

DEP SPECIFICATION

FIRE-FIGHTING AGENTS AND PORTABLE/MOBILE FIRE FIGHTING EQUIPMENT FOR ONSHORE APPLICATIONS

DEP 80.47.10.32-Gen.

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the following:

- a) Fire fighting agents;
- b) Portable/mobile fire extinguishing equipment;
- c) Components used for firewater hose systems;
- d) Portable/mobile foam generating and associated equipment;
- e) Personal protective equipment for fire fighters;
- f) Miscellaneous equipment associated with emergencies.

This DEP is applicable to onshore plants, both for new projects and for modification and extension of existing facilities.

This DEP shall be used in conjunction with the following DEPs:

- DEP 80.47.10.30-Gen.
- DEP 80.47.10.31-Gen.
- DEP 80.47.10.33-Gen.

Note: See (9) References for DEP titles.

The appropriate NFPA, CEN or equivalent standards shall be consulted for fire fighting agents and equipment not included in this DEP.

This DEP is a revision of the DEP of the same number dated September 2010; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in onshore facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may be applied also in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process should be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
AFFF (Aqueous Film Forming Foam) concentrate	A synthetic foam concentrate containing fluorocarbon surfactants that influence the physical properties of the foam solution so that it can float and spread across the surface of a hydrocarbon fuel.
Application rate	Rate at which solution should be applied on a fire. This is normally expressed in terms of a solution flow in litres per minute per square metre/gallons per minute per square foot.
Assessment	Process of analysing and evaluating hazards. It involves both causal and consequence analysis and requires determination of likelihood and risk.
Burn back resistance	Ability of a foam blanket to resist direct flame contact. Such property would be evident in a partially extinguished (petroleum) fire.
Class A fires	Fires in ordinary combustible materials such as wood, cloth, paper, rubber and many plastics (according to CEN and NFPA).
Class B fires	Fires in flammable liquids, oils, greases and tars (according to CEN).
Class B fires	Fires in flammable liquids, oils, greases, tars and flammable gases (according to NFPA).
Class C fires	Fires that involve flammable gases (according to CEN).
Class C fires	Fires that involve energised electrical equipment (according to NFPA).
Class D fires	Fires in combustible metals, such as magnesium, sodium, potassium (according to CEN and NFPA).
Clean agent	Electrically non-conducting, volatile, or gaseous fire extinguishing agent that does not leave a residue upon evaporation.
Combustible product	Substance having a flash point > 37.8°C (100°F) some codes define it as a substance having a flash point > 61°C (142°F). See also flammable product.
Critical application rate	Lowest application rate at which foam will extinguish a fire under laboratory conditions.
Critical shear stress	Measure of the stiffness of foam.

Drainage time	Rate at which foam solution liquid drains from the expanded foam (i.e., a measure of the foam's stability and an indication of the foam's viscosity). It is normally expressed as "25% Drainage Time" ("Quarter-Life"), which is the time in minutes required to drain 25% of the solution liquid contained in the foam sample.
Dry chemical	According to NFPA, various mixtures of finely divided solid particles additionally treated to provide resistance to packing, moisture absorption and proper flow characteristics. These agents are non-conductors and are designed for extinguishment of Class A, B and C fires.
Dry chemical powder	Powder composed of small particles, with an approximate size band between 20 µm and 100 µm, usually of sodium bicarbonate, potassium bicarbonate, urea based potassium bicarbonate, potassium chloride, or mono-ammonium phosphate with added particulate material supplemented by special treatment to provide resistance to packing, resistance to moisture (caking) and to provide the proper flow capabilities. This term is used in DEPs for extinguishing agents used for the extinguishment of Class A, B, C and D fires.
Dry chemical powder system	Supply system of dry chemical powder that can be automatically or manually activated to discharge through a distribution system onto or into the protected hazard by means of (hand) nozzles or monitors.
Dry powder	According to NFPA, solid materials in powder or granular form designed to extinguish Class D fires.
Expansion	Ratio of the volume of the expanded foam formed to the volume of the foam solution used to generate that foam. Expansion can be categorised further into low, medium or high expansion: • Low expansion - up to 20:1; • Medium expansion - between 20:1 and 200:1; • High expansion - between 200:1 and 1,000:1.
Fire incident	Event or chain of events resulting in an undesirable combustion process of one or more substances, which has caused or could have caused injury or damage to assets or the environment.
Fire risk	Product of the chance that a specified undesired fire incident will occur and the severity of the consequences of the event.
Flammable product	According to NFPA a substance having a flash point below 37.8°C (100°F) and a maximum vapour pressure of 276 kPa (abs) (40 psia) at 37.8°C (100°F) (some codes define it as a substance having a flash point below 61°C (142°F). See also combustible product and flammability.
Fluoroprotein foam	Protein based foam with additional selected fluorinated surfactants, which are loosely bonded to the protein to provide the foam with fuel resistance properties.
Foam (finished foam, expanded foam)	Product formed by mixing air with the foam solution homogeneously.
Foam branch pipe (foam nozzle)	Hand-held air aspirating foam nozzle.

