ordinary ambient temperatures expressed by a percentage of the gas or vapor in air by volume.

**Permit-Required Confined Space:** A confined space that has one or more of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere.
- Contains a material that has the potential for engulfing an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section.
- Contains any other recognized serious safety or health hazard.
**Qualified Worker:** Qualified is defined in this CSP, as being trained and knowledgeable in the procedures, potential hazards, and appropriate safety measures relevant to the work the person is required to perform.

### 6.0 RESPONSIBILITIES

Chem Lab - The Chem Lab is responsible for providing clearances for entering an enclosed space that may contain SF₆ gas or SF₆ by-products.

Electric Construction Group - The Electric Construction Group is responsible for installing and maintaining caution signs for SF₆ enclosed spaces.

**Employees:** Con Edison employees working in subsurface structures are responsible for following the requirements of this CSP and for attending required training.

**Environment, Health, and Safety (EH&S):** EH&S performs the following functions:
- Reviews applicable regulations and ensures that procedures meet all regulatory requirements.
- Revises procedures as applicable.
- Distributes updates and changes.
- Reviews training prepared by The Learning Center.
- Provides technical assistance to line management and the field.

In addition, the Director of EH&S Safety and Industrial Hygiene shall provide advice and counsel on this procedure.

**Facility-, Site, EHS; or Field Manager Responsible for Compliance:** The Con Edison designated individual within each operating department who is responsible for ensuring compliance with federal, state, and local regulations, and this procedure.

**Law Department:** The Law Department shall assist and provide guidance to EH&S by reviewing changes to these procedures in light of all applicable statutes and regulations to ensure that the procedures meet all legal requirements.

**Operating Departments:** Unless otherwise indicated, operating departments (Customer Operations, Electric, Gas, Purchasing and CFS, Steam, and Systems & Transmission Operation [S&TO]) are responsible for compliance with federal, state, and local regulations, and this procedure.

**Supervisors:** Responsible for ensuring that personnel follow proper procedures and for performing necessary training.

### 7.0 REFERENCES

**Federal:**
ATTACHMENT I

SAMPLING PROCEDURE FOR MANHOLE ATMOSPHERES

Detector must first be operated in fresh air. Initial test is for oxygen deficiency followed by a gas detection test.

STEP 1

Observations of the atmosphere in the manhole shall be made at a level approximately two feet from the top, near the middle of the manhole, and at a level near the bottom. If water should be present in the manhole, the latter observation should be made at a level just above the surface of the water. Care should be taken not to immerse the end of the sampling hose in water. When exposed to water, the filter at the end of the sampling hose will automatically close to prevent any material or gas from entering the tube. This action will also render the instrument inoperable until the filter is replaced. To prevent erroneous readings, operating difficulties and maintenance problems, always use the probe and filter supplied with each gas detector.

STEP 2

Insert ladder into structure and take sample around casting and chimney. While descending the ladder, take samples to the right and left for three levels.

STEP 3

Check the remainder of the manhole from the tested area.
STEP 4

Check remaining area at duct edges, comers, cracks, and other irregularities.
N: EO-10,359 (Periodic Underground Distribution Structure Inspections)
PERIODIC UNDERGROUND DISTRIBUTION STRUCTURE INSPECTIONS

FILE: OPERATION AND MAINTENANCE OF EQUIPMENT, MANUAL 1
SECTION 13 REPAIRS AND MISCELLANEOUS TESTS

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Periodic Underground Distribution Structure Inspections

1.0 PURPOSE

1.1. This specification describes periodic underground distribution structure inspections to comply with the Public Service Commission’s Electric Safety Standards issued in Case 04-M-0159 for the following:

1.1.1. All underground electric distribution structures such as manholes, service boxes and vaults.

1.1.2. All cable, joints, transformers, network protectors, etc. contained in underground distribution structures and underground residential distribution (URD) structures.

