UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Geomagnetic Disturbances to the Bulk-Power System) Docket No. AD12-13-000

PRESENTATION OF MICHAEL HEYECK
ON BEHALF OF
AMERICAN ELECTRIC POWER SERVICE CORPORATION

Introduction

Good afternoon. My name is Michael Heyeck, and I am Senior Vice President of Transmission for American Electric Power (AEP). AEP owns approximately 39,000 miles of transmission lines, including over 2,000 miles of 765 kV lines, and AEP companies own assets in PJM, SPP, and ERCOT. Thank you for the opportunity to speak on behalf of the AEP System Companies[1] during today's Staff Technical Conference on Geomagnetic Disturbances to the Bulk-Power System. My comments will focus on Geomagnetic Disturbances (GMD) and what I will refer to as The Way Forward.

We would like to commend NERC for its stewardship of the GMD task force and for producing the document entitled "2012 Special Reliability Assessment Interim Report: Effects of Geomagnetic Disturbances on the Bulk Power System." While recognizing the interim nature of this report, we support the report's assessment and recommendations as a very constructive step forward. We also wish to acknowledge EPRI's contributions to the subject in bringing about technical collaboration through its GMD project.

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[1] AEP Texas North Company, AEP Texas Central Company, Appalachian Power Company, Indiana Michigan Power Company, Kentucky Power Company, Kingsport Power Company, Ohio Power Company, Public Service Company of Oklahoma, Southwestern Electric Power Company and Wheeling Power Company.

We have recorded geomagnetically induced currents (GIC) and observed some temporary effects on the AEP system during GMD events during the most recent three solar cycles, yet we have observed no failures, deterioration or other lasting adverse impacts. Worldwide, others have attributed several transformer failures and some widespread system outages to GMD, but these few occurrences generally have been in areas closer to the earth's poles or in areas with high ground resistance. Despite the fact that AEP's experience with GMD to date does not indicate significant or lasting impact, more severe GMD events may result in greater impacts than we have seen in the past. As an industry, we need to perform three key activities for the way forward: continue monitoring, analysis and model development for GMD events and their electric system impacts; continue to refine practical grid operational procedures for significant GMD events; and design new facilities and equipment to cope with expected GIC.

Analysis and Monitoring

Although we have observed no consequential GMD-driven system impacts to date within AEP, the prospect that future GMD could include more severe events suggests that our industry and its researchers must continue to study and monitor solar cycles and their earth-based impact on our electric infrastructure. Our understanding of GMD events is better than it was twenty-five years ago, yet there is still much to learn. I believe there are three steps that are critical in order to advance our learning.

First, the industry should continue to closely monitor and measure solar storms through ground-based and space-based equipment. The end product of this work must be effective modeling and prediction tools described later in my comments. Researchers should continue to report on their findings of first principles and collaborate on the interpretation and application of findings.

Second, the industry should expand monitoring to not only capture GIC but also GMD impacts on the electric infrastructure at representative locations, with a specific focus on transformers where the greatest risk from GMD can be expected. Measured system impacts, such as voltage, reactive power, harmonic currents, transformer temperature and dissolved gas analysis (DGA) should then be correlated to GMD severity to better understand the actual sensitivity and vulnerability of equipment performance to GMD events. This additional data can then be used to improve modeling and predictive efforts. EPRI's Sunburst program has been a valuable contributor to the science, capturing GIC data for some time, although it has been among a limited number of industry subscribers. We can enhance the value of such programs by: increasing participants and locations to better represent more of North America; including more correlation between GIC and its impacts such as a harmonics, transformer temperature, voltages and reactive power demand; and reporting findings in as transparent and accessible a manner as practical in order to document true interrelationships between GMD and the power grid.

Finally, the industry should utilize the additional data from monitoring GMD events and their impact on the electric infrastructure, to improve existing models or create new models to better predict future GMD impacts on the grid. Individual company efforts, as well as collaborative efforts through EPRI, NERC, and other organizations, can improve models that can then be used to develop objective and realistic scenarios and the resulting predicted system impacts. The state of model validation should be openly reported. In time, consideration also must be given for how these models can be integrated into existing power system analysis tools for planners, operators and research analysts. These improved models can allow for a more targeted early warning system, which should allow grid operators to better prepare for ensuing events. This should also be supplemented with the development of a new GMD severity index system that provides far more meaningful information for grid operators than the existing Kp factor, which appears to bear little relationship to observed electric system impacts. In time, consideration should be given to how best to manage and communicate monitored and modeled conditions across the system with meaningful alerts for electric system operators.

In summary, additional system and equipment monitoring combined with more effective predictive models should lead to better preparedness and response to GMD. Once credible relationships between GMD and grid effects are better understood and modeled, appropriate measures can then be applied with respect to grid operations, as well as to facility design characteristics.

Grid Operational Processes

We are too early in our understanding and modeling of GMD to change NERC reliability practices at this time. Moving forward regarding grid operational practices for managing GMD events, we need better models of GMD impacts, further evaluation of effective operational procedures and effective spare equipment strategies that include consideration of GMD risks.

With better models in hand to predict GMD and its electric grid impact, future efforts can then focus on studying what operational maneuvers, such as equipment or line removal or generation redispatch, can effectively mitigate these same grid impacts. These studies will enable us to determine whether potential preventive measures are beneficial or detrimental to the system during a GMD event. Based on the results of the studies, operating procedures for grid operators can then be developed to guide operator actions during significant GMD events. As these procedures are employed, actual results should be compared with modeled results for validation and further improvement.

