STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
PUBLIC UTILITIES COMMISSION

Re: Proceeding to Establish a Contact Voltage Detection and Repair Program Applicable to National Grid Pursuant to Enacted Legislation

Docket No. 4237

PREFILED DIRECT JOINT TESTIMONY OF

Gregory L. Booth, PE, President
and
Micheal W. White, PE
PowerServices, Inc.

On Behalf of
Rhode Island Division of Public Utilities and Carriers

September 18, 2012

Prepared by:
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DIRECT JOINT TESTIMONY OF GREGORY L. BOOTH, PE AND MICHEAL W. WHITE, PE

I INTRODUCTION OF GREGORY L. BOOTH, PE

Q. PLEASE STATE YOUR NAME AND THE BUSINESS ADDRESS OF YOUR EMPLOYER.

A. My name is Gregory L. Booth. I am employed by PowerServices, Inc. ("PowerServices"), UtilityEngineering, Inc. ("UtilityEngineering"), and Gregory L. Booth, PLLC ("Booth, PLLC") all located at 1616 E. Millbrook Road, Suite 210, Raleigh, North Carolina 27609.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS MATTER?

A. I am testifying on behalf of the Rhode Island Division of Public Utilities and Carriers ("Division").

Q. WHAT IS YOUR POSITION WITH POWERSERVICES, INC., UTILITYENGINEERING, INC., AND BOOTH, PLLC?

A. I am President of PowerServices, Inc., an engineering and management services firm, UtilityEngineering, Inc., a design/build firm, and Booth, PLLC, an engineering firm. As such, I am responsible for the direction, supervision, and preparation of engineering projects and management services for our clients, including the corporate involvement in engineering, planning, design, construction management, and testimony.

Q. WOULD YOU PLEASE OUTLINE YOUR EDUCATIONAL BACKGROUND?

A. I graduated from North Carolina State University in Raleigh, North Carolina in 1969 with a Bachelor of Science Degree in Electrical Engineering. I am a registered professional engineer in twenty two states, as well as District of Columbia. I am also a registered land surveyor in North Carolina. I am also registered under the National Council of Examiners for Engineering and Surveying.

Q. ARE YOU A MEMBER OF ANY PROFESSIONAL SOCIETIES?

A. I am an active member of the National Society of Professional Engineers (“NSPE”), the Professional Engineers of North Carolina (“PENC”), The Institute of Electrical and Electronics Engineers ("IEEE"), American Public Power Association (“APPA”), American Standards and Testing Materials Association (“ASTM”), and the Professional Engineers in Private Practice (“PEPP”). I am also a member of the IEEE Distribution Subcommittee on Reliability and the National Fire Protection Association, and an advisory member of the National Rural Electric Cooperative Association (“NRECA”)-Cooperative Research Network, which is an organization similar to EPRI.

Q. HAVE YOU PUBLISHED ANY TREATISES, MANUALS, OR COURSES, OR TAUGHT SEMINARS?

A. Since 1972, I have authored manuals and taught numerous seminars each year on engineering matters, including reliability, rates and regulations, design and construction and construction management and services matters. I have also prepared engineering manuals and text for instruction, seminars and courses. My manuals and texts have included subjects such as the National Electrical Safety Code ("NESC"), Power Loss

Management, Power System Protective Coordination, Long-Range Planning, Asset Management Strategic Planning, Electric Utility Best Practices, Power Factor Optimization, Power Quality, Underground Design Standards, Hazard Assessment and Arc Flash Mitigation, the National Electrical Code, NERC Compliance, and many others. My seminars, instructions, courses and speaking have been before state and national electric utility organizations across the United States. I have been nationally published on some of these subjects as well.

Q. HAVE YOU ATTACHED TO YOUR TESTIMONY A COPY OF YOUR CURRICULUM VITAE?

A. Yes. My curriculum vitae is attached as Exhibit GLB-1, and includes an overview of my experience since beginning my work in 1963.

Q. PLEASE BRIEFLY DESCRIBE YOUR EXPERIENCE WITH ELECTRIC UTILITIES.

A. I have worked in the area of electric utility and telecommunication engineering and management services since 1963. I have been actively involved in system planning and protective coordination and stability studies, including detailed analyses of all components of distribution and transmission systems including electric utilities in 40 states, and the District of Columbia, for over 300 utility clients. My experience includes all phases of consulting engineering, engineering design and management services from generation through transmission and substation design and distribution of power on electric utility systems. I have been actively involved in cost-of-service studies, rate

studies and rate design, both retail and wholesale. My involvement has also included the planning, design, and construction management of generation, transmission, substation, and distribution line facilities. This involvement has included the inspection of these facilities and the evaluation of service reliability. I have performed hundreds of long-range and short-range planning studies, load flow studies, and cost estimates for electric utilities across the United States. I was involved in the management of all of the divisions of Booth & Associates, Inc. ("Booth & Associates"), for over 30 years, including transmission, substation, and distribution facilities design and construction management of approximately $100 million dollars per year in plant value additions. My involvement included electric utility systems in rural and urban areas as well as coastal, plain and mountain areas throughout the eastern United States and as far west as Arizona, Washington State, and Alaska, along with design and construction in light, medium and heavy loading districts as defined in the NESC. My work has included services to numerous electric systems in the northeast, including Maine, Maryland, Massachusetts, New Hampshire, New Jersey, Pennsylvania, Rhode Island, and Virginia. I have been involved in power supply contract bids, negotiations, economic analyses and implementation, including evaluating the transmission system network capabilities. I have also been involved in projects to relieve or mitigate transmission congestion in the PJM area.

Q. DO YOU HAVE OTHER INVOLVEMENT AND EXPERIENCE WITH COMPANIES THAT PROVIDE YOU WITH ADDITIONAL EXPERTISE RELEVANT TO THIS DOCKET?

A. Yes. My electric utility reliability assessment work for the Rhode Island Division of Public Utilities and Carriers ("Division"), the New Jersey Board of Public Utilities ("NJBPU") and at the Pennsylvania PUC and the Virginia State Corporation Commission ("SCC") over the last ten years has involved in-depth assessment and working with northeastern electric utilities on reliability enhancement and the costs associated with such enhancement, including annual construction work plan development for electric utility systems. Also, I was directly involved in the purchase and transition of electric utility facilities from Progress Energy Florida (formerly Florida Power Corporation) to the City of Winter Park, Florida, and also the Fort Bragg Army Base electric utility system purchase by Sandhills Utilities, LLC and its transition along with Delmarva Power & Light distribution and transmission system on the Eastern Shore of Virginia purchased by A & N Electric Cooperative and the Potomac Edison Company entire Virginia jurisdiction to Shenandoah Valley Electric Cooperative and Rappahannock Electric Cooperative. Along with these acquisitions, I prepared system condition assessments, and construction work plans for annual infrastructure expansion, safety, reliability, and loan purposes. These ranged from $50 million to $250 million, excluding the acquisition cost. Additionally, I investigate safety related accidents and testify as an

expert in state and federal courts concerning safety related accidents involving electric utility systems averaging over 30 cases a year.

Q. HAVE YOU BEEN INVOLVED IN STRAY/CONTACT VOLTAGE INVESTIGATIONS AND REVIEWS FOR ELECTRIC UTILITIES?

A. Yes.

Q. WOULD YOU PROVIDE A BRIEF OVERVIEW OF THIS EXPERIENCE?

A. My initial involvement with contact and stray voltage began in the early 1970's and was primarily associated with system analysis and design to mitigate step and touch potential. These projects included transmission and distribution substations and industrial complexes and dairy farms. One the greatest challenges has always been the evaluation and mitigation of contact and stray voltage on a dairy farm because of the heightened sensitivity of dairy cattle to contact and stay voltages. Dairy cattle and other farm animals are more susceptible to injury and death than even humans (horses and dairy cattle as an example). My involvement has not only included extensive assessment and mitigation solutions for utilities and industrial and commercial clients over the past 40 years; it has included services to Commissions such as the New Hampshire Public Utilities Commission. My contact voltage experience has included testing, evaluation and mitigation of serious contact voltage levels for numerous utilities and other clients. This has included contact voltage levels ranging from over 100 volts to as much as 480 volts, causing serious injury and deaths. My evaluations have included overhead and underground electrical systems in urban, suburban and rural areas in states such as New

Hampshire, Texas, Florida, West Virginia, Virginia, New York and North Carolina, among others. The evaluations have included street lighting systems, traffic signal systems, and residential and industrial facilities. I have testified as an accepted expert in litigated matters involving contact and stray voltage damage and injury or death in numerous states including New York, Texas, North Carolina, South Carolina, West Virginia, Wisconsin and others. I have assisted utilities in investigation involving damage or injury with eventual mitigation. I remain active to this day with utility and industrial clients in the areas of contact voltage, stray voltage and neutral to earth potential difference testing, evaluation, and mitigation, including several active matters in litigation which involve personal injury from contact voltage.

