Life SWSS – Smart Water Supply Systems

Summary

Water treatment and transport from the source to the user's tap are energy intensive processes, which denotes significant energy costs and environmental impacts. Thus, water supply utilities are currently looking for innovative ways to simultaneously reduce the energy consumption and to increase their financial and environmental sustainability using the existing conditions in their infrastructures. Simultaneously, large amounts of data from monitoring systems are being collected by the utilities, but not being treated and analysed. Thus, the networks operation and management still mostly rely on the utilities accumulated experience.

LIFE SWSS project aims to demonstrate an innovative platform for management and decision support for water supply systems under real working conditions. For that purpose, a platform (SWSS) composed of five modules is being developed: hydraulic simulation module, predictive model module, optimization module, assessment module and leakage detection module (Figure 1). These modules are continuously fed with data from SCADA and GIS systems, as well as other general systems' characteristics, and transform those data into information, helping the utilities finding the most efficient way to operate the systems. The ultimate goal is to demonstrate that water losses, electrical energy consumption and GHG emissions can be reduced by means of a smarter operation of the systems.

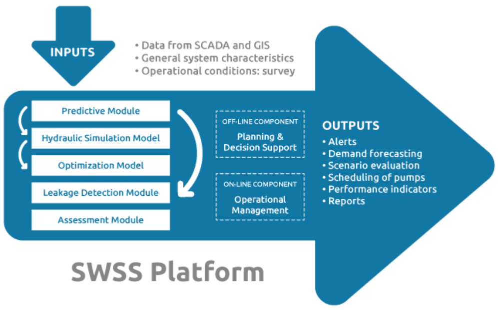

Figure 1. SWSS platform concept.

SWSS platform has been being demonstrated on three water supply systems under real working conditions. These three demonstration sites are parts of Águas do Algarve and EPAL water supply systems, located in the centre, west and south of Portugal.

CERIS team cooperates with all the other partners giving scientific support to modules development and particularly by establishing the assessment module. This module uses online data to calculate the water balance, the energy balance and the associated performance indicators (PI) on a monthly basis. The water balance methodology is well-known by the utilities, who report annually those results to the national regulator. The methodology for energy auditing is very similar to the water auditing one. It includes the calculation of the energy balance (Figure 2) as well as of a set of PI. Unlike the water audit, which has been applied and tested for several years, the energy auditing was only recently developed and it has been applied on a limited number of utilities. The assessment module includes the automatic calculation of all components of the energy balance, making use of the hydraulic simulator (EPANET) incorporated in the platform.

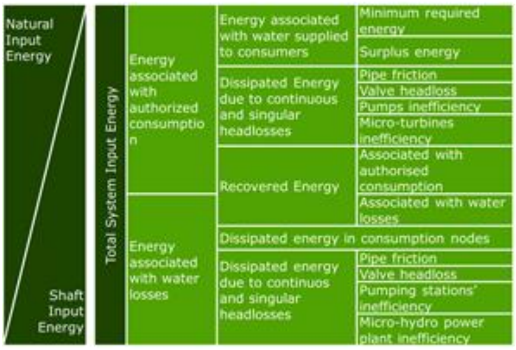

Figure 2. Energy balance.

Performance Indicators (PI) are key-tools for the assessment of the effectiveness of management processes in water supply systems. These allow carrying out (i) the diagnosis of the existing systems, (ii) the identification of critical problems and establishment of priorities, (iii) the comparison between alternative solutions of improvement (rehabilitation, change of pump scheduling and hydro-generation) and (iv) monitoring and control of the implemented measures. Their automatic calculation by the platform allows the utilities to continuously assess water losses and energy efficiency levels.

In the framework of Life SWSS, CERIS team has also assembled an experimental facility (Test-Hydro) for testing hydropower generation solutions, such as pumps as turbines (PAT), in the Laboratory of Hydraulics, Water Resources and Environment at IST (Figure 3).

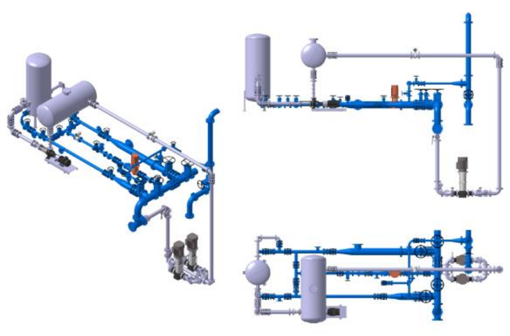

Figure 3. Test-Hydro experimental facility at IST: schematic representation.

