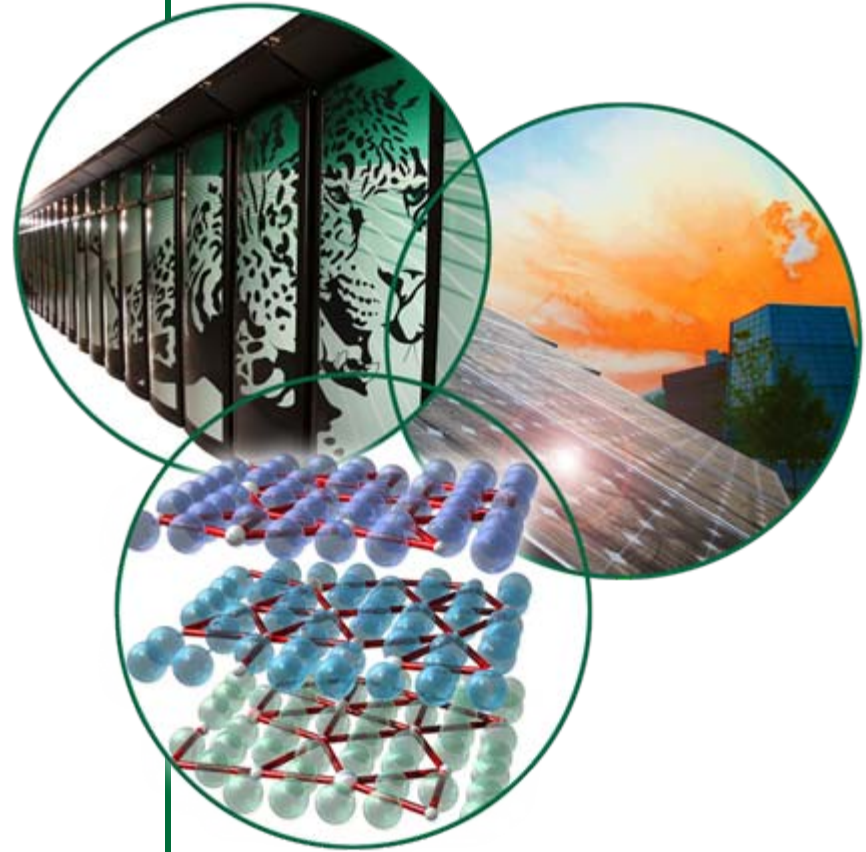


Standard PV/Storage Inverter Communication Workshop

Phase 2 Discussion

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Proposed Functions for Phase 2

- Voltage Sag Ride Through
- Autonomous Watt – Voltage Management
- Autonomous Watt – Frequency Management
- Islanding
- Additional Status Reporting
- Reliability Services Supplied to Bulk Power System

Voltage Sag Ride Through

- A means to configure inverters for the desired sag ride through behavior.
- Ensure consistency with and coordinate with UL and IEEE Standard Development.
- This gets into some major issues: It will be useful to support local voltage while a fault is being cleared, but existing high impedance fault detection on distribution circuits already cannot detect low current faults, how will protection be designed with rapid inverter voltage support?

Autonomous Watt Voltage Management

- **Steady State**

- Manage watt output as a function of local voltage (after conventional Volt/VAR schedule control has gone to kVA limit)
- May resolve “fairness issue” of dispatch of multiple inverters on a sunny day when capacity is greater than load.
- Storage management.

- **Transient**

- Dynamic system stabilization.
- This gets into system control issues and again must be coordinated with other control and planning activities.

Autonomous Watt Frequency Management

- Inverters would be configured to respond to deviations in line frequency as conventional generator governors do.
- This function must be designed to work in harmony with bulk power system planning and operational standards.
- The frequency response of generation and load, or Beta, is a growing concern in the Eastern Interconnection. The Beta value in 1996 was 3750 MW/0.1 Hz, it is now estimated to be 2,500. NERC is developing a team to address this issue.
- When inverter based generation (and load) is a significant percentage of the total, there will no option but to be frequency responsive in a method that has been planned and verified.

Islanding

- This issue of islanding will require specific instruction sets for safe, controlled islanding, including interaction and planning with the bulk power system for all modes of BPS operation.
- This is a broad topic and there will be other control entities involved and the role of each must be understood.
- Coordination with other Smart Grid standards activities and entities will be a primary need for this task.

Reporting/Status Items and Reliability Services

- Several other functions are possible:
 - On/Off function
 - Weather exchange
 - Revenue metering
 - Global inverter reconfiguration

- Other bulk power system reliability services may be available such as:
 - Automatic Generation Control (AGC)
 - Spinning Reserve
 - Power Quality

Other Considerations

- **Voltage Sag Ride Through – Local Voltage Control**
 - A strong argument can be made that we really need to support voltage rapidly (milli seconds) during the sag. This will prevent motor stall, improve power quality.
 - This practice will also enable Conservation Voltage Reduction.
 - A Smart Grid real time flow monitoring and management system will solve the relaying problem and enable loss and theft detection.
- **Autonomous Watt Management – Steady State**
 - There will need to be a way to automatically allocate PV dispatch, wind generation is being curtailed now because of transmission capacity.
 - This method will also include storage capacity, load shaping and ancillary services and will involve the PUCs.

In Conclusion

- Major changes to distribution system operation and protection will be required when high level penetrations of renewables are connected.
- These changes will be enabled by the Smart Grid, and we will see:
 - Frequency response provided by the distribution system in response to major transients.
 - Voltage optimized in the distribution system for reliability and efficiency.
 - Automatic reconfiguration and islanding that is performed in a safe, reliable manner.
 - Bulk power system planning and operation will depend on a range of services supplied from the distribution level.