Analysis tools for management of water losses in urban aqueducts
  Partners: - University of Perugia   - Technical University of Bari

   The development of advanced tools for the analysis of water distribution systems is a key point for their efficient and sustainable management. Their progressive deterioration and the adoption of management strategies based on analysis tools not consistent with the actual functioning of the systems are endangering their high economic and social value. The principal indicator of such a phenomenon is the growth of water losses rate, which in Italy was on average the 40% of the produced volume. Water losses involve: (1) the waste of water; (2) the loss of revenue for municipalities; (3) the unjustified increase in energy consumption and CO_2 emissions associated with water delivery service; and (4) the worsening of service level.   The pressure management is an efficient and economical solution to reduce water losses, while providing adequate service levels. However, the world's most popular tools for hydraulic analysis of networks (e.g., EPANET of US EPA) have evident limitations in the phenomenological representation and solution of the mathematical problem underlying the hydraulic simulation of networks. Such limitations are, for example, (a) the hypothesis of water demand components as pressure independent, (b) the inability to represent the relationship between pressure and water losses, and thus to quantify the water leakage volumes during an operating cycle; (c) the implementation of heuristics rules to predict the behaviour of control devices (e.g. pressure reduction valves - PRV).

In this scenario, the research proposal aims to address three central issues of the problem:

1. the experimental study of the hydraulics of water outflow from breaks in pipes, in order to determine the relationship between water flow and possible influential factors, e.g., pressure, pipe material, age;

2. the experimental hydraulic characterization of different types of PRV and energy recovery devices such as pumps used as turbines (PAT) that represent an effectivesolution to combine the control of pressures with energy recovery;

3. the development of advanced simulation models that allow: (a) the modelling of background water leakages as at point 1; (b) the simulation of PRV and PAT without the use of heuristic rules, implementing the results of the hydraulic characterization of point 2. To this aim the model for hydraulic analysis will be implemented in the WDNetXL system (www.hydroinformatics.it), already developed by POLIBA in a previous PRIN call.

Moreover, the water leakage models and the characteristic curves of the analyzed devices will be calibrated, since it is essential for the effective transfer of results from laboratory scale to the field. The reliability of the network model will be tested on real and literature case studies, reproducing continuous and discontinuous supply scenarios. The implementation of the research results within the WDNetXL will allow their direct transfer to the technical world.

The Research Units will also collaborate with reserachers from University of Enna Kore.