Distribution System Reliability Practices

Noteworthy Practices at Central Hudson Gas & Electric Corporation

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Technical Update, November 2011

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THE FOLLOWING ORGANIZATION PREPARED THIS REPORT:

Electric Power Research Institute (EPRI)

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NOTE

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EPRI wishes to acknowledge the high level of cooperation, openness, and information sharing by the Central Hudson Gas & Electric personnel involved in this study. During the immersion, EPRI observed excellent work and met highly competent, dedicated people. The identification of the practices illustrated in this report would not have been possible without the participation and cooperation of Central Hudson's talented staff.

In particular, EPRI wishes to thank Mr. Pano (Pete) Harpolis, Section Engineer, Distribution Engineering, for his support of this project and for welcoming EPRI to visit Central Hudson and share their practices.

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Additional Central Hudson personnel who were gracious with their time and consideration in allowing us to quiz them on their practices include the following:

- Mike Gallucci, Director, Line Clearance
- Ryan Hawthorne, Electric Operations Engineer, Poughkeepsie Operating District
- James Jolly, Director of Dispatch Operations
- Sal Martino, Engineer, Electric Distribution Operations
- Ron Roberts, Director of T&D Operations and Emergency Response
- Kevin Sheehan, Electric Operating Supervisor, Poughkeepsie Operation District
- Steve Vincent, Engineer, Electric Standards & Utilization

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PRODUCT DESCRIPTION

The Electric Power Research Institute's (EPRI's) members represent more than 90% of the electricity generated and delivered in the United States, and international participation extends to 40 countries. Participation by such a large cross section of the utility industry provides EPRI with a unique ability to reach out to and learn from a wide variety of utility companies. This level of exposure is a distinct advantage for this type of research, in which EPRI is documenting and sharing noteworthy practices by utilities from across the industry.

In 2010, EPRI embarked on the first phase of a multiyear effort to identify and illustrate noteworthy practices that utilities are using to meet the expectations of their customers regarding service reliability while operating in a resource-constrained business environment. The ultimate goal of this research is to collect and organize information on practices from many utilities and present this information in a manner that will help the industry achieve or exceed its reliability goals.

Results and Findings

This project focuses on the electric utility distribution system. The noteworthy practices presented in this report come from the Central Hudson Gas & Electric Corporation. The EPRI project team traveled to Central Hudson's headquarters in Poughkeepsie, New York, and conducted a series of interviews with key personnel to gain insight and understanding into Central Hudson's approach to distribution reliability. Because this project focuses on distribution system reliability, the project team crafted an agenda that covered the following topics:

- Current and historical reliability performance
- Regulatory environment
- Customer expectations
- Reliability metrics and goals
- Reliability initiatives and programs
- Future investments and cost-benefit analysis
- Storm response and outage restoration

When addressing these content areas, the project team focused on the following key reliability issues:

- Company approach to reliability
- Organizational structure and reliability responsibilities
- Reliability goal setting, tracking, and performance incentives
- Circuit inspection and assessment
- Vegetation management
- Project ranking and cost–benefit analysis

Challenges and Objectives

This project identifies and illustrates noteworthy practices used by electric utilities to enhance service reliability. This project also identifies short-term products, such as practice guidelines, that EPRI can provide to meet imminent industry needs while also developing an action research roadmap to address long-term industry needs.

Applications, Value, and Use

The ultimate goal of this research is to produce deliverables that support utility efforts for enhanced distribution system reliability. By identifying noteworthy practices from across the industry, EPRI's goal is to help utilities further their efforts to work safely, efficiently, and reliably.

Approach

The primary research method for this work is to visit host utilities to gather information about their practices. In this report, the utility visits are sometimes referred to as a *practices immersion* or simply an *immersion*. The term *immersion* is used because the project team travels to the host utility and attempts to immerse themselves in the utility's corporate culture and operation in order to understand the "how and why" of the host utility's reliability practices.

Successful performance of the practices documented by the EPRI research team requires the confluence of people, processes, and technologies. For this reason, the documented practices focus on the following three elements:

- **People:** This describes "who performs the work" and includes information such as organization designs, educational requirements, training, management control and policies, standards, audits, and performance-management practices.
- **Process:** This describes "how the work is performed" and focuses on the structure and performance of the activities involved in executing the practice.
- **Technology:** This describes the "tools of the trade" and highlights the application of tools, equipment, and information technology to support the execution of the practice.

Keywords

Central Hudson
Distribution
Immersion
Noteworthy
Practices
Reliability

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1
INTRODUCTION

The manner in which we design, construct, and operate electric distribution systems today is based upon and still quite similar to the methods that have been employed for the past several decades. During this same time period, the electric service reliability expectations of utility customers and regulators have evolved to the point at which traditional reliability standards are no longer good enough. Today's utility customers demand high reliability and enhanced power quality from their electric power supply. The increasingly stringent power supply needs of customers are requiring modern electric utilities to re-think the design, construction, and operational practices for their electric distribution circuits.

Modern electric power utilities must address their customer's expectations for enhanced reliability while also dealing with the challenges of an aging infrastructure, increasing costs for construction and maintenance, and loss of experienced staff to mergers, attrition, and a decline in the number of new engineers entering the workforce.

In 2010, EPRI embarked upon the first phase of a multi-year effort to identify and illustrate noteworthy practices utilities are using to meet their customer's service reliability expectations while operating in a resource-constrained business environment. The ultimate goal of this research is to collect and organize practices information from many utilities and present this information in a manner that will help the industry achieve or exceed its reliability goals.

Purpose

The purpose of this project is to identify and illustrate noteworthy practices used by electric utilities to enhance service reliability. This project is also intended to identify short-term products, such as practice guidelines, which EPRI can provide to meet imminent industry needs while also developing a research roadmap to address long-term industry needs.

Scope

This project focuses on the electric utility distribution system. The noteworthy practices presented in this report come from the Central Hudson Gas & Electric Corporation. The EPRI project team traveled to Central Hudson's headquarters in Poughkeepsie, NY and conducted a series of interviews with key personnel to gain insight and understanding into Central Hudson's approach to distribution reliability.

Because this project focuses on distribution system reliability, the project team crafted an agenda which covered:

- Current and Historical Reliability Performance
- Regulatory Environment
- Customer Expectations
- Reliability Metrics and Goals

- Reliability Initiatives and Programs
- Future Investments and Cost-Benefit Analysis
- Storm Response and Outage Restoration

When addressing these content areas, the project team focused on several key reliability issues:

- Company Approach to Reliability
- Organizational Structure and Reliability Responsibilities
- Reliability Goal Setting, Tracking, and Performance Incentives
- Circuit Inspection and Assessment
- Vegetation Management
- Project Ranking and Cost-Benefit Analysis

Method

EPRI is using a two-pronged approach to research electric distribution reliability practices. The main endeavor is to visit host utilities to gather practices information. The second method is to gather practices information through a survey.

