

**The 15<sup>th</sup> International Workshop on Electric Power Control Centers  
Reykjavik, Iceland, May 12-15, 2019**

**Integration of Renewable and Distributed Energy Resources –  
A Transactive Grid Perspective**

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**ABB**

The electricity grid has been going through major regulatory, operational and physical transformation in recent decades. The push for higher efficiency and improved reliability has driven major electric utility restructuring around the globe. This transformation has resulted transmission level electricity markets as well as new system operation entities and roles leading to increasing power exchanges. These exchanges and massive deployment of intermittent renewable resources have further aggravated the grid stress in the form of congestion, voltage, volatility, loop-flows and other operational problems. This phenomenon has presented system and market operators with the challenge of maintaining security and reliability while enabling a transactive transmission grid. Meanwhile, ever-increasing deployment of distributed energy resources (DERs) has accelerated the transformation of distribution systems. Two-way, and potentially multi-way, flows are replacing one-way power flows as the grid is becoming more “transactive.” This transformation of the distribution system is resulting similar operational and business model challenges that have been experienced at the transmission level.

This presentation provides an overview of the grid transformation. The challenges of integrating renewable and distributed resources, from both operational and market points of view, are highlighted and advances in mitigating these challenges are reviewed. Integration of DERs into wholesale electricity markets is discussed and a vision for a transactive distribution system is presented. The vision aspires to a transactive energy grid with intelligence distributed among all components to achieve improved reliability, resiliency and efficiency. This facilitates exchanges, including peer-to-peer, participant-to-market and market-to-market while

incorporating the security of the grid. The vision enables exploiting the proliferation of DERs and flexible demands to realize a more resilient grid in both normal and emergency conditions utilizing the transactive grid capabilities. A novel integrated IT architecture comprising of self-similar components for supporting the proposed distributed transactive system is described and a practical use case is presented.