Fact Sheet: DOE Award Selections for the Design of More Flexible and Adaptable Large Power Transformers (LPTs)

As part of the Energy Department's commitment to a strong and secure power grid, DOE today announced new funding to strengthen protection of the nation's electric grid from natural and manmade hazards. More than $1.5 million will catalyze new designs of large power transformers (LPTs) which are critical to the nation's power grid and represent one of its most vulnerable components. Producing LPTs that are more flexible will help the energy sector better prepare for the sharing and long-term replacement of LPTs in the event of catastrophic failures. This funding will allow corporations, small businesses, and academic institutions in Georgia, Illinois, New York and North Carolina to create new designs that will help produce the next generation of LPTs.

Applicant: Georgia Tech Research Corporation
Title: Modular Controllable Transformers for a Resilient Grid
Location: Atlanta, GA

This project will design an innovative modular controllable transformer (MCT) that can serve as a 'building block' for the transmission network. These smaller, standardized transformer blocks (50-75 MVA) are integrated with power converters that enable them to be paralleled as needed to realize a range of higher power ratings (100-500 MVA). The MCT design concept can support continued grid operations under single or multiple transformer failures and provide flexibility in terms of configuration, load balancing, ease of transportation, and faster restoration time following a large outage. In addition, the MCT provides dynamic control of voltage, impedance and phase angle to mitigate system congestion, and support the integration of higher levels of variable renewable energy onto the grid. This project will be led by Georgia Tech in partnership with Oak Ridge National Laboratory, Delta Star, and Southern Company.

DOE Funds:	$249,898
Cost Share:	$105,423
Total Project Value:	$355,321

Applicant: NextWatt, LLC
Title: A Modular and Flexible High-Frequency-Link Transformer with 63% Reduction in Device Count and Zero High-Side Devices
Location: Hoffman Estates, IL

This project will explore the design of a solid-state, modular high frequency link (HFL) large power transformer (LPT) rated at 100 MVA with a high-side voltage of 115 kV, variable low-side voltage, and variable impedance capability. The proposed design concept is targeting an average cost of $15-$22/kVA, lifetime of more than 40 years, and an efficiency of at least 99% which is comparable to current LPTs. The HFL design can also provide a 3X reduction in both volume and weight compare to a conventional LPT, easing transportation concerns. The project team will also investigate new capabilities such as voltage control, reactive power compensation, protection, and overloading which improve grid performance. This project will be led by NextWatt LCC and the National Center for Reliable Electric Power (NCREPT) at the University

of Arkansas in collaboration with General Electric.

DOE Funds: $270,000
Cost Share: $68,118
Total Project Value: $338,118

Applicant: General Electric Company
Title: Grid Ready, Flexible Large Power Transformer
Location: Niskayuna, NY

This project will design a flexible large power transformer (LPT) capable of accommodating multiple standard voltage ratios in the transmission network as well as providing an adjustable impedance to match that of a failed transformer to be replaced. A three-phase LPT is proposed with power capacity ranging from 300 to 600 MVA, high-side voltage of 345 kV with configurable taps at the low-voltage side for operation at 115 kV, 138 kV, and 161 kV, and adjustable impedance from 4% to 12%. The key innovations in this project include multiple transmission class voltage taps at the low voltage side; a method for selecting the transformer impedance without changing the voltage ratio; and arrangement and connection of all the extra windings to minimize stresses. The performance of the design will be evaluated through power systems simulations and will be compared with current state-of-the-art LPTs under the same conditions. This project will be led by GE Global Research along with its partner Prolec GE.

DOE Funds: $358,709
Cost Share: $149,954
Total Project Value: $508,663

Applicant: ABB Inc.
Title: Novel Concept for Flexible and Resilient Large Power Transformers
Location: Raleigh, NC

This project will investigate the feasibility of constructing, installing, and servicing flexible large power transformers (LPTs) comprised of easily transportable, standardized building blocks which house several transformer modules. Connections between blocks are implemented at the site of installation to create a transformer system. During the project, various design possibilities and system architecture will be explored to enable high-side voltages ranging from 115 kV to 500 kV and low-side voltages ranging from 69 kV to 230 kV, and power levels up to 500 MVA. Design tradeoffs between performance, cost, size, weight, and manufacturing, installation, and maintenance constraints will be analyzed. This concept creates a blueprint for future LPTs that can quickly and effectively replace a variety of existing LPTs. This project will be led by ABB in partnership with the University of Tennessee Knoxville.

DOE Funds: $356,304
Cost Share: $89,076
Total Project Value: $445,380

Applicant: North Carolina State University

Title: Flexible Large Power Solid State Transformer
Location: Raleigh, NC

The novel concept of Flexible Large Power Solid State Transformer (FLPSST) is proposed to achieve greater standardization to increase grid resilience. The FLPSST will be a modular solution, where flexible voltage ratings will be achieved by series/parallel connection of a basic building block (5 MVA). Each building block comprises a power electronics-based medium frequency transformer to achieve voltage isolation and variable step-up and step-down voltage ratios. The use of standard building blocks can reduce manufacturing and inventory cost and enable greater interchangeability. This solution will exhibit substantial size and weight reduction compared to conventional large power transformer designs, drastically reducing the time and cost associated with transportation. Moreover, the amount of raw materials needed (copper and magnetics) can be significantly reduced. This project will be led by North Carolina State University and partner Carnegie Mellon University.

DOE Funds:	$271,475
Cost Share:	$69,014
Total Project Value:	$340,489