The utility visits are sometimes referred to as a "practices immersion" or simply an "immersion" in this report. The term immersion is used since the project team travels to the host utility and attempts to immerse themselves in the utility's corporate culture and operation in order to understand the "how and why" of their reliability practices.

This EPRI research consists of:

- *Fact Finding* – Includes document reviews and in-depth interviews with management and technical staff for both corporate and field functions.
- *Condition Assessment* – Includes site visits, field inspections, and interview with key field and operations personnel.
- *Findings Verification* – After each visit, EPRI produces a summary report that outlines its findings. Each host utility is given an opportunity to comment on the findings to correct errors and omissions and to ensure that the summary accurately reflects their practices.
- *General Industry Comparisons* – EPRI will compare the practice findings from each immersion to the practices identified at other project participants and to general industry practices based on the experience and research of the EPRI team. This is useful to identify both common and contrasting practices and to highlight practices of note. To facilitate the sharing of practices by utilities, EPRI will be populating a practices database that positions practice descriptions from different companies side-by-side in an easy to use application.

Successful performance of the practices documented by the EPRI research team requires the confluence of people, process, and technology. For this reason, the practices documentation focuses on these three elements:

- *People* – This is a description of “who performs the work” and includes information such as organization designs, educational requirements, training, management control and policies, standards, audits, and performance management practices.
- *Process* – This is a description of “how the work is performed” and focuses on the structure and performance of the activities involved in executing the practice.
- *Technology* – This is a description of the “tools of the trade” and highlights the application of tools, equipment, and information technology to support the execution of the practice.

Report Structure

This research report is a summary document. The descriptions of the practices herein are relatively brief and intended to inform the reader of noteworthy practices in use at Central Hudson, providing enough detail to describe the practice but not the level of detail associated with a traditional benchmarking study. In some cases, the report appendix includes documentation provided by Central Hudson Gas & Electric Corporation that provides added detail about certain practices. In other cases, those interested in obtaining detailed information about a practice are encouraged to reach out to the host utility.

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CENTRAL HUDSON GAS & ELECTRIC BACKGROUND INFORMATION

CH Energy Group, Inc., headquartered in Poughkeepsie, New York, is the holding company of Central Hudson Gas & Electric Corporation and Central Hudson Enterprises Corporation.

Central Hudson Gas & Electric Corporation (Central Hudson) is a regulated transmission and distribution utility serving approximately 300,000 electric customers and 74,000 natural gas customers in a defined service territory of New York State's Mid-Hudson River Valley. Central Hudson's service territory extends from the suburbs of metropolitan New York City north to the Capital District at Albany as shown in Figure 2-1 (Central Hudson's service territory is outlined by the thick blue line).

Central Hudson owns substations having an aggregate transformer capacity of 5.3 million kilovolt amps and operates an electric transmission system consisting of 629 pole miles of line. The electric distribution system consists of 8,078 pole miles of overhead lines and 1,371 trench miles of underground lines, as well as customer service lines and meters.

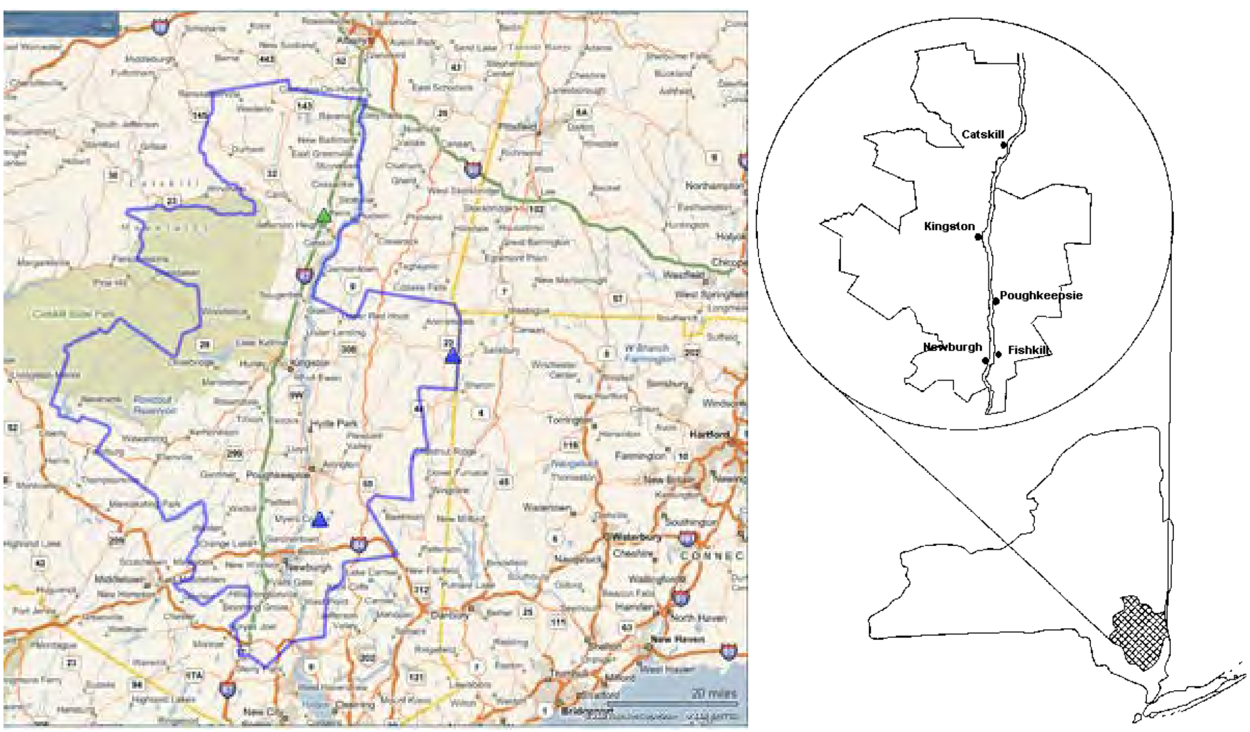

Figure 2-1
Central Hudson Gas & Electric Corporation's Service Territory in New York

Company Summary Information

Name	Central Hudson Gas & Electric Corporation
Website	http://www.CentralHudson.com
Corporate Headquarters	Poughkeepsie, NY
EPRI Contact	Wayne Mancroni wmancroni@cenhud.com
Utility Type	Investor owned NYSE symbol CHG (CH Energy Group, Inc.) OBB symbol CHGEN (Central Hudson G & E)
Number of Employees	Approximately 850
Service Types	Electric and Gas
Service Area	2,600 square miles
Electric Customers	300,000 Approximately 85% residential
Gas Customers	74,000 Approximately 85% residential
Electric Transmission and Distribution	629 pole-miles of transmission 8,078 pole-miles of overhead distribution 1,371 trench-miles of underground distribution
2009 Electric Delivery	5,274 million kWh
Peak Demand	1,107 MW (June 10, 2008)
Workers Represented by Collective Bargaining?	Collective bargaining workforce is represented by IBEW Local 320. Engineers and supervisors are not represented.

