Strumenti Innovativi per la simulazione e l'analisi delle reti idrauliche

Ministero dell'Istruzione dell'Università e della Ricerca - Programmi di Ricerca Scientifica di Rilevante Interesse Nazionale (DM n. 1407 del 4 dicembre 2008)

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Law n. 36 of 5 January, 1994, also know as the "Galli" law, serves firstly to outline the rational and sustainable use of water resources. It sets out by reasserting the primacy of human consumption from among different water uses and stresses the need to guarantee high quality. To accomplish this, it advocates that water use should occur in a manner that ensures its replenishment and does not compromise the resource stock for future consumers and, to this end, calls for the progressive restoration and gradual rehabilitation of existing water distribution networks which currently operate inefficiently and/or suffer from poor reliability. These objectives are pursued via the separation of planning and monitoring (jurisdiction of the regulating agency) and the management of integrated water services (task of the service provider, i.e. the utility). This latter is entrusted with both current system operation as well as improvement/enlargement planning of infrastructure and assets related to the transport and distribution of potable water. In executing its mandate, the utility must carry out all its activities and investments with an eye to network efficiency, reliability and security. The proposed research project is inserted in this framework with the target of producing the instruments which can be useful to the water distribution systems operators to set up their management and planning policies in order to achieve the targets mentioned above. These instruments are primary based on mathematical models developed to represent the complexity of the physical processes governing system behaviour. Consequently, numerous issues pertaining to the representation of leaks will be studied, especially the relationship between leakage and pressure, the spatial and temporal variability of consumer demand, the time-evolving characteristics of breaks, and the chemical processes related to substances employed in network operation (i.e., disinfectant residuals) or to species accidentally or intentionally introduced to the system. Moreover, a study will be made of the hydraulic simulation models able to represent and automatically manage leaks, user demand as a function of available pressure head, the position and setting of control devices, and various plausible topologies. Resulting analyses will, in turn, be incorporated into distinct single and multi-objective optimization approaches based on evolutionary algorithms. The procedures that derive from these, and that represent the ultimate aim of the project, are intended to function as useful decision support tools in system planning and operation for obtaining leakage minimization, general system reliability and enhanced security in the face of potential accidents or nefarious actions. In the proposed research, reference will be made to known and well studied systems from the literature as well as to real networks. In this sense, all of the investigators comprising the research team of this project have maintained active collaboration with utilities and water service providers in their respective zones. Their involvement offers the opportunity to test and validate developed approaches on complex systems and allows asset managers to influence the ultimate shape of these techniques, ensuring a more readily applicable research end product and solidifying the link between academic researcher and the water utilities/agencies

who are the ultimate end users of this research.