1.2. All work and operating procedures shall be in accordance with the provisions of the “General Instructions Governing Work on System Electrical Equipment,” “General Instructions Governing Work on Overhead and URD System Electrical Equipment” and the “General Rules and Regulations”.

2.0 APPLICATION

2.1. All Underground, I&A Services, I&A Networks, M&CS, and Quality Assurance personnel that enter electric distribution structures including, manholes, boxes, and vaults that contain/support primary or secondary cables and/or equipment.

3.0 WHEN TO PERFORM AN UNDERGROUND INSPECTION?

3.1. An Underground, I&A Services, I&A Networks, M&CS, and Quality Assurance crew should perform an underground inspection on/in every distribution structure that the crew enters to perform work. All crews entering underground structures shall follow approved manhole entry procedures in CSP 17.01, including testing for stray voltage (See Section 7), and should conduct the inspection at the time of initial entry into the structure. If a structure inspection has been documented within the last 7-days, another documented inspection is not required. If a repair is made, then an inspection shall be documented, regardless if 7-days have not passed. The crew shall test the structure for stray voltage at the conclusion of work in the structure and at the end of each work period before leaving the site unless relieved by another crew (see Section 7).

3.2. Scheduled or Targeted underground inspections. A Scheduled inspection is conducted to ensure that a structure is inspected on its 5-year cycle. A Targeted inspection is conducted as part of the secondary upgrade program.

3.3. Inspections of customer manholes, or service boxes are not required. If a
defect is identified in/on customer structures they should be reported to Energy Services for follow-up with the customer.

4.0 TYPES OF INSPECTIONS

4.1. **Underground Inspection** – An inspection of an underground distribution structure, such as service boxes, manholes, pull boxes, vaults, etc. and the electric equipment contained in the structure that are not normally buried. The inspection shall be performed in accordance with Paragraph 8.0.

4.2. **Critical Manhole Inspection** - Critical manholes are electric distribution underground structures where, if problems occurred, could have a major impact on the distribution system. Depending on operating region, examples of critical manholes are: the first feeder manholes leaving a substation, structures with three (3) or more feeders serving the same network, structures with more than three (3) network feeders serving more than one network and other structures selected by the Region’s Manager of Electric Operations Engineering. Transmission manholes containing distribution cables and splices shall be inspected as Critical manholes. Annually, each Region’s Manager of Electric Operations/Engineering should establish and issue the list of critical manholes in the region and then have these structures identified as critical manholes.

4.3. Joint Regulator Inspections – see EO-6141.

5.0 PERFORMANCE OF INSPECTION

5.1. Underground distribution structures should be inspected by visual examination of the structure and its equipment to identify conditions that can cause or lead to safety hazards or adverse affects on the performance of the structure or equipment. In particular, the inspection should determine whether any of the conditions stated below in subsections 5.4.1 through 5.4.17 are present. These conditions are listed in sections “B” through “R” of the “UG Structure Inspection Form (EO-10359)” form.

5.1.1. **D-Fault Tag (EO-1184) or Environmental Tag Present** – A chimney tag found installed after the structure cover has been removed.

5.1.2. **Flush Required to Complete Inspection** – A flush is required when the presence of liquids and/or debris in a structure prevent a full and complete visual inspection of all components of the structure and the equipment in the structure.

5.1.3. **D-Fault (EO-1184) or Environmental Condition identified during inspection** – A D-Fault or Environmental condition that was not previously identified is observed during the inspection.
5.1.4. **Stray Voltage** – A voltage found present on a conducting material that is not intended to be energized.

5.1.5. **Cable or Crab in Contact with Cover/Frame (Bulletin 51)** – A secondary or service conductor found in contact or within 6” of the metallic structure cover or frame.

5.1.6. **Improperly Sealed Secondary End Cap(s) (Bulletin 49)** – A secondary or service conductor that is not sealed in accordance with specification **EO-2509-C** or **EO-10979-C**.