Q. HAVE YOU PREVIOUSLY TESTIFIED AS AN EXPERT BEFORE STATE UTILITY COMMISSIONS, OTHER REGULATORY AGENCIES, AND/OR COURTS?

A. Yes. I have testified on numerous occasions before the Federal Energy Regulatory Commission ("FERC"), including pre-filed testimony in both wholesale rate matters as well as in electric utility reliability complaints, including Duke Power Company and Dominion Power issues. I have also testified before the New Jersey Board of Public Utilities, the Delaware Public Service Commission, Minnesota Department of Public Service Environmental Quality Board, Virginia State Corporation Commission, the Pennsylvania Public Utility Commission, North Carolina Utilities Commission,

Massachusetts Department of Public Utilities and Rhode Island Public Utilities Commission, most of them on numerous occasions.

Q. HAVE YOU BEEN ACCEPTED AS AN EXPERT BEFORE STATE OR FEDERAL COURTS?

A. Yes. I have been accepted as an expert in the area of electrical engineering and electric utility engineering, construction and reliability matters and the NESC, NEC, OSHA EMF, and forensic engineering, including standard and customary utility operation practices in the electric utility industry and the electric industry before 12 state and federal courts. This testimony has included property damage matters, personal injury and fatalities involving contact voltage.

II INTRODUCTION OF MICHEAL WHITE, PE

Q. PLEASE STATE YOUR NAME AND THE BUSINESS ADDRESS OF YOUR EMPLOYER.

A. My name is Micheal W White. I am employed by PowerServices, Inc. ("PowerServices"), located at 1616 E. Millbrook Road, Suite 210, Raleigh, North Carolina 27609.

Q. WHAT IS YOUR POSITION WITH POWERSERVICES, INC.?

A. I am employed as a Senior Engineer for PowerServices. I am responsible for the preparation and supervision of engineering projects in planning, design, construction management, and utility technology.

Q. WOULD YOU PLEASE OUTLINE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL BACKGROUND?

A. I graduated from Clemson University in Clemson, South Carolina in 1997 with a Bachelor of Science Degree in Electrical Engineering. I am a registered professional engineer in nine (9) states. I began working with Blue Ridge Electric Cooperative in 1997, and was employed ten (10) years with the company in the areas of system engineering and technology management. For the past six (6) years, as a consulting engineer, I have been involved in engineering activities assisting electric utilities in ten (10) states. My work experience has included all phases of engineering planning, engineering design and technology management concerning the distribution of power on electric utility systems. My involvement has also included the planning, design, and

inspection of transmission, substation, and distribution line facilities. On behalf of utility clients, I have conducted electric system inventories, electric pole data collections, post-storm evaluations, and electric system phasing projects. In the area of technology, I have worked with utilities in the evaluation, selection, and implementation of advanced utility technologies for Smart Grid initiatives.

Q. ARE YOU A MEMBER OF ANY PROFESSIONAL SOCIETIES?

A. I am a member of the The Institute of Electrical and Electronics Engineers ("IEEE"), National Fire Protection Association (“NFPA”), and Clemson University Engineering and Power Research Association (“CUEPRA”). I am also registered under the National Council of Examiners for Engineering and Surveying (“NCEES”).

Q. HAVE YOU PUBLISHED ANY TREATISES, MANUALS, OR COURSES, OR TAUGHT SEMINARS?

A. I have researched and prepared engineering text for instruction, seminars, and courses. My texts and seminars have included subjects such as the National Electrical Safety Code ("NESC"), Power System Computer Modeling, Power Factor Optimization, Power System Harmonics, and Electric Power Line Design.

Q. HAVE YOU ATTACHED TO YOUR TESTIMONY A COPY OF YOUR CURRICULUM VITAE?

A. Yes. My curriculum vitae is attached as Exhibit MWW-1.

Q. HAVE YOU BEEN INVOLVED IN STRAY/CONTACT VOLTAGE INVESTIGATIONS AND REVIEWS FOR ELECTRIC UTILITIES?

A. Yes.

Q. WOULD YOU PROVIDE A BRIEF OVERVIEW OF THIS EXPERIENCE?

A. My initial involvement with contact and stray voltage began while I was working with Blue Ridge Cooperative and was primarily associated with responding to stray voltage complaints from the public and included both testing and analysis of overhead and underground electric systems components, residential and industrial facilities, and street lighting. My continued experience while consulting with numerous utilities and other clients has included field testing, personnel testing procedures during field audits, and mitigation methods.

Q. HAVE YOU PREVIOUSLY TESTIFIED AS AN EXPERT BEFORE STATE UTILITY COMMISSIONS, OTHER REGULATORY AGENCIES, AND/OR COURTS?

A. No.

Q. WOULD YOU EXPAND ON YOUR PRIOR EXPERIENCE WITH CONTACT VOLTAGE AND TESTING FOR CONTACT VOLTAGE?

A. During my career with electric utilities I have evaluated contact voltage events. As an example, a local telephone reported a “hot” pedestal location in a customer’s yard. The customer ha d reported a shock from a metal telephone enclosure. I personally investigated, tested and evaluated the circumstances associated with the contact voltage event, including the transformer, pedestal, and customer service panel. The readings were above 100 volts. I established the series of contributing issues, including meter

grounding and bonding deficiencies, developed the mitigation process, and implemented the contact voltage mitigation. I have also investigated numerous instances where secondary insulated conductors, less than 240 volts, had become deteriorated and made contact with a pole ground, thereby energizing the pole ground. In addition, I have investigated several instances where poor electrical workmanship within a metal decorative light pole led to a wire splice coming into contact with the internal metal surface of a light pole, thereby energizing the ungrounded light pole surface. In all of these cases, the first step that I performed was to test the voltage on the pole ground with a multi-meter to verify the elevated voltage condition, then mitigate the elevated issue found. Each of these evaluations were associated with contact voltage levels that were mitigated because they represented severe electric shock hazards to the public.

Q. MR. BOOTH AND MR. WHITE, IF I WERE TO ASK YOU THE FOLLOWING QUESTIONS INDIVUALLY OR TOGETHER WOULD EACH OF YOU ANSWER THE QUESTIONS THE SAME?

A. Yes.

III PURPOSE OF TESTIMONY

Q. HAVE YOU REVIEWED THE FILING OF NATIONAL GRID IN THIS MATTER?

A. Yes, I have reviewed all of the documents as filed to date in Docket No. 4237.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING?

A. I am testifying on behalf of the Division.

Q. HAVE YOU REVIEWED ALL DATA REQUESTS AND RESPONSES IN THIS MATTER?

A. Yes, to the extent responses were filed prior to preparation of my testimony.

Q. HAVE YOU REVIEWED THE PUBLIC COMMENTS, INCLUDING THE TESTIMONY ON BEHALF OF CAPITAL ADVOCACY, LLC BY W. ALAN HOMYK, PE, CHP?

A. Yes, I have reviewed all of the public comments including associated attachments and the testimony of Mr. Homyk.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. My testimony is intended to represent an independent assessment of National Grid's Proposed Electric Contact Voltage Program ("Program"), the public comments and the filed testimony of others and provide recommendations to the Commission. My assessment and testimony specifically focuses on the areas of consideration by the Rhode Island Public Utilities Commission ("Commission") as outlined in Rhode Island Chapter 173, Section 39-2 amended by 39-2-25-Contact voltage, detection, repair and reporting.

This includes equipment and technology to be used, voltage threshold levels for detection, and the overall contact voltage detection and repair program establishment to meet the intent of Chapter 39-2-25. I include in my testimony comments on the various filings and comments of others, and guidance and recommendations as they relate to the Company's proposal to the Commission.

Q. HOW HAVE YOU ORGANIZED YOUR TESTIMONY?

A. In the initial portion of my testimony, I will explain my review and analysis process. My testimony is then divided into four (4) areas: Purpose of Testimony; Comments on National Grid's Proposed Program; Comments on Public Comments and Testimony; and Conclusion and Recommendations.

Q. PLEASE EXPLAIN YOUR REVIEW AND ANALYSIS PROCESS.

A. My review and analysis process has been comprehensive after completing my review of all the materials filed by the parties and review of National Grid's responses to discovery. I reviewed my extensive file on Contact Voltage, including materials on programs from other states, Institute of Electrical and Electronics Engineers (IEEE) standards, publications from utilities with extensive contact voltage programs and materials from other contact and stray voltage matters, and national organization publications. Most state regulated contact voltage programs are in their infancy (less than ten years old) and have not been through sufficient cycles of testing, reporting and remediation to adequately develop a definitive consensus and nationally accepted model program.

