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Backflow: Levels of risk

The water utilities have a duty to supply water, which complies with the water regulations, and the water industry act 1991. This ensures the supply of clean wholesome water suitable for domestic or food production purposes. Drinking water should therefore be obtained direct from the mains water supply without any intervening storage before use.

For the purposes of classification this quality of water is called *'fluid category 1'* and is the category that needs to be protected against all forms of contamination and pollution.

There are four further categories that have an increasing degree of risk these are described below. Links are provided to the backflow prevention components that are acceptable under the new regulations.

Fluid category 2:	**Examples would include:**
Water that has undergone a change in taste, odour appearance or temperature. For example water that is heated for bathing, or is discharged from showers, or water that has been treated with a water softener using a salt regeneration process. These changes tend to be aesthetic only and therefore present no threat to human health.	Mixing of hot and cold water through appliances and taps Supply of water through a vending machine where no ingredients are added direct into the water supply such as carbon dioxide Domestic salt regeneration water softeners. Ice making machines Fire sprinkler systems, which do not contain additives. Water-cooled air conditioning units, which do not contain additives

Fluid category 3:	Examples would include:
Water that is a hazard to health and is not suitable for drinking, cooking or other domestic purposes. For example water that has been used for bathing.	Water present in central heating systems. Water used by dishwashers, washing machines, home dialysing machines. Water that has been used for bathing or showering. Garden hoses that have a flow control or shut off control. Garden hoses that are attached to fertilizer sprays. Domestic or commercial irrigation systems, without additives, sprinkler heads to be not less than 150mm above ground level. Vending machines in which ingredients are injected. Commercial salt regeneration water softeners .

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Fluid category 4:	Examples would include:
Water that is a significant hazard to health due to the concentration of toxic substances and is not suitable for drinking, cooking or other domestic purposes.	Commercial central heating systems. Fire sprinklers that include anti freeze solutions. Mini irrigation systems that use pop up sprinklers or permeable hoses. Food preparation areas, dairies bottle washing etc. Commercial dishwashers. Car washing and degreasing plants. Industrial disinfection equipment .

Fluid category 5:	Examples would include:
Water that is a serious hazard to health due to the concentration of pathogenic organisms or toxic substances. Click here to view suitable backflow prevention devices suitable for fluid protection category 5.	Pathogens from any source. Human or animal waste. Grey water recycling systems. Medical waste e.g. bedpan washers or commercial laundry plants. Permeable pipes in other than domestic gardens. Drain cleaning plant.

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Managing the segregation and isolation of potable water systems on offshore installations

Offshore Information Sheet No. 4/2010

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Contents

Introduction

An offshore installation typically uses a single source of potable water for drinking, eating and washing; the integrity of this supply is of vital concern. Space is also at a premium; equipment and systems that require a higher standard of water may also be users of this single source.

This information sheet provides guidance on the specification, assessment, and management of process or non-potable interfaces to the domestic potable water supply. It is not intended to provide advice on the necessary segregation of 'off-water' arising from domestic usage.

Outbreaks of illness on ships, which have some features in common with offshore installations, have been associated with contaminated bunkered water, cross connections between potable and non-potable water, improper loading procedures, poor design and construction of potable water storage tanks, and inadequate disinfection[1].
This guide concerns process and equipment consumers of potable water, and uses two examples to illustrate the standards required by the legislation; connections to sewage handling/treatment systems, and those to sources of diesel.

Background

The typical non-domestic uses of potable water may include dosing/lab use, operational use (e.g. heating medium systems), flushing operations, equipment use (e.g. diesel centrifuges) and sewage treatment. Contamination from these or other systems may occur in a number of ways and may include; failure of check valves, failure in design, uncontrolled modification to plant, reverse flow conditions (through direct pressure or back siphonage), and the unintentional connection to a potable water system. With the hazardous nature of the potential contaminants, an entire system may be rendered unusable in an instant.

HSE inspections have revealed instances of poor standards of segregation and interface management between the domestic supply (drinking, washing and hygiene) and process and equipment consumers (i.e. sources of non-potable fluids such as diesel and methanol); regulatory intervention in these cases has included enforcement action.

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Standards and guidance

The following standards and guidance are relevant.

Standards of isolation and segregation

Oil and Gas UK (formerly UKOOA) Guidelines for Environmental Health for Offshore Installations[2] suggest that the standard defined by onshore legislation and guidance is the minimum that would be expected in the United Kingdom Continental Shelf (UKCS).
Comprehensive guidance is available for the relevant onshore legislation; The Water Bylaws Scotland 2004[3] and The Water Supply (Water Fittings) Regulations 1999[4] (applying in England and Wales). This guidance may be used to determine the standard of segregation when considering increasingly hazardous fluid interfaces with the domestic supply water systems. The guidance is supported by industry standards for both onshore and maritime system design:

- EN 1717:2000 - Protection against pollution of potable water in drinking water installations and general requirements of devices to prevent pollution by backflow[5].

