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Motivation
With the increasing demand of efficient & smart loads and rapid growth in renewable energy resources in its various forms, DC power distribution has become a suitable solution for many applications, as shown in Fig. 1.
- To ensure reliable and safe operation of such systems, DC protection equipment is a key component.

Actively Damped UFMS
- Thomson coil actuation (TCA) is utilized to develop a medium voltage ultra-fast mechanical switch (UFMS) (Fig. 4).
- The switch motion is actively damped to facilitate faster isolation from DC faults.

Progressively Switched Solid State DCCB
- Voltage differential is built up in a progressive manner leading to a reduced peak fault current.
- Response during fault isolation is defined by number of stages used.

Current Sensing & Control
- Bi-directional current sensing.
- Provides ground fault protection.
- Incorporates manual control.

Experimental Results
- A four-stage bidirectional progressively switched solid-state prototype has been built and tested in a 380 Volt / 25 Amp test-bench under load.

Potential Impacts
- Ultra-fast (< 2ms) and reliable fault isolation is provided in a DC distribution system.
- Reduction in peak fault current ensures reduced stress on protective devices and tied converters.
- Bi-directional nature of the protection element enables integration of DRERs in future smart grid designs to facilitate diverse energy capabilities.

Conclusion and Next Steps
- A silicon MOSFET based four-stage progressively switched bi-directional DCCB with necessary control is built and tested.
- Silicon Carbide (SiC) based semiconductor devices will be utilized in the next generation.
- The proposed high performance DCCB is suitable for safe and reliable harvesting of ocean energy.

References

Partners
Coastal Studies Institute

Background
- AC has natural a zero-crossing that facilitates arc quenching during fault interruption.
- Lack of zero crossing in DC makes safe fault current interruption challenging.
- Lower system inductance leads to faster current rise during DC fault.
- Fast and reliable fault isolation is required to facilitate safe integration of distributed renewable energy resources (DRERs).

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Conclusion and Next Steps
- A silicon MOSFET based four-stage progressively switched bi-directional DCCB with necessary control is built and tested.
- Silicon Carbide (SiC) based semiconductor devices will be utilized in the next generation.
- The proposed high performance DCCB is suitable for safe and reliable harvesting of ocean energy.
- Advanced algorithm for fault detection and isolation for an islanded subsea micro-grid is necessary which can be extended to other micro-grid applications.

References

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