Q. WOULD YOU PROVIDE AN OVERVIEW OF THE CONTACT VOLTAGE AND STRAY VOLTAGE ISSUES FOR THIS COMMISSION?

A. I will utilize much of the language from previously filed IEEE papers for my testimony overview. Failures in underground infrastructure or wiring errors have led to a number of highly publicized shocks to animals and people in urban areas. The media and New York State's utility regulatory agency borrowed the term "stray voltage" to describe the problem of shocks to pedestrians. The shocks are not a result of stray voltage. Rather, they are most often the consequence of uncleared line to ground faults in underground distribution systems. Such conditions are referred to by IEEE and the industry instead as "contact voltage." Contact voltage and stray voltage differ in many respects. Contact voltage is a result of a fault to a supply conductor or faulty open neutral conductor in the secondary distribution system. Contact voltage is prevalent in areas with dense buried infrastructure, often urban, and is especially common around unmetered loads (i.e. streetlights) with small supply conductors, minimal grounding, and no occupant present to report service or reliability problems caused by the fault.

Neutral to earth voltage ("NEV") ("stray voltage") will not reach significantly high voltages associated with shock injuries, but can present a significant problem to livestock as the small but perceptible voltage between watering or feed troughs and the earth discourage drinking and affect animal behavior in other ways. Several states, such as Michigan and Wisconsin, regulate stray voltage. Since 2004, utility regulators in several states and in Canada have also begun to mandate testing to eliminate contact voltage.

These contact voltage regulations borrow language from stray voltage regulations, but are made with the intent of improving pedestrian safety, rather than livestock health. To focus resources on contact voltage, an ideal measurement technique will also characterize the voltage sources as either a fault condition or neutral return condition. This allows prioritization of repair efforts on contact voltage supplied by system faults, which may present a shock hazard or become hazardous in the future, over stray voltage, which poses little or no shock hazard to humans or domestic animals.

It is appropriate to consider the maximum source potential and the potential for a person or animal to be exposed to line voltage should the fault condition worsen. The ability to distinguish between contact voltage and NEV or stray voltage is crucial to prudent safety decisions at the technical and managerial level. Making electrical contact for a measurement on a dry day is difficult, but the same surfaces become fairly conductive after rain or snow. Extra attention to making good contact is especially important when following up on reports of electric shock which occurred in earlier, wetter conditions. **Eliminate false positives using shunt-load:** Underground surfaces can have significant voltage due to capacitive coupling with a nearby high voltage object like a lighting ballast, unshielded power cord, or overhead power lines. Placement of a small, known load, or shunt, in parallel between the test leads or a digital voltmeter will eliminate false positive voltages due to capacitive coupling. **Measurement error of shunt voltage is a function of the ground and contact impedances in the measurement circuit:** Ideally, the variability in measurement as a result of typical error values in the field should be

<10%. We see that measurement error when using a 500 Ohms shunt is only low when ground and contact impedances are very low. When more realistic values of ground and contact resistance are considered, it is apparent that measurement error increases substantially.

Recent work at EPRI and by utilities in New York has demonstrated the use of spectrum analysis for differentiating NEV from a buried fault, even at identical voltage levels. The application of spectrum analysis in cases of energized objects in public spaces is a very effective way of separating small, normally occurring voltages from small voltages which could develop into shock hazards. In an urban setting, a voltage with less than 5% THD (Total Harmonic Distortion) is nearly certain to be sourced from distribution, and not from NEV. Such an energized object is a case of contact voltage, a potential shock hazard which should be investigated to discover and repair its source. Ground references do not meet any industry standards and may add hundreds of ohms to the measurement circuit, leading to inaccurate and unrepeatable voltage measurements when a 500 Ohms resistor is used. To achieve less than 10% error, a common measurement engineering standard, a larger 3000 Ohms shunt resistance is needed. National Grid should evaluate the IEEE work in this area as they proceed through implementation of a more structured program. I will later discuss how some of the Company's testing and reporting from its existing program may need further evaluation to assure enhanced accuracy which may be an existing program deficiency.

Sensitive detection of energized objects in a street level urban environment can find underground faults. To follow up with repairs, line workers must pay careful attention to eliminating sources of error in the measurement process so that they can identify the root cause and act on it. To these ends, a measurement technique based on selection of the best available ground references, and characterization of the source using harmonic analysis should be a component of the new proposed plan. These steps are possible using equipment readily available to utility field forces. Goals of both regulators tasked with control of contact voltages and the field workers and engineers tasked with mitigation are served through careful application of consistent measurement protocols and a quality control verification program.

IV COMMENTS ON NATIONAL GRID PROPOSED PROGRAM

Q. WOULD YOU PROVIDE AN OVERVIEW OF NATIONAL GRID'S EXISTING ELEVATED VOLTAGE TESTING PROGRAMS?

A. National Grid has operating procedures in place for testing overhead and underground facilities for elevated contact voltage. As part of this Docket, the Company did provide its current revised Electric Operating Procedure (EOP), EOP-G016, which addresses several areas of testing, procedures, corrective actions, and reporting for states served by the Company. The Company states that its current elevated voltage testing program[1] conducts manual testing for both overhead and underground facilities over a five (5) year cycle. However, the Company's response to Commission Request 4-2 concerning its overhead testing cycle states that "In 2011 this cycle has been changed to a six-year cycle to obtain efficiencies with our distribution overhead inspection program cycle."[2], from our review of other utility programs, five-year cycles seem to be normal cycle period. Both the overhead and underground testing programs have been ongoing since 2006 with the first five-year cycle completed for each in 2010. National Grid surveyed all metallic street light poles in Rhode Island for elevated voltage in 2006, with a subsequent five-year testing cycle started in April 2011 that is addressing 20% of metallic street light

[1] National Grid, Proposed Rhode Island Electric Contact Voltage Program, August 17, 2012.
[2] The Narragansett Electric Company d/b/a National Grid, Docket No. 4237, In Re: Commission Investigation Relating to Stray and Contact Voltage Occurring in Narragansett Electric Company Territories, Responses to Commission Data Requests Issued on March 15, 2012. Commission 4-2.

standards per year. A summary of the Company's elevated contact voltage testing programs is given in Table 1.

Table 1 - Summary of National Grid's Current Elevated Voltage Testing Programs

Program	Testing Scope	Year Started	Program Cycle	First Cycle Complete
Overhead	Wood Poles w/Metallic Risers Down (Pole) grounds Guy wires	2006	6-Year	2010
Underground	Padmount transformers Switchgear Metallic handhole covers	2006	5-Year	2010
Street Lights	Street Light Poles	2006, 2011*	5-Year	2006*

*National Grid tested 100% of street light poles in 2006, however a 5-year program did not start until April 2011.[3]

In addition, the Company also conducts voltage tests in cases outside of the regular cycle based testing as needed by the Company, including (1) each jobsite either at the end of each workday or at the end of the assignment, (2) underground facilities while completing working inspections, and (3) Company-owned street lighting facilities during outage investigations.

If an elevated voltage condition is found or reported, the Company has procedures that address the verification and handling of the site based upon the voltage measured. The Company uses a 4.5 volt threshold to determine when mitigation action should be taken and the site guarded to prevent public access. Currently, the Company utilizes handheld devices to (1) detect voltages from 5-600 volts using a handheld voltage probe, an

[3] Id. Commission 4-2 (continued p2).

example of which is shown below in Figure 1, and (2) verify voltage measurements using a digital multi-meter which has the ability to take readings using a 500 Ohms shunt resistor, as shown in Figure 2.[4]

Figure 1: Handheld voltage probe and its use. HD Electric Company.

[4] National Grid, Proposed Rhode Island Electric Contact Voltage Program, August 17, 2012. Page 15 of 29.

Figure 2: Fluke Multi-meter and Resistor and its use. Fluke Corporation and EPRI.

