Leakage/Non Revenue Water [NRW] Reduction

Non Revenue Water is the difference between the volume of water put into a system and the volume of water paid for by the customers and it comprises two components – Physical Losses and Apparent Losses.

Increasing demand on water resources and the heightened public awareness of leakage requires that resources are efficiently and cost effectively managed. In many areas of the world substantial investment is being made to reduce Leakage/NRW through various leakage management programmes. Distribution systems have unique characteristics and the appropriate combination of programmes needs to be introduced to provide effective solutions both in terms of economics and resources.

Leakage/NRW Reduction is becoming an increasingly important aspect of meeting demand, particularly in areas where water resources are limited and Halcrow Water Services (HWS) has substantial experience in this activity. In addition to designing and monitoring zonal and pressure reduction schemes, and undertaking on-site detection, HWS can also assist with the collation and analysis of data identifying the cost benefit of Leakage/NRW Reduction and monitoring the effectiveness of schemes. In addition, HWS can offer clients a 'one stop shop' approach to their leakage and NRW problems, drawing upon both Consultancy and Operational skills. Contracts can be developed in a flexible way in order to allow various alternative implementation routes. HWS's Operations Division can offer clients partnered packages based upon a shared benefits basis. This type of contract can be very attractive to clients both from a practical point of view and also financially.

Setting Economic Leakage Targets

Leakage within a distribution system is perceived to be waste, and hence an unnecessary cost for customers and the environment to bear. Reduction in leakage/NRW may not be economically viable for the water undertaking based solely on operating costs alone, however, such reductions may enable the deferment of major capital schemes and in turn also help with the abstraction requirements for an undertaking. These savings can be significant to an organisation. Undertakings therefore need to be able to justify their leakage/NRW Reduction policy and targets in the light of these economic and environmental circumstances.

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In addition, the establishment of the level of leakage, which balances the interests of the undertaking, its customers and the environment, requires careful consideration. The general characteristics of a distribution system – demand, pressure and infrastructure, are unique and targets relevant to particular areas need to be established in the early stages of a reduction programme.

The strategy for Leakage/NRW Reduction needs to take account of the existing leakage and target levels together with the Undertaking's other investment activities particularly related to the distribution system. For example, there may be reduced benefit in investment in Leakage/NRW Reduction in specific areas, if there may be other proposals to replace mains for water quality reasons.

Priorities can only be established if the potential savings and cost of leakage in particular areas can be identified. This approach necessitates quantifying the current level of leakage/NRW.

Water Audit/Balance

The total annual water losses in any water undertaking or a section of its water supply system can be calculated using a recommended standard format and terminology developed by the International Water Association (IWA). HWS has a wealth of experience in calculating losses using the IWA standard water balance with a clearly defined terminology and methodology. This methodology uses the Bursts and Background Estimates (BABE) concepts. This set of concepts applied as component-based computer models provide the tools for making a fully-integrated assessment of all the parts of NRW control – technical and economics. The main components of the water balance are:

- Authorised consumption which includes billed metered and unmetered use and unbilled metered and unmetered use.

- Water losses which include apparent losses (meter error, unauthorised use) and real losses (leaks, bursts and overflows).

The BABE concepts enables the component parts of any supply system to be established, quantifying losses from the source to the customers' tap with a clear trail of data. Absolute accuracy of water metering cannot be achieved; however installation of appropriately sized meters combined with regular servicing/renewals can substantially improve overall confidence in data. Losses need to be established from all sources, trunk mains and reservoirs and in the distribution system. Good quality data

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needs to be interpreted accurately and therefore a clear understanding of supply boundaries and transfers is therefore most important.

Developing a Leakage/NRW Reduction Strategy

The primary objective of a leakage/NRW strategy is to reduce and maintain losses at the long term economic level based on the assessment of costs, resources, demand levels and any regulatory requirements.

