Assessment and Renewal of Water Distribution Systems
[Project #2772]

ORDER NUMBER:
91025F

DATE AVAILABLE:
Fall 2004

PRINCIPAL INVESTIGATOR:
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OBJECTIVES:
The objectives of this project were to synthesize the knowledge base on condition assessment, repair and rehabilitation, and prioritization; to expand the knowledge base to lead to optimal capital management strategies for utilities; to help plan a responsive research agenda for the water supply industry; to help utilities use results of research projects; and to provide a critical evaluation and an assessment of requirements for implementing tools.

BACKGROUND:
Water utilities use their distribution systems to deliver high quality water to customers in spite of breaks, corrosive deterioration, and other forces. These aging and invisible water distribution networks, spread over large areas with multiple connections and points-of-access, require large allocations of capital resources for renewal. Needs studies began to appear around 1980 after implementation of the Safe Drinking Water Act converged with emerging awareness of national infrastructure investment needs and with the ramp-up of AwwaRF programs. To succeed in capital management, utilities must locate, assess, plan, repair, and renew their water distribution systems. However, management technologies for these tasks are in flux and utilities require guidance.

HIGHLIGHTS:
This report is a synthesis of knowledge and includes the suggestions of utility and other professionals about renewing distribution systems. The report covers a broad range of technologies—from technology-based assessment tools for operators to capital strategy planning methods. The first topic, condition assessment, or the “science” and engineering side of distribution system management, addresses locating assets, diagnosing failures, learning about deterioration mechanisms, and measuring condition. The second topic, planning and prioritization, or the “management” side, requires the utility to find funding sources, relate to governing boards and the public, and provide management and financial accountability. The third topic, or the “construction” side, comprises the physical work of maintenance, repair, and renewal.

APPROACH:
The project included a synthesis of the knowledge base, interviews with utilities, and three workshops, including an international workshop. A number of working papers and workshop summaries were prepared, and the project results have been merged into the final report.
RESULTS/FINDINGS:
An “issue tree” is used to show the components of the management problem and to provide a structure for analysis of problems. It shows the what, why, who, how, and when of the management problem. The report offers a framework for condition assessment to provide a common ground to exchange information. This is consistent with the findings in the field of benchmarking, where common definitions and measures are required. The framework adapts to system components and subsystems, to the technical and management sides of the organization, and to capital and operating components. It also links the parameters of condition assessment with the uses of the information for renewal work by operators, engineers, maintenance personnel, and by budget and finance staff.

The report describes how utility tasks in planning and prioritization span a spectrum from problem assessment to making decisions about solutions. It focuses on the prioritization process, as it fits into the capital planning process. It explains how, in prioritization, utilities face the dual problem of identifying their highest priority pipe renewal projects and comparing them to other capital investments, which are often more visible and attractive. The most direct way to evaluate fragility is with condition assessment technologies and direct inspection techniques. However, the sheer magnitude of buried pipe and the difficulty in accessing pipe make this problematic and this area needs more research.

The report describes how practices among utilities vary greatly in repair, rehabilitation, and replacement. At the project workshop, participants observed that North American water utilities are reluctant to use newer technologies for pipe renewal. Reasons are lack of awareness, cost effectiveness, liability, and uncertainty about sustainability. Options to speed adoption of new technologies were cost reduction by assembling larger projects; providing training; providing education for management, politicians, and customers about benefits of new technologies; and using the private sector for construction of renewals. The report describes how, for rehabilitation, utilities can choose from a family of nonstructural or semi-structural lining techniques, or they can replace a pipe with a new structural liner or pipe bursting, followed by insertion of new pipe. It also discusses the daunting aspect of the renewal problem. The problem is much more complex than other pipe scenarios due to congestion, pressurization, hidden assets, age, water quality, and service connections. In summary, the report discusses the issues faced by utilities in renewal and the options they have.

IMPACT:
The report provides comprehensive guidance to utilities about how to assess options for distribution system renewal. It will enable utility capital managers to review rapidly the knowledge base on condition assessment, planning and prioritization, and renewal methods. Although AwwaRF has sponsored a number of projects on distribution systems, the report identifies additional projects that are required.

PARTICIPANTS:
Eighteen water utilities from throughout the United States, Canada, and Australia participated in the project.