

# Technology Innovation Project



*Project Brief*

## TIP 385: Enhancing Hydropower Reliability through Cavitation Monitoring and Noise Condition Assessment

### Context

Hydroelectric generation has the flexibility and response characteristics to balance and regulate the grid's intermittent renewable loads. Hydroelectric turbines will therefore be expected to increasingly operate in unexpected hydraulic conditions, including cavitation zones.

Cavitation detection has become increasingly important as erosive cavitation has a direct impact on turbine components integrity and thus on turbine performances and profitability. Many studies were performed focusing on cavitation detection in experimental bench tests with controlled parameters.

A proper monitoring and detection system can provide valuable information regarding operating conditions with high cavitation-erosion potential. Precisely knowing the limits of incipient erosive cavitation can allow adding flexibility to the operating range. Furthermore, avoiding damaging operating conditions can help mitigate cavitation-erosion, which will reduce the number of required cavitation repairs over the years and thus maximize the hydro unit's availability.

### Description

This project investigates and develops condition assessment and monitoring methods for hydro turbine-generator units with the aim of minimizing forced outage.

These techniques will be useful tools in the reliability assessment and enhancement toolbox. To achieve this, extensive measurements will be carried out in a hydro turbine-generator unit and for a vast range of operating conditions. The dynamic behavior of targeted components will be assessed mainly using vibration sensors (accelerometers), acoustic sensors (microphones) and other sensors for secondary measurements (e.g. tachometer, pressure and temperature sensors). The data gathered will be used to develop efficient data post-processing components for condition assessment and monitoring purpose. Implementation of these signal processing techniques will then be used to develop a monitoring system that will allow gathering data over a long period of time. The resulting data set can then be used to validate the cavitation-erosion prediction model and assess the abilities and limits of noise measurements to provide condition and monitoring assessments of various components.

The findings will then be used to fine tune the monitoring techniques employed and propose definite methods for the tracking and prediction of cavitation-erosion potential, as well as for the condition assessments of several components using mainly noise measurements.

This will provide the ability to evaluate in real time the potential cavitation-erosion of a given operating condition and thus help the unit operation decision.

### Why It Matters

The project will yield several benefits for BPA. First, the implementation of an operational cavitation monitoring system demonstrator will allow extending the turbine-generator unit operating range to the limits of incipient erosive cavitation and serve as a guide for the operating team to avoid high cavitation-erosion potential operating conditions. Ultimately, if applied to several turbine-generator units and integrated in the operation system, this monitoring system could greatly increase the units' flexibility and reduce the number of cavitation repairs needed in the hydro projects with which BPA has commercial activities. In addition to significantly reducing the costs for cavitation repair campaigns, the minimization of required cavitation repairs would result in maximum availability of hydropower units for BPA to meet its balancing reserves and customer power demand drivers. Though difficult to quantify, such operating range widening and forced outage reduction would result, over the long term, in significant cost reductions for BPA.

### Goals and Objectives

This project is aimed at 1) developing a cavitation-erosion monitoring method that will be implemented in a monitoring system demonstrator and 2) thoroughly investigating the feasibility of using noise measurements for condition and monitoring assessments of hydro turbine-generator unit components.

## **Deliverables**

Project deliverables will include reporting and presentations for interim tasks.

These will include: reporting on test procedures and measurement campaign, analysis of data, programs and routines, as well as recommendations for the monitoring system specifications; results of the monitoring system integration and testing, as well as an overview of the system's installation and commissioning; analyses of data acquired by monitoring system and recommendations of adjustments for subsequent measurements;

complete analysis of data acquired by monitoring system and conclusions about the methods investigated.

The final report will detail the achievements, conclusions and lessons learned of the whole R&D project.

The prototype monitoring system, allowing acquiring data over long time periods will be left at the hydro turbine-generator unit in a fully operational state and will be the property of BPA/facility

# **TIP 385: Enhancing Hydropower Reliability through Cavitation Monitoring and Noise Condition Assessment**

**Project Start Date:** October 1, 2016

**Project End Date:** September 30, 2019

## **Funding**

Total Project Cost: \$1,235,000

BPA Share: \$605,000

BPA FY2018 Budget: \$476,000

## **Reports, References, Links**

## **Related Projects**

## **Participating Organizations**

Alstom Renewable Energy, LLC  
Alstom Global Technology Center

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