Some international experiences in promoting the recent advances in practical leakage management

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Abstract Substantial advances have been made by the IWA Water Losses Task Force in the last few years in the development of practical water loss management methods, including the benefits of active pressure management, calculation of economic intervention frequency for active leakage control, and economic levels of leakage. This paper reviews experiences to date in introducing and disseminating these advances to Utilities internationally, with particular reference to Australia, Europe, and North America.

Keywords: leakage management / water losses, pressure management

Promoting Practical Approaches to Water Loss Reduction.

The IWA Water Losses Task Force has evolved from a small group of five members in 1996-1999, to an interactive group of over 200 members in 35 countries across 5 continents. The Task Force has developed, through a series of specialist teams, a series of concepts and best management practices (BMPs) related to the control of water losses in municipal water distribution systems. These BMPs are being actively promoted internationally through seminars, Workshops, papers and personal contacts.

The outputs of the first Water Losses Task Force (1996-2000) consisted of recommendations for improved Best Practice performance indicators for Non-Revenue Water and Real Losses (including calculation of Unavoidable Annual Real Losses and the Infrastructure Leakage Index ILI), and a standard Water Balance and terminology (Lambert et al, 1999; Alegre et al 2000). The BABE (background and bursts estimates) concept of component analysis of Real Losses, and the FAVAD (Fixed and Variable Area Discharges) concept for pressure: leak flow rate relationships, were also introduced to international use during this period. At an IWA Conference at Brno (2001), the Water Losses Task Force was reconstituted to promote and further develop these and other best practice concepts.

During the period June 2003 to December 2004, a series of ‘Practical Approach’ articles by Task Force members, setting out the ‘state of the art’ and objectives of the various teams was published in ‘Water 21’ every 2 months. These articles can be downloaded by entering the month and year at the end as shown here: http://www.iwapublishing.com/template.cfm?name=w21jun03 etc.

In addition to major 2-day specialist Leakage conferences in Lemesos (October 2002) and Halifax, Nova Scotia (September 2005), Water Losses Task Force members have organized many other training course and Workshops, too numerous to mention individually, together with:

- 1-day Workshops at American Water Works Association Conferences in Anaheim and Portland (2003), with an additional Workshop scheduled for Phoenix in 2006
- Workshops at IWA Congresses in Marrakech (April 2004) and Santiago (March 2005)
- a series of Workshops with the Australian Water Industry (February 2005)
- a series of Workshops with the Italian Water Industry (May 2006).

This international activity has resulted in a consistent and rational approach to water loss management being implemented in more and more countries, with demonstrable success. Water Losses are being reduced significantly and the reductions are being maintained. Published examples of successful implementation of pressure management and leakage management initiatives are encouraging other Utilities to manage their water losses more effectively. But the task of communicating the new improved methodologies to thousands of Water Utilities continues to be a significant challenge.
Water Loss Reduction Strategy – making it happen

The authors of this paper, based in North America, Europe and Australia, use a common approach when explaining to Utility personnel how to begin to implement a Water Loss Reduction Strategy, as follows:

- **Step 1**: Assess your losses in volume terms, using the Best Practice international standard IWA annual Water Balance
- **Step 2**: Identify ‘How are we doing?’, using best practice performance indicators (PIs)
- **Step 3**: Analyse your data and identify your priorities and strategy
- **Step 4**: Get started and learn as you progress

**Step 1** has become much easier to accomplish during 2006, as there are now several free software packages (developed by, or with input from, Water Losses Task Force members, see Table 1), that allow the user to complete a basic water balance, and to assess the annual volume of Non-Revenue Water, Apparent Losses and Real Losses.

