

## Environmental Management of Firefighting Foam

*This Policy provides direction for government and industry on the environmental protection requirements of the Queensland Department of Environment and Heritage Protection when making decisions on activities with the potential to impact on the environment.*

### 1 Objective

*(see Explanatory Notes §1–3)*

The objective of this Operational Policy is to outline the Department of Environment and Heritage Protection's requirements and expectations for the handling, transport, storage, use, release, waste treatment, disposal and environmental protection measures relevant to the use of firefighting foam. Particular regard is given to its management for the prevention of the potential adverse impacts from acute effects such as toxicity and oxygen depletion, as well as persistence, bioaccumulation and any other chronic effects from toxic components.

### 2 Definitions

The following definitions apply for the purposes of this policy:

#### **ALARP**

*(see Explanatory Notes §1.3)*

As Low As Reasonably Practical – such that the risks from the activity must be averted unless there is a gross disproportion between the costs and benefits of doing so.

#### **Best practice environmental management**

*(see Explanatory Notes §1.3, 1.5, 9)*

The management of the activity to achieve an ongoing minimisation of the activity's environmental harm through cost-effective measures assessed against the measures currently used nationally and internationally for the activity.

#### **Biochemical oxygen demand (BOD)**

*(see Explanatory Notes §2, 2.6, 2.8, 8)*

BOD as measured over periods such as 5, 10, 20 and 28 days expressed in milligrams of oxygen per litre for each period. The terms *biochemical* oxygen demand and *biological* oxygen demand are interchangeable for the purposes of this policy. BOD is a measure of the amount of oxygen consumed, primarily by bacteria, in breaking down organic matter in a water body (algal respiration, sediment and chemical uptake can also contribute to BOD). Elevated BOD will result in depletion of dissolved oxygen from the water column and cause potential harm to aquatic life (e.g. related to decay of organic compounds in foam). BOD is very high for all foams and of considerable environmental concern.

Usually the natural decomposition of the degradable organics has proceeded so far after 28 days (typically >95%) that no further significant BOD occurs. For firefighting foams the 5 day BOD (BOD<sub>5</sub>), is commonly the time by which 50% to 70% of the final value has been reached\*. The standard method for determining BOD<sub>5</sub> in Australia is APHA (1998) section 5210B, using APHA (1998) Section 4500-O for the determination of dissolved oxygen. BOD<sub>5</sub> and BOD<sub>28</sub> are the most usual and relevant measures for assessing environmental risk, BOD<sub>5</sub> indicating likely acute oxygen stress to the receiving environment and BOD<sub>28</sub> reflecting ease of degradation.

#### **Bioaccumulation**

*(see Explanatory Notes §2, 2.5–3.1, 7\*)*

A general term for the progressive increase in the amount of a substance in an organism or part of an organism that occurs because the rate of intake exceeds the organism's ability to remove the substance from the body. Intake can be directly from environmental exposure, i.e. by

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\* Australian And New Zealand Guidelines For Fresh And Marine Water Quality 2000

## Operational Policy Environmental Management of Firefighting Foam

absorption through the skin or from the air through inhalation, or from food and water ingestion. See also the related terms *Bioconcentration* and *Biomagnification*<sup>†</sup>.

### **Bioconcentration**

(see Explanatory Notes §2, 2.5–2.8, 2.10, 7.4)

Process leading to a higher steady-state *concentration* of a substance in an organism compared to the concentration in the environmental media to which it is exposed. E.g. the *net uptake, against a concentration gradient*, of a contaminant directly from the environment by plants or animals (from water or soil) until an equilibrium (higher) concentration of the contaminant is reached in one or more tissues.

### **Biodegradability (value)**

(see Explanatory Notes §2.3\*, 5.1, 7.2, 7.6)

The degradability of the product or waste under environmental or biological treatment conditions, determined as the ratio of the 28 day biochemical oxygen demand (BOD<sub>28</sub>) to the total chemical oxygen demand (COD) for the oxidisable organics, expressed as a percentage:

- $(\text{BOD}_{28}/\text{COD} \times 100)$ .

### **Biodegradable**

(see Explanatory Notes §2.3, 2.8)

For the purposes of classifying and stating the biodegradability of a firefighting foam all the organic compounds in its composition must degrade under normal environmental conditions within 28 days or over a similar stated period from the time of its release to water by:

- Readily biodegradable (>95% in 28 days),
- Fully biodegradable (>99% in 28 days), OR
- Readily biodegradable (>95%) in ## days
- Fully biodegradable (>99%) in ## days (e.g., “Fully biodegradable (>99%) in 45 days”).

Otherwise the period over which at least 95% of the organics degrade should be stated (e.g. “readily biodegradable over 45 days”). Foams that contain organic compounds that do not degrade under normal environmental conditions, or break down or transform to produce organic compounds that do not degrade under normal environmental conditions, cannot be classed as readily or fully biodegradable. In particular, if transformation/degradation products with persistence, bioaccumulation, toxicity (PBT) properties are being generated, the substances themselves must be regarded as PBT substances<sup>‡</sup>.

Otherwise the biodegradability of foam that does contain persistent toxic compounds such as any fluorinated organics should not claim to be readily biodegradable or fully biodegradable and should state biodegradability as:

- *Non-persistent organic components ###% biodegradable in ## days.*  
e.g., “non-persistent organic components 88% biodegradable in 28 days”.

### **Biopersistence**

(see Explanatory Notes §2.5, 2.8)

The persistence of a chemical compound in plant or animal tissues unaltered or altered in a way that results in a chemical with similar characteristics or effects. Biopersistence is significant if the chemical compound is toxic and persists in the plant or animal tissues for long enough to have a potentially detrimental effect (beyond that of acute toxicity) or for the chemical to be passed on to further individuals via the food chain<sup>§</sup>, or across the placenta to the foetus in mammals.

