Advanced Electrical Power System Sensors for the Electric Power System

Achievement: Provided input into planning processes being undertaken by the National Institute of Standards and Technology (NIST), Department of Energy (DOE), and the Grid Modernization Laboratory Consortium (GMLC). The workshop provided these entities with the opportunity to hear industry concerns and ideas regarding emerging and future electrical power system sensors, transducers, and transformer technologies. As the grid continues to evolve, and as grid operation and planning support advanced functions, it may be necessary to measure aspects of the grid which have not been measured in the past, or to refine the way measurements, at present, are performed. This workshop explored various means by which grid related activities can be better informed.

Significance and Impact:
The results of this workshop illustrate the need for advanced sensors for electric power and many of the challenges that need to be addressed. Some of the overarching themes that emerged include the following:
(A) Advanced sensors will need to be able to better accommodate and interpret the nuances of new dynamic loads integrated into the grid and measure/sense their impacts on grid behavior to aid in planning and operations. (B) A much higher degree of resilience and security will be necessary, given the evolving cyber and threat scenarios and the increasing use of distributed, random, and intermittent resources on the grid, and future scenarios where larger number of consumers generate power from variable sources. (C) Future sensors need to be lower cost, more resilient and secure, able to self-regulate, and also exhibit higher performance and greater functionality, as well as longer life under multiple external conditions and dynamic loads. (D) The increasing volume of data from today’s sensors and advanced sensors will need new data platforms, algorithms and data fusion techniques to ensure data is interpreted, useful, and actionable for operators and those involved in planning and event analysis. (E) Standards will play a key role in advanced sensing capabilities; new standards and measurement methods will be needed to ensure higher sensor performance under future distributed and noncentralized grid conditions. Interoperability reduces overall costs and improves data integration. Standards aim to ensure data is consistent and usable by multivendor equipment and applications.

Research Details:
Findings from the workshop cover key application areas for next generation sensing devices, future targets for sensor performance, challenges and barriers to achieving performance, and research activities to address the challenges. Exhibit E-1 provides a high-level summary of the results in these categories.

- Application Areas. Grid planning, operations and event analysis were considered in terms of major challenges and information needs. Major challenges are related to managing dynamic and distributed generation.loads, modeling of resources, and evolving requirements for cybersecurity or specific applications. Information is needed to track loads, provide better situation awareness, and improve external inputs to planning/operations. Event analysis will require more robust sensors that yield useful, actionable data that is time-correlated.
- Future Targets. Advanced sensors should have a greater range of functionality and yet be low cost, resilient, secure, self-calibrating and able to transmit useful data about both traditional and non-traditional key parameters, regardless of external conditions.
- Challenges and Research Needs. Obtaining quality data, retrieving actionable, useful data, improving sensor performance, and increasing communication system capabilities are major challenges for development and use of advanced electrical power system sensors. Data fusion techniques, where large quantities of data are analyzed/fused so they are meaningful, is important for both operations and planning. A range of issues impact sensor performance, but most center around better testing and measuring and predicting performance (at lower cost). Standards are needed for performance including key factors such as interference and accuracy. The limits of present communication systems (bandwidth, speed, response to external conditions) could constrain the capability of advanced sensors.
Priority Research Areas. As shown in Exhibit E-1, the identified research priorities address the major challenges of performance testing, the need for new standards, increasing sensor functionality, sensor lifetime and maintenance, accuracy and other performance measures.

Sponsor/Facility: This work was a collaboration between ORNL, other laboratories, industry and academia. ORNL involvement was sponsored by the US Department of Energy Office of Electricity Delivery.

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