

# **The 15<sup>th</sup> International Workshop on Electric Power Control Centers**

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## **The development and application of PMU measurements in a power system dominated by hydropower**

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### **Abstract;**

Due to the global climate development, the production and consumption of renewable energy must increase to substitute the use of fossil and non-renewable resources. The Norwegian electricity production is almost entirely based on renewable hydropower but still the future will see a large increase in electricity production from new renewable sources such as wind power, photovoltaic and small hydropower plants. These production assets have other characteristics than the older largescale hydropower plants that has been the backbone in our electricity production so far. These differences challenge the stability and reliability of supply at system level. New concepts in monitoring, protection and control and the use of PMU data and associated communication system and control algorithms are seen as necessary to maintain power system reliability. The SPANDEx (SyncroPhaser Application iNtegration and Data EXchange) project in Statnett address these challenges. The use of PMUs rise questions about data reliability, integrity and cyber security. These challenges must be solved when the use of PMU measurements becomes an integral part of system operations.

The installation of PMUs is well underway in the Norwegian power system. In November 2018 73 PMUs were installed with a further 82 planned. The communication system is under development and the SPANDEx project will deliver a roadmap for further integration of PMUs and the inclusion of algorithms and applications for monitoring, protection and control. The integration and use of PMU measurements in the SCADA system is of critical importance in order to realize the potential benefits of using data from PMUs in our operations.

Statnett is planning, as a first step, to use PMU measurements for monitoring of system behavior in general together with voltage stability calculations and monitoring of oscillations in areas where we have known challenges. In the next steps, we will develop automatic control and system protection schemes.