**Step 2** has also become easier, as all these free software packages enable the user to calculate the ‘Best Practice’ performance indicators for operational management of real losses, which are:

- Best simple traditional PI: Litres/service connection/day (or m³/km mains/day if system has less than 20 service connections per km of mains)
- Best detailed PI: Infrastructure Leakage Index ILI (= CARL/UARL)
  CARL = Current Annual Real Losses; UARL = system specific Unavoidable Annual Real Losses

**Table 1: Some free softwares for Water Balance and Performance Indicator Calculations**

<table>
<thead>
<tr>
<th>Free Software</th>
<th>Additional Information</th>
<th>Availability</th>
<th>e-mail or website address</th>
</tr>
</thead>
<tbody>
<tr>
<td>AquaLite</td>
<td>Nearing completion</td>
<td>International</td>
<td><a href="mailto:RonnieM@wrp.co.za">RonnieM@wrp.co.za</a></td>
</tr>
<tr>
<td>Benchleak</td>
<td>Currently available</td>
<td>South Africa</td>
<td></td>
</tr>
<tr>
<td>CheckCalcs</td>
<td>Allocates ILIs to WBI Banding system, identifies priorities for action. Identifies possibilities and benefits of pressure management.</td>
<td>Europe, Middle East, Australia &amp; New Zealand, Canada and USA, All other countries</td>
<td><a href="http://www.studiomarcofantozzi.it">www.studiomarcofantozzi.it</a>, <a href="mailto:mfarley@alvescot.demon.co.uk">mfarley@alvescot.demon.co.uk</a>, <a href="mailto:sammiep@widebaywater.com.au">sammiep@widebaywater.com.au</a>, <a href="mailto:veritech@sympatico.ca">veritech@sympatico.ca</a>, <a href="http://www.leakssuite.com">www.leakssuite.com</a></td>
</tr>
<tr>
<td>Leakage CheckUp</td>
<td>Software cannot be downloaded, calculations done on TILDE website</td>
<td>Europe</td>
<td><a href="http://www.waterportal.com">www.waterportal.com</a></td>
</tr>
<tr>
<td>WaterAudit</td>
<td>Versions in both US and metric units, customised to N. American terminology</td>
<td>American Water Works Association Website</td>
<td><a href="http://www.awwa.org/WaterWiser/waterloss/Docs/WaterAuditSoftware.cfm">www.awwa.org/WaterWiser/waterloss/Docs/WaterAuditSoftware.cfm</a></td>
</tr>
<tr>
<td>W-B Easy Calc</td>
<td>Allocates ILIs to WBI Banding system</td>
<td>International</td>
<td><a href="http://www.liemberger.cc">www.liemberger.cc</a></td>
</tr>
</tbody>
</table>

Initial identification of priorities for leakage management, under **Step 3**, has recently been greatly facilitated by the World Bank Institute Banding system (Seago et al, 2005). **Table 2** shows how, once the Infrastructure Leakage Index (ILI) has been calculated for a particular system, it can be allocated within Bands A to D, each of which links to a general description of Real Loss Management Performance; note that Band widths for developing countries are twice those for developed countries. Once the appropriate Band has been identified, **Table 3** identifies the likely priorities for action. In the CheckCalcs software, the calculated system ILI is also compared with ILIs for the country or geographical region.

Using the latest prediction methods developed by members of the Pressure Management team of the Water Losses Task Force (Thornton & Lambert 2005), it is also now possible to make overview predictions of Pressure Management opportunities, and the likely effect on leak flow rates, new burst frequencies and residential consumption (Table 4).

**Table 2: Allocation of ILI to World Bank Institute Banding system**

<table>
<thead>
<tr>
<th>ILI range</th>
<th>Developed Countries</th>
<th>Developed Countries</th>
<th>BAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 4</td>
<td>Less than 2</td>
<td>A</td>
<td>1.4</td>
</tr>
<tr>
<td>4 to &lt; 8</td>
<td>2 to &lt; 4</td>
<td>B</td>
<td>Potential for marked improvements; consider pressure management, better active leakage control practices, and better network maintenance</td>
</tr>
<tr>
<td>8 to &lt; 16</td>
<td>4 to &lt; 8</td>
<td>C</td>
<td>Poor leakage record; tolerable only if water is plentiful and cheap; even then, analyze level and nature of leakage and intensify leakage reduction efforts</td>
</tr>
<tr>
<td>16 or more</td>
<td>8 or more</td>
<td>D</td>
<td>Very inefficient use of resources; leakage reduction programs imperative and high priority</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General description of Real Loss Management Performance Categories for Developed and Developing Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 4</td>
</tr>
<tr>
<td>4 to &lt; 8</td>
</tr>
<tr>
<td>8 to &lt; 16</td>
</tr>
<tr>
<td>16 or more</td>
</tr>
</tbody>
</table>
Table 3: Recommended Priority Activities for WBI Bands A to D