The goal of operational actions should be to effectively manage GMD event impact in order to maintain reliable system operation. The actions themselves, however, ought to follow as closely as possible other standard procedures for system or equipment distress. If it can be proven sufficient to simply follow existing or slightly modified procedures for events like transformer overheating or low system voltage, then operational actions are kept simple and consistent with practices already familiar to operators. In the unlikely event of a widespread outage, existing disaster recovery procedures can be employed or adapted to address GMD events. All changes in procedures should also have associated operator training included.

In addition to operator planning and preventive measures, equipment failure risks should be evaluated and accommodated through identifying particularly vulnerable transformer designs among the existing equipment population and then either mitigating the risk or replacing the equipment. Existing spare equipment strategies can be adapted as needed to accommodate an appropriate population of spares to address realistic incremental risks from GMD or other high impact events. These strategies might build upon any of the following approaches: spare plans by individual utilities, spares shared among neighboring utilities, the EEI STEP program, the NERC spare equipment database task force, and EPRI's Recovery Transformer program. To supplement spare populations, transformers that are being replaced, whether due to GMD vulnerability or other business reasons, can be retained to serve as emergency spares. This would provide a hedge against the long lead time for replacement transformers in the unlikely case of multiple failures from a high impact event. Such emergency spares must continue to be maintained so that they are ready for service upon demand.

The primary goal is to avoid outages by way of preventive actions prior to the expected impacts of a GMD event, and in the event that an outage cannot be avoided, programs like those described can then minimize the outage restoration time.

Facility Design Characteristics

To the extent practical, the impact of reasonably expected GMD events should be factored into system design practices including equipment standards and specifications, especially for transformer durability and control system sensitivity. The design requirements should emphasize durability to cope with its natural operating environment, as well as typical GIC magnitudes and durations, without the need of special protective or accessory equipment. New HVDC and reactive compensation equipment should also include requirements for coping with the impacts of GIC. The design and specification for new protection and control equipment should ensure an ability to withstand effects of GIC. These actions can be applied in the case of both facility additions and system refurbishment. We should seek the assistance of the supplier community, and encourage that GIC be specifically addressed by appropriate standards writing organizations such as ANSI/IEEE and IEC.

The industry also should carefully evaluate practical mitigating technologies for existing equipment. The optimal scenario is one in which the system is inherently tolerant of these types of impacts without the need for special protective devices. We must avoid adverse consequences to system reliability and protection systems, which is a real concern when extraordinary additional controls or specialized protection schemes are introduced to a system. For example, GIC blocking technology may be considered with respect to mitigating the impacts of a GMD, but it may have many unintended and adverse consequences that outweigh potential benefits. These blocking devices may also simply shift the GIC problem to another location. Further detailed evaluations of these mitigating technologies should be completed to more fully understand all of these impacts.

Summary

In summary, we recommend that the industry continue to support the work of the NERC GMD task force and EPRI GMD project. The industry should expand monitoring and analysis of the impact of GMD events on the electric infrastructure, including greater participation in collaborative programs such as EPRI Sunburst. We should develop effective models for prediction of and preparation for future events, and should determine how best to coordinate wide area GMD condition awareness and meaningful alerts for electric grid operators. We should refine operating procedures for GMD events that are as simple yet effective as possible to mitigate significant GMD impacts. We should address cost-effective spare equipment strategies to limit duration of facility outages in the event that failures cannot be prevented. With help from its suppliers and standards organizations, the industry should seek to design its electric infrastructure such that it is able to intrinsically withstand the challenges presented by expected GMD without the need for special accessory equipment. And finally, we should plan to review what we learn during the current solar cycle in order to determine whether any adjustments in our approach are needed prior to the next solar cycle. I believe that the steps I have outlined will provide The Way Forward for the industry as we strive to effectively understand, accommodate, and mitigate the impacts of GMD events. Thank you for the opportunity to provide these comments. I look forward to your questions.

MICHAEL HEYECK

SENIOR VICE PRESIDENT-TRANSMISSION, AMERICAN ELECTRIC POWER

Michael Heyeck is senior vice president - Transmission for American Electric Power, responsible for region operations, customer focus, and reliability compliance for AEP's 11-state transmission system. Heyeck is also president, Electric Transmission America (ETA), and responsible for Electric Transmission Texas (ETT), both joint ventures with MidAmerican Energy Holdings Company. Heyeck also retains officer and board positions for several of AEP's affiliates and joint ventures.

Heyeck has previously held leadership and engineering positions in AEP Transmission, including asset management, planning, engineering, project and construction management, and system operations. He also held leadership positions in AEP's Corporate Planning and Budgeting, including corporate budgeting and economic forecasting. He joined AEP in 1976.

Heyeck serves and has served the industry in numerous capacities, including member of the US Department of Energy (DOE) Electricity Advisory Committee, president of the US National Committee of the International Conference on Large High-Voltage Electric Systems (CIGRE), chairman of the Transmission Executive Committee of the Electric Power Research Institute (EPRI), and member of the Board of Directors of the Reliability First Corporation (RFC), a regional entity of the North American Electric Reliability Corporation (NERC). He also serves on the Electrical and Computer Engineering Industrial Advisory Board at The Ohio State University.

Heyeck earned his bachelor's and master's degrees in electrical engineering at the New Jersey Institute of Technology. He earned a master's in business administration at the University of Dayton. He also is a graduate of the Executive Program at the University of Virginia's Darden School and the AEP Management Development Program at The Ohio State University. He is a registered Professional Engineer in the State of Ohio, and a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE).

Heyeck holds elected office in Ohio as Westerville City Council member since 1993, and has served as Chairman (2001-2003, 2009-Present) and Mayor (2003-2005). Heyeck also serves and has served in other numerous community capacities, including positions as board member of the Central Ohio Transit Authority, Westerville Industry & Commerce Corporation, and Westerville Parks Foundation. He and his wife Fernanda have three children and reside in Westerville, Ohio.