5.1.7. **Voltage Present on Metallic Conduit or Lead Sheath (Stray Voltage)** - A voltage found present on the lead jacket of a main or service conductor or accessible metallic secondary or service duct that is not intended to be energized.

5.1.8. **Unsealed Service Duct (EO-1100) (EO-6217-C)** – A service duct found not sealed in accordance with **EO-1100** or **EO-6217-C**.

5.1.9. **Cover Damage/Needs Regrade/Structure Damage** – A structure cover found cracked, damaged, above grade or below grade. A vented cover with the holes clogged that can not be cleared. A structure condition with large cracks in walls or ceiling, steel support beams defective, etc. A URD structure with broken baffles or doors that do not close and lock.

5.1.10. **Sump Pump Inoperable/Ungrounded (EO-12160-C)** – A sump pump that does not operate when the float is lifted or a sump pump that is found not grounded in accordance with **EO-12160-C**.

5.1.11. **Exposed Conductor/Visible Burnouts** – A condition where secondary or service cables are burning or conductor is exposed.

5.1.12. **Damaged Neutral Cable/Connections** – A condition where the neutrals do not have the proper number of indents, the aluminum cables are not connected in accordance with **EO-5403**, the bonds are broken on lead mains or services, damaged neutral bus, or connections are broken apart.

5.1.13. **Damaged Secondary Service(s)/Main(s)/Crab(s)/Splice(s)** - Secondary conditions such as swollen, damaged, peeling, cracked, or burnt crabs/cable, jacket rolled back, damaged U-splices or connections without the proper number of indents.

5.1.14. **Damaged Primary Feeder Cable(s)/Joint(s)** – A condition on primary cable such as swollen joints-below-max, collapsed joints, feeder on floor that can not be re-racked, damaged elbows, etc. that are not D-Faults.
5.1.15. **Structure Conductor Upgrade** – A condition where the secondary cables not properly racked, the hole is very congested, there are no remaining pockets/tails for the required work within the structure or limited space for the employee to work safely.

5.1.16. **Main Requires Replacement** – A main that is recommended for replacement due to cracked lead armor, corroded lead armor where the insulation is exposed, or insulation is cracked, brittle, or baked.

5.1.17. **Service Requires Replacement** – A Service that is recommended for replacement due to cracked lead armor, corroded lead armor where the insulation is exposed, or insulation is cracked, brittle, or baked.

### 6.0 INSPECTION CYCLE

6.1. The underground inspections should be conducted according to the following schedule:

6.1.1. Underground Inspection – At least every 5-years.

6.1.2. Critical Manhole Inspection – Every 3 years.

6.1.3. Tunnels (Con Edison) – 5 years.


### 7.0 STRAY VOLTAGE TESTING DURING INSPECTIONS AND DURING WORK IN UNDERGROUND STRUCTURES

7.1. All crews entering underground structures for any purpose shall follow approved manhole entry procedures in CSP 17.01, including testing for stray voltage. The crew shall also test for stray voltage at the conclusion of work in the structure and at the end of each work period before leaving the site unless relieved by another crew.

7.2. Testing for stray voltage shall be conducted according to the procedures and using the approved device stated in EO-10129 and EO-100175.

7.3. Stray voltage testing includes a test of the exterior metallic surfaces (cover and rim) of any distribution structure, such as manhole covers, service box covers, and vault gratings. See Bulletin #39. Stray voltage testing inside the structure includes a test of the lead jacket of a main or service conductor and accessible metallic secondary or service duct.

7.4. Where stray voltage is found, the procedures stated in Bulletin #48 shall be followed. All locations identified with a stray voltage shall be immediately made safe or manned continually until the condition causing the stray voltage is made safe. The condition that caused the stray voltage must be repaired...
within 45 days of discovering stray voltage.

8.0 FILLING OUT THE UNDERGROUND INSPECTION FORM

8.1. Crews should use the “UG Structure Inspection Form (EO-10359)” in Appendix A to record the results of each underground inspection of an underground distribution structure. Refer to the UG Structure Inspection Form in Appendix A for Section 8 of this specification.