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NOTEWORTHY RELIABILITY PRACTICES AT CENTRAL HUDSON GAS AND ELECTRIC CORPORATION

Overview

An aspect of EPRI's methodology in assembling a practices summary is to visit a host utility such as Central Hudson and perform a series of interviews with personnel and conduct field visits. Although these visits may be brief, EPRI investigators often gain a sense as to where utilities place importance and how employees feel about the company.

Central Hudson requested that EPRI investigators focus on their reliability engineering initiatives and inspection and maintenance practices, so much of EPRI's overall impression of Central Hudson is based on these aspects of distribution reliability. EPRI investigators found Central Hudson personnel to be helpful, conscientious, knowledgeable, hard-working, and insightful. Central Hudson employees showed great pride in their company, craft, and workmanship.

The Central Hudson employees interviewed showed enthusiasm for participating in this practices investigation. They were willing and ready to share their knowledge, processes, and expertise and eager to receive practices information from other utilities that they could adapt for use at Central Hudson Gas & Electric.

EPRI investigators noted a strong culture of reliability at Central Hudson. Reliability performance and continuous enhancement is a core value of the company and originates from and is supported by senior management. This company-wide focus on reliability performance shapes the way Central Hudson conducts business in everything from daily outage reviews to pursuing novel approaches to enhance reliability such as the joint Central Hudson and NYSERDA microgrid.

Selected Reliability Practices of Note

The practices presented here were deemed to be particularly noteworthy by the EPRI research team. The information contained here does not encompass the full range of activities and resources that Central Hudson uses to ensure service reliability. Instead, this information provides a summary of the types of activities that Central Hudson employs and, more importantly, highlights the noteworthy practices that others may find valuable for enhancing service reliability on their systems. The practices are numbered to support further discussion but they are not presented in a particular order.

P-1: Strong Working Relationships between Reliability Stakeholders

Central Hudson engineers leverage the modest size of the company by fostering close working relationships with reliability stakeholders throughout the organization.

People

The Distribution Engineering group drives reliability performance in the Central Hudson organization. Therefore, it is important that they have strong working relationships with each Operating District and the field force to ensure their support of reliability initiatives.

Process

By the nature of its small size Central Hudson has almost a de facto (albeit informal) job rotation program by which personnel gain experience in a many areas of the company either through multiple responsibilities in a single position or by periodically moving to a new position. One major benefit of this rotation is that the Distribution Engineering group has built relationships throughout the company. They’ve worked in the Operating Divisions and with the field force and those relationships provide a basis for pushing reliability enhancements throughout the company.

A second benefit of having worked in roles throughout the company is it provides the Distribution Engineering group a solid understanding of the challenges faced by the Operating Districts and the field force.

Technology

Not applicable.

P-2: Major Projects Workforce

Central Hudson uses a defined system for scheduling capital construction crews to complete major projects with a dedicated workforce.

People

Capital construction crews are drawn from the overall pool of line crews within the company and once chosen for a capital project the individual line personnel are dedicated to the project for its duration.

Process

Central Hudson periodically publishes a list of upcoming capital construction projects including the type of project, location, and estimated duration. This information is sent to each line shop such that line personnel from any of the operating districts can "bid" to participate in the capital construction project. Using this bidding method, the required line crews are assembled from the available candidates. Line workers chosen for the capital construction crews then become dedicated to the construction project and work 10 hour days, 4 days per week.

Using dedicated line crews allows capital construction projects to be completed more efficiently and over a shorter time span than could be accomplished without dedicated crews. If crews are not dedicated to the project then their capital construction work can be interrupted by other jobs such as service installations and routine trouble repair. Having a crew stop working, pack-up, and leave the job site to perform other work causes delay and increases project costs, both of which are avoided by using a dedicated project workforce.

Technology

Not applicable.

P-3: Internal Reliability Goals Exceed Public Service Mandated Goals

Central Hudson's internal reliability performance goals exceed the requirements set by the New York State Public Service Commission.

People

Central Hudson's internal reliability performance goals are established based on recommendations from the Distribution Engineering group.

Process

The New York State Public Service Commission (NYS PSC) adopted electric service standards for most electric utilities in the state. These standards created SAIFI and CAIDI performance targets for each utility. The PSC updates these targets on a regular basis by adopting Changes to the Standards on Reliability of Electric Service.

Central Hudson's Distribution Engineering group deliberately sets internal SAIFI and CAIDI reliability goals that exceed the PSC's targets. The internal goals are based on previous performance over the past 5 years, adjusted annually by month, and are set such that they are achievable while also supporting continual performance improvement. A second benefit of having more stringent internal goals is that it helps mitigate the risk of failing to meet the PSC mandated targets which can result in fines and increased scrutiny from the regulator.

Technology

Not applicable.

P-4: Use of $/COA Metric

Central Hudson uses a customer interruption cost factor (CIFC), expressed as dollars per customer outage avoided ($/COA), for ranking reliability initiatives for implementation.

People

The district engineers propose reliability improvement projects and calculate the $/COA for work in their district. The Distribution Engineering group reviews the $/COA calculations to ensure that they are reasonable and achievable.

Process

The $/COA cost factor can be difficult to accurately predict and accurate calculations rely on proper assumptions and previous experience. The numerator (cost) is fairly easy to calculate if there is an accurate job cost estimation and accounting system in place. The denominator can be more difficult to accurately calculate since it is essentially trying to count something that does not occur – customer outage *avoided*. One approach is to rely on A/B comparisons in which initiatives are applied to one of two similar feeders and then performance over the next year(s) is compared. Another challenge comes in deciding *which initiative* is responsive for certain avoided customer interruptions. For example, if a circuit experiences less animal interruptions after undergoing maintenance pruning and wildlife guard installations it can be difficult to determine what portion of the reduced wildlife outages stemmed from each initiative. It becomes easier to accurately estimate avoided customer interruptions for various initiatives after using the metric for a few years and building up some experience with the process and real-world performance.

Central Hudson has been working with the $/COA ranking method for several years while also recording the appropriate data to facilitate future decision making. With this data now available, Central Hudson is using an approach based on the 5-year average of outages for each section of line considered for reliability enhancements. The 5-year average represents the current performance against which reliability improvements are measured. Central Hudson also considers factors such as line age and on/off road location in the project ranking process.

Technology

Not applicable.

P-5: 3x and 10x Reliability Initiatives

Central Hudson utilizes 3x (device interruptions) and 10x (customer interruptions) programs to ensure that severe recurring reliability problems are addressed in a timely manner and SAIFI performance is improved.