<table>
<thead>
<tr>
<th>WBI Recommendations for BANDS</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigate pressure management options</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Investigate speed and quality of repairs</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check economic intervention frequency</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduce/improve active leakage control</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify options for improved maintenance</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assess Economic Leakage Level</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review burst frequencies</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review asset management policy</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Deal with deficiencies in manpower, training and communications</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-year plan to achieve next lowest band</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fundamental peer review of all activities</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Overview predictions of Pressure Management opportunities and reductions in leak flow rates, new burst frequencies and residential consumption

<table>
<thead>
<tr>
<th>Wide Bay Water</th>
<th>Anytown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average System Pressure Pavis</td>
<td>65.0 metres</td>
</tr>
<tr>
<td>System is supplied principally by gravity with</td>
<td>Continuous supply</td>
</tr>
<tr>
<td>Using this information, and the assessment method shown in Cells B15 to M21, the probability of pressure management opportunities for this system can be provisionally categorised as</td>
<td>HIGH</td>
</tr>
<tr>
<td>Assumed change in average system pressure</td>
<td>-15.00 metres</td>
</tr>
<tr>
<td>Assumed % change in Faw</td>
<td>-23.1%</td>
</tr>
<tr>
<td>% of annual residential consumption outside property</td>
<td>30%</td>
</tr>
<tr>
<td>Do customers have private storage tanks? (Yes/No)</td>
<td>No</td>
</tr>
<tr>
<td>Probable range of predicted changes:</td>
<td></td>
</tr>
<tr>
<td>% change in current leak flow rates</td>
<td>Lower</td>
</tr>
<tr>
<td>% change in new burst numbers and annual repair costs</td>
<td>-12%</td>
</tr>
<tr>
<td>% change in residential consumption</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

Tables 1 to 4 above demonstrate that any Utility, using freely available software, can now:
- attempt a standard water balance, and assess the annual volume of real losses
- assess the simple (litres/service connection/day) and detailed (ILI) performance indicators for operational management of real losses, for their system or systems
- categorise the calculated ILI within the WBI Banding system; obtain a general overview of current performance, and identify likely priorities for action
- provisionally categorise pressure management opportunities, and make overview predictions of likely changes in leak flow rates, numbers of new bursts, and residential consumption.

With this type of low cost (or no-cost) analysis, it is hoped that many more Utilities will be motivated to get started (Step 4), and take action to manage their Real Losses more efficiently. The following sections of the paper outline the methods that the authors currently use to empower Utility personnel, so that they may gradually develop their skills and confidence in using the concepts, and make appropriate technical and managerial decisions as they implement their leakage management strategy.

The 4-Components Approach to managing Real Losses

The ‘4-Component’ diagram, shown in Figure 1, is now widely used internationally, to explain the practical concepts for managing Real Losses that are promoted by the Task Force.

For any distribution system, the large box represents the Current Annual Real Losses CARL (calculated from a standard IWA Water Balance, preferably with 95% confidence levels). The Unavoidable Annual Real Losses UARL are calculated from the equations developed in Lambert et al (1999), based on mains length, number of service connections, customer meter location and average pressure. The Infrastructure Leakage Index (ILI) is the non-dimensional ratio of CARL/UARL, and is the recommended ‘best practice’ Performance Indicator for operational management of Real Losses.
Real Losses can be constrained and managed by an appropriate combination of all of the four management activities shown as arrows. For each system, at any particular time, there will be an Economic level of Real Losses, this usually lies somewhere between the CARL and the UARL. The three activities of
- Speed and Quality of Repairs
- Pressure Management
- Active Leakage Control
all tend to be more cost-effective in the short term (in $ spent/m³) than pipeline and assets management, and should be considered jointly when calculating the Short Run Economic Level of Leakage (SRELL).

