EPRI researchers in the EPIC High Bay Lab adjusting the base adaptor for the composite insulator.

Good results

UNC Charlotte Research promises improved energy efficiency

Efficiency affects every aspect of an energy system including production, transmission, distribution, diagnostics, controls, costs, environment, resilience, reliability, and consumer satisfaction. Efficiency efforts often address increasing the flow of energy from the power generation facility or decreasing the use of energy by the customer. Areas receiving increasing attention are the infrastructures that support energy systems. Because they can have significant positive impacts on efficiency.

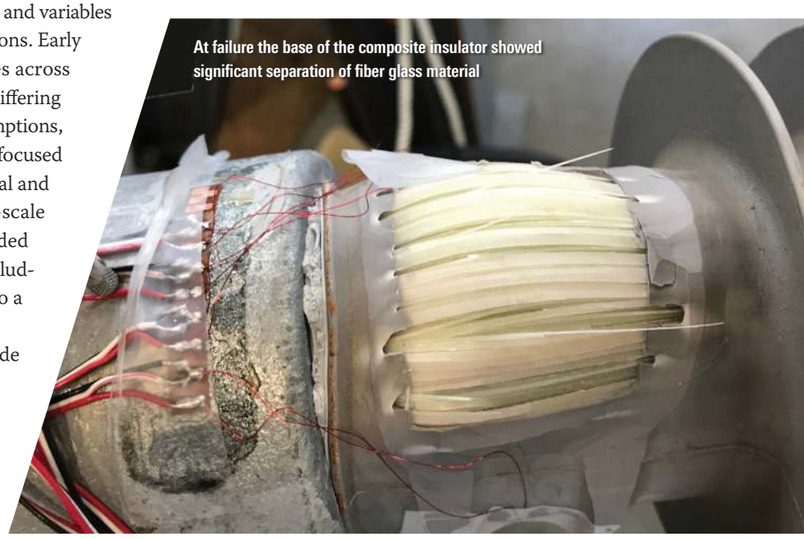
The Energy Production and Infrastructure Center (EPIC) was created on the UNC Charlotte campus by the State of NC with strong encouragement and support from the energy industry. This backing has remained strong throughout EPIC's six year history. Energy industry partners are heavily engaged in EPIC's activities, which focus on workforce development, research, technology development, and technical problem solving. The Electric Power Research Institute (EPRI) is a world-wide, 40+ year old, independent, nonprofit, member-supported organization conducting research on behalf of its members and the public on energy and the environment. Benefitting from facilities practically across the street from one another, EPRI and EPIC have formed a strong collaboration to tackle complex energy issues.

Engineering faculty and research staff at EPIC are working closely with engineers and scientists at EPRI to improve the efficiency of components in electricity transmission and distribution systems. One example includes their work on improving design procedures for the insulators suspended from transmission towers and distribution poles. Insulators carry the heavy power lines (conductors) that span from tower to tower. Over the last three years, EPIC's High Bay Lab Manager, Dr. Youngjin Park, has worked closely with EPRI scientists and engineers on several projects to improve the design and evaluation process for insulators. Early projects evaluated numerical models for analysis and design and more recent projects involved mechanical tests to evaluate insulator behavior under required loading conditions. This work is funded by EPRI with the support of its members.

Before transmission towers and distribution poles can be installed, details of the insulators must be specified by a designer or vendor. In recent years, the design process for insulators has become more complex as new insulator materials have become popular (composite materials instead of porcelain, for example). Design has been complicated further by an increase in the number of vendors, each of whom has its own set of insulator details. Furthermore, the need to carry more electricity through existing systems increases the physical loads on towers and insulators. These increased loads are not always easy to accommodate in the design process because they can act simultaneously in three directions. Dr. David Young, EPIC's Principal Investigator for the project states, "The complexities with insulators provide opportunities for improvements in the design process in three broad areas: simplification, standardization, and optimization. Success in any of these areas will result in more efficient designs, meaning less material, greater capacities, greater resilience/reliability, and/or lower costs."

Dr. Youngjin Park, EPIC High Bay Lab manager, prepares for insulator testing

The inherently large number of parameters and variables in the design process requires many assumptions. Early results of the investigation revealed disparities across analysts, designers, and vendors as they made differing assumptions. To standardize or eliminate assumptions, more recent phases of the EPIC-EPRI research focused on gaining a better understanding of the material and structural behavior of insulators through full-scale experimental testing. To date, work has included experimental studies of common insulators, including unbraced and braced insulators, subjected to a variety of load combinations.



At failure the base of the composite insulator showed significant separation of fiber glass material

Results of the work are encouraging and provide a better understanding of the behavior of insulators under required, complex loading conditions. This improved understanding will provide a more refined design with fewer customized assumptions, thereby leading to a more standardized and streamlined process across all designers and vendors. Additionally, increased confidence in analysis and design procedures has led to the development of new and innovative types of insulators. Already research work has begun through the EPIC-EPRI team on unique vendor-specific designs, which ideally will lead to greater efficiency through the optimum use of materials and components.

UNC CHARLOTTE
Energy Production and Infrastructure Center

UNC Charlotte
9201 University City Blvd.
Charlotte, N.C. 28223
704-687-8622 • uncc.edu
EPIC
704-786-1241 • epic.uncc.edu