8.2. The top of form consists of general information relating to

8.2.1. The name and employee number of the person conducting the inspection.

8.2.2. The date the inspection was completed.

8.2.3. The Region in which the structure is located.

8.2.4. The appropriate Municipality for Westchester

8.2.5. The Department of the employee conducting the inspection.

8.2.6. The Location of the structure relating to street address.

8.2.7. The Parking restrictions.

8.2.8. The Structure type (code abbreviations for each type of structure are provided)

8.2.9. The Structure number.

8.2.10. The presence of a Joint Regulator within the structure.

8.2.11. The location of the structure relating to the street, sidewalk, or other.

8.2.12. The M&S plate number of the structure.

8.2.13. The Cover type on the structure.

8.3. Item A on the inspection form is the reason for inspection and shall be marked as follows:

8.3.1. A Scheduled or Targeted inspection conducted as part of the upgrade program or to ensure the structure is inspected on cycle, shall be entered as Code 1.

8.3.2. An inspection of a Manhole conducted as part of the Critical Manhole program shall be entered as Code 2.

8.3.3. An inspection conducted in conjunction with regular work within the structure such as installing services, splicing primary or secondary, etc. shall be entered as Code 3.

8.3.4. An inspection conducted during follow-up repairs identified during a
structure inspection shall be entered as Code 4.

8.3.5. Item A also has a yes/no box called “Defects Found.” An answer of “No” in the box means that all Items from B through R have an answer of “No”. An answer of “Yes” in the box means that any one or more of Items B through R has an answer of “Rep”, or “Yes.”

8.4. If the structure has been found with a D-Fault tag, do not enter the structure, and refer to EO-1184 for appropriate action. No ECS ticket needs to be created as a result of this inspection. Item B on the inspection form shall be marked as “Yes”. Item S on the inspection form shall be marked “Stop,” the D-Fault Tag number recorded on the form, and the inspection shall cease.

8.5. If the structure has been found with an Environmental Tag, refer to the General Environmental Instructions for appropriate action. Item B on the inspection form shall be marked as “Yes” and Item S shall be marked “Stop,” the Environmental Tag number recorded on the form, and the inspection shall cease.

8.6. If the structure requires a flush to conduct a full and complete visual inspection, then the flush should be reported to the appropriate department. The flush number, if appropriate, should be recorded on the form for further follow-up. The inspection is incomplete. Item C shall be marked “Yes” on the inspection form and Item S shall be marked “Stop,” the flush number recorded on the form, and the inspection shall cease.

8.7. If a D-Fault is identified during the inspection, exit the structure, and refer to EO-1184 for appropriate action. In addition, this D-Fault shall be recorded in the Distribution Fault Tracking Application. Item D shall be marked “Yes,” Item S shall be marked “Stop,” and the inspection shall cease.

8.8. If the structure is found with an environmental condition, the condition shall be reported according to the General Environmental Instructions. Item D on the inspection form shall be marked “Yes,” Item S on the inspection form shall be marked “Stop,” and the inspection shall cease.

8.9. If the structure has been found with stray voltage, protect the location, call the appropriate Control Center to report the condition, and begin troubleshooting activities. The Control Center shall initiate an ECS ticket with a trouble type of ENE. The field crew and Control Center shall coordinate the collection of the information necessary in Bulletin #48. Item E on the inspection form should be marked “Rep” (repaired) when the stray voltage condition has been repaired.

8.10. If secondary/services cables/crabs are found in contact with the frame/cover or within 6” of the frame/cover, they should be reshaped to eliminate this contact and provide at least 6” clearance. If reshaping cannot be performed
then a secondary barrier shall be installed in accordance with Bulletin #51. In addition to installing the secondary barrier, the structure requires a Structure Conductor Upgrade and an enlargement review. If a barrier is installed, Item F should be marked “Rep” and Item P should be marked “Yes” on the inspection form.