- DoT Merchant Shipping Notice No. M.1214: Recommendations to prevent contamination of Ships freshwater storage and distribution systems[6].

Emergency plans

The Oil and Gas UK Guidelines for Environmental Health for Offshore Installations suggest that there should be in place documented plans to deal with emergencies, such as contamination of potable water supply.

The Approved Code of Practice to the Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995[7] advise that to meet legislative requirements, a documented emergency response plan must be provided that covers the arrangements and procedures needed to respond to all reasonably foreseeable emergencies; it should set out who does what, when, where, how and to what effect, in the event of an emergency.

Hazard identification and management

This section looks at a hazard weighted approach to the selection of a device or arrangement for the prevention of back-flow of non-potable water to the domestic supply; a 'back flow preventer'.

Determination of fluid category

The first step is to identify the fluids that are consumers of potable water, and evaluate the relative hazards they pose. The guidance to Water Supply (Water Fittings) Regulations 1999[4] and EN 1717:2000 divide fluids into 'Fluid Categories' based on their relative hazard. Table 1 considers the higher hazard fluid types likely to be present on an installation. In cases where insignificant concentrations or substantial amounts of substances are present it may be appropriate to modify the category.

Table 1: Determining fluid category

Category	Fluid Descriptor	Offshore Examples
3	Fluid which represents a slight health hazard because of the concentration of substances of low toxicity, including any fluid which contains: a. ethylene glycol, copper sulphate solution, or similar chemical additives; or b. sodium hypochlorite (chloros and common disinfectants).	• Softening plant (common salt regeneration only). • Chemical dosing for water treatment applications.
4	Fluid which represents a significant health hazard due to the concentration of toxic substances, including any fluid which contains: a. chemical, carcinogenic substances or pesticides, or b. environmental organisms of potential health significance.	• Laundry plant. • Diesel purification plant (centrifugal). • Biocides and other chemical dosing for process systems. • MEG/TEG in heating/cooling water medium.
5	Fluid representing a serious health hazard because of the concentration of pathogenic organisms, radioactive or very toxic substances, including any fluid which contains: a. faecal material or other human waste; or b. pathogens from any other source.	• Sewage treatment plant • Sewage conveying system • MEG/TEG in heating/Cooling water • Diesel Purification plant (Centrifugal).

Identification of interfaces and failure modes

Both the guidance to The Water Regulations 1999 and EN 1717:2000 consider existing or potential pressure differences between the domestic supply and the potential contaminating system as significant when determining the standard of backflow prevention

device. To identify interfaces and the failure modes (where back-flow will occur), it may be useful to use a rigorous method such as a HAZOP or HAZAN as described by ISO 17776:2000(E)[8] for offshore production installations.

Determination of backflow prevention device

Both the guidance to Water Supply (Water Fittings) Regulations 1999 and EN 1717:2000 provide extensive matrixes relating fluid category to the required protection standard and they are not reproduced here.

Identified risks from sewage

An offshore installation will normally have a facility for either treating or storage of sewage prior to disposal. Sewage is a category 5 fluid by virtue of the inherent biological risks from infection and disease. Arrangements to prevent back-flow for category 5 fluids are the most stringent and have the most inherent integrity; most arrangements involve an 'air-gap'. The example shown below in diagram 1 is a 'Type AB - Air gap with weir overflow' as described in the guidance to Water Supply (Water Fittings) Regulations 1999 and EN 1717:2000.

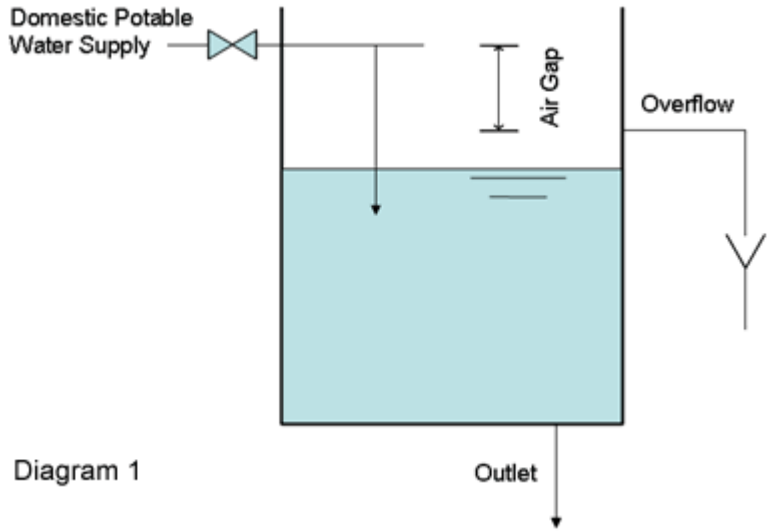

Diagram 1

The air gap in this case is the vertical distance from the lowest point of the discharge orifice which discharges into the receptacle, to the top of the weir overflow.