Foam concentrate (liquid)	Medium that is added to water to make a foam solution. This solution mixed with air will form the expanded foam. Foam concentrates can be purchased for mixing with water into solutions of 1, 3, and 6% by volume. Foam concentrate is also called foam agent .
Foam generator (foam maker)	Device in which air is mixed with foam solution to form foam. Suitable for backpressures of maximum 0.5 bar (7.2 psig).
Foam solution	Liquid formed when foam concentrate is mixed with water. This solution, mixed with air, gives (fire-fighting) foam.
Fuel resistance	Ability of foam to restrict fuel penetration between expanded air-bubbles, thus withstanding foam breakdown by fuel.
Fuel tolerance	Ability of foam to withstand fuel pick-up so that the air-filled foam bubble will not become saturated with fuel and thus support flames.
Hazard	Potential to cause harm, including ill health and injury, damage to property, plant, products or the environment; production losses or increased liabilities.
Heat resistance	Ability of foam to withstand the effects of exposure to heat through radiation or contact with a hot surface.
High back pressure foam generator	Device, used in selected foam applications, in which air is mixed with foam solution. The maximum allowable backpressure is expressed as a percentage of the generator's inlet pressure. The minimum inlet pressure is 7 bar (100 psig).
Inductor Eductor	Type of jet mixer operated by fire water, in which the foam concentrate, by means of suction, is entrained with firewater thereby forming foam solution. Only at specified flow is an inductor able to deliver foam solution of the required concentration. Typical inductor pressure loss is 30% of the inlet pressure.
LASTFIRE	Large Atmospheric Storage Tank Fires: A consortium of international oil companies reviewing the risks associated with fires in storage tanks and developing the best industry practices to mitigate those risks.
Master plan fire safety systems	Drawings covering the entire installation (location) on which all fire, smoke and gas detection systems, active fire protection systems and fire-fighting equipment (fixed, mobile and portable) are indicated.
Monitor	Device, either portable, fixed, trailer-mounted or truck-installed, to which a large throughput nozzle is attached to allow the operator to direct the fire-fighting agent as required.
Mobile equipment	Equipment that can be immediately moved to another location when required.
Multipurpose dry chemical powder	Powder, usually ammonium phosphate based. Effective on fires involving both ordinary combustibles, such as wood or paper, and fires involving flammable liquids.
Non-aspirated foam	Foam solution, discharged through a nozzle, in which no air is entrained intentionally.
Pick-up rate	Percentage at which foam concentrate is proportioned into the water flow. Normally this is either 3% or 6%, but may differ for certain types of fire or type of foam concentrate, or depend on the viscosity of the concentrate.
Portable equipment	Mobile equipment which can be hand carried by maximum two persons.

Premix foam solution	Liquid (foam solution) in which foam concentrate and water are already mixed in the correct ratio; thus ready for immediate use in the appropriate foam generator.
Prevailing wind	Direction, from which the wind is most likely to blow, based on local meteorological observations.
Proportioner	Device in which foam concentrate and water are mixed to form a solution. It is suitable for varying flow rates, e.g., between 1-6% with a pressure loss of 10% of the inlet pressure.
Protein foam concentrate	Concentrated solution of hydrolysed protein to which chemicals are added to obtain vapour suppression, freezing point depression and other desirable characteristics.
Semi-subsurface foam injection	Discharge of foam at the liquid surface in a tank by means of a foldable hose, through a rupture disc from an inlet near the bottom of the tank to avoid submerging foam in the liquid.
Subsurface foam injection	Discharge of foam into a tank near the tank bottom (above the free water layer), allowing the foam to travel through the product to the surface.
Trailer mounted equipment	Movable equipment mounted on a trailer and intended to be moved to another location by towing.
Universal foam concentrate	Alcohol-resistant foam concentrate that may be applied on hydrocarbons and water-miscible fuels.
Vapour suppression	Ability to suppress the formation of flammable vapours, thus minimising the risk of re-ignition.
Water branch pipe Handline Nozzle	Hand-held water nozzle, with a typical application rate of 200 L/min (52.8 gpm) to 400 L/min (105.8 gpm) at 7 barg (100 psig).
Wheeled equipment	Mobile equipment equipped with wheels to improve its mobility. Suitable for hand pulling by one person.

1.4 CROSS REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets (). Other documents referenced by this DEP are listed in (9).

