

Report on Collaborative Research for Hurricane Hardening

Provided by

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University of Florida

To the

Utility Sponsor Steering Committee

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I. Introduction

The Florida Public Service Commission (FPSC) issued Order No. PSC-06-00351-PAA-EI on April 25, 2006 (Order 06-0351) directing each investor-owned electric utility (IOU) to establish a plan that increases collaborative research to further the development of storm resilient electric utility infrastructure and technologies that reduce storm restoration costs and outages to customers. This order directed IOUs to solicit participation from municipal electric utilities and rural electric cooperatives in addition to available educational and research organizations. As a means of accomplishing this task, the IOUs joined with the municipal electric utilities and rural electric cooperatives in the state (collectively referred to as the Project Sponsors) to form a Steering Committee of representatives from each utility and entered into a Memorandum of Understanding (MOU) with the University of Florida's Public Utility Research Center (PURC).

PURC manages the work flow and communications, develops work plans, serves as a subject matter expert, conducts research, facilitates the hiring of experts, coordinates with research vendors, advises the Project Sponsors, and provides reports for Project activities. The collaborative research has focused on undergrounding, vegetation management, hurricane wind speeds at granular levels, and improved materials for distribution facilities.

This report summarizes the work completed on the Steering Committee's areas of focus. Sections II through IV provide information on the undergrounding research, wind research, and vegetation management workshop respectively. The conclusion of this report provides an overall assessment of the collaborative research program to date, including operational and financial viability and future planning to the extent these items are not already covered in the other sections of this report.

II. Undergrounding

An important consequence of hurricanes is that they often cause major power outages, which can last for days or even weeks. These outages almost always lead to a public outcry for electric utilities to move overhead power lines underground. To some it seems intuitive that undergrounding facilities should protect them from damage. However, research shows that this is not necessarily the case: while underground systems on average have fewer outages than overhead systems, they can sometimes take longer to repair. Furthermore, forensic analyses of hurricane damage in Florida found that underground systems may be particularly susceptible to storm surge.

The collaborative research on undergrounding has been focused on understanding the existing research on the economics and effects of hardening strategies, including undergrounding, so that informed decisions can be made about undergrounding policies and specific undergrounding projects.

The Project Sponsors contracted with Quanta Technologies for a project involving three phases. Phase I was a meta-analysis of existing research, reports, methodologies, and case studies.¹ Phase II examined specific undergrounding project case studies in Florida and included an evaluation of relevant case studies from other hurricane prone states and other parts of the world.² Phase III developed an *ex ante* methodology to identify and evaluate the costs and benefits of undergrounding specific facilities in Florida. Although the primary focus is the impact of undergrounding on hurricane performance, this study also considered benefits and drawbacks of undergrounding during non-hurricane conditions.

For 2010, the collaborative focused on refining the computer model developed by Quanta Technologies in response to Phase III of the overall project. Specifically, there has been a collective effort to learn more about the function and functionality of the computer code, and the testing group has accomplished that. The testers have made significant improvements to the flexibility of selecting input scenarios in which the calculator arrives at results.

The implementation of the calculator component of the model is under refinement. The computer program calculates complex, non-linear interactions between hundreds of input variables. These interactions result in probability distributions of various output parameters including the extent of damage from storm-related events and the time necessary to correct that damage. However, these results are highly sensitive to the input parameters used in the calculation. Some input parameters, like the costs associated with the installation of equipment, are well known to the utilities, but may be accounted for in different ways, depending on the internal accounting and work management systems that the utilities employ. Other inputs, such as the initial availability of repair crews and the rate at which additional crews become available are not known and measurable to the utility at the time the calculations are made. For these input parameters, the utility must employ a reasonable assessment of their value. To the extent that this assessment is not realized, however, actual results may vary greatly from what is originally calculated. The testers have improved their understanding of the extent to which this variation occurs, but

¹ The Phase I report is available at http://www.cba.ufl.edu/purc/docs/initiatives_UndergroundingAssessment.pdf

² The Phase II report is available at http://www.cba.ufl.edu/purc/docs/initiatives_UndergroundingAssessment2.pdf

educating users outside of the testing group will be an important step in the implementation process of the calculator.

PURC and the Project Sponsors have also worked to fill information gaps for model inputs through the forensics sub-group. Significant efforts have been invested in developing a forensics data collection form for all utilities to use, towards supplying input information for the undergrounding calculator, and for future research. The data from this form is to be stored in a customized database program developed by PURC. However, since the state has not been affected by any hurricanes since the database software was completed, there is currently no data.

Ted Kury, Director of Energy Studies at PURC, has drafted an academic paper discussing the collaborative effort to address storm hardening in Florida. In November of 2010, he presented this paper at the annual conference of the Organization of Caribbean Utility Regulators. The Caribbean regulators and operators at the event were very interested to see what Florida is doing to address a problem that is common to the state as well as the Caribbean nations. Several countries have expressed interest in helping the effort.

III. Wind Data Collection

Appropriate hardening of the electric utility infrastructure against hurricane winds requires: (1) an accurate characterization of severe dynamic wind loading and (2) an understanding of the likely failure modes for different wind conditions.

The Project Sponsors addressed the first requirement by entering into an agreement with WeatherFlow, Inc., which, at the time, was beginning to establish a granular wind observation network designed to capture the behavior of the dynamic wind field upon hurricane landfall. WeatherFlow has expanded its network to include 50 permanent wind monitoring stations around the coast of Florida. The wind, temperature, and barometric pressure data being collected at these stations has been made available to the Project Sponsors.

To address the second purpose of this project, namely to better understand the likely failure modes for different severe weather conditions, a group was convened through a series of conference calls to improve forensic data consistency. PURC developed a uniform forensics data gathering system for use by the utilities and a database that will allow for data sharing and that will match the forensics data with the wind monitoring and other weather data. Once a hurricane occurs and wind data is captured, forensic investigations of utilities infrastructure failure, conducted by the utility companies, will be overlaid with wind observations to correlate failure modes to wind speed and turbulence characteristics. Project Sponsors and PURC will analyze such data.

IV. Vegetation Management

The goal of this project was to improve vegetation management practices so that vegetation related outages are reduced, vegetation clearing for post-storm restoration is reduced, and

vegetation management is more cost-effective. The initial Vegetation Management workshop was held March 5-6, 2007 and the second Vegetation Management workshop was held January 26-27, 2009. The collaborative is evaluating the opportunity to convene another workshop in 2011.

V. Conclusion

In response to the FPSC's Order 06-0351, IOUs, municipal electric utilities, and rural electric cooperatives joined together and retained PURC to coordinate research on electric infrastructure hardening. For 2010, work has focused on the continued efforts in the areas of undergrounding research, granular wind research, and vegetation management. The Steering Committee is currently considering next steps in these research areas.

The benefits of the research work among the utilities and PURC include increased and sustained collaboration and discussion among the members of the Steering Committee, greater knowledge of the determinants of damage during storm and non-storm times, greater knowledge and data from wind collection stations and post-hurricane forensics in the State of Florida, and continued state-to-state collaboration with others in the Atlantic Basin Hurricane Zone.