# Developing IEEE Std 2800-Compliant Algorithms for Transmission-Connected Inverter-Based Resources

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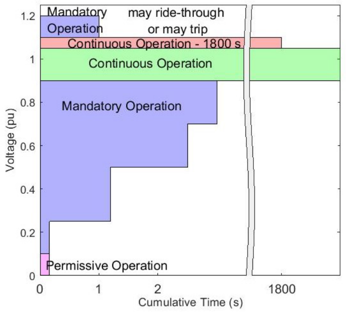
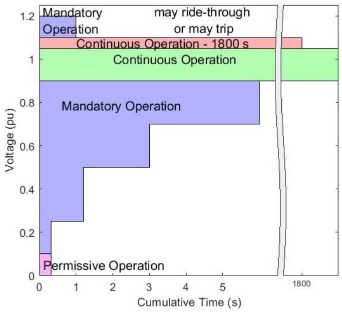
***Abstract: This study addresses the compliance of Inverter-based Resources (IBRs) with IEEE Standard 2800, a leading standard that defines interconnection and interoperability requirements for IBRs integrated into transmission systems. Focusing on abnormal grid scenarios, the research evaluates the specific demands on IBRs, proposing a controller development framework for abnormal grid conditions. This framework caters to maintaining ride-through operation in line with IEEE Std 2800, alongside managing currents during voltage ride-through scenarios. The effectiveness of this proposed controller framework is rigorously validated through case studies, employing a MATLAB/Simulink model of an IBR to test its performance under diverse grid fault conditions, ensuring the IBRs' alignment with standard requirements and their robust performance in enhancing grid reliability.***

## IBR RESPONSE IN ABNORMAL TS CONDITIONS (IEEE STD 2800)

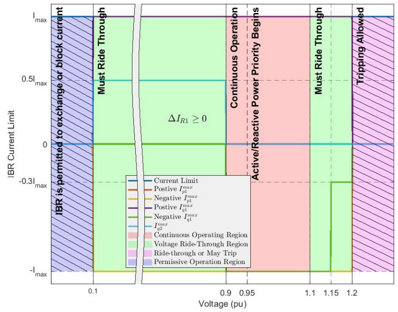
### Voltage Ride-Through Requirement



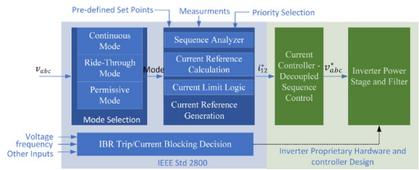

***Voltage Ride-Through Requirements as Specified in IEEE Std 2800 a) for IBRs Equipped with Auxiliary Equipment that can cause ride-through challenges (i.e. wind plants), b) for IBRs without Auxiliary Equipment that can cause ride-through challenges (i.e. PV and BESS)***

### Minimum Current Limits of IBR



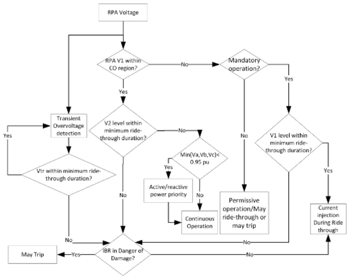

***Voltage-Dependent Maximum Current Limits as per IEEE Std 2800***

## Framework of IBR Controller for IEEE Std 2800 Compliance




***Conceptual diagram of an IEEE Std 2800-compliant IBR.***

### Voltage Ride-Through Mode of Operation




***Flow chart depicting the IBR response for different conditions during abnormal grid condition***

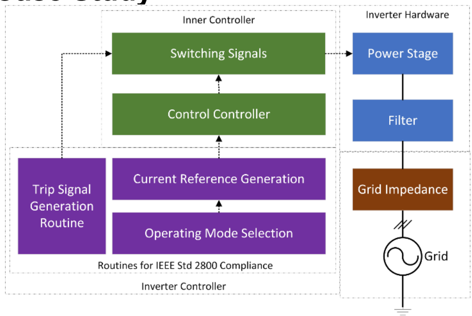
### Tripping Criteria for IBR

- **Voltage Deviation Tolerance**: IBRs must withstand voltage deviations beyond continuous operation range (0.9 to 1.05 pu Voltage).
- **Tripping Protocol under IEEE 2800**: IBRs trip only if desynchronization or damage risk is imminent.
- **Specific Conditions for WTG-Based IBRs**: WTG-based IBRs may can trip to prevent mechanical damage from voltage fluctuations.
- **Transmission Operators' Role**: Operators should set ride-through requirements for dynamic voltage oscillations.

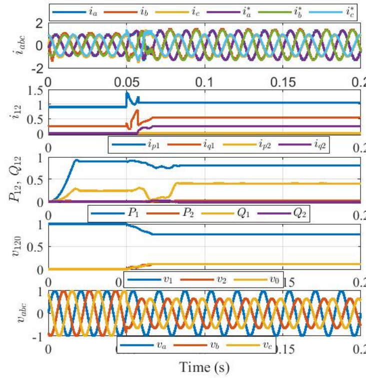
### Overview of Current Management

- **Active and Reactive Current Reference Generation:** Generate reference active and reactive currents in real-time based on the deviation from normal voltage levels at the point of connection,
- **Sequence Component:** The current references should be generated for both positive and negative sequence components for unbalanced fault.
- **Active/Reactive Current Priority:** Depending on the selected priority, the generated reference current might need to be adjusted to ensure that the IBR does not violate its current limits in any of the three phases.
- **Balancing of Sequence Currents:** Incremental positive sequence current, defined as difference in reactive current injection between during a fault and pre-fault, can not be negative.

## Case Study




**Schematic Diagram of the IBR Model for Case Study Analysis**




**Response of the IBR compliant with IEEE Std 2800 in response to an asymmetrical grid fault.**

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