PID	PUB.	TITLE	Scope/Applicability (a)	Origin (b)	Validation (c)	Caveats (d)	Notes	Link
3002016885	6/26/2019	Review of Peer-Reviewed Research Regarding the Effects of Geomagnetic Latitude on Geoelectric Fields: Updated Based on the Latest Peer-Reviewed Research	GMD	Report created by EPRI Transmission	Peer review document	None	This report is an examination of peer-reviewed research (updated since the publication of the North American Electric Reliability Corporation (NERC) Benchmark Geomagnetic Disturbance (GMD) Event Description white paper) regarding the effects of geomagnetic latitude on geoelectric fields (based on a reference earth model). This report includes an in-depth review of the new published work (e.g., by United States Geological Survey (USGS) and Los Alamos National Laboratory (LANL)), on the geomagnetic latitude scaling. The report determines whether modifications are needed to the industry-standard scaling factors and provides recommendations for further actions.	https://www.epri.com/#/pages/product/000000003002016885/?lang=en-US
3002016832	6/13/2019	Improving Understanding of Characteristics of Geoelectric Field Enhancements Caused by Severe GMD Events: Examining Existing Ground-Based Data	GMD	Report created by EPRI Transmission	Research results	None	This report presents the results of analyzing a dataset developed for large geomagnetic disturbance (GMD) events across all available magnetometer stations. This task builds on existing community-wide efforts that serve geomagnetic data to improve understanding of the characteristics of geoelectric field enhancements caused by GMDs, furthering the science behind the benchmark GMD presently used by industry in studying the impacts on the bulk power system. Researchers examined the variability in GMDs at different magnetic latitudes and across different levels of geomagnetic activity. Strong GMD hazards can be organized by the auroral oval location, and the expansion of the auroral zone during strong geomagnetic activity exposes locations further toward the equator to GMD hazards. The largest rates-of-change of the magnetic field are determined to be most prevalent in the pre-dawn region of magnetic local time. Researchers also examined the expected peak geoelectric fields based on measured magnetic timeseries and new regional 1D transfer functions. Extreme value analysis of the peak geoelectric fields observed within the auroral zone, for events in the EPRI GMD database, gives a result that is broadly consistent with other estimates using individual magnetometer sites to estimate the geoelectric field. Based on a literature review and analyses of data, this technical update provides recommendations for data requirements and research to better quantify the geoelectric hazard as a function of activity and magnetic time of day.	https://www.epri.com/#/pages/product/000000003002016832/?lang=en-US
3002015363	2/8/2019	Transmission and Distribution Resiliency - What's going on, and what is EPRI doing to help?	Summary Document	Report created by EPRI Transmission	Summary document of historic and current EPRI projects	None	Resiliency of the transmission and distribution (T&D) grid continues to be a major discussion item for electric utilities, regulators, and the media. Although not meant to be comprehensive, this document is intended to provide background and an understanding of the resiliency topic, and it describes some of the efforts that the Electric Power Research Institute (EPRI) and its industry collaborators are undertaking to address it.	https://www.epri.com/#/pages/product/000000003002015363/?lang=en-US
3002014855	1/17/2019	Impact of Geomagnetically Induced Currents on Transformer Tank Vibrations: Transformer Vibration Analysis	GMD	Report created by EPRI Transmission	Research results	None	This report presents results needed to further understand the impact of vibrations of power transformer tanks caused by geomagnetically induced currents (GIC).	https://www.epri.com/#/pages/product/000000003002014855/?lang=en-US
3002013978	6/8/2018	Advanced Overhead Line Design Considerations	Multiple Threats	Report created by EPRI Transmission	Research results	None	Globally, electric utilities are facing increasingly complicated and multidimensional challenges when designing and constructing new overhead lines. Utilities are frequently expected to construct more compact lines with reduced environmental impact and increased power transfer capacity. At the same time, utilities also are seeking to incorporate additional structural and electrical resiliency into new line designs to enhance grid reliability in the face of increasing climate variability. In addition, there is a financial imperative to construct lines with improved operational efficiency at the lowest possible cost. Finally, there is a need to create lines which are easy to maintain, and are designed effectively. Utilities need improved control over how multiple needs may be met and integrated into a holistic design approach but also tailor made to each specific application. EPRI initiated research to bring these issues together and formulate a unified design approach. This initiative will see the development of a holistic design strategy, incorporating the use of tools and technology to maximize the value of overhead lines. A testing and validation process will be formulated and documented, including developmental testing and field monitoring. This will provide utilities with a roadmap to achieve higher levels of performance.	https://www.epri.com/#/pages/product/000000003002013978/?lang=en-US