### **Biomagnification**

(see Explanatory Notes §2.5–2.8)

Also termed *ecological magnification*. Sequence of processes in an ecosystem by which higher *concentrations* are attained in organisms at higher trophic levels (at higher levels in the food web);

<sup>†</sup> Glossary of terms used in toxicology, IUPAC Recommendations 2007.

<sup>‡</sup> ECHA Background document to the proposed restrictions to PFOA and related substances, ECHA/RAC/RES-O-000006229-70-02/F, September 2015.

<sup>§</sup> Australian And New Zealand Guidelines For Fresh And Marine Water Quality 2000.

## Operational Policy Environmental Management of Firefighting Foam

at its simplest, a process leading to a higher concentration of a substance in an organism than in its food.

### **Chemical oxygen demand (COD)**

*(see Explanatory Notes §2.2, 2.3)*

Chemical oxygen demand (COD), expressed as milligrams of oxygen per litre, is a measure of the theoretical maximum amount of oxygen required to oxidise all the chemically oxidisable organics in a sample, as usually determined using acid dichromate. When BOD<sub>28</sub> is subtracted from COD the remaining amounts represent the oxidisable organic components that are not readily biodegradable. Fluorinated organic compounds in foam are a component of the total organic material present. However, because of their chemical stability, they do not contribute to the COD value, as normally measured, and are considered non-oxidisable and non-biodegradable organics, but detectable using the standard COD method.

### **Contaminant/contamination**

*(see Explanatory Notes §1.5, 2.6, 2.9.1, 2.10, 3, 6.1, 6.2)*

Contamination of the environment is the release into the environment (whether by act or omission) of a contaminant that is of concern or could cause environmental harm.

### **C6 purity-compliant foam**

*(see Explanatory Notes §6.3, 7, 7.5)*

For the purposes of the Policy, a foam product that is *C6 purity compliant* must not have greater than 50 mg/kg of total impurities in the concentrate for any compounds where the *perfluorinated* part of the carbon chain is longer than 6 carbon atoms (e.g. PFOA, PFOA precursors, 7:3Ft, 8:2Ft, 10:2Ft, fluoropolymers, etc.) but excluding PFOS which has a separate impurity limit of 10 mg/kg.

### **Environmental persistence\*\***

*(see Explanatory Notes §2.5, 2.5.1, 2.6, 2.8)*

The long-term persistence of chemicals, or their degradation products with similar characteristics or effects, in the environment under normal environmental conditions, with resistance to degradation by factors such as oxidation, hydrolysis, reduction, exposure to UV light and aerobic or anaerobic metabolic breakdown by microbes. Environmental persistence increases the exposure of organisms to the chemicals, and that is of particular concern for chemicals that bioaccumulate (as well as bioconcentrate or biomagnify) thereby increasing the risks of toxic adverse effects.

An organic compound is considered environmentally *persistent* or *very persistent* under *Annex XIII of REACH (EC 2011)* when its half-life, including that of its degradation products with similar characteristics or effects, is greater than the value shown in the table below for each environmental compartment.

| Criteria for identifying Persistent (P) and Very Persistent (vP) substances |           |                                            |            |
|-----------------------------------------------------------------------------|-----------|--------------------------------------------|------------|
| Persistent (P) degradation half-life                                        |           | Very Persistent (vP) degradation half-life |            |
| Marine water                                                                | >60 days  | Marine water                               | >60 days   |
| Fresh or estuarine water                                                    | >40 days  | Fresh, or estuarine water                  | >60 days   |
| Marine sediment                                                             | >180 days | Marine sediment                            | >180 days  |
| Fresh or estuarine sediment                                                 | >120 days | Fresh, or estuarine sediment               | >180 days  |
| Soil                                                                        | >120 days | Soil                                       | >180 days. |

\*\* REACH Annex XIII, PBT and vPvB criteria

## Operational Policy Environmental Management of Firefighting Foam

### **Firefighting foam**

(see Explanatory Notes §1.2)

Firefighting foam refers to concentrates and their aqueous solutions that are used in the production of streams or blankets of air/gas-filled bubbles to suppress flammable vapours, increase water penetration, reduce static spark generation, control or extinguish fires, and prevent re-ignition by excluding air and cooling the fuel. For the purposes of the Policy firefighting foams are divided into Class A foams that is used on carbonaceous combustible materials, such as wood, paper, fabric, plastics and rubber and Class B foams that is used on flammable and combustible liquids or spills such as liquid hydrocarbon fuels and polar solvents where the fire and vapours are on the surface of the liquid.

### **Firewater, wastewater or runoff**

(see Explanatory Notes §3, 3.1, 6)

Any contaminated water generated where water sprays, jets, mists, deluge, monitors or foam generators have been used to extinguish a fire, dilute a contaminant, cool a container or stockpile, blanket a spill with foam, disperse or dissolve a gas or vapour release or wash down a contaminated area. This includes firewater, wastewater or runoff produced during testing, training, maintenance, accidental release or an incident whether or not a fire was involved.

### **Fluorinated organic compounds**

(see Explanatory Notes §2.1, 7)

All organic compounds that contain the elements fluorine and carbon where the fluorine has replaced some or all of the hydrogen linked to carbon atoms in the straight or branched organic carbon chain including perfluorinated, polyfluorinated or fluoropolymer compounds. This commonly refers to, but is not limited to, PFOS, PFOA, fluorotelomers, fluorosurfactants, fluoropolymers and their precursors or breakdown products. All organic fluorochemicals, or any other fluorine-carbon compounds, fall within the general classification 'organohalogen' (i.e., under Annex VIII(1) of the EU Water Framework Directive).

### **Fluorinated organic compounds analyses**

(see Explanatory Notes §2.1, 7)

A very diverse range of fluorinated organic compounds (FOCs/PFCs) are now known to occur in fluorinated firefighting foam and associated wastes including poly- and perfluorinated, fluorotelomers, fluoropolymers and complexes of siloxanes and fluorinated compounds with branches ranging in chain length from C4 to C20.