People

The data that drives the 3x and 10x programs is collected and analyzed by engineers within the Distribution Engineering work group. Once the program information is tabulated it is forwarded to each Operating District for their review and action. It is the responsibility of each District to review the 3x and 10x program data and decide how to best address the issues.

Process

These programs are designed to address "pockets of poverty" or pockets of customers who may be experiencing poor reliability on the Central Hudson system.

Central Hudson's 3x program focuses on any protective device that has operated 3 or more times in the previous 12 months. This program uses a 12 month rolling timeframe and includes storm-related outages. Remediation work stemming from the 3x program is not budgeted for on an annual basis; this work is absorbed into existing budgets.

The 10x program identifies customers that have experienced 10 or more interruptions in the previous calendar year and includes all customer outages (storms, switching, etc.). The 10x report data includes customer account information and GIS coordinates, along with the location of each permanent service-interrupting fault. The data is imported into ArcVIEW[1], a desktop GIS mapping, data integration, and analysis tool, to facilitate further analysis. Remedial work stemming from the 10x program is included in the yearly Capital budgeting process.

Once the program data is forwarded to the Operating District, the local district Engineers decide how to best address each issue. This typically includes reviewing the outage causes, protective device coordination, wildlife protection, and current vegetation status on the affected circuit areas. Once the underlying causes are understood, the district engineers develop a plan to address the cause and improve reliability for the affected customers. Remediation activities can include adding wildlife protection, mid-cycle tree trimming, and revising protection schemes. In severe cases, the remedy may be relocating several miles of circuit from a wooded right-of-way to on-road to facilitate improved inspection, maintenance, and tree trimming.

Technology

Not applicable.

P-6: Vegetation Management – Program Contracting, Enhanced Tree Trimming Program, and Leading-Edge Technology

The distribution vegetation management program has been substantially enhanced during the last several years to support achievement of Central Hudson's reliability performance objectives and to conform with regulatory requirements. Sweeping changes for the distribution line clearance program (discussed in greater detail below) which have been systematically introduced in recent times include:

- Program funding has increased from $3.9M in 2005 to $9.9M in 2009.
- The trimming program was changed from grid-based to circuit-based in 2007.
- There is strong focus on completing a full four-year cycle (and maintaining on-cycle thereafter).

[1] More information on ArcView can be found at www.ESRI.com

- Trim requirements have been expanded, from the historical "box" (aka "window") specifying minimum vegetation clearance distances above, to the side and below conductors, to either "Enhanced" or "Modified Enhanced" requirements.
- An independent third-party conducts ongoing evaluation of tree contractor work quality.
- Escalation of program cost has been mitigated by use of multi-year contracts with multiple vendors, and use of both Time & Equipment and Lump Sum contracts.

Collectively, these program changes have had measureable positive impact on Central Hudson's tree-caused outage experience. Tree-related reliability ("tree SAIFI" for 2007 improved by 36.3% for tree-related outages and 17.5% for tree and storm-related outages when compared with the performance for the three-year average for 2004-2006. Impressive results were also realized in 2008, when a four-year SAIFI average for the period 2004-2007 showed a 4.5% improvement in tree-related outages and a 10.7% improvement for tree and storm-related outages, for those circuit that were trimmed to the new modified enhanced specifications.

People

The Central Hudson Distribution Vegetation Management program is lead by a director of line clearance. The director is also responsible for the smaller transmission line clearance program. The Distribution VM program staff includes three distribution line clearance foremen. Although none are degreed in Forestry or Arboriculture, one line clearance foreman is certified by the International Society of Arboriculture; a second line clearance foreman is working towards certification currently; and the distribution team is well experienced (as long as 38 years) with line clearance work.

Process

As noted above, Central Hudson's Tree SAIFI has improved (i.e., been reduced) by over 36% over a three-year period (2004/2006 vs. 2007) and by over 4% over a four-year period (2004/2007 vs. 2008) since VM program enhancements and increased funding were instituted. A number of processes and program requirements contribute to this noteworthy improvement in reliability:

- *VM Specifications* – Central Hudson utilizes two distribution line clearance specifications. "Modified Enhanced Trimming" is the standard for routine trimming of three-phase and single-phase distribution circuits.
    - "Enhanced Trimming" is used selectively on three-phase backbones and, subject to property owner permission, provides for removal of all tall-growing species within the boundaries of the right-of-way, and maintaining at least 10 feet of side clearance from both sides of the conductors. Subject to landowner consent, tree contractors also trim or remove trees including hazard trees located outside the right-of-way. Enhanced trimming (aka "blue sky" trimming) is widely recognized as an industry best practice for optimizing spending to mitigate tree-caused interruptions. Enhanced trimming is applicable to three-phase distribution with higher than acceptable tree-caused interruptions (calculated on a per mile basis).

- “Modified Enhanced Trimming” requirements are very similar to that for Enhanced Trimming, with the exception of trimming or removal of trees outside the right-of-way. It is applicable for three-phase distribution not eligible for Enhanced trimming, and for all single-phase distribution.

- *Clearance Cycle* – The implementation of the Enhanced Trimming and Modified Enhanced Trimming line clearance specifications coincided with the adoption of a four-year cycle for all distribution circuits. The four-year cycle was recommended by a nationally recognized vegetation management consultant based on a cost benefit analysis and available funding. Trimming the entire distribution system on a common cycle provides for a steady work volume over the long-term, which in turn provides for workforce stability for the tree contractor and lower costs for the utility.

- *Circuit-Based Trimming* – Central Hudson changed its line clearance program from grid-based to circuit-based in 2007. Grid-based trimming has long been recognized as sub-optimal from a reliability perspective, because while all circuits within a defined geographic area (or “grid”) are trimmed in the same year, all of the *remainder* of those circuits, which are outside the grid, are *not* trimmed in the same year. Thus for the dollars invested on the trimmed portions of the circuits, a higher level of reliability problems persist because the rest of the circuitry is still subject to more tree-caused outages than it would have been had all of the circuitry been trimmed at the same time.

- *Quality Assurance* – The Central Hudson quality control/quality assurance program is carried out by an independent third-party contractor. Additionally the person conducting the audits is not organizationally aligned with the Vegetation Management group. As a result, not only is Central Hudson assuring itself that contractors are performing the work they are paid to complete; it also provides for an independent assessment of the effectiveness of the company’s overall vegetation management program. Although it has an internal commitment to audit at least 25% of the work performed annually, Central Hudson is currently auditing 95% – 100% of the work.

  Performance Management – Central Hudson management conducts quarterly performance review meetings with its vegetation management contractor management. Crew productivity is closely monitored, and measured by crew hours per mile and cost per mile.

