Boosted Potable Water Supplies

Practical guidance on the operation and maintenance of boosted potable water supplies.

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Introduction

Escape of water can cause extensive damage to property and could lead to extended interruption of your business. However, identifying the potential damage and implementing effective mitigation measures will reduce the likelihood of such an incident occurring, helping to protect your property and business. This exposure exists for all water supplies within any property.

Traditionally, the majority of properties in the UK are fed with fresh potable water from a public town's main supply. Some make use of water storage tanks while in others, the practice is to feed all cold-water requirements directly.

Boosted potable water supplies are found where water pressure is an issue. This can be due to inadequate water mains pressure, or where the building height is such that the pressure needed to overcome the static head associated with the vertical distance to rise, compromises the water pressure required by the end user. This is normally the case with medium or high-rise buildings.

In these cases, water is supplied from the mains to a cold-water storage tank, usually located in the lowest level of the building. The stored water volume is then pumped and boosted by a set of electrically driven pumps throughout the property. The outlet from the pump set normally connects to a riser pipe that passes up through the building, with the supply to each floor level provided via pipes branching from the central riser. As a minimum there is a non-return valve at the discharge of the pump set, although there can be a series of these throughout the property. There can also be an accumulator tank which is fitted at the outlet of the pump set.

The accumulator tank acts as a brief back up to the booster pump set(s). Water from the pump discharge is used to partly fill the accumulator tank, which otherwise contains pressurised air. This stored volume then allows the booster pumps to be switched-off for brief periods of time, with no loss of water supply pressure, as the accumulator helps to maintain a constant supply pressure. To operate effectively, an accumulator requires an initial charge of air to a pressure less than the boosted water supply pressure.

Pressure Surges

The main cause of pressure surges in boosted water supplies is when the pipework fills or the water flows too quickly and the flow is suddenly stopped or the direction changes sharply, e.g. when it reaches the top of the riser, a 90-degree dead-end bend, a valve is closed suddenly or the end of the distribution pipework. This is often referred to as 'water hammer'.

Water hammer is exacerbated if a partial vacuum forms at the top of the riser and the water supply is restarted. This can occur when the water supply is temporarily withdrawn, sometimes as a result of one of the following:

- Complete electrical failure to the controls of the pump booster set.
- Interruption of the water supply to the water break tank.
- Loss of priming water due to air ingress in the suction pipework feeding water to the booster pump - an 'air lock'.
- Failure of non-return valve(s).

Fractured Pipe Risk

When there is a supply interruption and it is returned, if this is not managed correctly the sudden increase in flow to the riser pipe can rapidly pressurise the pipe and any partial vacuum, ultimately causing a sudden stop in the liquid flow, which can result in a back surge. Any weak joints are likely to absorb the pressure and can fail, causing an escape of water.

Certain types of protection, such as gas filled expansion vessels and arrestors, may be too slow to operate if the pressure surge is too great, or if installed in the incorrect location may fail to function as intended.

Consequences

Failure of the boosted water supply systems within residential and commercial properties can occur, and these incidents can result in large volumes of water being released into the building causing widespread damage. In residential blocks, this can result in a large number of apartments being made uninhabitable with alternative temporary accommodation being required.

The use of dry linings and laminate floorings, as examples, in modern apartments often adds to the damage, and the resulting insurance claim can be challenging due to the various interests of the parties involved, such as:

- Property owners.
- Housing associations.
- Private buy-to-let owners and tenants residing within the property.

Potential Control Measures

Ways to help prevent a pressure surge include:

- Size and design the pump set(s) to meet the highest expected demands.
- Ensure there is effective control of the filling operation following any shut-downs or low water-pressure events.
- Install a suitably designed 'vacuum breaker' at the 'top-most point' of each riser pipe. This is an effective method of preventing a vacuum occurring in the riser pipe of a tall building. This should be installed by a competent contractor.

The control system and pumps should be set to require a manual reset following a shut down or low-pressure event, e.g. a power cut, or any other incident that results in the output pressure being insufficient to reach the top of the building.

During periods of low demand, it is generally more energy efficient to use a small pump. Therefore, the use of several small pumps arranged in parallel, with the appropriately sized piping network and control systems, should be more economical than a single large, variable speed drive pump. It is also easier to arrange and conduct maintenance procedures for multiple pump systems, as individual pumps can be worked on independently from each other.

