OBJECTIVES

- Protection devices must be fast and accurate to bring reliability, resiliency, and stability during and after fault condition.
- Fast protection devices prevent the major blackouts and Protection Unit is complete package to bring medium voltage circuit breaker to market.
- Hybrid Circuit Breaker (HCB) vs. conventional mechanical circuit breaker is a trade-off between operation time vs. cost.
- HCBs significantly reduce operation time and fault current level.
- Fast circuit breakers are crucial for recoverability of the system after fault removal.
- Main aspects of the project were down selection of current limiting solid state circuit, state of the Art review of no-load Switches, protection relaying schemes, and real-time simulation to bridge the gap between offline simulation and hardware.

SIGNIFICANCE OF THE STUDY

- Fast and accurate protection scheme is necessary to prevent: 1- Explosion of the electrical equipment (Transformers, Generators, etc.)
- Major blackouts which have always been a nightmare of having a nationwide power system. (21st century major blackouts: Northeast Blackout 2003, Southwest Blackout 2011, Derecho Blackout 2012, Hurricane Sandy 2012)

PROTECTION SYSTEM

- **Protection systems:**
  1. Protective relays which are the brain of the protection system. They detect and allocate faults and command the circuit breakers to interrupt the current.
  2. Circuit breakers tend to isolate the faulted part from the rest of the system to prevent spreading the effects of fault.

ADVANTAGES OVER CONVENTIONAL MECHANICAL CIRCUIT BREAKERS

- Advantages over conventional mechanical circuit breakers: 1- Significant reduction in fault clearing time (5ms vs. tens of milliseconds)
  2- No arc phenomena due to the alternative path during interruption.
  3- Significant reduction in the fault current.

MV HYBRID CIRCUIT BREAKER

- Proposed topology with Thomson Coil dual contact mechanical circuit breaker has advantages over the baseline topology:
  1- Reduction in fault clearing (5ms vs. 13ms)
  2- Smaller snubber components
  3- Can use the inductor for current scalability

CONCLUSION

- Fast protection system including protective devices and circuit breakers survive the equipment and system stability
- The investment of protection equipment can save millions of dollars if it prevents blackouts and explosion of the equipment
- As power electronic devices improve in terms of voltage and current ratings and conduction loss, solid state circuit breakers will be the future replacement of mechanical and hybrid circuit breakers.
- The future work will be considering higher voltage rating up to 20kV.