- *“Hybrid” Contracting Strategy* – The Central Hudson vegetation management workload is performed under multi-year contracts with multiple vendors, and employs both Time & Equipment (T&E) and Lump Sum pricing. Multi-year contracts coupled with a steady workload (i.e., maintaining on-cycle trimming) provides for workforce stability, which in turns leads to lower turnover in an industry challenged with a dwindling pool of people willing to perform this physically challenging and high risk work. In addition the assurance that the contractor will be on the property on an ongoing basis is an incentive to acquire the best and latest equipment and to hire the best qualified workers. The use of both T&E and lump-sum contracts enables Central Hudson to continually “test the waters” as to current market costs, and thereby optimize the value it receives for the dollars spend for vegetation management. The hybrid contracting strategy is a strong enabler for the most favorable pricing and lower overall program over the long term, and is widely recognized as an industry "best practice".

Technology

Central Hudson is using leading-edge technology to capture and catalog vegetation management program data. Its electronic mapping system is used to track work scope; danger tree removals; spans not needing trimming (17% of its distribution circuits are "clear spans"); which contractor performed the work, both on road and off road; and which specification the circuitry was trimmed to (Enhanced or Modified Enhanced). Data is collected in the field using PDAs, and once downloaded the data can be sorted any way desired (by district, company, contractor, circuit parameters, etc.). This is an industry-leading practice; and once fully implemented it will enable Central Hudson to further optimize its distribution vegetation management program.

P-7: Inspection Program Training and Performance Oversight for Contact Inspection Crews

Central Hudson's inspection programs are performed by a contractor under the guidance and administration of an engineer in Electric T&D Operations & Quality Productivity/Initiatives.

People

An engineer within Central Hudson's Electric T&D Operations and Quality area is responsible for overall management of the inspection program. A key aspect of this work is communicating to the inspection contractor what work is to be performed and how it should be accomplished. It is also necessary to ensure that the inspectors are well trained and that the inspections are being performed accurately.

Process

Central Hudson, in conjunction with the inspection contractor, developed several documents to facilitate the training and continued proficiency of the circuit patrollers. These documents include:

- *Guidelines for Overhead and Underground Distribution Circuit Inspection* – guidelines designed to provide for consistent and uniform inspection of electric facilities in order to verify the safety and reliability of the facilities while identifying and deficiencies requiring corrective. There are separate documents for overhead and underground inspections.

  These documents detail the frequency of inspection, the hazards of working around energized facilities, basic inspector training, severity ratings, and how to use the mobile inspection tool (PDA).
- *Overhead and Underground Inspection Training Manuals* – the training manuals (one each of overhead and underground / URD) provide information on the required personal protective equipment required, how to perform the various inspections, common deficiencies observed in the field, and how to record and report findings. These documents make extensive use of annotated pictures to help inspectors understand what to look for and how to assign a severity rating to the deficiencies.

- *Thermographic Inspection Specification* – outlines how the inspection program should operate, billing and payment criteria, and severity grading criteria for deficiencies found during the inspection.

Technology

Not applicable.

P-8: Mobile Inspection Data Collection Tool with Integrated Camera

Central Hudson's circuit inspection program incorporates a hand held mobile computing device to facilitate data collection and analysis.

People

The mobile inspection data collection tool is used by contract patrollers engaged by Central Hudson to provide circuit inspection services.

Process

The inspection process at Central Hudson is designed to assess the condition of the facilities and record any damage or deficiencies. Data collection and analysis is facilitated by the use of a hand held mobile computing device which helps increase productivity, accuracy, and completeness. Inspection data is entered directly into the mobile inspection tool at each pole / equipment location and GPS coordinates, local time, and date are automatically recorded. The inspection data is stored on the handheld device and later transferred to Central Hudson's computer database.

A patrol starts with the inspector locating the pole or equipment in the handheld inspection tool. The device incorporates search tools for finding locations by pole number, grid and map, or GPS coordinates. Figure 3-1 shows screenshots of the location tools in the device. Once the pole or equipment is selected in the device the main inspection menu is displayed. The content of the inspection menu differs depending on the type of equipment being inspected. Figure 3-2 shows example inspection screens for overhead facilities while Figure 3-3 shows similar screens for padmount equipment. The main inspection menu lists several categories such as pole, conductor, transformer, etc., witch check boxes next to each category for satisfactory or unsatisfactory. When unsatisfactory is checked next to any of the categories an additional screen opens to collect to collect further information on the deficiency. Examples of these additional information screens are shown on the right side of Figure 3-2 and Figure 3-3 for overhead and padmount equipment respectively.