A suitable procedure should be in place for manual restarting of the pump set(s):

- Manual closing of an isolation valve located towards the bottom of the riser.
- Switching-on a single pump set.
- Partially opening the isolation valve, so 'bleeding in' the water and limiting the fill rate of the riser.
- Once the riser is filled and supply pressure stabilised, then opening the isolation valve fully.
- Switch the pump set(s) to automatic.

Modern control units can incorporate automatic filling modes when the pressure is less than that required to fill the riser. However, care must be taken in setting-up such systems to ensure safe and effective operation to prevent water hammer and pressure surges.

Pressure reducing valves (PRV) may be of benefit for specific aspects of pressure control in boosted systems, however, it should be noted that these are designed to limit supply pressure, not flow rate. Therefore, they may not prevent sudden water hammer or surge events.

Maintenance and Testing

During the construction process, phased testing and inspection of all pipework is essential as the build progresses to ensure the systems operate reliably and as expected. This should be carried out either on a floor-by-floor basis, or alternatively, on a zoned or sectional basis during the build. This is particularly important where installations will ultimately be concealed in wall, floor or ceiling voids upon completion. A record of all the inspections and tests should be held and retained, detailing those responsible for carrying out, recording and managing the checks, the date completed and any findings.

Note: Any findings or issues discovered in the construction phase should be extrapolated from the specific area of concern to the entire project. Poor or weak joints; inappropriate supports; incorrect routing; etc. could be a function of the entire installation.

Once installed and a site is 'operational', ongoing maintenance of boosted water supplies is considered essential. This should include PRV which, if not maintained, can seize-up or stick resulting in any excessive high pressures not being relieved and so being realised into the wider system, with an increased risk of failure occurring.

All equipment, including pump sets, control systems, pipework, fittings, valves and ancillary equipment should be installed in accordance with manufacturers or supplier's instructions with suitable systems in place to monitor, inspect, maintain and test all installations.

Key Action Steps

- Ensure all companies and individuals engaged to work on plumbing installations are affiliated to and members of approval schemes, such as:
  - ✓ CIPHE (Chartered Institute of Plumbing and Heating Engineering) Approved Contractor Scheme.
  - ✓ CIBSE (Chartered Institution of Building Services Engineers) Member Company.
  - ✓ WIAPS (Water Industry Approved Plumbers' Scheme).
  - ✓ Or similar schemes, a number of which are operated by some of the larger Water Authorities and are generally considered to be of a similar status.
- Architects and Property Developers should consider the design of water systems to minimise the risk. Where this cannot be mitigated then other measures should be considered to minimise potential water damage, especially when using modern methods of plumbing, including these boosted water systems.
- Ensure full inspection and commissioning tests are completed on all new systems in their entirety. This includes all equipment and fittings at their working pressure, in line with equipment supplier's guidelines.
  - ✓ A minimum commissioning period of not less than 8-hours is recommended. This should be:
    - Risk assessed.
    - Fully attended in all exposed areas (to check for leaks) for its full duration.
    - Have an Emergency Response Plan in place in case there is a leak or catastrophic failure.
- Ensure the boosting pump equipment and control systems is subject to regular inspection, service and maintenance by a competent contractor.
- Residential Management Committees or Managing Agents should:
  - ✓ Complete a risk assessment to understand the potential exposures and what damage could be caused. Following this, an Action Plan should be produced to minimise the potential for water damage.
    - Implement any damage mitigation measures which arise out of these documents.
- ✓ Consider the use of leak detection equipment or water flow analytic equipment to help identify any leaks or reduce the impact of water leaks.
- ✓ Establish a formal Emergency Response Plan for water-related infrastructure and leaks. This should include appropriate drawings and isolation and drain valve identification.
- ✓ Provide a copy of the Action Plan and Emergency Response Plan to be held on site and be freely available to all appropriate personnel including employees, contractors, security, maintenance, etc.

Checklist

A generic **Boosted Potable Water Supplies Checklist** is presented in Appendix 1 which can be tailored to your own organisation.

Specialist Partner Solutions

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Leak detection and prevention - **Leaksafe**
Leak detection and prevention - **Quensus**

For more information please visit:Aviva Risk Management Solutions – Specialist Partners

Sources and Useful Links

- CIPHE (Chartered Institute of Plumbing and Heating Engineering)
- CIBSE (Chartered Institution of Building Services Engineers)
- WIAPS (Water Industry Approved Plumbers' Scheme)
- BESA (Building Engineering Services Association)
- BS EN 806-5:2012 - Specifications for installations inside buildings conveying water for human consumption. Operation and maintenance

Note: Whilst UK standards and legislation are referenced in this document, other international standards and legislation should be referenced where applicable.