Whilst the basic logic and principles of this approach are becoming widely accepted, potential users in interested Utilities, who have had their interest and expectations raised, can easily become demotivated if there is a lack of appropriate calculation tools to ‘get started’. Accordingly, the authors have produced a series of educational Excel Workbooks to provide a common approach in a user-friendly format for training Utility personnel. As well as the free CheckCalcs software, the Standard softwares are:
- PIFastCalcs: for a more detailed water balance calculation, with 95% confidence levels, and conversion of Non-Revenue Water components from volume to value.
- PressCalcs and ALCCalcs: these explain the latest concepts used for practical pressure management and active leakage control calculations, including economic intervention
- ELLCalcs: explains practical concepts for assessing Short-Run Economic Level of Leakage.

The effectiveness of these dissemination activities to date in Australia, North America and Europe, is summarised in the remainder of the paper, for the following aspects of the ‘4-Component’ approach
- the IWA Best Practice Water Balance and Performance Indicators for Real Losses
- Active Pressure Management
- Active Leakage Control, Sectorisation, and Economic Intervention
- Calculation of short-run economic levels of leakage

**Dissemination Activities in Australia.**

**Overview of the Australian Water Industry**
The Australian Water Industry consists of some 300 Water Utilities. The Water Services Association of Australia (WSAA) represents the Urban Water Industry, and has some twenty members that provide services to 60% of the population. Another 70 Utilities service 20% of the population, and the remainder (around 200) serve the remaining 20% of the population. Much of Australia has suffered long and severe droughts over the past five years, and water loss management has a high priority nationally.
IWA best practice concepts and methodologies have been introduced and promoted to much of the remainder of the Australian Water Industry by Wide Bay Water Corporation (WBWC), a local Government Owned Corporation in Queensland. WBWC has developed a training centre, and has run numerous Workshops and training sessions in Australia for more than 50 Water Utilities. They have also developed a series of 10 manuals ‘Managing and Reducing Losses from Water Distribution Systems (2004). They provide a range of support and consultancy services to promote pressure management, active leakage control, sectorisation and other best practices to any Utility which requires specialist assistance.

IWA Best Practice Water Balance and Performance Indicators
The WSAA was quick to recognise the benefits of the IWA Standard Water Balance and performance indicators, and in 2000 commissioned a software (Benchloss) so that these calculations to be made in a consistent manner. WSAA also adopted the Infrastructure Leakage Index (ILI) as the performance indicator for Real Losses management, and has published ILIs for most of their members in ‘WSAA Facts’ since 2003. They set consistent guidelines for assessing unmeasured components of the Water Balance.

Wide Bay Water Corporation also strongly promotes the IWA Water Balance and Performance Indicators, through training and distribution of over 100 copies of the ‘PIFastCalcs’ customised Water Balance and Performance Indicators software. WBWC also uses the WSAA guidelines for assessing unmeasured components of the Water Balance, and has set up an initial national data base of ILI values.

Active Pressure Management
For several years, Wide Bay Water Corporation has promoted the concept of Active Pressure Management, to reduce leak flow rates and frequencies of new bursts, and prolong infrastructure life. The schemes implemented in its own system have produced excellent results. Despite one successful pilot project in the Hunter Valley in the 1980’s and one in Brisbane in 1994, most of the remainder of the Australian Water Industry appeared reluctant to attempt pressure management other than as a ‘last resort’ response to the extended drought of recent years. However, excellent results from pressure management schemes in the last two years, with significant reductions in night flows and new burst frequencies, have resulted in a major shift in attitude. Yarra Valley Water (Melbourne) is installing 15 pressure reduction valves; Gold Coast and several other Utilities are in process of installing pressure management schemes.

There are several specific concepts and parameters associated with best practice pressure management – such as Average Zone Point (AZP), Night Day Factors (NDFs), FAVAD N1 exponents etc. These concepts and parameters have been shown in WBWC Workshops, and are included in the educational standard software for Utilities which will be available in Australia through WBWC from October 2006.