Figure 3-1
Inspection Tool Screens used when Locating Facilities in the Field

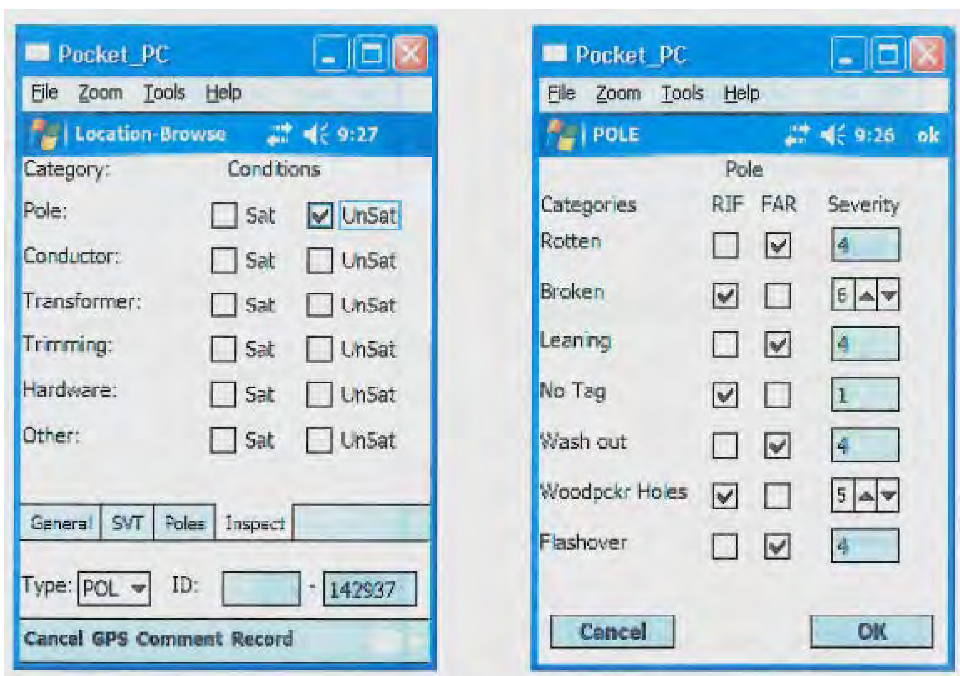

Figure 3-1
Inspection Tool Screens used when Evaluating Overhead Facilities

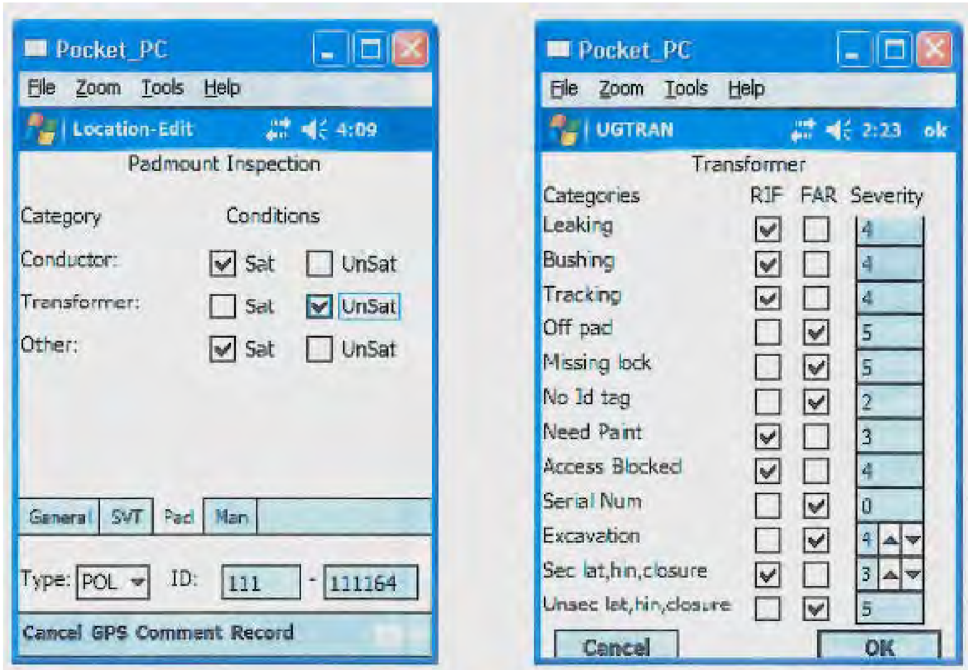

Figure 3-2
Inspection Tool Screens used when Evaluating Padmount Facilities

There are also occasions where a pole or equipment can't be accessed and the system includes a variety of classifications for inaccessible sites such as heavy brush, ornamental landscaping, and pole/equipment not physically there.

Any emergency (Severity 6) conditions found in the field are reported at once to initiate immediate repairs; this is typically done via cell phone call to the System Dispatch Center. Severity 6 conditions that pose an imminent danger to the public initiate a "standby" and the patroller remains at that location until relieved by Central Hudson personnel. Severity 6 conditions also trigger additional data entry as shown in Figure 3-4.

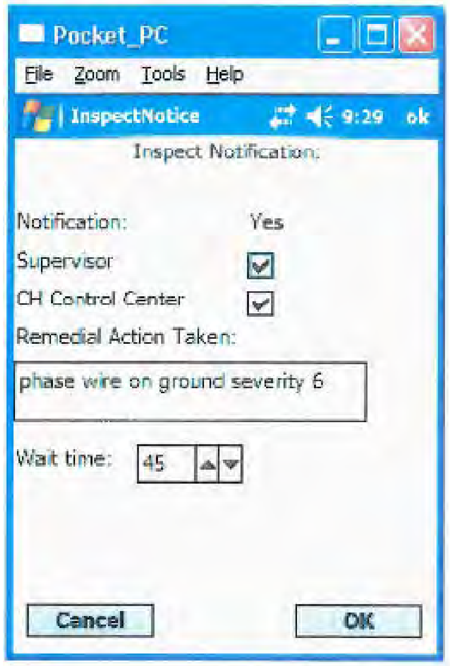

Figure 3-3
Example Inspection Tool Screen used for Severity 6 Conditions

Technology

The inspection device currently in use is a Trimble Juno SB[2] which is a ruggedized hand held computer with an integrated display, camera, and GPS capabilities as shown in Figure 3-5. The Juno SB is based on a 533 MHz processor and incorporates a 3.5-inch display, 3 megapixel camera, Bluetooth® connectivity for peripheral devices, and wireless LAN connectivity. The Juno SB also has a field replaceable battery.

Figure 3-4
Mobile Inspection Data Collection Tool

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[2] www.Trimble.com

Future handheld inspection tools may leverage one of the current smart phone platforms, such as the Android system, to build upon the current functionality by adding cell network connectivity, enhanced graphics display, and real-time voice and image communication for high-priority deficiencies found in the field.

P-9: Standards Review with Line Personnel

Central Hudson's Standards Department reviews proposed and revised standards with the field force before the standard is issued.

People

The Standards Department revises existing standards and also creates new standards as the need arises. Part of the process for this work involves meeting with line crew foremen and experienced line workers to seek their input on the standards.

Process

The process itself is rather straightforward – provide a copy of the new standard to the experienced members of the field force for their input. The benefit of including this review as in the standards process is that it provides a check on whether or not the standard can really be built in the field as designed. It also gives insight into whether or not there are any aspects of the standard that the field force might not adhere to simply because there is an easier or more common way of performing the work; in this case either the standard needs to be revised or the field force needs to be trained on why that aspect of the standard is important. A good example of this is teaching the field force why it is important to keep arrester lead lengths short (to limit voltage build-up on the leads) even though it may be more aesthetically pleasing to use curled leads.

The ultimate outcome of including the field force in the standards review process is the creation of better, more buildable designs with greater adherence by the workers who have to build them.

Technology

Not applicable.

P-10: Migration to GW Vacuum Viper Reclosers

Central Hudson is migrating from hydraulic reclosers to electronic controlled G&W Viper vacuum reclosers.

People

The migration to vacuum reclosers is being led by the Distribution Engineering group at Central Hudson. The impetus for this migration comes from the results of a recent review of Central Hudson's overcurrent protection and reliability practices by an independent consultant.

Process

Due to the increased coordination ability and flexibility of electronic reclosers, Central Hudson began to migrate from hydraulic reclosers to electronic reclosers around 2008. As is common within the industry, they started with a small trial and then began to increase the number of electronic reclosers on the system after the successful trial. During the migration process, the maintenance benefits of vacuum reclosers became apparent and Central Hudson decided to standardize on vacuum reclosers as part of the migration process.

Technology

Vacuum reclosers make use of solid dielectric insulation and a vacuum bottle to interrupt current flow. This design greatly reduces maintenance and mitigates environmental risks by eliminating the need for oil or gas insulating mediums. Vacuum recloser manufacturers often quote units as being able to perform 10,000 operations without maintenance. Vacuum reclosers do usually require a battery replacement on a 7 to 10 year schedule but other than that they are virtually maintenance free and therefore can significantly reduce the maintenance costs associated with maintaining the recloser plant.

