Interconnection Requirements: Need for Harmonization

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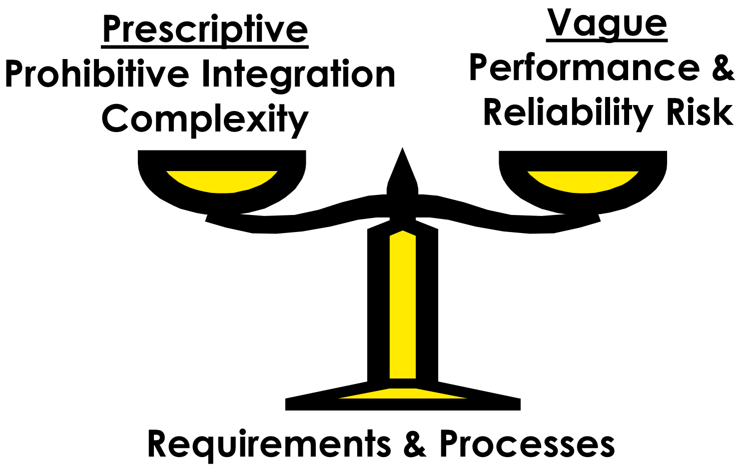
Topics

- Harmonization of requirements
- Example and opportunity for harmonization:
  - Proposed IBR behavior during and recovering from disturbances

Harmonization of Requirements & Processes



Necessary elements to meet future grid needs:

- **Balanced and harmonized interconnection requirements** play a critical role in the deployment of advanced technology capabilities to meet grid needs
- **Tools, modeling, harmonized interconnection & integrated planning practices** that fully identify system risks and capabilities of equipment to mitigate risks
- **Interoperability** between all resources to prevent instability and interactions under all system conditions
- Need solutions to compensate loss of **synchronous inertia, support grid voltage, frequency and equipment control stability** to keep the grid stable
- Collaboration between **regulators, system operators, equipment owners and OEMs** is imperative to define requirements and mechanisms to deploy technology and break chicken-egg dilemma (What comes first? Requirements or capabilities?)

Harmonization of Interconnection Requirements

- Some BAs adopt requirements from LGIA and NERC standards alone
- Other BAs have more advanced requirements that are different from one another
  - This adds costs to equipment and interconnection due to added complexity for developers and OEMs
- Technology advancements have been made and minimum capabilities are being defined across wider areas. Examples:
  - ENTSOe RfG
  - IEEE 2800
  - NERC IRPS Reliability Guidelines
- Harmonization of balanced requirements is needed for more efficient and cost-effective deployment of capabilities and performance across areas

