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| **Project name:** | **Needs Assessment and Initiation of a Digital Twin for Hydropower Systems Open Platform Framework (DTHS-OPF)** |
| **Project leader and partners:** | Hong Wang (Oak Ridge National Laboratory)  Ahmed Osman (Pacific Northwest National Laboratory)  Hans Skjelbred (Stiftelsen for industriell og teknisk forskning)  Ole Dahlhaug (Norwegian University of Science and Technology) |
| **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. To address these strategic needs, the project combines ORNL expertise in hydropower system modeling, controls and digital twin; PNNL expertise in digitalization and power grid simulation; and Norwegian capabilites in scale modeling to craft an achievable and effective road-map for DTHS-OPF development. |
| **Short project description:**  The project partners envision a future state, more than 5 years hence, in which the *hydropower digitalization challenge* is being met by a widely-adopted extensible digital twin for hydropower systems (DTHS) core product as a best practice and baseline digitalization technology for designing, operating, and managing the reliability, performance, and costs of most hydropower assets. This project aims at scoping and launching the DTHS so as to assist the DOE Water Power Technologies Office (WPTO) in preparing and publishing a multi-year research roadmap for the DTHS to achieve this future state.  **Addressing a Challenge for Hydropower Systems Digitalization:**  The partners are evaluating the feasibility of developing a DTHS-OPF that is primarily data driven, developed by engaging and collaborating with industry stakeholders, and driven by value propositions this collaboration engenders.  A DTHS can integrate data from heterogenous systems and devices using open interoperable protocol uses an open system architecture for creating solutions. In developing the DTHS-OPF, we envisage it to have certain features and functionalities in terms of: 1) internet of things (IoT) platform capability; 2) data acquisition and integration; 3) configuration that allows user friendly data definitions; 4) data processing, modeling and management. The DTHS will also have an applications layer for predictive analytics, control, optimization and grid services with an effective user interface. The DTHS will be designed to be open access and will serve as an R&D platform for accelerating the pace of developing new technologies for the growth in hydropower for industry, national labs, and academia.  In the execution of this project, we envision significant benefits in collaborating with the Waterpower Laboratory at the Norwegian University of Science and Technology (NTNU), where there is a compact testing system for waterpower systems including water-hydro-turbine system and generation units linked to a local power grid. This facility can mimic a large range of water head and load variations, and thus can facilitates our digital twin full-scale development in its modeling scope work, where data from NTNU testing system can be used. We also envisage potential collaborations with Norwegian team on its recently awarded project titled “Twin Lab” where research information exchanges on digital twin structure, platform, data and user’s interface would benefit both sides in the scientific endeavor for the development of effective digital twin for hydropower systems. | |
| **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)*  WPTO to further assess the confidentiality on the contents in this document and its release to the third party. | |
| **Available resources:**  More information on this project can be found at <https://www.ornl.gov/content/digital-twin-hydropower-systems-project> | |