P-11: Individual Phase Tripping with Triple-Single Reclosers

Central Hudson's protection schemes allow for single-phase tripping and reclosing on three phase lines which can improve both SAIFI and CAIDI.

People

Not applicable.

Process

Under classic (and very common) protection schemes, three-phase reclosers trip and reclose all phases for an event and lockout all three phases if the fault is permanent. However, this unnecessarily interrupts customers on the unfaulted phases and negatively affects reliability. Another approach which is finding increased use it to individually trip and recloser the phases but still lock-out all three phases for any permanent, regardless of phase. This reduces momentary exposure for the unfaulted phases but doesn't help with SAIFI.

A still better approach for improving reliability is to utilize individual phase tripping, reclosing, *and* lockout. With this approach, the unfaulted phases are protected from unnecessary interruptions and reliability is improved.

Probably the biggest concern with individual phase tripping and lockout is the potential affect on customer's three phase loads. However, phase loss protection is a common part of typical three-phase motor protection schemes. Central Hudson further addresses this issue with their Tariffs which specifically state that providing loss of phase protection is the customer's responsibility. It should also be noted that using an individual phase lockout scheme has essentially the same potential for phase loss as the common practice of protecting a three phase tap with fuses and so the potential for phase loss is not a new result of this protection scheme.

An additional concern with enabling individual phase lockout is that is will cause circuit imbalance and lead to operation ground overcurrent relay operation[3]. One way to address this issue is to modify the relay settings to increase the tolerance for higher unbalance. In certain situations it may also be necessary to restrict use of individual phase reclosing and lockout to portions of the circuit where the unbalance is not significant enough to cause the operation of the ground overcurrent relay.

Technology

Many modern reclosers are capable of providing individual phase trip, reclose, and lockout functionality. For Central Hudson, this scheme was initially employed using single-phase hydraulic reclosers and is continuing to find use as Central Hudson migrates to electronic controlled G&W Viper vacuum reclosers.

P-12: Use of Contract Inspection Personnel for Major Storm Damage Assessment

Central Hudson utilizes their contract line inspection personnel to help perform damage assessments during storm response and restoration activities.

People

Central Hudson utilizes an outside contractor to perform routine circuit inspections on their system. Because of their inspection work, the contract patrollers are familiar with Central Hudson's circuits, distribution hardware, and the service territory which makes them well suited for performing storm damage assessment.

Process

It is not feasible to carry out routine inspection work in the aftermath of a major storm due to the damage inflicted on the system. Rather than let the contract patrollers sit idle, Central Hudson has an agreement in place with the contractor to deploy the patrollers to perform storm damage assessment under a time and expenses (T&E) pricing structure. This provides dual benefits of tapping into a skilled work force for short-term mission-critical work while also providing a mechanism to reduce patroller downtime (which helps reduce turnover in the contractor's workforce).

Technology

Not applicable.

P-13: Use of GPS in Field Vehicles

The majority of Central Hudson's field vehicles have onboard GPS technology.

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[3] http://tdworld.com/customer_service/single-phase-reclosing-20090901/

People

The majority of the field force has GPS technology in their vehicles for routing and direction information. All of Central Hudson's service trucks (used by trouble shooters) have integrated GPS technology that provides both routing directions for Trouble Shooter and feedback to the Dispatch Center on the truck's location. Central Hudson is moving towards adopting this technology for all line mechanic trucks as well as they currently use a mix of GPS devices and most do not currently utilize automated location reporting to the Dispatch Center.

Process

The GPS system used in the service trucks provides routing and direction information to the service truck and also automatically transmits the vehicle's location to the dispatch center. This location information is fed into Central Hudson's work management system which enables more efficient dispatch and routing of service trucks in both daily and major storm activities.

Technology

The GPS units used in line mechanic trucks are typically off-the-shelf models that are widely available on the general consumer market. These offer the advantage of being easily moved between vehicles but do not provide automated location information which can be useful for crew tracking and dispatch.

The GPS system used in the service trucks is a commercially available product and is part of a family of products that has seen wide-spread adoption over the past decade with companies that utilize large fleets of vehicles.

P-14: Development and Deployment of Damage Prediction Computer Model

Central Hudson worked with The FleetWeather Group, a local weather services company, to develop a computerized storm damage prediction tool to aid in storm preparation and response activities.

People

Major storm preparation and response activities fall under the purview of the Director of T&D Operations and Emergency Response. The Director, in council with Central Hudson's executive management, has supported the development of the storm damage prediction model over multiple years.

During storm preparation activities, the damage prediction model is run by Central Hudson and the results are communicated to the Director of T&D Operations and Emergency Response and others within the company.

The FleetWeather Group[4] is a private weather consulting service that provides global weather intelligence, customized weather interpretations, and weather decision assistance to weather-sensitive professional decision makers.

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[4] http://fleetweathergroup.com/

Process

The damage prediction model uses weather forecast data such as wind speed and direction, precipitation type and amount, and temperature to create damage and outage predictions for each of the three meteorological zones in Central Hudson's operating territory.

Currently, the model is run by Central Hudson over the internet on a daily (or more frequent) basis as severe weather is approaching. The damage and outage prediction information is used to help Central Hudson asses their resource and material needs for the impeding weather event starting several days before the event with continuous refinement as the event draws near.

Technology

FleetWeather analyzed Central Hudson's operating territory and divided it into three distinct meteorological zones. Central Hudson provided FleetWeather with several years of outage information which was combined with historical weather data to develop damage predictors for each of the three zones.

The damage prediction model uses weather forecast data such as wind speed and direction, precipitation type and amount, and temperature to create damage predictions for each of the three meteorological zones.

Now that the model's functionality has been proven additional resources are being dedicated to fine tuning the damage prediction algorithms. Additional development is also being performed to permit the model to automatically acquire the necessary input data via the internet.

P-15: Effective Planning Process to Mitigate "Just in Time" Engineering

Central Hudson has established a strong, forward-looking distribution planning function which identifies the optimal system infrastructure changes required to accommodate reliability improvement objectives and anticipated load growth.

People

The adoption of a forward-thinking planning process is embedded in Central Hudson's corporate culture and extends throughout the distribution Planning and Engineering work groups.

Process

Oftentimes reliability and load growth solutions require engineering evaluation of multiple alternatives; require the purchase of new equipment with very long lead times; require the permitting and acquisition of land and/or rights-of-way; and significant time for purchasing, acquisition of labor resources, construction, testing and commissioning of new facilities. Together all of these activities typically represent time spans ranging from three to five years.

