DC Circuit Breaker for Emerging Power Systems

Tech ID: 33439 / UC Case 2018-392-0

BACKGROUND

Many non-traditional energy sources, such as solar panels, fuel cells, and batteries, supply direct-current (DC) power. This has led to development of DC power systems for a number of applications since conversion to alternating-current (AC) can be eliminated. For example, DC distribution is now used for computer data centers, office buildings, and ship power and propulsion. Though the source, loads, and other components in a DC power system are well understood, there may be interest in innovation with respect to protection schemes since DC systems do not have a zero crossing in its current, and circuit breakers are unable to open up a faulted component without sustaining an arc.

TECHNOLOGY DESCRIPTION

UC Santa Cruz (UCSC), in collaboration with Clemson University research, have developed a DC circuit breaker that uses a short conduction path between the breaker and load along with inductive coupling to automatically switch off in response to a fault. The breaker responds to faults such as abnormally high currents without the need for detection and control circuitry. The design also has fewer components than other solid-state breakers; improving manufacturability and reliability. The new prototype device has fewer components than traditional circuit breakers, a common ground path, and can easily distinguish between a fault and natural step changes in load. When an abnormally high current becomes present, the DC circuit breaker utilizes coupled inductance to automatically switch off. This intrinsic mechanism eliminates the need for detection and control circuitry. It also has a crowbar-type switch on the output so that it can be used as a DC ON/OFF switch. A prototype has been constructed that sustains a 200 percent step change in load, but switches off in response to a direct fault on a 100V DC circuit.

APPLICATIONS

- DC power systems
  - solar
  - wind
  - boats/ships

ADVANTAGES

- Reduces the number of components required of a solid-state DC circuit breaker, improving manufacturability and reliability.
- Automatically switches off in response to faults, eliminating the need for detection and control circuitry.
- Designer can determine the amount of transient current that will be identified as a fault, providing variability and flexibility for the user.

INTELLECTUAL PROPERTY INFORMATION

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,998,711	05/04/2021	2018-392
United States Of America	Issued Patent	10,389,104	08/20/2019	2018-392

RELATED MATERIALS

- Maqsood A, Rossi N, Ma Y, Corzine K, Parsa L, Oslebo D. A coupled-inductor Dc breaker with STFT-based arc detection. In 2020 IEEE Applied Power Electronics Conference and Exposition (APEC) 2020 Mar 15 (pp. 1747-1754). IEEE. - 06/25/2020

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INVENTORS

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OTHER INFORMATION

KEYWORDS

direct-current, DC power, arcing, fault detection, coupled-inductor, arc fault, circuit breaker, DC power system, DC power systems, arcing fault, shunt fault, DC circuit breaker, solid-state breaker, magnetic coupling, magnetically coupled

CATEGORIZED AS

- **Energy**
  - Solar
  - Transmission
  - Wind
- **Engineering**
  - Other

RELATED CASES

2018-392-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Power Transistor Light Emission For Gate Control And Reliability Monitoring

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