3002013736	4/27/2018	Furthering the Research of Geomagnetic Disturbances Impact on the Bulk Power System	GMD	Report created by EPRI Transmission	Research results	None	In collaboration with the North American Electric Reliability Corporation (NERC), the utility industry, and other stakeholders, EPRI is building on decades of research in geomagnetic disturbances (GMDs) to better understand, predict, and mitigate the impacts of GMDs on electric power systems. This white paper serves as a guide to EPRI's GMD research work plan. It explains the background and motivation for the work, presents some basics of the underlying technical principles, and outlines the major components of the research effort.	https://www.epri.com/#/pages/product/000000003002013736/?lang=en-US
3002011527	12/21/2017	Summary Report: Technical Analysis and Assessment of Resilient Technologies for the Electric Grid: High-Temperature Superconductivity	Multiple Threats	Report created by EPRI Transmission, summarizing work done in conjunction with DHS	Research results	None	The U.S. Department of Homeland Security (DHS) Science & Technology (S&T) Directorate is involved in a multi-year, multi-partner research, development, and demonstration program, Resilient Electric Grid (REG), to facilitate the research, development, demonstration and commercialization of a high-temperature superconductivity (HTS) technology that has the potential to revolutionize the nation's electric grid, making it more resilient to natural and man-made threats. Through the proposed manufacture, installation, and operation of a long-length (3 or more miles; 4.8 or more km) HTS cable in a dense urban utility grid, DHS and its partners in the project believe that the costs of this technology can be reduced, while demonstrating the capability to meet the reliability needs of the electric utility industry. In conjunction with the proposed in-grid deployment of a long-length HTS cable in an urban network, DHS S&T contracted with the Electric Power Research Institute (EPRI) to conduct an independent, third-party evaluation and critical expert assessment of an inherently fault current limiting (IFCL) high-temperature superconducting cable technology.	https://www.epri.com/#/pages/product/000000003002011527/?lang=en-US
3002007376	2/8/2016	Electric Power System Resiliency: Challenges and Opportunities	Strategy Document	Report created by EPRI	Strategy document covering approaches to tackle resiliency	None	In examining the electricity sector and trends related to natural gas prices, load growth, energy policy, and the penetration of distributed generation and demand response, EPRI and its members determined that the power system needs to be more resilient, flexible, and connected. This document addresses the first of these three cornerstones – resiliency – for the power system. Companion white papers address flexibility and connectivity. In the context of the power system, resiliency includes the ability to harden the system against – and quickly recover from – high-impact, low-frequency events. Recent extreme weather events – including the U.S. Hurricanes Katrina and Sandy and the Tohoku earthquake and tsunami in Japan – have demonstrated the need for resiliency. Other "natural" high-impact, low-frequency events that pose threats to resiliency include tornadoes, wildfires, and severe geomagnetic disturbances (GMDs). Extreme weather has occurred throughout the system's history, although these recent events have raised awareness of the need for enhanced resiliency	https://www.epri.com/#/pages/product/000000003002007376/?lang=en-US
3002007170	12/31/2015	Distribution Grid Resiliency: Storm Response Practices – Appendix F: Compilation of Individual Utility In		Report created by EPRI Distribution	Best practices	None	EPRI undertook a three-year Distribution Grid Resiliency (DGR) research project to study six tasks of most importance to utilities to enhance distribution system resiliency. This report includes information related to the storm response practices DGR task 5. More specifically, this report includes the results of one-day interview ("immersions") with member utilities to collect storm response practices information first hand from utility subject matter experts. This report serves as Appendix F to the main report of DGR task 5, which is documented in the EPRI report entitled "Distribution Grid Resiliency: Storm Response Practices," (EPRI report 3002006784, December 2015)	https://www.epri.com/#/pages/product/000000003002007170/?lang=en-US
