SMASH Project

Agile Maintenance Service for Hydroelectric Systems

1. Background:

The hydropower industry has a special role in the production of electricity. It is one of the oldest sources of electricity generation (dating to the early 20th century) while also being one of the most relevant today, given the rise of renewable energy generally. However, hydropower has an image problem when compared to wind and solar energy, being seen as "old" and somewhat unmodern.

Innovations have nevertheless been introduced over the past decade in both materials used in production such as new turbines and the use of permanent magnets. These changes have made it possible to reduce CAPEX and operate fewer production sites. Fewer advances have been made in operations/maintenance, except in the use of remote installation monitoring via web interfaces.

The SMASH project targets the operations/ maintenance niche. Generally speaking, it aims to integrate the following five issues:

- Specific site maintenance, difficult to integrate into a CMMS
- France – regulatory changes, end of purchase requirements and market exposure
- An "old school" industry that needs to be modernized
- International - hydroelectric projects that rarely integrate operations
- Diverse type of equipment and infrastructure, requiring great "agility"

With its extensive experience, the SHEM has developed a simple tool for monitoring ongoing maintenance, based on its maintenance records and list of operations to be performed. However, this tool needs to be used, a precise knowledge of the "hydraulic technology" and planning of operations. Thus, if it allows the monitoring of the operations, it requires a certain expertise for programming operations according to the equipment component factory and is therefore difficult to use for a person without special technical knowledge.

2. Project leader

The SHEM (Société Hydro-Electrique du Midi) is a major hydroelectric producer in the greater Southwest region and a leading regional player, employing around 320 staff. Its 56 factories and 12 major dams, spread throughout the Pyrenees mountains on the Lot and Dordogne rivers, produce clean energy without CO2 emissions, and have been certified 100% renewable by the independent certification organization TÜV SÜD.

Its production facilities, with a total capacity of 783 MW, generate an average of 1,838 GWh per year, equivalent to the electricity consumption of almost one million inhabitants.

SHEM's facilities are arranged in nine groups of power plants, supervised by two regional headquarters and a regional office, located near their local service areas. These groups are supported by a maintenance workshop, the regional headquarters and administrative and engineering services from the main headquarters located in the Toulouse metropolitan area. Production is controlled by a remote control center based in Lyon.

While the SHEM's core business is to produce renewable energy, its other major activities include the design of facilities and dam safety. Employees of the SHEM thus work in future-facing fields linking the energy sector with environmental protection and valley-level regional development.

The SHEM's three main activities are:

· To design and build hydroelectric projects both for the SHEM itself or for communities or private companies, while respecting the environment and associated regulations;

· To operate and maintain the sites in close contact with local stakeholders while ensuring the balance of the French electric grid during peak consumption and to address the intermittency of wind and solar power;

· To continuously optimize the facilities to ensure that production is efficient and that people and property downstream are safe.

There are five major job categories at the SHEM. The singular skills that these involve have been acquired over the course of nearly a century and have been passed down through the company.

· Electricity

· Mechanical

· Machinery and welding

· Civil engineering

· Environment

Experts in high- and medium-head hydroelectricity, the SHEM is now developing additional benefits for its external customers.

It can respond to different kinds of technical requests for both private businesses and communities in France and Europe.

The SHEM also supports local communities through external services such as helping to set up new forms of governance related to the development of hydropower, including the establishment of mixed-ownership companies.

It is with this background in mind that the SHEM wants to launch the SMASH project.

3. Targets:

As seen above, the world of hydropower, which had remained relatively quiet until now, is undergoing changes comparable to those that shook the mobile phone sector in recent years. Changes in the energy market and the development of renewable wind and solar energy have generated network risks that were thus far unexpected or little known.

Also, the current movement towards decentralized energy production, growing ever closer to the consumer, is changing the European electricity landscape, which until recently revolved around large production sites.

These changes have resulted in new demands on stakeholders in this market, especially regarding how reactive they are with regards to maintenance. Independent producers are particularly affected by this phenomenon, as owners of small production facilities that face multiple challenges. The end of contractual purchase obligations will soon force them to sell energy on the market and therefore turn to aggregators to handle sales. These providers will doubtless require guarantees about the availability of machines and production capacity.

While "big" hydroelectric producers are majorly affected by energy market reforms, independent producers will also need to professionalize their business practices and make good on plans to maintain their facilities in ways they don't necessarily do today.

This is why the SHEM wants to develop a monitoring tool for routine maintenance. Less intensive than a CMMS, adaptable to smaller facilities, this kind of tool should be a simple response to the challenges faced by small producers by enabling them to:

· Establish an annual routine maintenance plan

· Schedule operations, possibly by sharing with other producers

· Ensure that their facility is properly monitored

4. Project Description and Objectives

To give a sense of its basic outlines, let's say that a hydroelectric facility is built around the following components:

· Water intake (dam or run-of-river)

· Water channeling (channel, piping)

· Hydraulic turbine

· Electric transformer (generator or alternator)

· Outgoing energy equipment

To operate these facilities efficiently, all are equipped with either controllers (or relay systems for the oldest ones). Monitoring and operations are done through supervisory equipment that gathers all of this information in one place.

a) Project goal 1

To be agile enough to adapt to all types of electrical system configurations. Objective 1 is to design a tool to reconstruct the architecture of the hydroelectric plant that can be plugged onto the supervisor. The information recovered this way could come from:

· Sensors: type, number, positioning ...

· Facilities: type, actuators, features, ...

b) Project goal 2

Once the structure of the system has “automatically” been set up with the equipment properly identified, we need to be able to transfer it functional setup that corresponds to that belonging to the SHEM.

c) Project goal 3

Once the functional division has been established with the identified equipment, the database developed by SHEM can be incremented to enter the appropriate equipment maintenance records.

This step, by following established rules, allows us to automatically schedule routine maintenance operations.

It must also allow the person in charge of the facility to measure information and assess the state of the equipment as observed during inspections.

d) Project goal 4

The previous step was about planning daily operations. For some equipment (including turbines, flues, alternators, etc.) a second level of maintenance also needs to be planned for. Planning for this level of maintenance will be based on information from certain features (TBD by SHEM).

This step must also allow the person in charge of managing the information to measure and assess the status of the facility observed during inspections.

e) Project goal 5

This level aims to provide access to the management of hydroelectric assets. The information gathered in the previous steps (3 and 4) should be used to describe the condition of facilities / equipment and to decide whether major interventions are needed.

5. SMASH: what kind of tool?

SHEM will use its existing business expertise to achieve these five goals, but it needs a partner to develop the tools, interfaces and algorithms that will help make "old-school maintenance" more modern.

SMASH should therefore have the following characteristics:

· An interface that can be "plugged" into where possible (supervisor...)

· An algorithm or equivalent to reconstruct the list of equipment and their characteristics,

· An algorithm for repositioning the latter based on SHEM's functional breakdown,

· The ability to manage a maintenance database and the automatic allocation of tasks to equipment,

· The ability to management of maintenance data + real time

· A task planner,

· An asset management algorithm based on the operating and maintenance data.

All of which should be able to be accessed remotely, paperlessly and digitally!