8.11. If secondary/services cables/crabs are found with the ends not protected in accordance with EO-2509-C or EO-10979-C, they shall be repaired upon discovery and Item G shall be marked “Rep”.

8.12. If voltage is found on the metallic sheath or accessible metallic conduit of a secondary or service conductor, the condition shall be considered a stray voltage and immediate repairs initiated. Item H shall be marked “Rep” when the stray voltage condition has been corrected.

8.13. If an unsealed service duct is observed during the inspection, it shall be sealed during the inspection and item I shall be marked “Rep”.

8.14. When the structure has been determined to require a regrade or a cover replacement, Item J on the inspection form should be marked “Yes”, and an ECS ticket should be generated with a trouble type of SIP. This ticket should be office completed and receive a DOCS referral to the organization in the region responsible such as Sub-Surface Construction (SSC) or Construction Management (CM) for further evaluation of the required work. Do not refer these ECS tickets as “FYI”. This department should evaluate the required work. Examples of appropriate DOCS referral codes are:

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<tr>
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<td>NSSS</td>
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<tr>
<td>Bronx</td>
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8.15. If the sump pump does not operate when the float is lifted or the pump is found improperly grounded Item K shall be marked “Yes.” If the sump pump or grounding is repaired Item K shall be marked “Rep.” If the structure does not require a sump pump, Item K shall be marked “No.”

8.16. If exposed secondary/service conductors or visible burnouts are found during the inspection, they must be repaired immediately or referred to Control Center for repair. Item L on the inspection should be marked “Rep” if the repair is made at the time of the inspection. If the condition has been referred to the Control Center, then Item L should be marked “Yes”. Do not
refer these ECS tickets as “FYI”. Examples of appropriate DOCS referral codes to the Control Center are:

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<td>Change trouble type on ECS ticket to RDSSIP</td>
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8.17. If the neutral cables or connections are found defective or damaged, they should be repaired upon discovery and Item M on the inspection form shall be marked “Rep”. If repairs are not possible at the time of inspection, an ECS ticket should be made out, referred to the appropriate department for repair, and Item M shall be marked “Yes”. Do not refer these ECS tickets as “FYI”. Examples of appropriate DOCS referral codes to the Underground are:

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8.18. If Damaged Secondary Service(s)/Main(s)/Crab(s)/Splice(s) are found, they should be repaired upon discovery and Item N on the inspection form shall be marked “Rep”. If repairs are not possible at the time of inspection, an ECS ticket shall be made out, referred to the appropriate department for repair and Item N should be marked “Yes”. Do not refer these ECS tickets as “FYI”. Examples of appropriate DOCS referral codes to the Underground are:
8.19. If Damaged Primary Feeder Cable(s)/Joint(s) or other primary conditions that are not D-Faults are found during the inspection, report the condition to the appropriate Regional Control Center.

8.20. If a Structure Conductor Upgrade is required within the structure, an ECS ticket should be made out and closed out unless Tier One items remain open. Item P should be marked “Yes” on the inspection form.

8.21. If a main is recommended for replacement, Item Q should be marked “Yes”. An ECS ticket shall be generated with trouble type SIP. Add all pertinent data about the main and service in the remarks of the ECS ticket and close the ECS ticket unless Tier One items remain open.

8.22. If a service is recommended for replacement, Item R should be marked “Yes”. An ECS ticket should be generated with trouble type SIP. Add all pertinent data about the main and service in the remarks of the ECS ticket and close the ECS ticket unless Tier One items remain open. See Section 8.2 for prioritization of Tier Two repairs.

8.23. Once all the preceding conditions have been observed, Item S on the inspection form shall be marked “Yes,” except when Items B, C, or D are marked “Yes,” in which case Item S shall be marked “Stop.”