PFCs are of particular interest due to their widespread use in foams and the occurrence of transformation products with the potential for adverse effects. To meaningfully assess the levels of PFCs present and the probable associated risk it is not sufficient to analyse only for the current limited suite of about 20 to 28 standard fluorinated organic compounds as it is highly likely that many compounds of concern and their precursors will remain completely undetected.

An analytical method is now available that reveals PFCs hidden to the standard analyses. This recently developed method is a total oxidisable precursor assay (TOPA)<sup>††</sup> which reveals the undetected PFCs through treatment of samples to transform the diversity of precursors to detectable end-point perfluorinated carboxylic acids (PFCAs) that relate to the precursor's perfluorinated chain component. This information can then be used to assess one aspect of the likely risks posed by the unidentified precursor compounds according to the chain-length which relates generally to toxicity, dispersibility and bioaccumulation.

While the functional groups of fluorinated organic compounds have an influence on their effects, for practical identification and assessment purposes the *TOPA C4-C14* method will show approximately what precursors are present grouped according to perfluorinated chain length in the C4 to C14 range and, in particular, the total amount of PFOA and longer chain PFCA precursors present.

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<sup>††</sup> Houtz, E. & Sedlak, D. Oxidative Conversion as a means of Detecting Precursors to Perfluoroalkyl Acids in Urban Runoff. Environmental Science & Technology, 2012, 46, 9342–9349

## Operational Policy Environmental Management of Firefighting Foam

For the purposes of determining and reporting the presence of fluorinated organic compounds in soil, water, foam solutions or foam concentrate, sample analyses shall be done for:

- The standard suite of PFCs (including key sulfonates), plus
- Total oxidisable precursor assay reported as the analyses for the resulting perfluorinated carboxylates for C4 to C14 carbon chain length (TOPA C4-C14).
- The sum of the oxidisable precursors (TOPA C4-C14) plus perfluoroalkyl sulfonates (PFBS, PFHxS, PFOS, PFOSA, PFDcS) can be taken as a surrogate for the total fluorinated organics (C4-C14) if a total organic fluorine analysis is not available.

The TOPA C4-C14 method is under development and expected to be available through commercial laboratories shortly. Where other persistent organic compounds are known or likely to be present, such as siloxanes, other relevant analytical methods will be required.

### **General environmental duty (GED)**

(see Explanatory Notes §9)

A person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm having regard to the current state of technical knowledge for the activity and other relevant matters.

### **Intergovernmental Agreement on the Environment (IGAE)**

The agreement made on 1 May 1992 between the Commonwealth, the States, the Australian Capital Territory, the Northern Territory and the Australian Local Government Association. This includes the commitment to Ecologically Sustainable Development and the obligation to apply the *Precautionary Principle*.

### **PFOA**

(see Explanatory Notes §7)

The fluorinated organic compound perfluoro-octanoic acid: CAS RN 335-67-1 (straight-chain isomer), IUPAC systematic name 2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-Pentadecafluoro-octanoic acid (C<sub>7</sub>F<sub>15</sub>CO<sub>2</sub>H) or its carboxylate anion perfluoro-octanoate.

### **PFOS**

(see Explanatory Notes §2.1-2.9, 7)

The fluorinated organic compound perfluorooctanesulphonic acid: CAS RN 1763-23-1, IUPAC systematic name 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-Heptadecafluoro-1-octanesulfonic acid or its ionised form perfluoro-octane sulphonate (C<sub>8</sub>F<sub>17</sub>SO<sub>3</sub><sup>-</sup>)

### **6:2 Fluorotelomers (6:2Ft) and short-chain homologues**

(see Explanatory Notes §7.5)

The polyfluorinated organic compounds containing a perfluoroalkyl tail (n=6), a dimethylene spacer (n=2) and a functional group. For example, 6:2 fluorotelomer sulphonate (6:2FtS): CAS RN 27619 97-2, IUPAC systematic name 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctane-1-sulphonate or 1H,1H,2H,2H-perfluorooctane sulfonic acid. Also other short-chain fluorotelomer homologues such as 4:2 and 5:3 fluoroteleomers.

### **Safety data sheet (SDS or MSDS)**

(see Explanatory Notes §5)

Safety data sheet, sometimes referred to as a material safety data sheet (MSDS), in the form described by the Safe Work Australia Code of Practice *Preparation of Safety Data Sheets for Hazardous Chemicals (2011)*. Information relevant to potential environmental impacts should be placed in *Section 12—Ecological Information* of the SDS.

## 3 Scope

This policy applies to any person, organisation or corporation that handles, transports, stores, uses, releases, treats wastes or disposes of any products, compounds, water, soils, wastes or other materials associated with or contaminated by firefighting foams at any concentration at any place in the state of Queensland and its waters.

## Operational Policy Environmental Management of Firefighting Foam

This policy does not consider the range of other possible contaminants in addition to firefighting foam that might be in firewater or runoff such as hydrocarbons, chemicals, combustion products, sediments, etc., which may have significant environmental impact.

### 4 Legislation

The *Environmental Protection Act 1994* (EP Act) requires that all persons undertaking any activity that impacts or has the potential to impact the environment in Queensland are required to take all reasonable and practical measures to prevent such harm from occurring (s319). This includes having regard for the nature of the harm or potential harm, the sensitivity of the receiving environment and the current state of technical knowledge for the activity.

This policy has as its objective the prevention of short-term and long-term environmental harm taking into account the *Precautionary Principle* as set out in the *Intergovernmental Agreement on the Environment* and best practice environmental management.

In regards to response to emergency incidents, disaster management and health provisions other legislative provisions may apply or take precedence during the emergency (e.g. Fire and Emergency Services Act 1990, Public Safety Preservation Act 1986 and the Work Health and Safety Act 2011). However those provisions primarily apply to the powers and actions of the emergency services personnel and do not negate the obligation of the facility owner/operator or site manager to have considered and put into place all the necessary plans, measures and controls to deal with an incident.