If an elevated voltage is verified greater than 4.5 volts and less than 8 volts, it will either be guarded in person or guarded by the installation of a protective barrier that prevents public contact. If the voltage measurement is greater than 8 volts, it is guarded by elevated voltage inspector or Company employee who has been trained to stand by on energized facilities until immediate steps can be taken to mitigate the voltage level.[5]

Q. WHAT WAS YOUR ANALYSIS OF THE ELEVATED VOLTAGE PROGRAM FINDINGS PROVIDED BY THE COMPANY?

A. The Company provided data in two main categories: (1) results and analysis for the regular cycle testing program, and (2) summaries of elevated voltage events that the Company addressed during the course of daily utility operations. The Company has

[5] Id. page 6 of 29.

operated a formalized testing program since 2006 that tests the facilities given in Table 1 over a regular period equaling approximately 20% of the total facilities. The Company submitted data and analysis from the years 2005 to 2011 based upon the elevated voltage findings provided by Osmose, who was contracted by the Company[6]. The Company stated in several responses that "over the period from 2005 to 2011, the Company tested over 220,000 units for elevated voltage, and found 55 instances (0.02%) of voltages 1 volt or greater".[7] Table 2 shows a summary of findings from the first complete program cycle of the elevated program field survey. The results from the Company's elevated testing survey did find a minimal number of instances of measurements above 1.0 volt on tested facilities which corresponds with findings from other utilities in other states.

Table 2: National Grid Testing Summary 2005-2011[8]

Facilities	Total System Units	Units Tested 2005 - 2011	Units with Voltage Found (>= 1.0v)	Percent of Units Tested with Voltage (>= 1.0v)
Overhead	286,368	202,238	15	0.007%
Underground	13,870	11,630	1	0.009%
Street Lights	5,888	6,737	39	0.579%
TOTAL	306,126	220,605	55	0.02%

The second category of data submitted contains findings outside of those found by the regular elevated voltage program, and provides insight into the frequency of elevated voltage situations encountered by the Company. Two reports provided by the Company

[6] The Narragansett Electric Company d/b/a National Grid, Commission Investigation re: Stray Voltage, Commission 1-4 Attachment.

[7] The Narragansett Electric Company d/b/a National Grid, Docket No. 4237, In Re: Commission Investigation Relating to Stray and Contact Voltage Occurring in Narragansett Electric Company Territories, Responses to Commission Data Requests Issued on March 15, 2012. Commission 4-3.

[8] Id. Response to Commission 4-3.

included (1) DTE Siemens Report for Rhode Island[9] and (2) Channel 10 Voltage Survey Report[10].

The DTE Siemens report is a listing of reported elevated voltage incidents for Rhode Island, 06/01/2006 to 02/28/2011, as reported to the Company by the public, employees, or by companies working in the vicinity of Company facilities. The period covered by this data closely matches the first cycle period of the cycle testing program. The DTE Siemens report contains 43 total incidents with the Company performing a permanent repair on 28 of 43.

The Channel 10 Voltage Survey Report is a listing of elevated voltage findings performed by a party outside of the Company, which apparently surveyed an area served by Company using mobile voltage surveying equipment. The Company was not associated with the survey and obtained the findings from Channel 10, which produced a news piece. The survey indicated 43 locations with elevated voltage readings and nearly all were located in Providence, RI. The Company verified measurements at all locations and performed either maintenance or repairs at 27 of the 43 locations.

While the DTE Siemens and Channel 10 Reports don't directly call into question the effectiveness of the Company's cycle testing program, these findings should be

[9] The Narragansett Electric Company d/b/a National Grid, Commission Investigation re: Stray Voltage, Attachment COMM 1-2(c).

[10] Attachment Comm 2-4, In Re: Commission Investigation Relating to Stray and Contact Voltage Occurring in Narragansett Electric Company Territories, Responses to Commission Data Requests (Set 2).

considered and act as an indication the Company should incorporate a quality control component into its Program. The DTE Siemens report was compiled by the Company over a number of years and, due to the ever-changing nature of the electric facilities, it should be expected that instances will continue to occur and require mitigation efforts. The 5-year average based on the DTE Siemens report would indicate eight (8) reported instances to the Company annually for Rhode Island, which would not seem to be unsubstantiated based upon the amount of electric system facilities operated. However, more historical data is necessary to gauge these results.

The Channel 10 Report is of more concern, since that particular survey found nearly as many instances as the cycle testing program found in 5 years, 43 compared to 55, over a limited survey area. This would seem to indicate the need to review the procedures and methods used by the current cycle testing program to determine what limitations exist in the current program. It would point to the need to verify whether contractors used for the testing were adequately trained and utilizing the equipment properly. Furthermore, it directly indicates a need for a quality control component to be included in the Company's new Program. In addition, the results from the Channel 10 report survey also evaluated facilities outside of the current Company cycle program including those not-owned by the Company which also accounted for some instances found.

Q. HOW DO THE VOLTAGE SURVEY FINDINGS COMPARE WITH PROGRAMS OPERATED BY UTILITIES IN OTHER STATES?

A. The Company submitted elevated voltage survey findings for the program years 2005-2011, and these findings were compared to other utility survey results shown in Table 3. The survey results from the researched utilities correlate to National Grid's current manual testing program results finding, that the corresponding percentage of units with elevated voltages was in most cases, less than one tenth of a percent. The only exception was street light facilities, which were found to have more instances of elevated voltage than any other facility type tested. National Grid's findings were provided since the program's inception, which may account for higher findings when compared to the other utilities' reported survey results. This certainly is an indication that more frequent streetlight facility testing may be warranted.

Table 3: Summary of Stray Voltage Survey Findings

			Percent of Units Tested			
	Year(s)	**Survey Type Voltage Level**	**Overhead Distribution**	**Underground Distribution**	**Street Lights**	**Total**
National Grid- RI[11]	2005-2011	Manual-1V	0.007%	0.009%	0.579%	0.02%
New York- All Utilities[12]	2011	Manual-1V	0.022%	0.008%	0.1%	0.05%
Rochester Gas & Electric-NY[13]	2011	Manual-1V	0.012%	0%	0.016%	0.043%
WE Energies- Wisconsin[14]	2009	Manual-5V	0%	0%	0%	0%
Con Edison- NY[15]	2009	Manual-1V	0.006%	0.003%	0.314%	0.058%

[11] The Narragansett Electric Company d/b/a National Grid, Docket No. 4237, In Re: Commission Investigation Relating to Stray and Contact Voltage Occurring in Narragansett Electric Company Territories, Responses to Commission Data Requests Issued on March 15, 2012. Commission 4-2.

[12] State of New York, Department of Public Service, Case 12-E-0198- 2011 Compliance Report on Stray Voltage Testing and Inspections as Required by Electric Safety Standards. May 31, 2012. Page 6 of 23.

[13] Rochester Gas and Electric, Report on the results of stray voltage tests and facility inspections for the period ending on December 31, 2011. February 15, 2012. Page 18 of 48.

[14] Contact Voltage Detection, Chad Hadley, WE Energies, Presented at Midwest Rural Energy Conference 48th Annual Rural Energy Conference, March 11-12, La Crosse, Wisconsin.

[15] State of New York, Department of Public Service, Case 04-M-0159, Report on the results of stray voltage tests and facility inspections for the period beginning January 1, 2009 and ending on December 31, 2009, Con Edison, February 15, 2010, Page28 of 47.

Q. DISCUSS REGULATORY REQUIREMENTS IN R.I.G.L. §39-2-25 THAT ARE NOT CONSIDERED IN NATIONAL GRID'S EXISTING ELEVATED VOLTAGE PROGRAM.

A. The regulatory requirements in R.I.G.L. §39-2-25 cover a number of areas that will require additional consideration from the Company regarding its existing elevated voltage program. R.I.G.L. §39-2-25 modifies and expands the scope and requirements of the Company's current elevated voltage testing procedures. Specifically, the legislation requires a program designed to implement appropriate procedures for testing publicly accessible surfaces, such as Company-owned equipment, sidewalks, roadways, storm drains, streetlights, and other conductive surfaces that can become energized by the electric system within specific designated contact voltage risk areas. Contact voltage testing of 40 percent of designated contact voltage risk areas is to be completed by June 30, 2013, with 20 percent annual surveys due thereafter. A discussion of specific sections is given below:

1. **§39-2-25(b)- The program shall also recognize the potential for publicly accessible objects such as sidewalks, roadways, fences, storm drains, or other metallic gratings to become energized by faults to the underground distribution system.** These types of community-use facilities are not part of the existing program and currently would only be tested by the Company as part of evaluation of a reported incident. These facilities will also be more time

consuming for field personnel performing manual scans and in the case of sidewalks and roadways, large scale manual scanning is impractical.

2. **§39-2-25(b)(1)- Designate contact voltage risk areas. The boundaries of such areas shall be approved by the commission and shall be based on the presence of underground electric distribution and situated in pedestrian-dense areas such as urban neighborhoods, commercial areas, central business districts, tourist heavy locations, and other places where pedestrians could be exposed to contact voltage.** These areas would be a subset of the existing electric distribution facilities operated by the Company based upon land-use factors or as deemed by the Commission. The Company's current programs are based upon electric facility type.