9.0 PERMANENT RECORD OF STRUCTURE INSPECTIONS

9.1. The Stray Voltage Log shall be used as the permanent record of underground distribution structures inspections.

9.2. The data on the “UG Structure Inspection Form (EO-10359)” form shall be entered into the Stray Voltage Log.

10.0 REPAIR OF CONDITIONS FOUND ON INSPECTION OF UNDERGROUND DISTRIBUTION STRUCTURES

10.1. Crews performing an underground inspection are expected to make minor
repairs and should be equipped with material necessary to make such minor repairs, such as fairleaders, porcelains, shrink caps, shrink sleeves, etc.

10.2. Any repair work identified during the inspection should be initiated at the time of inspection. If repairs are not completed before Company forces leave the site, an ECS ticket shall be created and routed to the appropriate department for follow-up repairs. If multiple repairs are required, one ECS ticket should be issued indicating all required follow-up work. If repairs are completed before Company forces leave the site, an ECS ticket is not required unless stray voltage was found at the structure. All ECS tickets created as a result of an underground inspection should have a trouble code of “EDSSIP”, except structures found with stray voltage. Structures found with stray voltage, should have ECS tickets issued with a trouble code of “EDSENE.”

11.0 REFERENCE DOCUMENTS & SPECIFICATIONS

11.1. The following specifications and documents are referenced in this specification:

- **EO-10111** Schedule For Maintenance And Inspection Of URD Subsurface Transformers
- **EO-10113** Schedule For Maintenance And Inspection Of Padmounted Transformers (Single / Three Phase), Padmounted Switchgear (PME) And T-Tap Boxes
- **EO-10110** Inspection And Maintenance Of Network Type Distribution Equipment
- **EO-6141** Maintenance of Oil Reservoirs on Distribution Feeders
- **EO-6217-C** Method Of Sealing Phase Grouped Cables And Conduits For Services, Manholes, And Vaults
- **EO-1184** Periodic Inspection, Maintenance and Reporting of Distribution Underground Cables & Joints
- **EO-1147** Secondary Cable Distribution Boxes
- **EO-1022** Design Limitations of Primary Feeder Subway Systems
Won Choe (Signature on File)
Won Choe
Secondary System Analysis
Department Manager
Distribution Engineering Department

Leo A. Scally

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12.0 **APPENDIX A: INSPECTION FORM FOR UG DIST. STRUCTURES**

### UG STRUCTURE INSPECTION FORM (EO-10359)

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<thead>
<tr>
<th>LOCATION</th>
<th>PARKING RESTRICTIONS</th>
<th>VS vault vulnerable</th>
<th>V vault</th>
<th>SB service box</th>
<th>IJ in-line jumper</th>
</tr>
</thead>
<tbody>
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<table>
<thead>
<tr>
<th>STRUCTURE NUMBER</th>
<th>LOCATED ON STREET</th>
<th>R&amp;B PLATE</th>
<th>PM pad mount</th>
<th>TM cover</th>
<th>M manhole</th>
<th>P splice chamber</th>
<th>TT tee</th>
</tr>
</thead>
<tbody>
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</tbody>
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<table>
<thead>
<tr>
<th>JOINT REGULATOR</th>
<th>YES</th>
<th>NO</th>
<th>OTHER</th>
<th>COVER TYPE</th>
<th>vented</th>
<th>grading</th>
<th>N/A</th>
<th>solid metallic</th>
<th>solid non-metallic</th>
<th>STRUCTURE TYPE</th>
</tr>
</thead>
<tbody>
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If no defects are found, indicate next to line A, otherwise, indicate defects in appropriate boxes below.