### 5 Related Policies, Standards and Procedures

Standards and references for contaminant threshold and trigger values have been derived from those sources listed in the footnotes on each page.

### 6 Policy

(see Explanatory Notes §1.3, 2, 9)

The Department of Environment and Heritage Protection is committed to managing the health of Queensland's environment by protecting the state's unique ecosystems, including its landscapes and waterways, as well as its native plants, animals and biodiversity through strong environmental regulation that supports sustainable long-term economic development.

Foams are acknowledged as an essential firefighting tool for protection of life and property with a prime consideration being safety and the protection of life. Nonetheless, the consequences of foam use on environment, human health, economic assets and amenity should be taken into account in contingency planning as well as during the incident response with consideration of all likely downstream adverse effects. This can include public and economic use of resources such as recreational activities, public amenity, water supply, aquaculture and fisheries.

All firefighting foams pose a range of hazards to the environment when released during activities such as training, maintenance, testing, incident response, fires and waste disposal. The combination of chemicals used in firefighting foams can have direct and indirect acute and chronic impacts on biota, soils and waterways through their persistence, bioaccumulation, toxicity and biochemical oxygen demand (BOD) when they are released and degrade.

Of particular concern in regards to firefighting foams is the significant body of existing and growing evidence that persistent organic compounds including fluorinated organic compounds, which have been and are commonly used in some Class B firefighting foams, pose significant risks to the environment through their extreme persistence, bioaccumulation potential and toxicity.

The majority of historical major environmental pollution events with fluorochemicals have been the result of firefighting foam use. Although the proportion of global tonnage of fluorochemicals used

## Operational Policy Environmental Management of Firefighting Foam

for firefighting purposes is ~5%, foam is used in the most highly dispersive manner of all applications.

When choosing and procuring firefighting foam, assessing its suitability for a particular application, assessing its potential to cause undesirable adverse effects, and determining the necessary management measures, the user must take into account in their risk assessment and contingency planning the following issues (including consideration of any relevant performance standards):

- the composition of the foam and appropriate effectiveness for the intended application
- the types and quantities of concentrate to be held on site
- the potential volume of firewater that could be generated during an incident
- the ability to manage and contain spills and firewater on site
- the measures to prevent release of contaminants to soils, groundwater, waterways and air
- the facility location and proximity to environmentally sensitive areas
- the circumstances under which an intended or unintended release might occur
- the pathways for foam and other incident contaminants to be released to the environment
- the potential for PBT and BOD impacts on the local and wider environmental values
- on-site and off-site treatment and disposal of wastewater and contaminated materials
- potential remediation of contaminated soils, waterways and groundwater
- any training, maintenance and testing needs and requirements.

The Policy also recognises that a prime consideration when choosing and procuring firefighting foam is the effectiveness of the foam for the intended application in providing adequate levels of firefighting performance, safety and property protection. The alternatives available that meet the appropriate independently verified performance standards and approvals must then be compared in terms of a net environmental benefit analysis<sup>‡‡</sup> to select the optimal combination that also best addresses the relevant environmental protection standards and overall best practice.

All firefighting foams must be assessed for their potential to cause environmental harm prior to use or disposal. The need for management, containment as well as protective measures and procedures must be assessed in terms of the foam's properties relative to:

- Environmental persistence of the compounds in their formulation and any breakdown products.
- Biopersistence, bioaccumulation, bioconcentration and biomagnification potential.
- Toxicity (both acute and chronic effects).
- Biochemical oxygen demand and biodegradability.

### 6.1 Non-persistent firefighting foams

(see Explanatory Notes §8)

Although non-persistent (including fluorine-free) foams may not contain highly persistent organic compounds such as PFCs, the potential for causing environmental harm and the need for management, containment and protective measures and procedures must be fully assessed. Particular regard should be paid to potential impacts from biochemical oxygen demand, acute toxicity and the biodegradability characteristics of the foam.

Where non-persistent firefighting foam is used site managers must take all reasonable and practical measures to adequately manage, contain, treat or properly dispose of the foam, firewater, wastewater, runoff from activities or after incidents on the site such that any unavoidable release to the environment is not likely to cause significant environmental harm.

The site manager is the person or entity or their agent with management or control of the site but does not include the emergency services incident controller during the incident emergency response. Where practicable the emergency services incident controller may facilitate initial

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<sup>‡‡</sup>Deacon, S., Goddard, A., & Eury, N. 2010 - Assessing risks to ecosystems and using a net environmental benefit analysis framework to assist with environmental decision-making," in *Restoration and Recovery: Regenerating land and communities*, Howard R. Fox and Heather M. Moore, Eds. ISBN 978-184995-012-1, 2010, pp. 164-175.

## Operational Policy Environmental Management of Firefighting Foam

pollution control measures such as bunding to contain runoff with the site manager responsible for ongoing prevention of releases to the environment.

Where small volumes of foam are used for vapour and spark suppression on a hydrocarbon incident are contained on site and the only significant contaminant is the firefighting foam it may be disposed of by:

- irrigation onto adjacent land to soak in and degrade *in situ*
- holding of larger quantities in on-site ponds or drains for 28 days or longer according to its BOD profile to fully biodegrade<sup>§§</sup>
- covering with sand or soil to prevent or limit subsequent movement to a waterway in runoff
- soaking into soil along a roadside drainage line to degrade *in situ* (clear of any waterway)
- pumping out and disposal to sewer or wastewater treatment plant.

The disposal of firewater that also contains significant levels of contaminants, such as hydrocarbons, chemicals or fire combustion products, in addition to containing non-persistent firefighting foam, needs to be considered on a case-by-case basis.

### **6.1.1 Direct releases to land of non-persistent foam**

(see Explanatory Notes §8)

Where fully-biodegradable, non-persistent firefighting foam is released to land, away from waterways, such as when used by Rural Fire Brigades for ignition prevention, fire control, extinguishment, damping-down and training on vegetation fires, it is expected that no adverse effects will occur from the application of small amounts of foam at low concentrations. For the normal application of foam across a wide area or fire front away from waterways the foam will rapidly soak into the soil and biodegrade in-situ. Significant releases of foam directly to, or within 50 metres of a waterway during rural firefighting should be avoided where possible.