Test-Hydro is an innovative test-rig for testing small power hydraulic, fully equipped with a

Project Reference

LIFE14 ENV/PT/000508

Leading Institution

ISQ (Portugal)

Partners

IST – Instituto Superior Técnico (Portugal), HIDROMOD – Modelação em Engenharia (Portugal), AdTA – Águas do Tejo Atlântico (Portugal), EPAL (Portugal), AdA – Águas de Alenquer (Portugal)

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Funding

EU – LIFE Programme

Period

2015-2019

Total

1 372 888.00€
(802 747.00€ EU contribution)

CERIS

149 575.00€
(94 339.00€ EU contribution)

Project Website

life-swss.eu

state-of-the-art data acquisition system and measurement equipment for testing hydraulic turbomachines in both pumping and generating mode (Figure 4). Acquired data (i.e., discharge, pressure, temperature, shaft torque, rotational speed, active and reactive electric powers) allows the full hydraulic, mechanical and electrical characterization of the turbomachine.

Figure 4. Test-Hydro experimental facility at IST: overall view.

Measurements in the pump and turbine modes showed that the machine achieves the same order of magnitudes in the efficiency in both modes. The maximum efficiency of the tested PAT is of 70% and that the efficiency greatly varies with discharge and with the turbomachine speed (Figure 5). Higher efficiencies can be achieved for larger-sized machines, as their efficiencies in pump mode are higher.

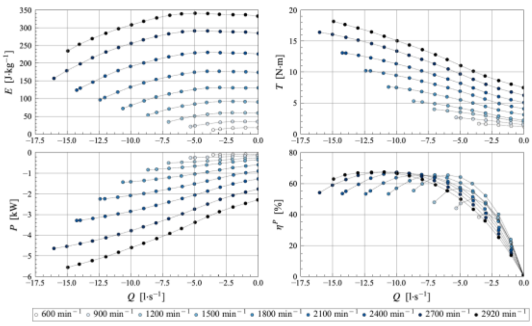

Figure 5. Collected data for pump mode of the pump NK40-160/158 – nq = 26.3.

CERIS team has also analysed the potential for energy recovery in the three demonstration systems. The study consisted of identifying the locations were excessive energy is dissipated in control valves (at the inlet of gravity fed storage tanks) and of assessing the economic viability of the installation of a micro hydropower device.

Results have shown that many sites are located in the 15 to 100 kW range The minimum hydraulic power for a feasible energy recovery project is not yet set in literature, as it depends on many variables, for example, the diurnal and seasonal flow variation, the energy cost and the cost of installing a turbine or PAT for energy recovery. Yet, the produced energy per year depends not only on the hydraulic power and equipment efficiency, but also on the operating time of the system throughout the year. In this study, the viable solutions have hydraulic powers higher than 50 kW simultaneously with operating times higher than 100 days per year (Figure 6).

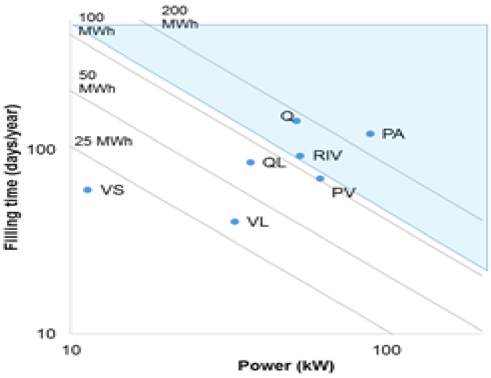

Figure 6. Tank's filling time at the maximum power and produced energy. Viable projects are located in the blue area.

Life SWSS Platform is already being tested at the Algarve demonstration case and the tailored dashboards are being developed (Figure 7). Optimization scenarios are already being run and optimal operational conditions for water losses reduction and energy efficiency improvement are being computed.

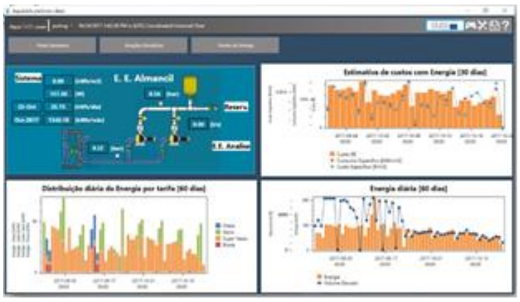

Figure 7. SWSS Dashboard for Almancil pumping station.

In the fore coming months, CERIS team will perform the socio-economic impact assessment of the SWSS platform, namely by studying: (i) the influence of energy costs on the water tariff of each water supply system, (ii) the potential reduction of water tariff due to the implementation of SWSS platform, (iii) the average water costs for population served by each water company and (iv) the economic benefit for population due to the implementation of SWSS platform in the water companies. In addition, the next studies will also focus on determining the replication potential of the SWSS Platform implementation on other supply systems and on the development of transferability guidelines. It will include (i) a sector analysis to identify the main characteristics of the existing water supply systems, mainly on EU-27 countries, (ii) a comprehensive analysis of the key conditions and requirements for SWSS platform implementation and (iii) the identification of the main barriers.