Proposed Interconnection Requirements

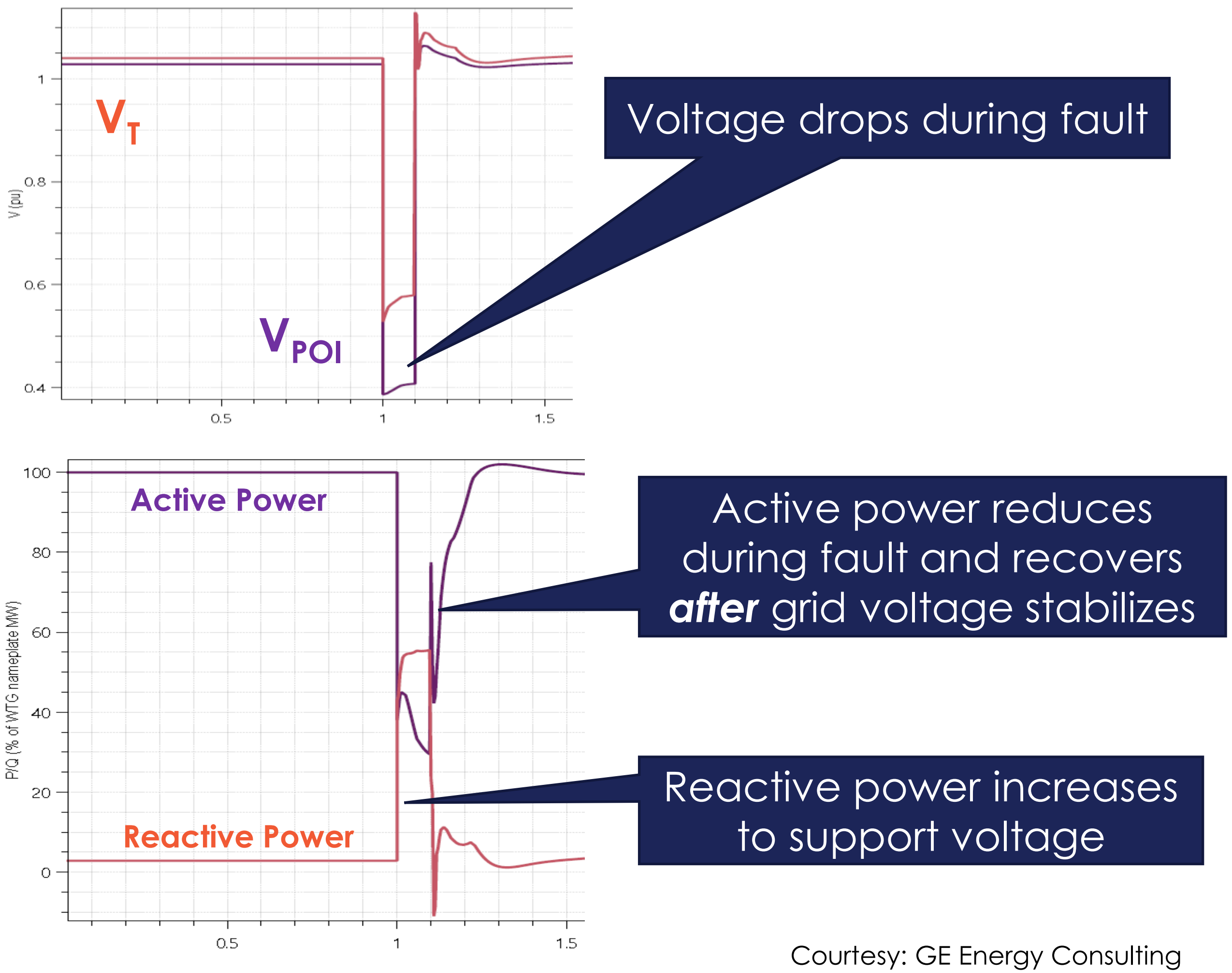
FERC NOPR RM22-14-000

Clause 9.7.3: Ride Through Capability and Performance (p. 389)

… During abnormal frequency conditions and voltage conditions within the "no trip zone" defined by Reliability Standard PRC-024-2 or its successor standards, non-synchronous Generating Facilities must ***maintain real power production at pre-disturbance levels*** *unless providing primary frequency response or fast frequency response and must* ***provide dynamic reactive power to maintain system voltage in accordance with the Generating Facility's voltage schedule****.*