Active Leakage Control, Sectorisation and Economic Intervention
Many Utilities in Australia have never considered it necessary to undertake Active Leakage Control (looking for unreported bursts), as some of them experience relatively low numbers of such events. Wide Bay Water Corporation has been promoting Active Leakage Control and Sectorisation of systems, with increasing success. But one problem was how to calculate the economic frequency of intervention for Active Leakage Control, and how to rationally calculate an appropriate annual budget for such activities.

A simple but effective basis for calculating Economic Intervention was recently published (Fantozzi & Lambert 2005, Lambert & Lalonde 2005), based on three parameters – Variable Cost of Water, Cost of Intervention, and Rate of Rise of Unreported Leakage. As ‘Rate of Rise’ is as yet an unfamiliar parameter for most leakage practitioners, WBWC propose to run training courses from October 2006 onwards showing how to calculate Rate of Rise (in diverse ways) and how to calculate Economic Intervention Frequency and Annual Budgets, using the appropriate standard Utility software.

Economic Level of Leakage
Calculation of Short-Run Economic Levels of Leakage, based on data intensive methodologies developed in the UK for highly sectorised distribution systems with continuous night flow measurements, have not been much applied in Australia. One of the key differences is that, unlike the United Kingdom, a substantial amount of pressure management is yet to be carried out in Australia; this will influence burst frequencies, background (undetectable) leakage, economic intervention etc. The practical method for moving towards economic leakage levels in Australia has been to repair all leaks and bursts quickly and effectively; introduce pressure management wherever feasible; and calculate and implement economic
interventions for active leakage control. The standard Utility software that allows priorities to be assessed, and calculations to be made on a predictive basis, has been tested on the Wide Bay Water system.

One further notable aspect is that in Queensland, the Water Act 2000 has specified that financial benefit: cost calculations relating to leakage management initiatives must be based on the retail price of water. WBWC and ILMSS Ltd have recently completed customised Water Balance and PIs softwares for the Queensland Water Directorate and Regulator, and the Water Directorate of New South Wales.

Dissemination Activities in North America

Overview of North American Water Industry

The North American Water Industry (Canada and the U.S.A.) consists of many thousands of Water Utilities, varying widely in size. Leakage management activities tend to be limited to repairing reported breaks and replacing mains — as in many cases the customer owns the service connection from the property line to the customer meter. The customer meter may be located at the property line (in the Southern States) or inside the property (in colder climates). Active leakage control and pressure management are not widely practised, and when practised are not necessarily based on sound economical reasoning.

IWA Best Practice Water Balance and Performance Indicators

In Canada, the IWA Water Balance methodology was recommended in the InfraGuide publication ‘Water Use and Loss in Water Distribution Systems (NRC-CNRC, March 2003), but there is no recommendation relating to Best Practice performance indicators in this or other InfraGuides as yet.

The lack of readily available software to carry out water balance calculations has, until very recently, limited the uptake of this method to around 20 Utilities which have committed to detailed training and use of the IWA Water Balance methodology and performance indicators. Since December 2005, over 100 copies of the free ‘CheckCalcs’ software have been distributed, with a 15% response for more information.

In the U.S.A., the Water Loss Control Committee of the American Water Works Association (AWWA) recommended both the IWA Water Balance and the IWA Performance Indicators (including the Infrastructure Leakage Index) in their Committee Report (Kunkel et al, 2004) as the current industry best practice for assessing water losses. As with Canada, the lack of readily available software to carry out water balance and PI calculations had limited the uptake to around 20 Utilities, most of which used an early version of PIFastCalcs software. However, organizations in several States are now adopting the methodology at State level (e.g. Texas Water Development Board, California Urban Water Conservation Council). Also, two free introductory softwares became available in early 2006; a Water Balance and PIs software developed by the AWWA Water Loss Control Committee in U.S. and Canadian units, and a USA version of CheckCalcs (see Table 1). The Water Balance and PIs calculations to date show ILIs typically in the range of 2 to 12, clearly demonstrating that many North American Utilities could make substantial reductions in Real Losses by implementing the IWA 4-Components approach.