3002006784	12/31/2015	Distribution Grid Resiliency: Storm Response Practices	Severe Weather	Report created by EPRI Distribution	Best practices	None	This report describes the results of the storm response practices task of EPRI's three-year distribution grid resiliency (DGR) initiative. The overall goal of this research task is to produce a database of industry storm response practices that utilities can use to identify and adapt industry leading practices to their storm response processes. The research focused on topical areas deemed a priority in previous industry workshops, including major event emergency planning and preparedness; major event management; damage prediction, damage assessment and analysis; estimated time of restoration (ETR); and stakeholder communications. The approach uses a combination of surveys, individual company interviews, document reviews and analyses, and workshops to gather and document industry practices with the goal of empowering members with leading practice information from peer utilities.	https://www.epri.com/#/pages/product/000000003002006784/?lang=en-US
3002006668	12/31/2015	Distribution Grid Resiliency: Prioritization of Options	Multiple Threats	Report created by EPRI Distribution	Research results	None	This report describes the results of the Prioritization of Options Task of EPRI's three-year distribution grid resiliency (DGR) initiative. The goal of this task is to provide utility decision makers with guidance for prioritizing and selecting among the resiliency options identified in the other DGR project tasks. Other DGR tasks examined hardening and recovery options in the areas of overhead structures, vegetation management, undergrounding, modern grid technology, and storm response practices. In this context, resiliency means the performance of the distribution system in a severe impact event such as a hurricane or major storm. As demonstrated by the impacts of recent severe weather events, investment in distribution resiliency is needed – this report helps utilities determine how best to respond to this need over a period of years. Interviews with project participants determined that utility decision makers need data to support their resiliency investment decision-making processes and guidance in choosing among alternatives. Resiliency improvement options were investigated in each of the other DGR tasks and resulted in performance data that can be used to project the benefits of applying an option and prioritize investments. This report describes the process of choosing among various distribution resiliency alternatives and introduces a methodology and model to illustrate the process for nine representative resiliency options, including options from each of the major research areas in the DGR project.	https://www.epri.com/#/pages/product/000000003002006668/?lang=en-US
3002006443	12/31/2015	Geomagnetically-Induced Current (GIC) Reduction Device Application Guide	GMD	Report created by EPRI Transmission	Research results	None	Solar disturbances can initiate a terrestrial geomagnetic disturbance (GMD) that can result in the flow of very low frequency geomagnetically induced currents (GIC) in power systems. These quasi-dc currents can cause part-cycle saturation of the power system's transformers, which can lead to a number of adverse consequences including potential damage to transformers, system voltage collapse, and misoperation of protection systems. One of the mitigation measures being considered within the industry is the use of GIC reduction devices (GRDs). GRDs are devices intended to reduce or eliminate the flow of GIC in particular transformers or transmission lines. Application of GRDs requires considerable technical diligence to ensure that the devices provide the desired function and do not introduce adverse impacts on the transmission system's equipment and reliability. This guide provides a comprehensive review of the factors critical to the specification and design of GRDs and the assessment of their impacts on the power system. This guide also details the technical studies that should be performed when GRD deployment is planned and specified.	https://www.epri.com/#/pages/product/000000003002006443/?lang=en-US
3002006783	12/23/2015	Distribution Grid Resiliency: Modern Grid Technology	Multiple Threats	Report created by EPRI Distribution	Research results	None	This report describes the results of the modern grid technology task of EPRI's three-year distribution grid resiliency (DGR) initiative. The overall goals of this research were to 1) document the challenges and opportunities that key modern grid technologies present with respect to DGR, 2) gather and document utility practices intended to manage these challenges, 3) communicate and identify opportunities that can be exploited for the benefit of the industry, and 4) identify and scope specific proposals for EPRI research to overcome difficult-to-manage challenges, or further exploit high value opportunities.	https://www.epri.com/#/pages/product/000000003002006783/?lang=en-US
