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National Center for Reliable Electric Power Transmission

Department of Electrical Engineering

UNIVERSITY OF ARKANSAS COLLEGE OF ENGINEERING

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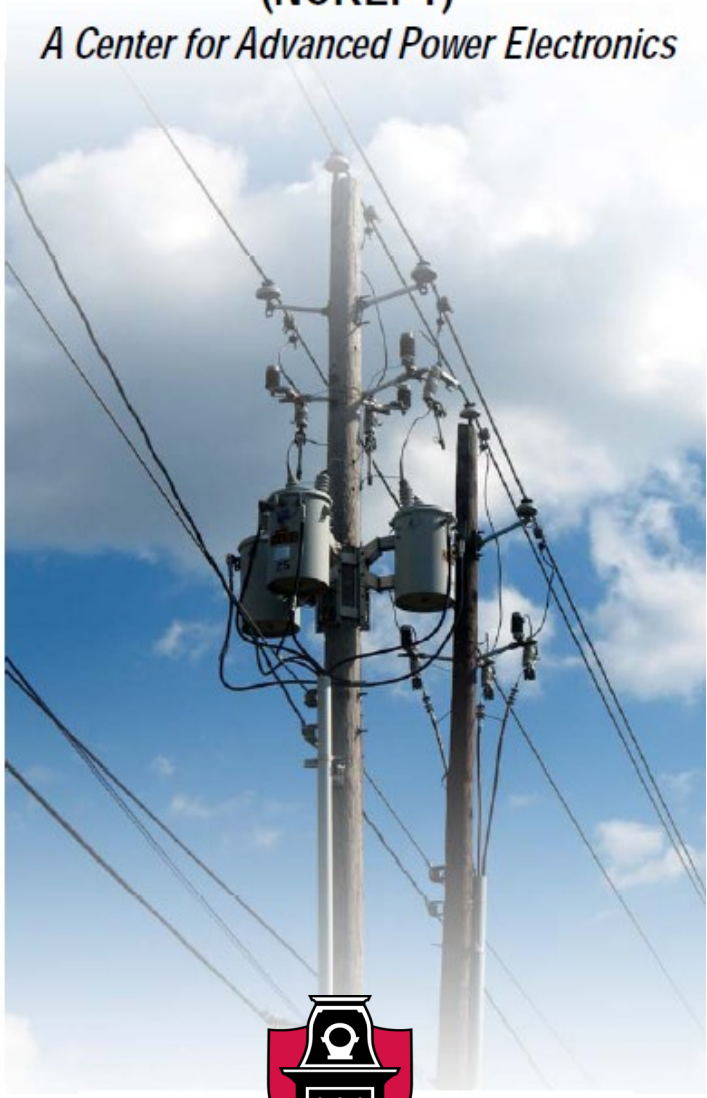
National Center for Reliable Electric Power Transmission (NCREPT)

A Center for Advanced Power Electronics



UNIVERSITY OF ARKANSAS

Background

The National Center for Reliable Electric Power Transmission (NCREPT) was established for the purpose of investigating solid-state solutions for the electric power grid including protection devices and FACTS as well as energy storage and distributed generation applications. NCREPT is involved in five areas of research that impact the realization of power electronics solutions:

- **Power electronic design and modeling**
- **Power electronic packaging**
- **Power electronic testing**
- **Mixed-signal integrated circuit design**
- **Sensors and Controls**

Objectives

The primary objectives of the center are in Design, Packaging, and Test of Advanced Power Electronics. Specifically, the objectives are:

- To research and develop prototypes of advanced power electronics systems for applications in the power grid including both solid-state protection devices and energy storage.
- To develop advanced packaging solutions for high current, high voltage power semiconductor devices and applications.
- To establish a state-of-the-art test facility for advanced power electronic circuit and package designs for distribution-level voltages (15 kV-class) and relatively high power (6 MVA).
- To provide much-needed human resources in the form of educated students for the newly emerging technologies of the power utility sector.

Facility

The University of Arkansas has constructed a unique distribution-class test facility. This facility has 6 MVA capability. It is equipped with state-of-the-art regeneration capability so that only the losses will be drawn from the power grid. Cutting edge human interface controls allow maximum flexibility and configurability for a variety of high-power experiments.

Resources

The University of Arkansas is home to the most comprehensive university-based electronic packaging facility available in the United States. The Low-Temperature Co-fired Ceramics (LTCC) Laboratory coupled with thin and thick film processing laboratories provides a full range of electronic packaging. Further, accelerated testing equipment is available to perform reliability studies.

A dedicated service rated at 12.47 kV (voltage level servicing the UA campus) and 300 A are brought into this 7000 sq. ft. test facility. The facility is composed of four test cells that can be used for power electronics tests and evaluations ranging from 480 V to 13.8 kV.

Special instrumentation is available for device, package and circuit evaluation over extreme environmental temperatures (-271° C to 1100° C) to easily cover any temperature range that devices or circuits might be subjected to either in cryogenic cooling

Current Projects

Fault-Current Limiter (FCL)

Fault-current limiters using high temperature semiconductors offer a solution to controlling fault-current levels on utility distribution and transmission networks. These fault-current limiters, unlike reactors or high-impedance transformers, will limit fault currents without adding impedance to the circuit during normal operation. They also have more capabilities than current fault-current limiting approaches.

Power Electronics Interfaces

Distributed generation and energy storage solutions depend, in most cases, on power electronics to interface with the power grid. NCREPT is developing “plug and play” interfaces to enable faster adoption of these applications.

Device Modeling

In order to carry out the design of new power electronics, device models are required. The UA team is the world’s leading research team on modeling SiC power semiconductor devices. They have developed JFET, MOSFET, diode, thyristor and IGBT device models, and can readily create additional models as needed. This team also possesses state-of-the-art modeling tools created at the UA for model creation and characterization.