Active Pressure Management

The importance of pressure management, in terms of reducing new break frequencies and reducing real losses, has not as yet been widely recognised in North America. Although most Water Utilities do implement pressure management, it has been traditionally based on hydraulic design constraints (e.g. setting up pressure districts) as opposed to active pressure control to minimize water losses. Design requirements for pressure management schemes in North American can be quite complex due to regulatory needs dealing with fire flow, security of supply (dual feeds) and water quality (dead ends). However, this situation is starting to change, as progressive Utilities implement successful pilot studies and disseminate the results at Conferences, often demonstrating significant reductions in frequencies of new breaks.

Advanced pressure management schemes using flow controlled PRVs are being implemented successfully in several Canadians Utilities, and being piloted as part of the AWWA research foundation study to determine appropriate design requirements for North American systems. Water Loss Task members from Canada and the USA are now collecting data on the effect of pressure management on new break frequencies and this information is being used to increase the accuracy of predictive calculations.
**Active Leakage Control, Sectorisation and Economic Intervention**

The limited number of North American Utilities that undertake Active Leakage Control usually do so by regular survey, at infrequent intervals (typically once every 4 years, or 25% of large systems each year) and with no clearly defined economic reasoning. A research contract for the AWWA Research Foundation, to assess how best leakage management practices can be transferred to North America, is nearing completion.

The use of sectorization and district metered areas (DMA) is increasing, with most of the larger water utilities across Canada implementing DMAs either on a pilot or full system basis. DMAs provide utilities with the information needed to prioritize and justify active leakage control initiative on a cost effective basis. DMAs or “zone flows” were widely used across the USA in the late 1950s and early 1960s but disappeared in the ‘70s until more recent activities and education by the IWA Water Loss Task Force and the AWWA Water Loss Control Committee. The AWWA Research Foundation study will help North American utilities with addressing the best practice approach for DMA design.

The simplified Economic Intervention method based on ‘Rate of Rise’ was introduced to North America in 2005 (Lambert & Lalonde, 2005) with the objective of allowing Utilities that do not undertake any Active Leakage Control to quickly calculate Economic Intervention Frequency and annual budget requirements, on a rational basis. This methodology is being tested in two Canadian Utilities at present using the appropriate standard Utility software, and used on several consultancy projects to provide utilities with the appropriate business case to establish a more permanent approach to water loss control.

**Economic Level of Leakage**

The standard Utility software to calculate short-run ELL is currently being used in two large Utilities and several consultancy projects in Canada, and as part of the testing procedure for the AWWARF Project referred to above. Currently, economic leakage level calculations are not used by most Water Utilities in North America; decisions on implementation of water loss control measures are based on subjective targets set from inappropriate performance indicators such as “unaccounted-for water” percentage.

With the revision of the AWWA best practice manual M36 on water loss control, and the example of leading state agencies (Texas Water Board, California Urban Water Conservation Council), future decisions on implementing water loss control measures should be based on sounder economic principles.

**Dissemination Activities in Europe**

**Overview**

The DVGW (Germany) used the IWA Water Balance, and many of the concepts such as the importance of pressure, when changing it's regulations (Liemberger, 2004). Malta Water Services Corporation also rapidly accepted the methodologies, and the ILI is now used by their regulator. In Cyprus, the Lemesos Utility has been at the forefront of applying the methods, with impressive results (Charalambous (2005).

The most recent and extensive upsurge in interest in the methodologies in Europe has been in Italy. Of the 8000 Utilities active in the water sector, most are still publicly owned, with less than 5% having private operators. Non revenue water ranges from 15-60% of system input volumes, the average being 42%. The majority of Utilities only repair ‘reported’ leaks, and do not practice any regular form of pressure management or active leakage control, except perhaps as an emergency action response during droughts.. According to the existing law (Decree 99/97), Utilities are required to calculate the water balance for each of their water systems. ILIs typically in the range 3 to 12 demonstrate that many Italian Utilities could make substantial reductions in Real Losses.

