BREAKERS

PROJECT DESCRIPTIONS

Drexel University – Philadelphia, PA

Resonant Solid State Breaker Based on Wireless Coupling in MVDC Systems – $500,000

Drexel University aims to design a significantly more efficient, fast, low-cost, compact, and reliable circuit breaker for medium-voltage direct-current (MVDC) power system. The breaker is designed to protect MVDC systems from electrical faults and expected to respond in 500 microseconds. To realize this goal, Drexel proposes a solid-state circuit breaker based on silicon carbide devices that aims to significantly improve breaker performance for the MVDC ecosystem.

Eaton Corporation – Arden, NC

DC Wide Bandgap Static Circuit Breaker – $3,760,000

Eaton will develop a silicon carbide-based direct-current circuit breaker design that boosts efficiency and can scale up or down medium voltage application requirements. The team's comprehensive approach includes a robust design that effectively dissipates excess energy and autonomously coordinates fault protection across multiple devices. The project results will extend to future ultra-wide bandgap power semiconductor devices and other advances affecting future generations of devices and power electronics.

Eaton Corporation – Menomonee Falls, WI

Ultra-Efficient Intelligent MVDC Hybrid Circuit Breaker – $4,413,913

Eaton will build an ultra-high efficiency, medium-voltage direct-current (MVDC), electro-mechanical/solid-state hybrid circuit breaker prototype, combining the advantages of both breaker types in offering low conduction losses and fast response times. The team will develop a high-speed actuator/vacuum switch to carry the normal electrical load. Combined with a novel transient commutation current injector, this switch will transfer power to a separate solid-state device, interrupting the current in event of a fault. The design should allow for scaling in voltage and current, enabling a range of circuit breakers across the MV application space.

GE Global Research – Niskayuna, NY

Inline Gas Discharge Tube Breaker for Meshed MVDC Grids – $4,350,686

GE Global Research will develop a medium-voltage direct-current (MVDC) circuit breaker with exceptionally fast response time based on its innovative gas tube technology. Gas tubes switch without mechanical motion by transitioning the internal gas between its ordinary insulating state and a highly conductive gas plasma. The team will develop a new cathode and control grid to reduce power loss during normal operation and meet program performance and efficiency targets. A fast MVDC breaker is an important component to enable uprating existing alternating-current distribution corridors in congested urban areas to MVDC, and connect distributed renewable energy sources to concentrated demand for growing applications such as electric vehicle charging.

Georgia Tech Research Corporation – Atlanta, GA

EDISON – Efficient DC Interrupter with Surge Protection – $3,000,000

Georgia Tech is proposing a novel hybrid direct-current (DC) circuit breaker technology that will enable multi-terminal DC power systems. The breaker's mechanical switch enables switching speeds 10 times faster than the existing technology, severing the mechanical linkage while the power-electronics-based circuit handles the fault current. A new configuration of the fast switch and solid-state devices/circuits will reduce steady-state losses compared to state-of-the-art hybrid circuit breakers. A new control scheme dramatically reduces the peak fault current levels, enabling more compact packaging and increasing reliability. A consortium of industry partners will guide the design process and advise on commercialization.

Marquette University – Milwaukee, WI

Ultra-Fast Resonant DC Breaker – $500,000

Marquette University will develop a direct-current (DC) breaker combining the advantages of a vacuum interrupter with a wide-bandgap based resonant current source and novel actuator topology. The proposed solution represents a transformational state-of-the-art DC breaker scalable across voltage and current in medium voltage DC applications, such as power distribution, solar, wind, and electric vehicles.

The Ohio State University – Columbus, OH

T-Type Modular DC Circuit Breaker (T-Breaker) for Future DC Networks – $2,309,950

The Ohio State University will develop a medium-voltage direct-current (MVDC) circuit breaker prototype based on a modular design using silicon carbide modules to reduce cost and weight while enabling simpler manufacturing, increased reliability, functionality, efficiency, and power density. The modular structure will be self-sustaining and allow for inherent scalability while providing possibilities for multiple ancillary functions.

Sandia National Laboratories – Albuquerque, NM

ARC-SAFE: Accelerated Response semiconducting Contactors and Surge Attenuation for DC Electrical systems – $2,250,000

Sandia National Laboratories will develop a solid-state circuit breaker for medium-to-high voltage applications using switches based on the wide-bandgap semiconductors silicon carbide (SiC) and gallium nitride (GaN). The concept builds on Sandia's knowledge of optically triggered GaN devices, as well as the team's experience in circuit design for medium-voltage (MV) applications. Sandia will build a prototype breaker to demonstrate a fast response time using a photoconductive switch that is potentially scalable from 1 to 100 kV for direct-current (DC) systems. This technology could contribute to more widespread adoption of MVDC power distribution across the grid.