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| **Project name:** | Hydropower Digitalization for US-Norway R&D Coordination |
| **Project leader and partners:** | Pradeep Ramuhalli (Oak Ridge National Laboratory)  Kenneth Ham (Pacific Northwest National Laboratory)  Hans Skjelbred (Stiftelsen for industriell og teknisk forskning) |
| **Finalization year:** | 2021+ |
| **Type of project/ main topic:** | DOE direct laboratory funding |
| **Main relevance for DOE-Norway MOU:** | WPTO has emphasized the strategic significance of hydropower digitalization for grid-interaction, modernization, and growth of the hydropower industry. Recent advances in digitalization technologies provide unique opportunities for increasing hydropower reliability and availability. The project examines the current status of digitalization upgrades in the fleet, identifies research gaps, highlights opportunities to enable full implementation within the hydropower industry to obtain benefits, and provides information to inform R&D. The Norwegian Research Institutes have a variety of investments and interests in digitalization and hydropower reliability that have led to information and tools to support decision making and management. |
| **Short project description:**  This project assesses the present state of digitalization of the hydropower fleet in both the United States and Norway and highlights opportunities to enable the hydropower industry towards full implementation and obtain its benefits. The project represents an opportunity for research organizations representing each country – the US Department of Energy’s Water Power Technologies Office (WPTO) representing the United States and Stiftelsen for industriell og teknisk forskning (SINTEF) representing Norway – to document the perceived value proposition of digitalization based on recent technology advances, identify research needs and opportunities for increasing digitalization in hydropower, and inform R&D activities to enable and support increased deployment of digitalization in hydropower for modernization and growth.  **Addressing a Challenge for US Hydropower and a Changing Electric Grid:**  While historically hydropower facilities have largely been operated reliably using analog and electromechanical systems for operations and control, there is an increasing movement towards leveraging digital technologies to maintain reliability and safety of hydropower. Digitalization as a concept includes a number of elements that augment information from the plant both electrically and mechanically, reduce operator burden, and optimize staffing levels, collectively ensuring that facility operations and maintenance (O&M) activities are performed in an effective and efficient manner, reducing O&M costs while not compromising safety or plant reliability. Elements of digitalization may include sensors and wireless platforms for real-time monitoring of operations, machine condition monitoring (MCM), predictive/condition-based maintenance practices, human-computer interaction technology for information visualization and plant control, automation technology for everything from plant controls to improved work order processes, and optimal plant dispatch. Collectively, these technologies which are supported by a digital architecture, are expected to benefit hydropower through improved safety systems, greater operational efficiencies/optimizations, lower operational costs, increased component life and added visibility into the plant state, and finer grained control allowing for new hydropower mission profiles. The value of these technologies is greater when considering the impacts of high penetration of Variable Renewable Resources (VRE’s) in the production mix on hydropower flexible operations, which can include steeper ramping, lower turn downs, and shorter peaks.  Accessing this value-potential requires increasing the level of digitalization in hydropower facilities. In turn, this requires an improved understanding of the unique operational and technical needs associated with the hydropower fleet given changing mission profiles, and creating the linkages between these requirements and digitalization technology development needs. This project aims to create these linkages through an assessment of the status of digitalization by engaging with hydropower asset owners and operators, defining the scope of hydropower digitalization, and quantifying the priorities and range of ongoing efforts. Recent technical advances in sensing, instrumentation, control, and data science that may be leveraged for increasing the value of digitalization to hydropower are being identified along with any associated research needs and potential paths towards increasing the speed of hydropower digitalization. The ORNL team is also collaborating with SINTEF to validate findings through an understanding of the state and future plans of digitalization of hydropower assets worldwide. The project represents an opportunity for research organizations representing each country – the US Department of Energy’s Water Power Technologies Office (WPTO) representing the United States and Stiftelsen for industriell og teknisk forskning (SINTEF) representing Norway – to document the perceived value proposition of digitalization based on recent technology advances, identify research needs and opportunities for increasing digitalization in hydropower, and inform R&D activities to enable and support increased deployment of digitalization in hydropower for modernization and growth. | |
| **Other comments:**  *(please let us know if there are any confidentiality issues or limitations to how the results can be used, or if there are other important comments)* | |
| **Available resources:**  More information on this project can be found on the US Department of Energy’s HydroWIRES Lab Call Projects website at https://www.energy.gov/eere/water/hydrowires-lab-call-projects | |