Concentrated and repeated applications of non-persistent foam, such as on an intensively-used bare-earth training area, should have firewater control measures in place to prevent immediate releases to adjacent waterways. Where a volume of firewater is generated, beyond that which can readily soak into the soil or be irrigated to adjacent land to soak in, control measures such as bunding or ponds should be used to hold the water for at least 28 days to allow it to degrade until it is suitable for release and/or to evaporate.

### **6.1.2 Direct releases to waterways of non-persistent foam**

(see Explanatory Notes §2.2, 8)

Where a discharge directly to a waterway, or to a place where contaminants may then travel to a waterway, of a non-persistent foam is unavoidable, as far as practicable consideration should be given to the potential extent of impacts from the combined effects of acute toxicity and BOD in the affected waterway when selecting a non-persistent foam type (e.g. marina fire, foam from a firefighting tug, other vessel, shipping berth or wharf where hydrocarbons are transferred).

Testing, training, certification and maintenance activities are recognised as essential and necessary to maintain fire protection standards and proficiency and may result in unavoidable releases of non-persistent foam directly to the environment. These activities should be undertaken and managed in such a way as to minimise the potential for pollution or environmental harm to be caused. For example:

- avoid discharging to environmentally sensitive areas (where plant is mobile)
- avoid or minimise discharges to confined waterways where water turnover is limited
- block drains and pump out wastewater to adjacent land where it can soak in and degrade
- limit the quantity of foam used in tests
- wash down of decks and hardstands with large volumes of water to dilute discharges
- use only water for testing or lower toxicity and BOD training foam
- test systems in segments spread over a time period to allow dispersion of foam
- schedule activities to coincide with large outgoing tidal flows to dilute and disperse foam.

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<sup>§§</sup> Decomposition of organic matter causing elevated BOD is likely to have progressed to near completion by 28 days.

## Operational Policy Environmental Management of Firefighting Foam

### 6.2 Persistent firefighting foams

*(see Explanatory Notes §7, 7.1, 7.2)*

A persistent foam is any foam that has in its composition any persistent compounds such as fluorinated organic compounds (see Definitions). If foams containing fluorotelomers are to be used for firefighting (subject to the purity standards – see Definitions) then the user must be aware of the composition of the foam in terms of:

- The presence and overall concentration of fluorinated organic compounds with a perfluorinated 6-carbon chain length and shorter including 6:2 fluorotelomers.
- The presence and overall concentration of fluorinated organic compounds with a perfluorinated 7-carbon chain length and longer including PFOS, PFOA, their precursor compounds and their higher homologues.
- The presence of any other persistent, toxic or bioaccumulative compounds, e.g. siloxanes.

Where there is any potential for spill or release of foam containing fluorotelomers, fluoropolymers, perfluorinated organics, their precursors or other persistent toxic compounds the user must be able to demonstrate that they are able to fully and completely contain and properly dispose of the concentrate, foam solution, produced foam, firewater, wastewater, runoff, contaminated soils and other materials. This includes spills or releases produced during accidental spills and the testing and maintenance of fixed or mobile equipment.

Of particular concern are foams containing long-chain fluorinated organic compounds including PFOS, PFOA, their precursors and higher homologues that require special consideration.

#### 6.2.1 Foams containing PFOS

*(see Explanatory Notes §3, 3.1, 7.2, 7.4, 9.1)*

Use of foams that contain the fluorinated organic compound PFOS (perfluoro octane sulphonic acid) as well as its salts or any compound that degrades or converts to PFOS at a concentration of greater than that listed in [Table 6.2.2 A](#) in foam concentrate must be withdrawn from service and replaced as soon as possible (taking into account related obligations under the *Work Health and Safety Act 2011*) and no longer used in any situation where they might be released to the environment, including legacy stocks.

#### 6.2.2 Foams containing PFOA & PFOA precursors to be withdrawn

*(see EN §3.2, 7.2, 7.4)*

Firefighting foams that contain PFOA, PFOA precursor compounds or their higher homologues, where the total organic fluorine content equivalent to PFOA and higher homologues exceeds that listed in [Table 6.2.2 A](#) in foam concentrate must be withdrawn from service as soon as practicable and any held stocks (and any other related wastes) must be secured pending disposal. These materials are to be managed and disposed of as regulated waste<sup>\*\*\*</sup>.

**Table 6.2.2 A – Fluorinated organic compounds limits in concentrates**

| Compound(s)                                                                                                                                                                                | Limit<br>(mg/kg)                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| PFOS (Perfluoro-octane sulfonic acid) and PFHxS (perfluorohexane sulfonate).                                                                                                               | 10 <sup>†††</sup><br>(sum)         |
| PFOA (Perfluoro-octanoic acid) and higher homologues, PFOA precursors and higher homologous PFCs as the sum of the total oxidisable precursor assay for C7 to C14 compounds (TOPA C7-C14). | 50 <sup>†††</sup><br>(as fluorine) |

<sup>\*\*\*</sup> *Environmental Protection Regulation 2008, Schedule 7.*

<sup>†††</sup> Environment Agency UK, 2011– PFOS Fire Fighting Foams. Use and disposal information.  
EU Commission Regulation No. 757/2010

<sup>†††</sup> 50 ppm limit is moderate compared to ECHA limits of 0.025 ppm for free PFOA and 1 ppm for precursors.

## Operational Policy Environmental Management of Firefighting Foam

PFOA precursor compounds and their higher homologues include any compounds that potentially degrade or convert to PFOA, such as 8:2 fluorotelomer derivatives, or the higher homologous perfluoroalkyl carboxylic acids (PFCAs) as well as precursors, such as C7 to C14 carbon-chain or similar fluorotelomer derivatives.