1.5 SUMMARY OF CHANGES

This DEP is a revision of the DEP of the same number dated September 2010. The main, non-editorial changes, have been to remove informative wording (e.g., background and explanation) from the DEP Specification and move this to the companion Informative document. This revision has resulted in a reduction in the overall content and sub-sections compared to the previous DEP.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of "DEPs on the Web", available through the Global Technical Standards web portal <http://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

2. FIRE FIGHTING AGENTS

2.1 GENERAL

2.1.1 Fire classification

Fire fighting agents are subdivided according to the types of fires for which they are suitable. Fires are classified into groups in accordance with the flammable materials involved:

American Class (UL 711)	Material involved	European and International Class (EN 2, ISO 7165)
A	Wood, paper, rubber (glowing embers)	A
B	Flammable liquids such as petroleum products, varnish, lacquer thinners, etc.	B
B	Vapours and gases	C
C	Energised electrical equipment	None
D	Combustible metals such as magnesium, sodium, titanium, potassium, lithium and zirconium	D
K	Cooking fires involving oils and fats	F

In order to avoid misunderstanding, the UL 711 classification is used in this DEP.

2.2 WATER

2.2.1 Water general

Water is the most commonly used agent for:

- Cooling adjacent equipment;
- Controlling fires and vapour releases.

2.2.2 Limitations

Since water is conductive, it should not be used on electrical fires. Factors influencing the likelihood of shock from live electrical equipment are:

- Electrical loading (voltage and current);
- Distance separating water application equipment and live electrical equipment;
- Dispersion of the water stream or spray, i.e., the electrical conductivity of the water stream.

Water shall not be used on burning metal fires and other water reactive products.

2.2.3 Compatibility with other fire fighting agents

2.2.3.1 Water and foam

Water may be used to cool down adjacent/nearby equipment while foam is being applied onto a pool fire. It shall be used with care where foam is applied since it tends to dilute the

foam. Water jets will disturb the foam blanket with the result that extinguishment may not be achieved and/or vapour suppression effectiveness may be reduced.

2.2.3.2 Water and powder extinguishing agents

Care shall be taken in using water together with powder, as the powder's extinguishing efficiency will be adversely affected. However, immediately after flames have been extinguished by powder it may be necessary to apply water to cool adjacent hot surfaces to avoid flash fires. (In general, powder has no cooling effect and so re-ignition should be expected.)

2.3 FOAM

2.3.1 Foam general

Foam is generally used for suppressing and extinguishing pool fires; it may be applied also on non-ignited pools of liquids to suppress vapours.

2.3.2 Limitations

The following points should be taken into consideration:

- (a) Foams are not effective in extinguishing three-dimensional fires involving jetting or falling fuels and flowing liquid fires.
- (b) A release of pressurised LPG is unlikely to form a liquid pool of more than very brief duration, due to flashing of the liquid. Therefore the use of foam is not effective.
- (c) Aspirated Foams have a limited throwing distance, due to their low density. Wind force and direction may influence this distance as well.
- (d) Non-aspirated foams may be able to be thrown over larger distances than aspirated foam. (In practice, some aspiration will occur due to foam travelling through the air and due to impinging jets.) However, force of impact onto a fuel surface may be greater and as a result, there may be more fuel pickup and fires may be more difficult to extinguish at the impact point.
- (e) Unless specially approved foam is used, the same restrictions as mentioned for water are valid (foam is in principle water).
- (f) If the bulk temperature of the liquid is high ($>100^{\circ}\text{C}$ (212°F)) this will restrict the use of foam, and may even cause violent frothing or slop-over. (It is not fully known whether foam application could, for example, increase boilover consequences in the case of crude oil tank fires where large amounts of foam are applied and water is allowed to settle to the tank bottom.)
- (g) The water required for producing foam should not be contaminated with water miscible components e.g., alcohols, etc.

2.3.3 Specification, testing and procurement of foam

2.3.3.1 Standards

Relevant foam standards are produced by the following organisations:

National Fire Protection Association	NFPA
Comite européen de Normalisation	CEN
Underwriters Laboratories Inc.	UL
Factory Mutual	FM

NFPA and CEN standards are primarily concerned with system design, installation and maintenance, whilst UL/FM produce approvals aimed specifically at foam equipment and foam concentrate combinations.

NFPA/CEN standards shall be used for system design.

NFPA/CEN standards include requirements for foam concentrate and foam quality.

2.3.3.2 Testing

Independent testing authorities, such as Underwriters Laboratories Inc. (UL), are the customers' guarantee that the foam Manufacturer has demonstrated, through extensive fire testing and evaluations that the product complies with the rigid requirements and specifications of the testing authority. In addition, an UL-listed manufacturing source will be checked at regular intervals to confirm the quality of product and the manufacturing process in the factory. Any deviation from these standards can lead to the foam concentrate Manufacturer being removed from the approval listings.