IBR Behavior during a grid fault

IBR terminal quantities during a normally cleared 3ph fault

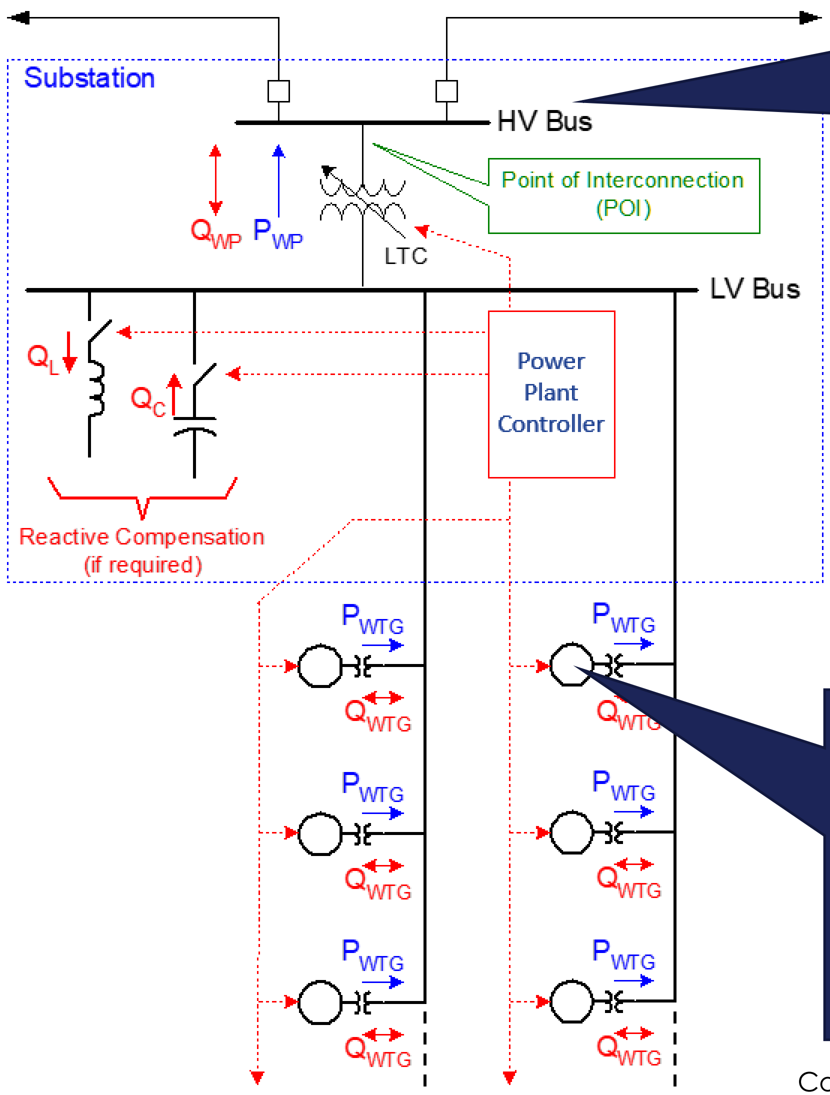


Courtesy: GE Energy Consulting

What happens during a grid fault?

- Grid and IBR terminal voltage drop
- Reactive power increases to support grid and terminal voltage (reactive power is given priority)
- Active power reduces ***depending on severity of voltage drop*** to prevent further voltage collapse
- Fault is cleared and plant rides through disturbance
- Voltage recovers; recovery highly dependent on grid strength and network topology
- Active power recovers **after** voltage recovers to prevent voltage collapse.

IBR Behavior during a grid fault



Courtesy: GE Energy Consulting

Power plant controller maintains plant voltage schedule in quasi-steady-state (many seconds)

IBRs quickly maintain terminal voltage during disturbances (msecs); follows plant command during recovery (many seconds)

What happens during a grid fault?

- Grid and IBR terminal voltage drop
- IBR unit (inverter) responds quickly to support terminal voltage and reactive power and ride through (~100(s) msec)*
- Plant controller adjusts plant reactive power from all units to rebalance system during and after recovery (seconds to 10s of seconds)

Behavior during disturbances is dominated by the IBR unit managing its terminal quantities to ride through

* Highly dependent on grid conditions

Considerations

- Align with the intent of PRC-024-3 language:

  *R1: Each Generator Owner shall set its applicable frequency protection in accordance with PRC-024 Attachment 1 such that the applicable protection **does not cause the generating resource to trip or cease injecting current within the "no trip zone"** during a frequency excursion…*

- Align with the intent of IEEE 2800 language:

  ***The active power recovery time shall be configurable within a range between 1.0 s and 10 s.** The default active power recovery time is 1 s; however, **in weak grids**, in order to reduce oscillatory behavior of the IBR plant upon fault recovery and maintain system stability, it may be **desirable to reduce the average rate of active power recovery** in consultation with the TS owner.*

  *The IBR unit shall have capability to select operation in either **active current priority mode** or **reactive current priority mode** during a high- or low-voltage ride-through events. **By default, the IBR unit shall operate in reactive current priority mode during high- and low-voltage ride-through events.** If requested by the TS owner, and mutually agreed with the IBR owner, the IBR unit may operate in active current priority mode for both the high and low-voltage ride-through events.*