3. **§39-2-25(b)(2)- By June 30, 2013, conduct an initial survey of no less than forty percent (40%) of designated contact voltage risk areas for contact voltage hazards on all conductive surfaces in public rights-of-way using equipment and technology as determined by the commission.** This survey will operate on 5-year cycle, 20 percent per year, after the initial survey of 40 percent. Therefore, the Company will complete the first full survey of the designated area in 4 years. The Company will need to establish a methodology for determining how the 40 percent is calculated, since the areas include items that are not currently tracked by the Company such as storm drains or sidewalks. In addition,

the technology used to complete the survey will be certified by the Commission which is not required of the Company's existing program.

4. **§39-2-25(b)(6)- Annually report on contact voltage findings, including, but not limited to, the number and type of energized objects on both company-owned and customer-owned assets, voltage level, corrective action taken, shocks that occur to members of the public or to pets owned by members of the public, and any other information that the commission deems appropriate.** The Company will need to develop reports that will address (1) cycle elevated voltage testing on all facilities, (2) cycle elevated voltage testing in all designated areas, and (3) Rhode Island specific public shock reports.

Q. HOW DOES NATIONAL GRID PROPOSE TO ADDRESS THE REGULATORY REQUIREMENTS OF R.I.G.L. §39-2-25?

A. The Company has provided a proposed program[16] that discusses its existing elevated voltage program and proposed program considerations based upon the regulatory requirements enacted. R.I.G.L. §39-2-25(b)(1) requires National Grid to identify areas of risk for contact voltage, defined as the Designated Contact Voltage Risk Areas, which will be surveyed as part of this program. The boundaries of these Designated Contact Voltage Risk Areas are to be determined by the presence of underground electrical

[16] National Grid, Proposed Rhode Island Electric Contact Voltage Program, August 17, 2012.

distribution facilities situated in areas such as urban neighborhoods, commercial areas, central business districts, locations with large tourist areas or venues, and other places where pedestrians could be expected to be exposed to contact voltage. National Grid identified potential pedestrian dense areas by using land use data layers maintained by the Rhode Island Geographic Information System (RIGIS)[17], then the Company's underground facility locations were overlaid to determine the risk areas. Attachment 2 of the Company's proposed plan contains maps identifying the specific designated contact voltage risk areas within each community.[18] The Company proposed that other areas with underground facilities not included by the above described process be tested under the existing underground elevated voltage program. To comply with the requirements of §39-2-25(b)(2) and §39-2-25(b)(3), the Company developed a survey schedule of risk areas.[19] The next issue is what to survey within the Designated Contact Voltage Risk Areas to comply with the statutory requirements of R.I.G.L. §39-2-25, which specifies that publicly accessible objects must be included. The Company is proposing to utilize mobile voltage testing to conduct these surveys with the results to be confirmed using the already existing manual testing methods, examples of this technology is shown in Figure 3 below.

[17] Id. Page 9 of 29.
[18] National Grid, Proposed Rhode Island Electric Contact Voltage Program, August 17, 2012. Attachment 2.
[19] Id. Attachment 3.

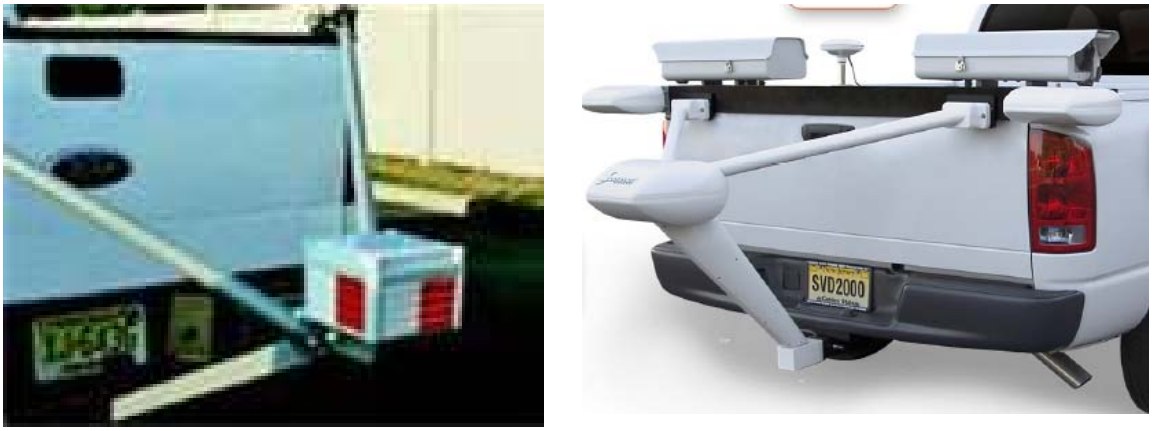

Figure 3: Examples of Mobile Testing Systems. Left: Narda Safety Test Solutions; Right: Power Survey Company.

The Company proposes the following exemptions within the Designated Contact Voltage Risk Areas: (1) to use a 50 foot buffer to limit the designated contact voltage risk area to that area that is "solely underground and not subject to interference by overhead facilities" due to interference from overhead power lines , (2) areas where the mobile technology cannot be used due to the presence of overhead facilities will continue to be tested manually, (3) facilities will be tested either by mobile or manual programs, but not included in both, (4) areas where public access is prevented or areas where the public is reasonably not expected to be walking will not be considered, (5) areas with temporary construction or other work that obstructs facilities, and (6) Company will not test in designated contact voltage risk areas where there is non-conductive equipment, such as concrete or fiberglass handholes. I will comment later on why some of these exceptions should be modified.

Although not specifically stated by the Company's proposed plan, these manual tests for areas where mobile testing is currently affected by overhead lines, will need to include any publicly accessible objects such as sidewalks, manholes, and conductive surfaces in addition to Company owned facilities. In addition, the Company should not redefine the Designated Contact Voltage Risk Areas based upon the overhead buffer limits of the mobile scanning technology. The Designated Contact Voltage Risk Areas are defined by the land use and the presence of underground facilities, and should not be limited by technology. The Company should simply differentiate zones within the risk areas in which it will use either mobile or manual methods. Additionally, the Company should test in all areas, including locations with non-conductive Company equipment, due to the possibility of other publicly accessible objects having elevated voltages in the vicinity of the underground electric system as stated in the regulations. There are specific examples of non-conductive covers causing abrasion of conductors not properly installed and later causing injury or death at the time of a rain event.

The Company also seeks approval of its proposed plan provisions relating to selection of equipment and technology, as well as to establishing voltage levels. The Company plans to introduce mobile technology into its existing elevated voltage program and is evaluating two (2) vendors that provide mobile survey technology services. The Company has provided a RFP for this work and is currently working within its evaluation and purchasing processes. As part of the RFP, the Company has also requested that both companies complete an on-site demonstration and pilot survey. This is a common

requirement for many utilities when the RPF process involves the collection and evaluation of electric facilities. When the Company has selected its desired vendor, a recommendation will be made to the Commission. The Company, in its operating procedures EOP-G016 Section 4 Test Equipment[20], lists the handheld devices approved by the Company for use in manual voltage tests and requests the Commission certify the use of these devices to meet the regulatory requirements. Finally, the Company seeks the Commission's approval of its use of a 4.5 volt elevated voltage threshold.

Q. HAVE YOU PREPARED RECOMMENDATIONS CONCERNING NATIONAL GRID'S PROPOSED CONTACT VOLTAGE PROGRAM?

A. Yes. My recommendations are summarized in the Conclusion and Recommendations section.

[20] National Grid, Proposed Rhode Island Electric Contact Voltage Program, August 17, 2012. Attachment 1, Page 9 of 17.

V COMMENTS ON PUBLIC COMMENTS AND TESTIMONY

Q. HAVE YOU REVIEWED THE PUBLIC COMMENTS, ATTACHMENTS, AND TESTIMONY OF MR. HOMYK FILED IN THIS DOCKET?

A. Yes.

Q. WHAT OBSERVATIONS OR COMMENTS DO YOU HAVE IN REGARD TO THE FILED TESTIMONY OF MR. HOMYK?

A. Mr. Homyk suggests what he characterizes as seven (7) improvements that should be made in the Company's proposed Program. His testimony lacks any substantive support for his statement that the improvements can and should be made. I will address each of his suggested improvements individually.

1. **Threshold Testing Voltage Level.** Mr. Homyk states the mobile automated scanning should be performed at a threshold testing voltage level of 1 volt. I find no meaningful reason for this level to be below the 4.5 volt level widely used in other states for testing. Although levels below 4.5 volts may present a "stray voltage" issue for certain animals such as dairy cattle, it is not a level requiring action associated with humans or domestic animals. Therefore, I recommend this suggestion by Mr. Homyk be rejected.