Additional Information

Relevant Aviva Loss Prevention Standards include:

- **Escape of Water and Fluid Leakage**
- **Escape of Water on Construction Sites**

To find out more, please visit Aviva Risk Management Solutions or speak to one of our advisors.

Email us at riskadvice@aviva.com or call 0345 366 6666.*

*The cost of calls to 03 prefixed numbers are charged at national call rates (charges may vary dependent on your network provider) and are usually included in inclusive minute plans from landlines and mobiles. For our joint protection telephone calls may be recorded and/or monitored.

Appendix 1 – Boosted Potable Water Supplies Checklist

Location	
Date	
Completed by (name and signature)	

	Design and Installation	Y/N	Comments
1.	• Are all companies and individuals engaged to work on your plumbing installations affiliated to and members of approval schemes, such as: • CIPHE (Chartered Institute of Plumbing and Heating Engineering) Approved Contractor Scheme • CIBSE (Chartered Institution of Building Services Engineers) • Member of the Water Industry Approved Plumbers' Scheme (WIAPS) or similar?		
2.	• Have measures been considered to minimise potential water damage especially when using modern methods of plumbing including the boosted water system?		
3.	• Has a suitably designed 'vacuum breaker' been installed by a • competent contractor at the 'top-most point' of each riser pipe for • tall buildings?		
4.	• Has consideration been given to the installation of several small • pumps arranged in parallel rather than a single large, variable • speed drive pump?		
5.	• During the construction processes, was/is phased testing and inspection of pipework carried out as the build progresses? ✓ On a floor-by-floor basis? ✓ On a zoned or sectional basis? Particularly where installations will ultimately be concealed in wall, floor or ceiling voids on completion. • Are these formally recorded?		

	Design and Installation Cont'd	Y/N	Comments
6.	• Following on from question 5 above, have full inspections and full commissioning tests been carried out on all new systems in their entirety? ✓ Including all equipment and fittings at their working pressure? ✓ In line with equipment supplier's guidelines? ✓ For a minimum commissioning period of not less than ✓ 8-hours and attended for its duration? • Are these formally recorded?		

	Control Measures	Y/N	Comments
7.	• Has a formal water services based risk assessment been completed? • Are there formal drawings of the entire network, and do these include the following: ✓ Isolation valves? ✓ Drain lines? ✓ Pressure reducing valves? ✓ Pressure relieving valves? ✓ Vacuum breakers and other components of the network?		
8.	• Has the boosting pump set(s) been sized and designed in order to: ✓ Cope with the highest demands? ✓ Ensure effective control of the filling operation following shut-downs or low-pressure events?		
9.	Have the control system and pump(s) been set to shut down, requiring manual reset, following a power cut or other event during which the output pressure is insufficient to reach the top of the building?		
10.	• Is a suitable procedure in place requiring manual restarting of the pump set(s)? • Does this include limiting the fill rate of riser? • Are written instructions provided detailing the procedures required?		

	Control Measures Cont'd	Y/N	Comments
11.	When pressure is less than that required to fill the riser: ✓ Has the boosting pump control unit automatic filling mode been disabled? ✓ If not where the pump(s) control unit incorporates an automatic filling mode, has this been set-up to ensure safe and effective operation and to prevent water hammer or surge?		
12.	• Has an escape of water event been clearly documented in an Emergency Response Plan or an Action Plan, developed for potential water damage? • Does this highlight what steps to take to stop any escape of water? • Does this include what damage control/mitigation measures to take?		
13.	Is a copy of the Emergency Response/Damage Control Action Plan held on site and freely available to all relevant personnel?		
14.	• If a leak occurred downstream of the booster pump, would the boosted water supply system continue to pump water? • Has this been assessed? • If there are appropriate controls to prevent this, have they been tested?		
15.	Has leak detection equipment or water flow analytic equipment been installed to help identify a leak or to help reduce the impact of water leaks?		

	Maintenance	Y/N	Comments
16.	• Is the boosted pump(s) and control equipment and associated infrastructure subject to regular: ✓ Inspection? ✓ Service and maintenance? ✓ Testing? • Is this based on the manufacturer's guidelines, learning from the installation and failure rates, etc.?		
17.	• Are suitable measures in place to control the risks of escape of fluid during service or maintenance? • Are there written procedures and steps to refill systems in a controlled manner following any maintenance work?		
18.	Are any pressure reducing or relief valves inspected, maintained and tested?		
19.	Additional comments:		

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