### **6.2.3 Disposal of foam containing PFOS, PFOA, precursors & higher homologues** (§3–3.2)

Foam concentrate that contains the fluorinated organic compound PFOS, PFOA, perfluorohexane sulfonate (PFHxS), their precursors or their higher homologues at greater than the limits in [Table 6.2.2 A](#), or any compound that degrades or converts to those compounds, must not be on-sold, traded, exported or otherwise provided to any person other than for the purposes of proper disposal. Wastewater from the cleaning of such contaminants from equipment and pipe-work must be fully contained and removed for disposal to an approved facility.

A disposal plan for waste fluorinated foam concentrate containing PFOS, PFOA, their precursors and their higher homologues (at greater levels than those in [Table 6.2.2 A](#)) must be drawn up as soon as is practical but nonetheless within 6 months of the Policy being approved. This plan must include management measures to secure and prevent release of the material until arrangements are put into place for eventual disposal. Waste fluorinated foam concentrate must be disposed of to an approved facility. Such foams must not be used in training, maintenance, testing or other activities that may result in their release to the environment on or off the user's site.

### **6.2.4 Foams containing short-chain fluorotelomers** (see Explanatory Notes §7, 7.1–7.5)

Foam containing short-chain fluorotelomers (C6 or shorter perfluorinated moieties) can be used if it is found to be the only viable option, after firefighting effectiveness, short and long-term health, safety and environmental risks and property protection characteristics have all been appropriately considered, however, the following requirements must be met:

- The foam must be *C6 purity compliant* foam (see Definitions).
- No releases directly to the environment (e.g. to unsealed ground, soakage pits, waterways or uncontrolled drains).
- All releases must be fully contained on site.
- Containment measures such as bunds and ponds must be controlled, impervious and must not allow firewater, wastewater, runoff and other wastes to be released to the environment (e.g. to soils, groundwater, waterways stormwater, etc.).
- All firewater, wastewater, runoff and other wastes must be disposed of as regulated waste to a facility authorised to accept such wastes.

### **6.2.5 Portable extinguishers & mobile plant extinguishers – Special considerations** (§4.4)

Most existing portable and hand-held extinguishers used in commercial applications and fixed systems mounted on large earthmoving vehicles currently rely on AFFF, containing long-chain ( $\geq$ C7) fluorinated organic surfactant-based foams for their effectiveness.

While the quantities of foam in these extinguishers and systems are individually small there are very large numbers in use, involving a large total volume of foam, with a significant potential for cumulative health and environmental impacts if the discharges and wastes are not managed properly.

There is a high probability that foam from these small-quantity extinguishers will be discharged directly into the environment by users with limited knowledge or through poor waste disposal practices during testing and servicing resulting in no control of dispersal.

There are now non-persistent (fluorine-free) foams available for hand-held extinguishers and mobile plant systems that meet Australian fire performance standards. Hand-held and mobile plant extinguishers that contain persistent fluorinated surfactants are subject to the following restrictions:

## Operational Policy Environmental Management of Firefighting Foam

- Foam concentrate must not have a concentration of PFOS in it higher than the limits in [Table 6.2.2 A](#).
- Foam concentrate must not have a concentration of PFOA precursors or higher carboxylate equivalent homologues in it higher than the limit in [Table 6.2.2 A](#) unless there is no other fluorine-free or *C6 purity compliant foam* certified for the particular use.
- All discharges of foam containing fluorinated organic compounds and the associated contaminated water, soils and other materials must be collected and contained for proper disposal as regulated waste whether discharges are from operational use or from testing and maintenance activities.
- Foams and wastewater containing fluorinated organic compounds must not be disposed of by discharge to the ground, drains or waterways.
- Foams and wastewater containing fluorinated organic compounds must not be disposed of to sewers or general wastewater treatment facilities. Disposal must only be to facilities capable of properly disposing of such wastes with the facility operator being made aware that the wastes contain fluorinated organic compounds.

### 6.2.6 Shipping – Special Considerations

(see Explanatory Notes §4.3)

Regulations pertaining to safety systems and foam that off-shore facilities and international and domestic shipping are required to comply with and procedures to contain and deal with on-board firewater will have an effect as to what mitigation measures can be practically achieved and how much a facility, vessel or port operator may be able to influence how risks from potential incidents are managed. However, the Master of a vessel, the ship's owner, the vessel's insurer and the offshore facility operator are ultimately responsible for making good any damage that their vessel/facility cause in Australian waters and the port, shipping and/or offshore facility operator may have to deal with the ongoing effects of the incident.

In terms of practical management of current carriage and use of firefighting foam by vessels the risks of short or long-term adverse environmental effects could be reduced while still addressing the priority of maintaining safety at sea by:

- **Forward planning** – Contingency planning and relevant facilities to manage and prevent as far as practicable the release to the environment of firewater containing persistent pollutants, e.g. procedures to capture and hold firewater on board.
- **Incident management** – Prevent discharge of firefighting foam or related wastewater containing a persistent pollutant to the sea or any waterway unless it is unavoidable to secure the safety of a ship or to save life at sea by taking all reasonable and practicable measures during and after the incident to prevent the discharge into the sea.
- **Waste disposal** – Wastes or firewater containing persistent pollutants must be disposed of to an appropriately licenced onshore facility capable of treating and disposing of the wastes appropriately.

The large numbers, diversity of types and nationalities of ships operating in Australian waters limits the consistent and adequate application of on-board risk reduction practices. Accordingly port managers may need to consider what practical measures could be implemented locally to assist vessels to minimise the risk to their local environment where the environmental sensitivities are highest.

### 6.2.7 Training and testing foams

(see Explanatory Notes §4.1, 4.3)

For the purposes of this policy “training foams” are regarded as the same as firefighting foams for all intents and purposes. Foams used for training, testing or maintenance purposes must not contain any fluorinated organic compounds with the exception that if there is a defined requirement for testing with the operational foam the foam must be fully *C6 purity-compliant*. Any firewater, wastewater, runoff and other wastes containing fluorinated organic compounds must be able to be fully contained and disposed of as regulated waste.