Fondazione AMGA is a non-profit organization sponsoring research to enable water utilities, public health agencies, and others to provide safe and affordable drinking water to consumers. FederUtility is an organization representing 400 water and gas utilities supplying water to some 36 million people. Together, Fondazione AMGA and FederUtility are promoting the application of international best-practices in water loss management, to improve the management of water losses in Italy. To achieve this goal, they have created a Water Losses Group. The activity of the Group, with more than 80 members from Utilities, Universities and Water Institutions, began officially in October 2004 in Genoa at a FederUtility Workshop.
Towards More Effective Management of Water Losses in Distribution Systems. The Water Losses Group is a vehicle for:

- increasing water utility awareness of the importance and economic benefits of improved management of pressure-dependent leakage;
- acting as a National Centre for promoting IWA specialist information to the Italian Water Industry;
- disseminating the IWA practical approach to a wide number of end-users and obtain their feedback;
- communicating available methodologies and innovative techniques for efficient water loss management, allowing end users to make contact with each other and exchange ideas and experiences.

Fondazione AMGA has strongly promoted the IWA Water Balance and Performance Indicators through training and distribution of copies of a simplified version of the ‘PIFastCalcs’ Water Balance and Performance Indicators software customised to Italian situation and language. Regular training workshops are organised in association with FederUtility to stimulate the application of efficient methodologies for water loss management. As a consequence of the training activities the Regulator of Emilia Romagna Region has introduced IWA performance indicators in their Guidelines and the Italian Ministry of Environment appears likely to use litres/connection/day as the suggested PI for real losses and targets.

Active Pressure Management

In Italy, in a successful pilot project in Turin in 1998, a strategically located booster station resulted in a 10% reduction in night pressures (and average pressures) over a major part of the city, a sustained reduction of around 50% in annual repair costs, and a reduction in real losses. Mention of this and other successful projects (including one at Salerno) at the October 2004 Workshop, coupled with explanation the evolving theories of pressure: burst frequency relationships, and international examples of burst reduction by pressure management, stimulated three other Utilities to successfully attempt pressure management schemes, which were reported at the April 2005 Genoa Workshop.

Therefore, mainly as a consequence of the training activity of Fondazione AMGA, excellent results from pressure management schemes have been achieved in the last two years by Umbra Acque, Abbanoa, Acque SpA and others; with significant reductions in night flows and new burst frequencies, and a major change in attitudes to pressure management. Abbanoa (Sardinia) is in process of installing several pressure reduction valves; Enia, AMGA Genova and some other Utilities are in process of implementing numerous schemes with technical support from Water Loss Task Force members based in Italy and other specialists.

Active Leakage Control, Sectorisation and Economic Intervention

The limited numbers of Italian Utilities that do undertake Active Leakage Control usually do so by regular survey, at infrequent intervals. The simplified Economic Intervention method based on ‘Rate of Rise’ was introduced to Italy in 2005 (Lambert & Fantozzi, 2005). This methodology is now being used in two Italian Utilities at present, and direct links to district metering systems are being actively developed.

Economic Level of Leakage

Calculation of Short-Run Economic Levels of Leakage has not yet been successfully applied in Italy. The practical method for moving towards economic leakage levels so far is to repair all leaks and bursts quickly and effectively; introduce pressure management wherever feasible; and calculate and implement economic interventions for active leakage control.

Conclusions

- Free softwares for calculating IWA best practice water balance and performance indicators are now increasingly available
- The World Bank Institute banding system, introduced in 2005, enables Utilities to quickly identify deficiencies in their management of real losses, and likely priorities for action
- Initiatives based on training workshops and educational softwares can significantly speed up the application of the methods by large numbers of Utilities in individual countries
- Demonstration of successful examples of pressure management to reduce burst frequencies, at Workshops in individual countries, backed up by practical theory and predictions, encourages others to use this very effective approach
- The ability to calculate economic intervention frequency and annual budget requirements should enable more Utilities to quickly make a sound financial basis for introducing active leakage control
References