Managing Losses in Water Distribution Networks

An international strategy for an international problem

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Water Supply Management Workshop, Hue City, Vietnam 26th May 2005

Dubai: 12 million litres of desalinated water in Wild Wadi Water Park

Calcutta, India: Mother bathing child
Managing Losses in Water Distribution Networks

26th May 2005

Water Loss Monitoring Points

Challenges and Limitations

- Resources - Water, Staffing and Finance
- Public v Private Sector
- Utility and Customer Perception
- Operation and Organization
- Policy Changes
- Social, Political and Cultural Issues
- Dependency Culture - Donors and Consultants
- Motivation and Skills
- Security
- Health & Safety

Resources - Water, Staffing and Finance

Public v Private Sector

Utility and Customer Perception

Operation and Organization

Policy Changes

Social, Political and Cultural Issues

Dependency Culture - Donors and Consultants

Motivation and Skills

Security

Health & Safety

Developing a Strategy

The key to developing a strategy for any organisation is to:
- Ask some questions
- Select procedures and tools to find the solutions

The same applies to water loss management exception

Questions and Solutions

- How much water is being lost?
  - Water Balance
- Where is it being lost from?
  - Network Audit
- Why is it being lost?
  - Review network and operational practices
- How to improve performance?
  - Strategy development
- How to sustain performance?
  - Training and O&M

IWA Water Losses Task Force

- International best practice
- Network of members involved in water loss reduction
- Focused activity groups
- Exchange of information
- Key actions for implementation
- Contributing to publications, workshops, and conferences

IWA Standard Water Balance
Real or apparent losses?

- How to prioritize?
  - Water Balance (how much and where?)
  - Analyze causes

Real loss component analysis

<table>
<thead>
<tr>
<th>Leakage and Overflows at Storage Tanks</th>
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</thead>
<tbody>
<tr>
<td>Background Losses</td>
</tr>
<tr>
<td>Reported Bursts</td>
</tr>
<tr>
<td>Unreported Bursts</td>
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<tr>
<td>Excess or Hidden Losses</td>
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</tbody>
</table>

Leak Volume = Awareness + Location + Repair Time x Flow Rate

Bottom-up real loss assessment

- 24h inflow and pressure measurements
  - entire system (if small)
  - sample areas within the system
- Area data to be collected
  - length of mains
  - number of service connections
  - number of household properties
  - number and types of non-household properties

Zone inflow analysis

Zone inflow analysis

Pressure Management

- Speed and Quality of Repairs
- Minimum Achievable Annual Real Losses
- Potentially Recoverable Real Losses
- Pipeline and Asset Management
- Selection: Installation: Maintenance: Rehabilitation: Replacement
- Active Leakage Control
- Current Average Volume of Real Losses
Network records and recording systems

- Update network plans and records
- Pipe location survey
- GIS

Review of network operating practices

- Why is water being lost?
  - Management policy
  - Network characteristics
  - Operational practices
  - Technology and skills
  - Social and cultural influences

Improving the network

- How to improve the network?
  - Zoning (sectorization)
  - District Meter Areas (small zones)
  - Pressure management

Sectorization (Zoning)

District Metered Area (small zone)

Zonal Monitoring

- Volume of water
- Equivalent service pipe bursts
- Cost of lost water
- Prioritizing system
- Allows the operator to focus leak location effort to give most benefit
Design constraints and aids

Design constraints
- network pressures
- critical points
- too many closed valves
- traditional values and reluctance
- intermittent supply

Design benefits
- pressure testing
- network model
- extra meters or re-design boundary
- education and awareness training
- restore supply in pilot DMA

DMA (Zone) Maintenance

Boundary integrity
- record changes
- mark boundary valves
- educate staff!

Plant and equipment
- meter checks
- instrumentation checks

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Zone night flow data

Occurrence of large burst & repair

Customer night flow assumed constant in time

Background leakage assumed constant with time at current pressure

Pressure management

‘One-off’ reduction in leakage

Pressure Management Area (PMA)

Design within DMA

Cost beneficial

Fast payback

Active leakage control

Leakage monitoring (zones)

Analysis of data

Leak detection programs:
- leak localizing (noise loggers)
- survey (correlator/sounding)
- leak location

Leak Localizing (noise loggers)
Leak Location (traditional)

Leak Location (new technology)

Infrastructure management and repairs

Illegal connections, theft and fraud

Customer meter under-registration

- Customer metering policy:
  - Measurement accuracy
  - Meter type
  - Installation procedure
  - In situ or workshop testing
  - Customer use pattern and plumbing (tanks filling, ‘trickles and drips’ etc.)

Billing and collection

- Tariff structure and charging policy
  - political/social factors
  - encourages demand management
  - low income concerns (health/hygiene)
  - can encourage damage and bypass

- Meter reading and revenue collection
  - integral part of strategy
  - supervision and checks
Maintaining the strategy

- Training and skills transfer
  - Workshops
  - Technology transfer
  - Field training
  - O&M programme

Case Study 1. Bahamas

Technical Problems

- Direct pumping into the system (6 PS)
- Fixed speed pumps
- No surge control
- Limited storage (~100 ML) and gravity supply
- Effect on burst rate

Issues for Improvement

- Additional sources
- Address pumping regime
- Increase storage
- Utilise cross-department skills
- Improve Quality Assurance and O&M policies
- Customer metering policy

Action Plan (1)

- Pressure Management
  - System Optimisation (PRVs, PCVs, SRVs, gravity flow)
  - Telemetry
  - Infrastructure Management
- Infrastructure Audit
  - GIS
  - Standards
  - QA/QC

Action Plan (2)

- Active Leakage Control
  - Monitoring and Testing Equipment
  - Meter Sizing/Calibration
  - NRW Reduction: Pilot Project / Performance-Based Contract
- Leak Repairs
  - Re-organisation
  - Establish standards
  - Outsourcing (internally/externally)
  - QA/QC
- Technical Assistance/Training
Project characteristics
- Duration: 4 years
- Reduction of real and apparent losses
- Outsourced to private contractors
- Total cost: US$ 27 M
- Includes establishment/refurbishment of 80 DMA zones and selective mains replacement

Conclusions
- Real losses can be calculated from top-down and bottom-up approach
- After knowing HOW MUCH? and WHERE FROM? the water loss reduction strategy can be designed
- Strategy addresses real and apparent losses
- Case studies demonstrate similar costs and benefits
- Strategy can be applied to any organisation anywhere in the world

Case Study 2. Rarotonga - Cook Islands
- 13 upland spring sources
- Limited storage (2.5 Mi reservoir)
- No active leakage control
- Coastal ring sub-mains, no zoning
- Some planned replacement
- High local and tourist demand (330-1000l/h/d)
- Successive drought years
- Planned pipe replacement and dammed valley augmentation
Rarotonga network

Short and Medium Term Action Plans

- Bulk meters at sources
- Create source supply zones
- Use zones for water loss monitoring
- Set up customer use studies
- Set up pilot study areas
- Introduce leakage control teams
- Empower with equipment, vehicles and knowledge
- Conduct awareness seminars and training
- Plan network improvements while upgrading
- Plan water conservation programmes

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