## Operational Policy Environmental Management of Firefighting Foam

Where a training foam may be released to the environment, for example to soils its release must be in a controlled manner and managed in such a way so as not to cause environmental harm by adverse toxicity or BOD effects in water bodies or groundwater.

### 6.3 Environmental acceptability

(see Explanatory Notes §5)

In the assessment of overall suitability of a foam product including considerations of performance, initial and lifetime costs, operational constraints, etc. the environmental acceptability of any foam being considered or used must also be assessed by the user in terms of potential impact upon the environment including consideration of all of the following:

- Persistence in the environment.
- Biopersistence, bioconcentration, bioaccumulation and biomagnification potential.
- Toxicity (both acute and chronic impacts).
- Biochemical oxygen demand and biodegradability.

Environmental acceptability related tests should be conducted against standards and methodologies, such as those accepted and recognised in Australia, the USA, Canada, New Zealand and the OECD, and carried out by an independent laboratory or organisation.

This assessment must be undertaken for the combined formulation of all the ingredients, that is, the concentrate as is normally formulated and marketed, and intended for final use, and not just the principal or selected ingredients in isolation. Note that assessment of toxicity must include both chronic longer-term toxicity as well as acute toxicity.

It is the manufacturer's and/or supplier's responsibility to undertake such testing and provide the results to the user in the SDS for the product. SDS for any firefighting foam product intended to be used or stored on a site must be held and readily available for inspection on that site.

#### 6.3.1 Persistence and bioaccumulation

(see Explanatory Notes §2.5, 2.5.1, 2.6–2.8)

Persistence and bioaccumulation data should be derived from accepted and recognised best practice Australian, USEPA or OECD methods or tests, for example but not limited to:

- **Persistence** – OECD (2008), *Test No. 314: Simulation Tests to Assess the Biodegradability of Chemicals Discharged in Wastewater*, OECD Guidelines for the Testing of Chemicals, Section 3.
- **Bioaccumulation** – OECD (2012), *Test No. 305: Bioaccumulation in Fish: Aqueous and Dietary Exposure*, OECD Guidelines for the Testing of Chemicals, Section 3.
- **Bioaccumulation** – OECD (2010), *Test No. 317: Bioaccumulation in Terrestrial Oligochaetes*, OECD Guidelines for the Testing of Chemicals, Section 3.

Highly persistent degradation products must also be identified together with relevant persistence, bioaccumulation and toxicity (PBT) data.

The tests must be conducted by an internationally certified laboratory accredited for the relevant tests in order to demonstrate what the firefighting foam ALARP bioaccumulation and persistence risks to the environment are.<sup>§§§</sup>

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<sup>§§§</sup> Civil Aviation Authority (UK)–Foam and the Environment, Information Paper IP-6, 2008, Aviation Fire Fighting Foam – Performance Testing and Environmental Impact, IP-04, 2012

## Operational Policy Environmental Management of Firefighting Foam

### 6.3.2 Acute toxicity testing

(see Explanatory Notes §2, 2.4)

Toxicity testing should be conducted in accordance with standards and methodologies, such as those accepted and recognised in Australia, the USA, Canada, New Zealand and the OECD, by an independent laboratory or organisation. Australian or equivalent test species should include fresh water and marine species, for example but not limited only to:

- 48-hour acute (immobilisation) test using a freshwater species, e.g. the daphnid *Ceriodaphnia dubia* (using USEPA 2002 method) or Australian or equivalent test species.
- 72-hour micro-algal growth inhibition (cell yield) tests using, e.g. freshwater alga *Selenastrum capricornutum* (using USEPA Method 1003.0) or Australian or equivalent test species.
- 96-hour fish imbalance tests using a freshwater fish species, e.g. Rainbow fish *Melanotaenia splendida splendida* (based on OECD Method 203) or Australian or equivalent test species.
- 72-hour micro-algal growth inhibition tests using *Isochrysis aff. galbana* or *Nitzschia closterium* (based on USEPA Method 1003.0 and Stauber *et. al.* 1996 for the National Pulp Mills Research Program) or Australian or equivalent test species.
- 96-hour acute toxicity tests using juvenile tiger prawn *Penaeus monodon* (based on USEPA OPPTS 850.1045), or the amphipod *Melita plumulosa* should tiger prawns not be available or Australian or equivalent test species.

### 6.3.3 Chronic toxicity testing

(see Explanatory Notes §2, 2.7)

Chronic toxicity data should be derived from accepted and recognised best practice Australian, USEPA or OECD methods or tests, for example but not limited to:

- OECD (1992), *Test No. 210: Fish, Early-Life Stage Toxicity Test*, OECD Guidelines for the Testing of Chemicals, Section 2.

### 6.3.4 Biochemical oxygen demand and biodegradability\*\*\*\*

(see Explanatory Notes §2.2, 2.3, 2.8)

Biochemical oxygen demand (BOD) has the potential to cause severe depletion of oxygen levels in waterways. The SDS for any foam held for use or stored on a site must include information on its BOD, COD (chemical oxygen demand) and biodegradability.

The BOD must be expressed as biochemical oxygen demand measured at least for 5 day and 28 day periods in milligrams per litre - i.e., BOD<sub>5</sub> and BOD<sub>28</sub> values. The values cited for BOD must be reported in the SDS relative to foam concentrate (as sold) and additionally for the normal concentrations recommended by the manufacturer for the finished foam, e.g. at 1%, 3% and/or 6%. A value for chemical oxygen demand (COD) must also be reported in milligrams per litre relative to the foam concentrate.