Identified risks from diesel

Many offshore installations use diesel purifiers or centrifuges; these are typically consumers of potable water. HSE inspections have revealed the potential for diesel to contaminate the domestic supply.

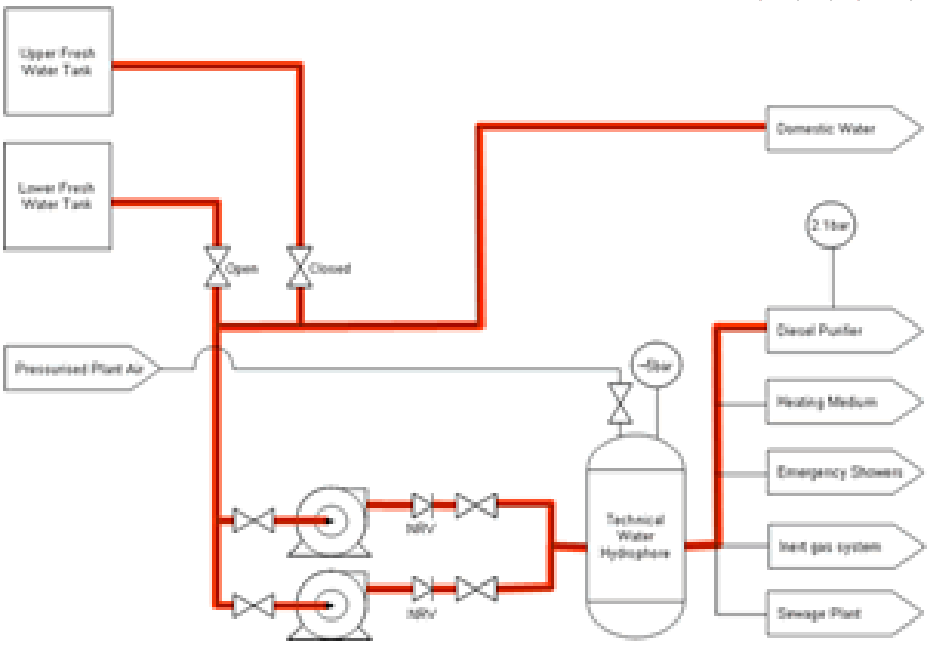

Diagram 2

Diagram 2 shows the route by which diesel entered the fresh potable water tank, in an actual instance of contamination. Under normal operating conditions, the developed pressure in the hydrophore was enough to prevent diesel backflow. However, during process start-up the hydrophore was offline and the pressure from the purifiers overcame the static head of the fresh water tank. The non-return valves fitted to the system had an unrevealed failure.

Diesel is a category 4 or 5 fluid. In addition to being a possible carcinogen, severe lung injury may occur following aspiration[9]; this may occur for example, if a person were to shower in diesel contaminated water. A device or arrangement suitable for a category 5 fluid will also be suitable for a category 4 fluid.
Due to the number and complexity of connections, and the requirement to maintain all of these, it may be advisable to specify or modify an existing system to achieve a single back-flow prevention arrangement that feeds all process and equipment consumers, and which is designed to protect against the highest category fluid, under the worst case conditions.

Maintenance

The devices or arrangements for backflow prevention are safety devices. The guidance to the Provision and Use of Work Equipment Regulations 1998[10], advises that where safety-critical parts could fail and cause the equipment, guards or other protection devices to fail and lead to immediate or hidden potential risks, a formal system of planned preventative or condition-based maintenance is likely to be needed.

Relevant legal requirements

Health and Safety at Work etc Act 1974; Sections 2 and 3 concerning the duties of an employer with regards to protection from risks.

Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995 as amended; Regulations 17 and 18 apply with regard to the supply and quality of drinking water offshore.

Offshore Installations and Wells (Design and Construction, etc) Regulations 1996; Regulation 12, Schedule 1 applies in relation to construction of premises.

Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995; Regulation 8 applies where it concerns emergency planning.

Provision and Use of Work Equipment Regulation 1998; Regulation 5(1) where every employer shall ensure that work equipment is maintained in an efficient state, in efficient working order and in good repair.

Although The Water Bylaws Scotland 2005 and the Water Supply (Water Fittings) Regulations 1999[11] do not apply to offshore installations, the associated guidance should be considered highly relevant when considering arguments of 'reasonable practicability'.