# Panelist Comments
# Technology Session 3: Control and Protection

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**Bruce Fardanesh, Chief Technology Officer, New York Power Authority**

The NEED: More coordinated and closer to real-time power system control and operation

Requirements:

1. High quality sensory and measurement feedback; robust and redundant communications
2. Local and System-Wide State Estimation
3. Non-iterative State Estimation, advanced computational methods and High Performance Computing
4. Advanced Control algorithms for System-Wide Coordinated (most likely multi-level hierarchical) Control

**Jay Giri, Director, Power System Technology, ALSTOM Grid**

1. Intelligent use of synchrophasor data to enhance grid operations
2. Develop synergies between existing control center functions and emerging synchrophasor analytics
3. Advanced tools for automated grid control - decentralized and wide area control schemes
4. Enhancing Operator Situational Awareness with data from diverse grid measurement sources
5. Mining historical data archives of grid measurements - to develop best practices and signatures for real-time alerts
6. Develop solutions to mitigate impact on grid operations caused by growth of renewables, distributed generation, demand response

**Mladen Kezunovic, Texas A&M University**

1. Future power system developments affecting protection:
   - Distributed and renewable generation
   - Increased transmission line loading
   - Mobile loads
2. Need for improvement in protection
   - Existing protection fails occasionally causing huge losses
   - Fixed tradeoff between dependability and security may cause cascades
   - System and local conditions cannot be easily coordinated causing needs for additional SIPS
3. Innovative protection framework
   - Has to be able to coordinate with existing protection
   - Needs to allow use of multiple data sources to predict faults
   - Has to be able to correct missoperations of existing relays
   - Has to be able to avoid impacts of fixed settings

4. Predictive protection
    - Uses unfolding electrical circuit events to determine that relay settings will be exceeded
    - Uses data from other sources such as weather and animal activity to anticipate fault events
    - Allows development of fault mitigation strategy before fault occurs
5. Corrective protection
    - Uses the same data as existing protection but more elaborate algorithms to determine existence of faults
    - Compares action of existing relays and compares it with a more accurate reference
    - Corrects final outcome of the tripping action of existing relays if needed
6. Inherently adaptive protection
    - Does not use settings to avoid missoperations under unexpected events
    - Uses training and learning to capture patterns of system behaviors
    - Interacts with existing relays to help them make correct decisions

**Sakis Meliopoulos, Georgia Tech**

1. Protection schemes and coordination have become very complex due to the multifunctional capability of numerical relays. We need new ways of dealing with complexity and greater automation in coordinating complex protection schemes.
2. Renewables with power electronic interfaces add to the complexity as their fault currents are comparable to load currents. Protection schemes are typically based on wide separation between fault and load currents. We need new protection paradigms to deal with these new technologies.
3. Renewables may be typically connected to distribution systems. The present approach to distribution system protection is optimized for radial systems. Renewables create bidirectional flow of load and fault currents. The protection approach for distribution systems must be re-engineered.
4. New technologies such as GPS synchronized measurements, more accurate relay instrumentation can facilitate new approaches to protection. EPRI's setting-less protection initiative could enable robust protection schemes for renewables without the need for complex coordination procedures.