Energy & Homeland Security

SANDIA NATIONAL LABORATORIES' WATER-POWER PROGRAM CAPABILITIES IN CONVENTIONAL HYDROPOWER PRODUCTION

Sandia's conventional hydropower (CHP) capabilities are a product of a range of core capabilities that include optimization, uncertainty and risk assessment, resiliency, climate change impact modeling, techno-economic modeling, rainfall/runoff modeling, river-routing, machine learning, and high-performance computing. When properly integrated, these capabilities may address a wide range of questions concerning the operations and performance of CHP and its role in the national energy portfolio.

TURBINE LOAD

Sandia has extensive experience in turbine load measurements, structural analysis (fatigue and wear modeling), and computational fluid dynamics modeling. Load measurements focus on implementing off the shelf piezoelectric- and fiber optic- sensors to measure torque, force, strain, and vibration for monitoring system conditions. Sandia has internal resources from the tribology, non-destructive inspection, and MEMS laboratories to aid in turbine load assessments.

RIVER HYDRODYNAMICS

Over the past few decades, Sandia has developed 1D, 2D, and 3D river hydrodynamic models (e.g., HEC-RAS, RMA2, DELFT3D, ANSYS FLUENT & CFX) to design and assess hydraulic structures and low head/hydrokinetic turbines. The team has collective experience in modeling rivers across the US (including the Colorado and Mississippi basins) and in Europe, and in conducting riverine hydrodynamic measurements using acoustic profilers, large-scale particle image velocimetry, LIDAR, and optical/hyperspectral imagery. Expertise in GIS, remote sensing, and data processing are integral to this capability.

SYSTEM DYNAMICS MODELING

System dynamics (SD) is a modeling approach that focuses on the temporal dynamics of multiple, linked, yet disparate systems. Sandia has a long history of applying SD to a variety of areas such as the water and energy nexus, climate change, and national security. Sandia has used SD to simulate and optimize CHP operations and to conduct analyses that examine CHP impacts from climate change in the context of power generation, water availability, and environmental performance. Within this capability is the ability to optimize systems across multiple objectives, such as maximizing power output while minimizing environmental impacts.

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