The biodegradability of the foam must be expressed as the ratio of the 28 day BOD to the total chemical oxygen demand (COD) for foam concentrate. The 28 day BOD is considered to be an appropriate indicator of likely overall impact in the environment and biodegradability given that it would be expected that for most commercially available foam formulations 90% or more of the BOD impact should occur within 28 days. This implies a normal half-life for BOD, as measured by standard protocols, of 7 to 10 days. Where the BOD curve departs substantially from that normally expected it is recommended that additional intermediate values for BOD, or a representation of the BOD as a graphed curve, are reported to assist users and responders plan for potential impacts in the early stages of a release. The 5 day BOD, on the other hand, indicates the likely degree of acute oxygen stress that the affected aquatic ecosystem will be exposed to.

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\*\*\*\* Civil Aviation Authority (UK)–Foam and the Environment, Information Paper IP-6, 2008

## Operational Policy Environmental Management of Firefighting Foam

### 6.4 Disposal of fluorinated organic compound wastes

*(see Explanatory Notes §3)*

All solid and liquid wastes that contain fluorinated organic compounds (e.g. concentrates, firewater, wash-water, run-off, absorbents, etc.), including those from *C6 purity-compliant foam*, are regarded as regulated wastes and must only be disposed of through a facility that is licensed to take regulated wastes. For water contamination criteria see limits in [Table 6.4.2 A](#).

Waste materials not containing persistent hazardous materials may be disposed of by the appropriate means according to the contaminants present.

#### 6.4.1 Contaminated sites and contaminated soil disposal

*(see Explanatory Notes §3)*

Where investigation of a site suspected of being contaminated finds significant concentrations of fluorinated organic compounds in soils such that there is the potential to cause pollution or environmental harm a detailed site investigation should be carried out in accordance with the guidance in the *National Environment Protection (Assessment of Site Contamination) Measure* to determine the nature and extent of the contamination. Assessment criteria for contaminated soils assessment and disposal are to be considered separately from this Policy.

Where soils is contaminated with fluorinated organic compounds or other persistent pollutants and needs to be disposed of the site operator, site owner or their responsible agent must contact the relevant authorities (including the Department) to ascertain the requirements for disposal.

Where soils contaminated with fluorinated organic compounds are to be stockpiled on a site, (e.g. as part of a remediation plan for a site while awaiting transport or disposal) they shall be contained and covered in such a way as to prevent the release of contaminants in leachate, runoff, sediment or dust that may lead to contamination of land, waterways or groundwater.

After the removal of the stockpiled contaminated material the site operator, site owner or their responsible agent must ensure that there is no significant remaining contamination that poses a risk of causing environmental harm.

#### 6.4.2 Waste foam concentrate and contaminated water disposal

*(see Explanatory Notes §3)*

Notwithstanding that firefighting foams containing PFOS and PFOA must not be held or used, water contaminated by fluorinated organic compounds must not be released to the environment if the levels of fluorinated organics exceed the levels in [Table 6.4.2 A](#). These release limits are interim levels until more robust criteria can be developed by the National Policy Action Group (National Project Action Group Technical Committee) or evidence of more appropriate standards for the protection of environmental and other values become apparent.

**Table 6.4.2 A – Interim contaminated water criteria**

| Compound(s)                               | Water trigger value (µg/L) |
|-------------------------------------------|----------------------------|
| PFOS                                      | 0.3                        |
| PFOA                                      | 0.3                        |
| Sum of *TOPA C4-C14 plus C4-C8 sulfonates | 1.0                        |

\* See definitions.

It shall not be acceptable to artificially dilute contaminated water to make it suitable for release.

Disposal of contaminated water must be in a way that prevents its release to the air, waterways, soils or groundwater. For example, by treatment to capture the fluorinated organic compounds and/or high temperature (>1,100°C) destruction with scrubbing of HF from the flue gasses.

Firefighting foam concentrate, foam solution, firewater or other wastewater containing fluorinated organic compounds or other persistent toxic compounds must not be discharged to sewer or similar waste treatment facility. Standard sewage and wastewater treatment facilities have been shown to be ineffective at removing fluorinated organic compounds, resulting in their release to the environment, e.g. via contaminated bio-solids applied to land as soil conditioner or treated effluent discharges to land or waterways.

## Operational Policy Environmental Management of Firefighting Foam

### 7 Implementation

(see Explanatory Notes §9)

It is recognised that for some users immediate compliance with the requirements of the *Environmental Protection Act 1994* as defined by the provisions in this policy may not be practically achievable. Given the diversity of facilities and foam protection systems it is also recognised that some users will be able to achieve compliance much more readily than others. Nevertheless all foam users are expected to achieve compliance as soon as is reasonably practicable.

#### 7.1 Effective date

(see Explanatory Notes §9.1, 9.2)

Notwithstanding that the requirements of the *Environmental Protection Act 1994* and the *Environmental Protection Regulation 2008* are already in force, this policy will be in effect from the date of approval.

#### 7.2 Interim measures

(see Explanatory Notes §9.2)

Where it is not practical for a foam user to be able to achieve immediate full compliance with this policy they shall put in place interim measures to appropriately manage the risk of release of firefighting foam to the environment until such time as they put in place fully compliant permanent measures. Such interim measures may include things such as:

- Temporary bunding and containment facilities for a spill or firewater.
- Temporary modifications to existing facilities to control, transfer or contain a spill or firewater.
- Arrangements or procedures for measures to be put in place in a timely manner in the event of a spill or foam use.

#### 7.3 Full compliance

(see Explanatory Notes §9.2)

Full compliance with this policy shall be achieved *within three years of the date of approval of the policy*. Users unable to achieve full compliance with the provisions of this policy within the specified time for practical reasons are advised to seek approval of their implementation plan and specific timelines under other relevant provisions of the *Environmental Protection Act 1994*.

### 8 Review

This policy may be reviewed and amended on the basis of any significant new information or changes in technology or best practice that become evident. This policy will be reviewed no later than three years after the date of approval.

### 9 Further information

For further information please contact the Policy Branch of the Queensland Department of Environment and Heritage Protection.

**Operational Policy**  
**Environmental Management of Firefighting Foam**

**Approved by:**



Signature



Date

Anne Lenz  
Acting Deputy Director-General  
Environmental Services and Regulation