#### A. Reason for visit

1. 1 – Scheduled or Targeted Underground Inspection
2. 2 – Critical Manhole Inspection (**MANHOLE ONLY**)
3. 3 – Inspection incorporated into routine work
4. 4 – Repairs or follow-up to previous inspection

#### B. D-Fault Tag or Environmental Tag Present (EO-1184)

- B. No
- C. No
- D. No

#### C. Flush Required to Complete Inspection

- C. No

#### D. D-Fault or Environmental Condition Identified during Inspection (EO-1184)

- D. No

### Structure Access Restrictions: Record tag or flush numbers below and Stop, otherwise, continue.

- B. No
- C. No
- D. No

### Tier 1: You must repair these items before leaving location

- E. Stray Voltage
- F. Cable or Cable in Contact with Cover/Frame (Bulletin 51)
- G. Improperly Sealed Secondary End Cap(s) (Bulletin 49)
- H. Voltage Present on Metallic Conduit or Lead Sheath (Stray Voltage)
- I. Unsealed Service Duct (EO-1100) (EO-6217-C)

#### Tier 1: Repair on location or initiate detailed B Ticket for follow up. Use ECS code “SIP”

- J. Cover Damage/Needs Regrade/Structure Damage
- K. Sump Pump Inoperable/Ungrounded (EO-12160-C)
- L. Exposed Conductor/Visible Burnouts
- M. Damaged Neutral Cable/Connections
- N. Damaged Secondary Service(s)/Main(s)/Crab(s)/Splice(s)

#### Call Control Center to report

- O. Damaged Primary Feeder Cable(s)/Joint(s) that are not D-Faults – feeder outage required for repair

#### Tier 2: Initiate detailed B ticket for follow up. Use ECS code “SIP”

- P. Structure Conductor Upgrade
- Q. Main Requires Replacement
- R. Service Requires Replacement

#### Mark inspection complete unless D-Fault tag, Environmental tag, or Flush prevent access to structure.

- S. Inspection Complete

#### Reporting Problems:

It is everyone’s responsibility to make sure follow up work is documented and completed. Report any item marked “Yes” with repairs not completed to your clerk or control center, get a tracking number and write it below. For line B and D, follow procedures and DO NOT continue inspection if D Fault is present. Finally, remember that details of Stray Voltage events must be recorded on a B Ticket even if repairs are completed at the time of inspection.

**Flush □□□□□ B Ticket □□□□□□□□□□ D Fault □□□□ Environmental □□□□□**

Effective 4/19/2005
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O: Certification of Stray Voltage Testing

John Mucci, on this 12th day of January 2007, certifies as follows:

1. I am Vice President of Consolidated Edison Company of New York, Inc. ("Con Edison" or "the Company").

2. I am responsible for overseeing Con Edison's stray voltage testing program, and in that capacity I have monitored the Company's stray voltage testing program during the twelve months ended November 30, 2006 ("the twelve month period"). During the twelve-month period, Con Edison instituted and diligently carried out a program designed to meet the stray voltage testing requirements of the Public Service Commission's Safety Standards, issued and effective January 5, 2005 as modified by Order issued July 21, 2005 in Case 04-M-0159, Proceeding Instituting Safety Standards.

3. To the best of my knowledge, information, and belief, during the twelve month period, Con Edison identified and tested for stray voltage (i) all publicly accessible electric facilities owned by the Company, and (ii) all streetlights located in public thoroughfares in the Company's service territory as identified through a good faith effort by the Company, except for such facilities that are identified in the Company's Annual Report, submitted herewith.

[Signature]

John Mucci
P: Certification of Inspections

John Mucci, on this 12th day of January 2007, certifies as follows:

1. I am Vice President of Consolidated Edison Company of New York, Inc. ("Con Edison" or "the Company").

2. I am responsible for overseeing Con Edison's electric facility inspection program, and in that capacity I have monitored the Company's inspection program during the twelve months ended November 30, 2006 ("the twelve-month period"). During the twelve-month period, Con Edison instituted and diligently carried out a program designed to meet the inspection requirements established by the Public Service Commission's Safety Standards, issued and effective January 5, 2005 as modified by Order issued July 21, 2005 in Case 04-M-0159, Proceeding Instituting Safety Standards.

3. To the best of my knowledge, information, and belief, Con Edison has visually inspected the requisite number of electric facilities during the twelve-month period, including the requirement to have conducted a visual inspection of at least 35% of its electric facilities through November 30, 2006.

John Mucci