An Assessment of Water Distribution Systems and Associated Research Needs [Project #706]

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BACKGROUND
The purpose of this project was to assess the condition of water distribution systems throughout North America and to develop a 10-year research agenda for the American Water Works Association Research Foundation (AwwaRF) oriented toward needs of these systems. The Research Advisory Council (RAC) and the AwwaRF Board of Trustees have always believed that water distribution systems are very important in the supply of high-quality drinking water; however, research in this critical area has sometimes lacked focus.

APPROACH
The project team (Economic and Engineering Services, Inc.; Roy F. Weston, Inc.; and General Waterworks Corporation) approached this study by:

- collecting information on distribution systems from utilities and AWWA data bases
- identifying and prioritizing problems in distribution systems
- determining which problems could be addressed by research
- developing a 10-year research agenda for water distribution systems

The project team used several sources of information to develop its major findings, including reviews of literature, previous AwwaRF projects, expert workshops, conference proceedings, AwwaRF comprehensive assessments, the Water Industry Data Base (WIDB, [AWWA and AwwaRF 1992]), and Water Industry Technical Action Fund (WITAF) reports. In addition, the project team developed a detailed survey questionnaire oriented toward distribution systems and conducted 20 in-depth interviews with small, medium-size, and large utilities across North America to complete the survey. The findings of this Research Agenda Survey (RAS), plus other data from the sources listed above, were invaluable to accomplishing project goals.

RESULTS
Comparing the $4.5 billion spent annually by U.S. utilities to operate and maintain transmission and distribution systems with the $1 million allocated annually by AwwaRF for Distribution Systems research gives some insight into the funding issue. This level of research funding equates to less than 0.03 percent of the annual O&M expenditure by U.S. utilities. Further, there needs to be a new focus on practical applications and prototype development in the area of infrastructure and significant expansion in study and use of design and operations tools such as computer modeling, SCADA, and GIS. The following goals and research needs are offered to meet these and other future requirements.

Based on the needs as identified by utility personnel, the project team has formulated a goal statement for distribution systems:
The strategic goal for AwwaRF in the area of Distribution Systems is to conduct research that will enable utilities to plan, design, construct, operate, and maintain transmission and distribution systems in a manner that (1) minimizes water quality deterioration through to the customers taps and (2) extends the life of and makes efficient use of pumping plants, storage facilities, conveyance systems, and water system appurtenances.

To support the strategic goal, the research program needs to be divided into four subcategories:

- Water Quality Maintenance and Regulatory Issues
- Corrosion, Permeation, and Materials Deterioration
- Water Distribution System Infrastructure
- Distribution System Design and Operation

Water Quality Maintenance and Regulatory Issues
Research should be conducted that will further the understanding of the causes of water quality deterioration in distribution systems and practical solutions should be developed that will enhance compliance with drinking water quality regulations and maintain aesthetic properties. The research approach should include paper, bench-, pilot-, and full-scale studies.

Corrosion, Permeation, and Materials Deterioration
Research should be conducted that will investigate causes of and practical solutions to internal corrosion, materials deterioration, metals leaching, and permeation of nonmetal piping and joints by outside contaminants. This subcategory will contain elements of basic research, especially in corrosion control, where some fundamentals are still not clearly understood.

Water Distribution System Infrastructure
Application-oriented research should be conducted to develop state-of-the-art test methods for determining condition and serviceability of existing and new piping and appurtenances and to develop and demonstrate innovative methods in the field for rehabilitating and replacing piping.

Distribution System Design and Operation
Research should be conducted into tools that will help operators document the location and condition of their infrastructure and enhance efficient operation of their distribution systems. Areas of emphasis are development of system performance standards, control systems, hydraulic and water quality models, and mapping.

Based on the preceding evaluation, specific projects and recommended research to be conducted within the next 10 years are included and prioritized. The priorities were established based on the seriousness of the problem identified, the need for one project to precede or to build on another, and mandated time frames stemming from the SDWA regulations.