The integrated management of water distribution systems has continued to become a research topic and focus of technological exchange of understandable and growing importance and study of innovative network simulation tools has attracted considerable interest for its potential contributions to applied research and infrastructure management. Pressure to achieve improved management of water supply infrastructure has arisen from a calculus of interrelated exigencies including financial, socio-economic, environmental and regulatory needs, which call for new paradigms of network administration that are supported by effective modeling instruments that go beyond standard consolidated packages (EPANET2 [16]). Optimal management of water distribution systems aims at realizing service quality via the well-conceived (efficient) application of a utility's financial, structural and human resources, all of which entail satisfaction of specific objectives such as the optimization of network pressure, service continuity (reliability), and maintenance of water quality. These in turn call for system monitoring, control, design and rehabilitation, necessitating a coherent planning strategy. Moreover, adopted planning schemes should be accompanied by indications of the risk associated with different decisions with respect to the variability of key parameters (roughness, demand, etc.), encouraging an approach that fixes confidence levels around such choices in a cost-benefit context.

Clearly, there exist numerous modelling needs and, inspired by these, group's research themes will address the advanced hydraulic simulation of networks accounting for water leakages as function of pipe pressure, topological analysis and analysis of the system of isolation valves. In this context, the Bari research unit proposes to develop:

1) An advanced head-driven hydraulic network simulation model which can be used for extended period simulations.

2) Integration of the aforementioned simulator with a water leakage model with a pipe resolution and accounting for pipes' structural features.

3) A model analyzing the role of topological variation resulting from the disconnection of mains and the temporary isolation of network zones by means of valve

closures.

4) A method of analyzing and optimal designing the comprehensive structure of isolation valves that govern system rehabilitation and influence network reliability.

5) An automatic design technique that, beginning from an enhanced hydraulic simulation and topological analysis, considers the mechanical and/or hydraulic

reliability of network configurations.

The advanced hydraulic simulation model realistically captures supplied flows as a function of nodal pressure and is integrated with a pipe-level leak simulation module [2].

The topological analysis model considers the role of isolation valves within the network and, by simulating in a probabilistic manner the segregation of network zones by means of valve closure (common in daily system operation), the resulting interruption of various mains can be studied, admitting also the possibility of

representing valve malfunction.

Comprehensive analysis of the network's valve system, within the context of the network's current state, permits scrutiny of its ability to maintain service standards (or to limit its underperformance) in unusual or extreme operating conditions, such as during asset replacement/repair, allowing for assessment of mechanical reliability.

Setting out from such an approach, the automatic valve allocation procedure considers probabilistically the effect of valve location on the network's hydraulicperformance and renders possible evaluation of the system's reliability in relation to potential isolation valve deployment scenarios, automatically conceived in the design phase. The automatic planning method for network mains, in simulating the occurrence of both mechanical and hydraulic service

interruption, permits design considering the mechanical/hydraulic reliability of the proposed solution as the probability that service levels will remain satisfied.