Utilities which do not provide for adequate planning time by default resort to "just-in-time" engineering. Every facet of the process -- be it planning, engineering, purchasing, property acquisition, or construction -- is left with insufficient time to fully explore options and identify and implement the most cost-effective solution. Recognizing these pitfalls, Central Hudson has established and maintains a planning process which prevents the risks of just-in-time engineering.

Technology

Not applicable.

P-16: Use of Distributed Generation to Mitigate Reliability Issues on a Long Rural Feeder

Central Hudson, with support from the New York State Research and Development Authority (NYSREDA), developed a small microgrid to enhance reliability for an isolated pocket of customers on a long rural feeder.

People

The New York State Energy Research and Development Authority[5] (NYSERDA), is a public benefit corporation which is primarily funded by state rate payers through a System Benefits Charge. NYSERDA's aim is to help New York meet its energy goals: reducing energy consumption, promoting the use of renewable energy sources, and protecting the environment.

Central Hudson partnered with NYSERDA to pursue this microgrid solution instead of a more conventional line relocation to an on-road location from the existing wooded right-of-way. The total cost for the micro-grid project was approximately US$1 million and NYSERDA contributed approximately 40% of the funding.

Process

Central Hudson has an isolated pocket of customers served from a long rural feeder that were experiencing chronic below average reliability. Engineers investigated the issue and determined that the best traditional solution was to relocate five miles of circuitry through a wooded right-of-way to an on-road location. This work was estimated to cost $5,142 per customer outage avoided. An alternate plan was then developed to utilize a diesel engine powered generator to supply a microgrid for these customers when the feeder was interrupted. Once the costs were tallied, the microgrid plan had an estimated cost of $1,984 per customer outage avoided.

The microgrid project went forward with the installation of a 1.0 MVA diesel generator set and the accompanying switching and control equipment the substation serving this pocket of isolated customers. The key feature of this microgrid is its ability to separate the substation from the utility system when the utility feed is not available and then supply the local customers from the diesel generator until the utility feed can be restored.

The microgrid was officially placed into service on January 14, 2010. In February 2010, back-to-back severe winter storms affected Central Hudson's service territory bringing large amounts of wet heavy snow and high winds. In the aftermath of the "Twin Peaks" storms the microgrid was called on to supply its customers. From January 14 though March 14, 2010 the microgrid

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[5] www.NYSERDA.org

generator logged 175.9 hours of operation and served 26,047 kWh. Central Hudson received the EEI Emergency Response Award for the “Twin Peaks” Storm.

Technology

The core of the microgrid is a 1-MVA diesel generator set placed in the substation. When the microgrid is called into operation, the substation disconnects from the transmission feeds and begins to supply the local load from the diesel generator thus operating in a islanded mode.

A
ESTIMATED TIME OF RESTORATION GUIDELINES

ESTIMATED TIME OF RESTORATION GUIDELINES

The following guidelines provide expectations of when information will be available and/or provided in response to storms or storm-like electric emergencies, absent extraordinary circumstances as determined by the Department of Public Service (DPS). Notification to the DPS should follow the guidelines issued relating to Appendix B of Case 04-M-0159. Utilities procedures and practices that require actions prior to those identified should continue to be used on a forward going basis.

The table below identifies actions to be taken within the restoration period by the utilities to properly keep the Staff and the public informed. The start of the restoration period will be considered the point in time when field personnel are able to be dispatched without safety risks from continued severe weather conditions and the potential additional damage to the electric system from a storm would be low in proportion to the expected level of damage already sustained. The start of the restoration period may be different for distinct areas where the effect of a storm limits access to facilities (e.g., severe flooding).

During the course of restoration, utilities are expected to continuously refine estimated restoration times and update customer representatives, Interactive Voice Response (IVR) systems, and web sites in a timely manner (at least every six hours). Additionally, utilities shall issue at least one press release daily for all events with an expected restoration period longer than 48 hours. The estimated restoration times provided should be applicable to at least 90% customers in the area.

Within the first 6 hours of the restoration period
• The utility shall provide a status of the storm's effect on customers and if the restoration period is likely to be within 24 hours, within 48 hours, or a multi day event (over 48 hours). The status should be reported to the DPS and be made available to the public via customer representatives, IVR systems, and web sites. The storm status should reflect whether the restoration period for a sizable amount of customers is going to be over 24 hours in duration.
Within the first 12 hours of the restoration period
• The utility should update the initial estimated restoration period and inform the DPS if the estimate has changed from that previously reported. • The utility shall assess need for mutual assistance and complete a mutual aid conference call if aid is needed. • For storms with expected restoration periods less than 24 hours, estimated restoration times for each locality affected should be available via customer representatives, IVR systems, and web sites. • For storms with expected restoration periods more than 24 hours, the utility will also prepare a press release for issue at the next upcoming news cycle and communicate with affected municipal and governmental officials (may or may not be by way of a municipal conference call). • For storms with expected restoration periods between 24 and 48 hours, estimated restoration times should be available on a general geographic basis and reported to the DPS.

Revised 9/3/09

Within the first 18 hours of the restoration period

- For storms with initial expected restoration periods less than 24 hours, the utility should determine if the restoration period is likely to exceed 24 hours, and if so, the utility is expected to notify the DPS of the number of customers projected to remain without power over 24 hours.
- For storms with expected restoration periods between 24 and 48 hours, estimated restoration times for each locality affected should be available via customer representatives, IVR systems, and web sites.
- For storms with expected restoration periods more than 48 hours, the utility should schedule a municipal conference call, unless the company requests and DPS agrees that an alternative municipal contact method is more appropriate. The first scheduled municipal conference call itself does not necessarily have to fall within the first 18 hours, but shall be within the first 36 hours.

Within the first 24 hours of the restoration period

- For storms with expected restoration periods between 24 and 48 hours, the utility should consider issuing additional press releases for the upcoming news cycle based on conditions.
- For storms with expected restoration periods more than 48 hours, the utility shall issue a press release(s) for upcoming news cycles with descriptions of what areas sustained the most damage to the electric system and estimated restoration times, where known, on a general geographic basis.

Within the first 36 hours of the restoration period

- For storms with initial expected restoration periods between 24 and 48 hours, the utility should determine if the restoration period is likely to exceed 48 hours, and if so, the utility is expected to notify the DPS of the number of customers projected to remain without power over 48 hours.
- For storms with expected restoration periods more than 48 hours, estimated restoration times for each county affected should be available and reported to the DPS. The utilities should also have completed the first scheduled municipal conference call.

Within the first 48 hours of the restoration period

- For storms with expected restoration periods less than one week, estimated restoration times for each locality affected should be available via customer representatives, IVR systems, and web sites.
- For storms with expected restoration periods more than one week, a global estimated restoration time should be available via customer representatives, IVR systems, and web sites.

Beyond the first 48 hours of the restoration period

- Estimated restoration times for each locality affected should be available via customer representatives, IVR systems, and web sites as they become available.

Revised 9/3/09

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