2. **Contact Voltage Areas.** I agree with Mr. Homyk's suggestions of expanding the contact voltage areas to include direct buried cables to residences.

3. **Testing Findings.** I believe the test program data should be readily accessible and easily searchable.

4. **Mobile Testing Cost Savings.** I disagree with Mr. Homyk's suggestion that there will be cost savings with mobile technology. There is virtually no competition in the mobile testing area. Furthermore, the three (3) available technologies have not been sufficiently utilized and evaluated in order to reach a definitive conclusion associated with accuracy or ultimate cost benefit.

5. **Manual Testing Equipment.** I disagree with Mr. Homyk's testimony that IEEE suggests varied shunt resistor levels. Additionally, I find scanning at the 1 volt level offers no enhanced hazard detection. The proposed National Grid program and process are appropriate.

6. **Wooden Poles with Metal Objects.** The Commission should reject the broad inclusion as unnecessary, particularly since utility grounding and metal object bonding on poles is the standard. Therefore, this is a broad addition which will increase cost with no meaningful benefit. The one area where wood poles with metal objects should be expanded in the program is at locations where a metal object is located away from the pole within a six (6) foot radius. These locations often have objects, such as telephone pedestals, which have not been bonded to the electric utility ground and therefore present a real contact voltage threat.

7. **Scan Schedule.** I categorically disagree with Mr. Homyk's testimony recommending scanning the entire system annually and with mobile automated scanning equipment. National Grid has already been in a program for five (5) years. The data reviewed from other utilities not only indicates a relatively low percentage of unacceptable locations, but once these locations are mitigated the reoccurrence rate would only follow the ongoing system deterioration which is very slow. The scan schedule proposed by National Grid is well within acceptable and customary levels. Furthermore, mobile scanning technology still requires more evaluation before being fully embraced. The Con Ed EPRI equipment developed and being used may afford the industry a preferred option to the other two available pieces of mobile equipment. I will be recommending a more aggressive schedule for streetlight facility testing.

Q. WHAT OBSERVATIONS OR COMMENTS DO YOU HAVE CONCERNING THE OTHER PUBLIC COMMENTS?

A. The other public comments and materials filed primarily focus on the utilities and mobile testing program in New York. The results of the many other states and utilities involved in contact voltage programs should also be considered. The Rochester Gas and Electric Corporation (RGE) report and others combined with the trends would indicate the approach National Grid is taking is prudent and acceptable. The RGE report states "The majority of findings this year were in the 1-1.9 volt range, many in areas where induction may be probable. The effect of this procedure increased the number of findings, and can

lead to misconceptions making it difficult to draw any substantial conclusions from year to year trending. This procedure would account for the significant amount of findings reported this year as compared to the previous 2 years." Again, the evidence and history on mobile testing equipment and its results remain questionable as it relates to the accuracy and value of the results. The Power Survey Company letter to the Commission is clearly self serving and there is a significant back story with assessment required. Additionally, the Con Ed EPRI equipment and testing progress must also be evaluated by National Grid as it assesses mobile testing technology and implementation. There is no dispute that human fatality is a real potential consequence of failure to detect contact voltage. However, I find no evidence of human fatality at a contact voltage below 4.5 volts, much less in the range of 1 to 1.9 volts, which seems to constitute the preponderance of the Power Supply equipment detection of unacceptable locations.

VI CONCLUSION AND RECOMMENDATIONS

Q. HAVE YOU REACHED A CONCLUSION CONCERNING MOBILE AUTOMATED SCANNING TECHNOLOGY?

A. Yes. There are currently only two technologies being widely marketed. As I indicated in my prior testimony, there is significant negative promotional program occurring between the two vendors. This has created some obvious misconceptions. There is no reliable unbiased independent assessment concerning these two technologies. As I indicated in earlier testimony, Maryland is undertaking an evaluation. The preponderance of data indicates that manual testing technology produces an extremely low number of false readings and the highest accuracy at a competitive price level. In order to meet the requirements on 40 percent system evaluation in the first year, a mobile system will need to be implemented to assess non-company facilities such as sidewalks, storm drains, or signs adjacent to the Company's underground facilities where no overhead lines are present.

Q. WHAT IS YOUR RECOMMENDATION CONCERNING MOBILE AUTOMATED SCANNING TECHNOLOGY?

A. I recommend the Commission adopt a two step phased approach. Step 1 would be accepting the National Grid RFP and pilot project approach. Step 2 would be conducting a technology assessment using (1) the National Grid pilot project and program data to not only compare any proposed mobile technologies but to also determine the overall

accuracy of the mobile scans; (2) the evaluations completed by other states; (3) introducing a separate and independent evaluation after allowing each vendor to introduce its product through a vetting process, and; (4) evaluate the ConEd and EPRI equipment and its utilization versus the National Grid Pilot Program assessment.

I strongly recommend against adoption of a single technology, such as the Power Supply SVD 2000, absent any competition and absent the ability to purchase and utilize the technology itself for evaluation purposes. This would not be in the best interest of the electric ratepayer or the citizens who will be relying on the success of the program for hazard mitigation. Furthermore, National Grid and the Commission should determine the success of the ConEd EPRI equipment development and utilization by ConEd before widely adopting any specific mobile scanning technology. It is apparent ConEd may be moving from the Power Supply system to its own use of equipment developed through an EPRI project. I concur with the Company's process of using a pilot project to assess the most accurate and cost effective mobile scanning technology. To the extent a vendor refuses to participate is such a pilot project assessment, the Company should consider that Vendor a non-responsive bidder and proceed without consideration of that Vendor's system and process.

Q. HAVE YOU REACHED A CONCLUSION CONCERNING THE APPROPRIATE PROGRAM VOLTAGE THRESHOLD LEVEL?

A. Yes. There is no engineering or scientific support for a voltage threshold below the 4.5 volts proposed by National Grid. Utilities such as WE Energies, who have had an extensive program utilizing all manual technology, indicate nearly no unacceptable contact voltage locations and less than 0.002 percent false positives with its manual program. Furthermore, Rochester Gas and Electric's reporting of its program and utilization of mobile scanning technology would indicate most unacceptable readings were between 1 and 2 volts, which is not a hazardous level and per RGE is most probably due simply as a result of induced voltage.

Q. WHAT DO YOU RECOMMEND TO THIS COMMISSION FOR A PROGRAM TESTING VOLTAGE THRESHOLD?

A. I recommend the Commission accept the National Grid program proposal voltage threshold level of 4.5 volts, as achieved using the proposed testing equipment rated at 5 to 600 volts plus or minus 10 percent along with its pilot program process for the mobile scanning technology deployment. As part of the survey process, I also recommend that the Company compile historical counts of voltage readings less than 4.5 volts but greater than 1.0 volt, if available, in order to develop an understanding of these low threshold readings and the primary drivers for these low levels.

Q. WHAT DO YOU RECOMMEND CONCERNING NATIONAL GRID'S PROPOSED ELEVATED CONTACT VOLTAGE PROGRAM?

A. After reviewing both National Grid's Proposed Elevated Contact Voltage Program and EOP documents, I found that the documents did provide a basis for existing program and was sufficient in its discussion of the determination of the designated areas that will require additional testing. However, I also found that the program documents lacked clarity in a number of areas that will be influenced by the regulatory changes in elevated voltage testing requirements. Specifically, I recommend that the Company address the following:

1. Revise the existing EOP for elevated voltage testing and the proposed electric contact voltage plan to include all Rhode Island state regulatory requirements and recommendations.

2. Include the cycle survey schedule for each facilities type or program.

3. Provide a detailed listing of all company or non-company items that will be addressed by each survey program. These changes will reflect similar procedures that are already listed for New York and Massachusetts and should include the following:

    a. Overhead Distribution Facilities- Remove the exception that testing and documentation will only occur on metallic risers. Include all of the following company or non-company items for testing and documentation:

        i. Metallic Risers

        ii. Uncovered or insulated down grounds

iii. Down guys

iv. Any other publicly accessible conductive piece of equipment on the pole within reach from ground.

b. Underground Distribution Facilities- Add requirement that addresses the Rhode Island specific requirements for testing of all publicly accessible facilities and adjacent objects within the Designated Contact Voltage Risk Areas as required by the Commission. Include testing schedule information and all of the following company or non-company objects to be addressed including:

i. Metallic Covers (manhole, handhole, vault covers, junction box, splice box equipment covers)

ii. Equipment (Padmount Transformers, Switchgear, primary junction cabinets, Transclosures)

iii. Street Lights

iv. Publicly Accessible Objects (sidewalks, roadways, storm drains, metallic gratings, metal pedestals, traffic poles, fire hydrants, community fences)

4. Add a new section that describes the Designated Contact Voltage Risk Areas and any exceptions that the Company proposes to apply therein in order to clarify the requirements and differences between the normal cycle testing programs and the Rhode Island specific risk area surveys.