3002006781	12/23/2015	Distribution Grid Resiliency: Vegetation Management	Multiple Threats	Report created by EPRI Distribution	Research results	None	This report describes the results of the vegetation management (VM) task of EPRI's three-year distribution grid resiliency (DGR) initiative. The VM task objectives were to 1) better understand the mechanisms of vegetation-caused damage to distribution infrastructure during storms, 2) gather and document utility practices related to VM programs, and 3) identify new options for VM programs that could result in less system damage during storms and overall greater resiliency. EPRI worked with participating utilities on six VM research activities, which are summarized in this report: 1) an industry survey, 2) a literature review, 3) a series of interviews with VM program managers and subject matter experts, 4) a study of the force of impact on distribution equipment from tree failures, 5) a damage prediction modeling study, and 6) a compilation of practices gathered from the program interviews in a Microsoft One Note repository to help facilitate comparative investigation of the VM research results. The full reports of these activities are attached as appendices. The report provides the results of this effort and recommends gathering of specific types of data in the future to prioritize VM resiliency improvements.	https://www.epri.com/#/pages/product/000000003002006781/?lang=en-US
3002006780	12/23/2015	Distribution Grid Resiliency: Overhead Structures	Multiple Threats	Report created by EPRI Distribution	Research results	None	This report describes the results of the overhead structures task of EPRI's three-year distribution grid resiliency (DGR) initiative. The objective of this task is to identify options for improving the resiliency of overhead distribution infrastructure, including hardening, graceful degradation, and ease of repair. The project team developed and compared resiliency options with standard construction schemes through targeted laboratory testing on multiple-span pole lines, full-scale structures, and pole tops. Testing of individual components was also conducted to better understand overall hardened designs. Components and structures selected for tests were based on utility input and a brief survey, along with utility data provided on specific damage instances from past storms. A highlight of the project was field testing at Xcel Energy, American Electric Power (AEP), and PPL Electric Utilities. In each of these tests, decommissioned distribution lines were subjected to simulated tree impacts. In other work, the team tested new penta- and CCA-treated southern yellow pine utility poles to determine the amount of force and/or energy needed to cause breakage under dynamic loading conditions. Hand ties, preformed ties, and clamp-type insulators were evaluated in dynamic and static tests. The team also tested pole-top assemblies, full-scale distribution, and spacer cables. Testing results, data collection, and input from utility members were used to collect and evaluate specific options to improve resiliency. Where possible, the team quantified the specific benefits of each option. General characteristics and disadvantages of options were also considered. Several design and construction options were identified that could improve resiliency. The team also considered several maintenance, inspection, and practices options.	https://www.epri.com/#/pages/product/000000003002006780/?lang=en-US
3002006782	12/13/2015	Distribution Grid Resiliency: Undergrounding	Multple Threats	Report created by EPRI Distribution	Research results	None	This report describes the results of the undergrounding task of EPRI's three-year distribution grid resiliency (DGR) initiative. The task's objectives were to 1) develop a set of representative costs for undergrounding that utility decision makers can use to compare the undergrounding option with other options for increasing grid resiliency; 2) provide information that enables a utility decision maker to project the benefits of an investment in undergrounding to improved performance in a severe impact event; and 3) explore opportunities for applying new technologies to lower the cost differences between underground and overhead solutions. EPRI worked with participating utilities on six undergrounding research activities, which are summarized in this report: 1) a literature review on undergrounding electric distribution systems, 2) a survey on distribution undergrounding for grid resiliency, 3) a cost study of six representative underground conversion project designs, 4) an analysis of the ongoing operations and maintenance cost implications of investing in undergrounding distribution, 5) documentation of case studies of two companies that have implemented successful underground conversion programs, and 6) an analysis of the options for converting underground that were assessed to enhance resiliency. The full reports and supporting information of these activities are attached as appendices.	https://www.epri.com/#/pages/product/000000003002006782/?lang=en-US