The reduction of physical losses is mainly concerned with the carrying out of several different activities:

- The management of pressures and the monitoring of flows and actively detecting and repairing leaks.

- The reduction of apparent losses, water i.e. delivered to users but is not measured frequently due to inaccurate or failed production and customer meters. Also included is unauthorised usage (illegal connections), and water legitimately used for which no income is received, including operational use and firefighting.

- The reduction of physical losses, water, which is physically lost form reservoirs and the distribution system form transmission mains through to the location of the customer meter is mainly concerned with the carrying out of several different activities.

The Reduction of Physical Losses

Manpower

It is most important to have well trained and motivated staff engaged on NRW activities. Manpower levels need to be monitored against NRW targets over the years to ensure staff levels have been both adequate and appropriate to fulfil the NRW reduction targets.

Flow Monitoring

The monitoring of flows, particularly night flows, most is important to leakage managers who use the details to prioritise their leak location effort.

An efficient leakage management system will comprise a water distribution system divided into small geographic area containing between 1000 and 3000 service connections. A common term for these areas is District Meter Areas (DMAs). The monitoring of flows to DMAs result in the efficient use of leakage detection resources and monitoring the effects of this effort.

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Pressure Management

The management of pressures within a water distribution system is a fundamental consideration in any efficient leakage reduction strategy. Research undertaken in recent years by water engineers around the world has resulted in a rational explanation why leakage in distribution systems is so sensitive to pressure.

Advanced pressure management schemes address one of the key issues – the importance of maintaining consistent low, but acceptable pressures with minimal variation

Potential benefits of pressure management schemes:

- Leakage reduction
- Decrease in burst frequency
- Reduce the rate of deterioration of pipework
- Efficient distribution of water

Pressure management software is used to assess the likely savings of various pressure management facilities (fixed outlet, time and flow modulation) in any part of a distribution system.

Leak Location and Repair

Having prioritised areas for leak location from night flow data, the leakage teams then need to precisely locate the leak positions. Advanced technology is now available to assist with this activity such as acoustic logging and specialist leak correlation equipment. Following this activity, the leak repair teams can then be called and a repair effected. Repairs need to be carried out as quickly and safely as possible in order to maximise the savings and reduce the inconvenience to customers. Specific targets need to be developed for repair work and these need to be regularly reviewed.

Asset Replacements

By adopting an effective Leakage/NRW Reduction strategy, organisations can defer significant levels of capital expenditure, particularly resource development. However, it is most important to link the asset replacement programme to the Leakage/NRW strategy including in particular, pipeline replacements. It is also important to consider service pipe replacements, as it has recently become more evident that a significant proportion of leakage from distribution systems comes from service pipes and their associated fittings.

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Reduction of Apparent Losses

At the early stages of Leakage/NRW Reduction programmes, meter change-out programmes need to be developed, particularly for large commercial customers. This is necessary because old mechanical meters under-record to varying degrees (typically 3 to 15%) which inevitably reduces revenue to the water undertaking. Thus a meter change-out programme has the combined benefit of producing more reliable information for the Leakage/NRW teams and also increased revenue for the organisation as the old meters invariably under-recorded.

Quantifying and controlling the amount of water illegally taken from a water distribution will not only reduce apparent losses but may also increase revenue to the water undertaking. The problem varies greatly in different parts of the world and HWS have assisted water undertakings with developing methodologies for controlling the amount of water taken illegally from a distribution system.

Distribution Network Modelling

Computer based network modelling is now a well established technique for the analysis of water distribution systems. An area where models are particularly useful is in the design of Leakage/NRW Reduction schemes. The principal mains within a distribution system can be identified from the model thus enabling potential District Meter Areas to be designed and evaluated.

Training Programmes

Distribution staff need to be kept up to date with new leakage management techniques and technology. Structured training programmes need to be implemented and the appropriate staff trained. In this connection, HWS Operations has the expertise to provide training of staff to suit the client's requirements.

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