5. The Company should also clarify that any company owned overhead, underground, or street light facilities that are addressed by the publically accessible objects survey will be excluded from the regular cycle testing. These Company facilities will not be concurrently tested between the various programs.

6. The Company needs to implement a Quality Assessment/Quality Control (QA/QC) program to monitor the accuracy of testing results and field personnel measurements and field personnel equipment utilization practices obtained as part of all equipment elevated voltage testing.

Q. DO YOU HAVE RECOMMENDATIONS CONCERNING NATIONAL GRID'S PROPOSED TESTING SCHEDULE?

A. Yes. I recommend that the Company should return to a 5-year testing cycle, equaling 20 percent of the existing overhead units, for Overhead facilities instead of the 6-year cycle currently proposed. This would be consistent with the Company's first survey cycle and standard within the industry. Additionally, I recommend that the Company test all street lights on a 3-year testing cycle due to the higher incidents of elevated voltage findings. Based on the Company's explanation, I agree with the proposed schedule for meeting the 2013 Rhode Island regulatory requirements, based upon the current assumption of using mobile technology to survey these areas. The Company will also need to establish its measurement methodology that it will use to confirm its compliance with the 2013 40 percent initial survey requirement.

Q. HAVE YOU REACHED A CONCLUSION CONCERNING THE EQUIPMENT AND TECHNOLOGY USED TO PERFORM MANUAL ELEVATED VOLTAGE SURVEYS?

A. Yes. I find that the Company's combined use of a voltage probe and digital multimeter is consistent with industry practices and other utilities that are operating similar programs. However, I recommend that the Company should include specifications for all items needed for proper testing such as ground rod, ground plate, probe grounding clips, and lead wire. Also, the Company should review and revise its standards to provide greater detail concerning testing procedures. The Company should specify that all meters measure a true RMS voltage, be calibrated as recommend by the manufacturer, and have regular schedules for handheld battery replacements.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes it does.

EXHIBIT

GLB-1

GREGORY L. BOOTH, PE, PLS

President
PowerServices, Inc.
Gregory L. Booth, PLLC

RESUME

Gregory L. Booth is a registered professional engineer with engineering, financial, and management services experience in the areas of utilities, industry private businesses and forensic investigation. He has been representing over 300 clients in some 40 states for more than 40 years.

Mr. Booth has been accepted as an expert before state and federal regulatory agencies, including the Federal Energy Regulatory Commission, the Delaware Public Service Commission, the Minnesota Department of Public Service Environmental Quality Board, the New Jersey Board of Public Utilities, the North Carolina Utilities Commission, the Pennsylvania Public Utility Commission, the Rhode Island Public Utilities Commission, and the Virginia State Corporation Commission. He has been accepted as an expert in both state and federal courts, including Colorado, Florida, District of Columbia, New York, Pennsylvania, North Carolina, South Carolina, Virginia, West Virginia, and Wisconsin and several Federal Court jurisdictions. Investigation and testimony experience includes areas of wholesale and retail rates, utility acquisition, territorial disputes, electric service reliability, right-of-way acquisition and impact of electromagnetic fields and evaluation of transmission line options for utility commissions. Additionally, Mr. Booth has extensive experience serving as an expert witness before state and federal courts on matters including property damage, forensic evaluation, fire investigations, fatality, and areas of electric facility disputes and Occupational, Safety and Health Administration violations and investigations together with National Electric Code and National Electrical Safety Code and Industry Standard compliance.

The following pages provided are the education and experience from 1963 through the present. Also included are courses taught, publications and a list of cases from 1981 to present.

GREGORY L. BOOTH, PE, PLS

Mr. Booth is a Registered Professional Engineer with engineering, financial, and management experience assisting local, state, and federal governmental units; rural electric and telephone cooperatives; investor owned utilities, industrial customers and privately owned businesses. He has extensive experience representing clients as an expert witness in regulatory proceedings, private negotiations, and litigation.

PROFESSIONAL EDUCATION:

NORTH CAROLINA STATE UNIVERSITY; Raleigh NC, Bachelor of Science, Electrical Engineering, 1969

REGISTRATIONS:

Registered as Professional Engineer in Alabama, Arizona, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Kansas, Maryland, Minnesota, Missouri, New Hampshire, New Jersey, North Carolina, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Texas, Commonwealth of Virginia, West Virginia, and Wisconsin
Professional Land Surveyor in North Carolina
Council Record with National Council of Examiners for Engineering and Surveying

EXPERIENCE:

1963-1967
Technician
Booth & Associates

Transmission surveying and design assistance, substation design assistance; distribution staking; construction work plan, long-range plan, and sectionalizing study preparation assistance for many utilities, including Cape Hatteras EMC, Halifax EMC, Delaware Electric Cooperative, Prince George Electric Cooperative, A&N Electric Cooperative; assistance generation plant design, start-up, and evaluations.

1967-1973
Project Engineer
Booth & Associates

Transmission line and substation design; distribution line design; long-range and construction work plans; rate studies in testimony before State and Federal commissions; power supply negotiations; all other facets of electrical engineering for utility systems and over 30 utilities in 10 states.

1973-1975
Professional Engineer
Associates
1975-1994
Executive Vice President
Booth & Associates

Directed five departments of Booth & Associates, Inc.; provided engineering services to electric cooperatives and other public power utilities in 23 states; provided expert testimony before state regulatory commissions on rates and reliability issues; in accident investigations and tort proceedings; transmission line routing and designs; generation plant designs; preparation and presentation of long-range and construction work plans; relay and sectionalizing studies; relay design and field start-up assistance; generation plant designs; rate and cost-of-service studies; reliability studies and analyses; filed testimony, preparation and teaching of seminars; preparation of nationally published manuals; numerous special projects for statewide organizations, including North Carolina EMC. Work was provided to over 130 utility clients in 23 states, PWC of the City of Fayetteville, NC, Cities of Wilson, Rocky Mount and Greenville are among the utilities in which I have provided engineering services in North Carolina during this time

frame. Services to industrial customers include Texfi Industries, Bridgestone Firestone, Inc and many others.

1994-2004
President
Booth & Associates

Responsible for the direction of the engineering and operations of Booth & Associates, Inc. for all divisions and departments. The engineering work during this time frame has continued to be the same as during 1974 through 1993 with the addition of greater emphasis on power supply issues, including negotiating power supply contracts for clients; increased involvement in peaking generation projects; development of joint transmission projects, including wheeling agreements, power supply analyses, and power audit analyses. The work during this time frame includes providing services to over 200 utility clients across the United States, including NCEMC and NRECA.

2004-Present
President
Gregory L. Booth, PLLC

Providing engineering and management services to the electric industry, including planning and design. Providing forensic engineering, product evaluation, fire investigations and accident investigation, serve as an expert witness in state and federal regulatory matters and state and federal court.

2005-Present
President
PowerServices, Inc.

Providing engineering and management services to the electric industry, including planning and design and utility acquisition. Providing forensic engineering, product evaluation, fire investigations and accident investigation, serve as an expert witness in state and federal regulatory matters and state and federal court.

WORK AND EXPERTISE:

Electric Utilities:
(more than 300 clients)

Utility acquisition expert, including providing condition assessment, system electrical and financial valuation, electrical engineering assessment, initial Work Plan and integration plans, acquisition loan funds, testimony, assessment and consulting services for numerous electric utility acquisitions. Utility clients for acquisition projects include Winter Park, FL acquisition of Progress Energy, FL, system in the City limits, A & N Electric Cooperative acquisition of the Delmarva Power & Light Virginia jurisdiction, Shenandoah Valley Electric Cooperative acquisition of Allegheny Energy Virginia jurisdiction, Rappahannock Electric Cooperative acquisition of Allegheny Energy Virginia jurisdiction, and numerous other past and currently active electric utility acquisitions.

- System studies, including long-range and short-range planning, sectionalizing studies, transmission load flow studies, system stability studies (including effects of imbalance and neutral-to-earth voltage), environmental analyses and impact studies and statements, construction work plan, power requirements studies, and feasibility studies.
- Fossil and hydro generation plan analysis, design, and construction observation.
- Transmission line design and construction observation through 230 kV overhead and underground.

- Switching station and substation design and construction observation through 230 kV.
- Distribution line design and staking, overhead and underground.
- Design of submarine cable installations.
- Supervisory control and data acquisition system design, installation and operation assistance.
- Load management system design, installation and operation assistance.
- Computer program development.
- Load research and alternative energy source evaluation.
- Field inspection, wiring, and testing of facilities.
- Relay and energy control center design.
- Mapping.
- Specialized grounding for abnormal lightning conditions.
- Ground potential rise protection.
- Protective system/relay coordination.

TELECOMMUNICATION: UTILITIES:

- Subscriber and trunk carrier facilities design.
- Stand-by generation and DC power supplies
- DC-AC inverters for interrupted processor supplies.
- Plant design and testing.
- Fiber optics and other transmission media.
- Microwave design.

FINANCIAL SERVICES:

- Long-term growth analyses and venture analyses.
- Lease and cost/benefit analyses.
- Capital planning and management.
- Utility rate design and service regulations.
- Cost-of-Service studies.
- Franchise agreements.
- Corporate accounting assistance.

FORENSIC ENGINEERING:

- Compliance with NESC, NEC, OSHA other codes and industry standard.
- Equipment and product failure and analysis and electrical accident investigation.
- Stray voltage, electrical shocking, and electrocution investigations.
- Building code investigations.
- New product evaluation.

INDUSTRIAL/ELECTRICAL ENGINEERING:

- Building design (commercial and industrial).
- Building code application and investigation.
- Electric thermal storage designs for heating, cooling, and hot water.
- Standby generation and peaking generation design

INSTRUCTIONAL SEMINARS AND TEXT:

- Seminars taught on arc flash hazards and safety, including National Electrical Safety Code regulations for utilities
- Courses taught on National Electrical Safety Code and National Electrical Code.
- Courses taught on Distribution System Power Loss Evaluation.
- Courses taught on Distribution System Protection.
- Text prepared on Distribution System Power Loss Management.
- Text prepared on Distribution System Protection.
- Seminars taught on substation design, NESC capacitor application, current limiting fuses, arresters, and many others electrical engineering subjects.
- Courses taught on accident investigations and safety.

TESTIMONY AS AN EXPERT:

- Concerning rate and other regulatory issues before Federal Energy Regulatory Commission and state commissions in North Carolina, Virginia, Delaware, New Jersey, Pennsylvania, Rhode Island, and Minnesota.
- Concerning property damage or personal injury before courts in Maryland, Minnesota, North Carolina, Virginia, West Virginia, Wisconsin, New York, South Carolina, Texas and Pennsylvania.

FIELD ENGINEERING:

- Transmission line survey.
- Distribution line staking.
- Property surveying.
- Relay and recloser testing.
- Substation start-up testing.
- Generation acceptance and start-up testing.
- Ground resistivity testing.
- Work order inspections.
- Operation and maintenance surveys.

PROFESSIONAL ORGANIZATIONS:

a. National Society of Professional Engineers (NSPE)
b. Professional Engineers in Private Practice (PEPP)
c. National Council of Examiners for Engineering & Surveying (NCEES)
d. Professional Engineers of North Carolina (PENC)
e. National Fire Protection Association (NFPA)
f. Associate Member of the NRECA
g. NRECA Cooperative Network Advisory Committee (NRECA-CRN)
h. The Institute of Electrical and Electronics Engineers (IEEE) (Distribution sub-committee members on reliability)
i. American Standards and Testing Materials Association (ASTM)
j. Occupational Safety and Health Administration (OSHA) Certification
k. American Public Power Association (APPA)

EXHIBIT

MWW-1

MICHEAL W. WHITE, PE

Senior Project Manager
PowerServices, Inc.

RESUME

Mr. White is a professional engineer with 16 years of utility and consulting experience focused on electric utility engineering and technology. He is a licensed professional engineer in several states and is nationally certified with the National Council of Examiners for Engineering and Surveying. His responsibilities have included managing multiple employees, electric system studies, RUS loan applications, protective equipment coordination, energy and power forecasts, Smart Grid and utility technology projects, power quality and service reliability, Construction Work Orders, substation operations, and transmission line planning. His experience and background in many aspects of power system engineering, utility operations, and technology management has provided him with the experience to address a broad range of electric utility issues.

MICHEAL W. WHITE, PE

Mr. White is a Registered Professional Engineer with engineering, management, and operational experience assisting municipalities; rural electric cooperatives, and investor owned utilities.

PROFESSIONAL EDUCATION:

CLEMSON UNIVERSITY; Clemson, SC,
Bachelor of Science, Electrical Engineering, 1997

REGISTRATIONS:

Registered as Professional Engineer in Alabama, Florida, Georgia, Kentucky, North Carolina, Mississippi, South Carolina, Tennessee, and Commonwealth of Virginia.

Council Record with National Council of Examiners for Engineering and Surveying

EXPERIENCE:

1997-2000
System Engineer
Blue Ridge Electric Cooperative

Developed electric system improvements for customers through the design of distribution conversions, system upgrades, and substation projects. Implemented sectionalizing plant that focused sectionalizing plans that focused on further improving distribution main feeder reliability. Worked with Field Engineers to stake system improvements and completed phase verification projects for underground subdivisions. Assisted industrial and commercial customers through rate comparisons and billing analyses. Developed annual usage and wholesale power historical projections. Created and verified models in Milsoft Windmil working with AutoCAD and CIS exports.

2000 – 2006
Manager of Information Technology
Blue Ridge Electric Cooperative

Managed technology operations and supervised IT department department with responsibility of implementation, integration deployment, operation, and budgeting of capital expenses as significant improvements were necessary to support the utility's grow and technology changes. A roadmap process was used to plan expected technology deployment while understanding the underlying infrastructure requirements and operational issues. Utility software upgrades, Smart Grid, and automation solutions were deployed in strategic areas such as SCADA, GIS, CIS, historical databases, AMR/AMI, fiber connectivity, substation networking, construction crew planning, and document imaging. Completed network security audits and vulnerability assessments, then deployed solutions to address cyber vulnerabilities within the utility networking and work processes.

MICHEAL W. WHITE, PE

2006-2009 Manager of Engineering Services Power Delivery Associates	Completed projects that included: electric system engineering and coordination, utility system design, transmission and substation design, RUS 219 processing, construction inspections, system inventories, pole attachment agreement negotiations, and technology management. Construction Work and Long Range Plans involved the engineering analysis of the utilities' electric system and historical data through the development of engineering models, load forecasts, and customer growth projections. Assisted utility operations and field engineers to review: staking project designs, joint-use make-ready, motor starts, power quality issues, switchgear installations, and underground distribution phasing. Provided technology selection, integration, and implementation support for utility Smart Grid applications including: GIS, CIS, AMI/AMR, OMS, SCADA, Engineering Analysis, and Automated Staking packages.
2009-2011 Senior Project Engineer McCall-Thomas Engineering	Completed projects that included: electric system planning and coordination, utility system design, pole attachment agreement negotiations, and technology management. System engineering involved the engineering analysis of the utilities' electric system and historical data through the development of engineering models, load forecasts, and growth projections. Arc Hazard Analysis projects involved working with utility and industrial clients to properly collect system information, develop models, coordinate protective equipment based upon load flow analyses, and recommended protective changes to mitigate arc flash hazards. Analysis Software Experience: WindMil, CYME, ARCPRO, SynerGEE, SKM Power Tools
2011 – Present Senior Project Manger PowerServices, Inc.	Providing engineering, technology, and project management services to the electric industry, including system planning and modeling, electric facility design, equipment and technology specifications, construction inspections, and field engineering services.

MICHEAL W. WHITE, PE

WORK AND EXPERTISE:

ELECTRIC UTILITIES:

- System studies, including long-range and short-range planning, sectionalizing studies, load flow studies, construction work plan, power requirements studies, and feasibility studies.
- Distribution and transmission line design and staking, overhead and underground.
- Supervisory control and data acquisition system design, installation and operation assistance.
- Computer program development.
- Specification, selection, and implementation of advanced utility technologies.
- Field inspection, wiring, and testing of facilities.
- Mapping.
- Protective system/relay coordination.

FINANCIAL SERVICES:

- Long-term growth analyses.
- Cost-of-Service studies.

INSTRUCTIONAL:

- Seminars taught on distribution line design, power system modeling and software, arc flash hazards, and National Electrical Safety Code regulations for utilities.

FIELD ENGINEERING:

- Distribution line staking.
- Relay and recloser testing.
- Ground resistivity testing.
- Work order inspections.
- Underground distribution, transmission, and substation system phasing.
- Post storm system inspections.
- Power quality waveform collection and analysis

PROFESSIONAL ORGANIZATIONS:

a. National Society of Professional Engineers (NSPE)
b. National Council of Examiners for Engineering & Surveying (NCEES)
c. National Fire Protection Association (NFPA)
d. The Institute of Electrical and Electronics Engineers (IEEE)