Foam types and/or applications not covered in the UL standards shall be tested to an agreed protocol before acceptance by the Principal.

The tests that are specified by approvals bodies and other industry groups (e.g., LASTFIRE) include foam concentrate physical property tests, foam fire performance tests and foam quality tests. All of these types of tests shall be regularly performed from the procurement and batch acceptance stage onwards.

When selecting a fire test performance protocol, one that is relevant to the application shall be specified.

2.3.3.3 Procurement

When procuring foam stocks, a recognised fire test should be specified and independently witnessed that is relevant to the application.

Fire testing should be carried out at batch acceptance and at regular intervals thereafter to ensure that the foam will perform as intended.

A detailed procurement specification should also require measurement of various physical properties on the batch. These, whilst not having a direct relevance to fire performance, can be used to assess any changes in the concentrate due to degradation, contamination or dilution. The end user should keep retained samples supplied by the Manufacturer to act as reference points to facilitate identification of the cause of any degradation.

The foam concentrate Manufacturer or Supplier shall guarantee that the foam concentrates are biodegradable and non-toxic. For this purpose, the Manufacturer shall supply data on chemical oxygen demand and biological oxygen demand.

A "return" clause should be included in any purchase order for disposal of redundant/deteriorated foam concentrate stock.

Procuring foam concentrate in bulk quantities will significantly reduce the price.

2.3.4 Safety and environmental effects of foam concentrates

The Manufacturer's Material Safety Sheets for each foam concentrate type stored at, or planned to be used at site shall be available. The Manufacturer shall confirm that the product meets the legal requirements of the country of destination.

Foams containing Perfluoro octanyl sulphonate (PFOS) shall not be specified for use for new projects and for replenishment of foam stocks regardless of application. PFOS is a persistent, bio-accumulative and toxic chemical no longer accepted for use in fire fighting foams.

Normally, the various types of foam concentrates are complex mixtures. Foam concentrates can contain phosphates, mercury or other materials identified as contaminants or pollutants. Protein based foams may contain added freezing point depressants and organic and inorganic stabilisers. Synthetic foams may contain freezing point depressants and glycol ether solvents. Both can include surface-active fluorocarbon ingredients such as PFOS.

The use of foam, including use during training and testing, shall be done in an environmentally responsible manner to minimise any associated risk. Fluorine free training foams are now available that can mirror the induction and foam property performance of the front line operational foam in use on site.

In the design of facilities where large quantities of foam could be released, ways to contain foam discharge and prevent escape to sensitive environments (e.g., lakes, drinking water sources or ecologically vulnerable water bodies) shall be considered. In most cases, disposal will also need to be considered (e.g., by the use of incineration or use of activated carbon filters/granules). Local environmental protection agencies shall be consulted prior to discharge. In an emergency, agencies shall be advised as soon as possible with confirmation of steps taken to restrict/minimise release of foam and incident run-off into the general environment.

During training the foam shall not be allowed to escape to watercourses.

2.3.5 Functioning of foam

Reference is made to the DEP 80.47.10.32-Gen. Informative.

2.3.6 Expansion ratio of foam

Depending on the type of foam concentrate and the foam producing equipment used, the expansion ratio will vary widely. The expansion ratio is also governed by the nozzle type and pressure as well as presence of impurities in the firewater. Generally, the following terminology is used:

Low expansion foam	Up to 20:1;
Medium expansion foam	Between 20:1 and 200:1;
High expansion foam	Between 200:1 and 1,000:1.

2.3.7 Travel distance of foam

The assumed foam travel distance over the pool surface should be documented in the design basis for any installed fixed or semi fixed foam systems, and in the emergency response pre-plans for foam delivery by mobile foam apparatus.

2.3.8 Types of foam

Commercially available fire fighting foams can be divided into two main groups:

- Protein based foams;
- Synthetic based foams.

Foam concentrates possessing components of both groups are available.

The required type of foam shall be selected according to the flammable liquids present at the location. If the majority of these liquids on site are non-water-miscible, which is normally the case; it may be more cost effective to keep different types of foam in stock. If polar solvents are present, an "alcohol resistant" or "multipurpose" type foam concentrate shall be specified for that use.

For Products containing up to 15% polar solvents standard fluoroprotein foam or film forming foam (FFFP or AFFF) could still be used provided the foam Manufacturer for the specific product verifies application rates.

2.3.9 Application rate of foam

To be effective, foam must be applied at a rate greater than the "critical application rate", which is the minimum recommended application rate that has been found by laboratory tests to be the most practical in terms of speed of control of the fire and the amount of agent required.

For application rates of foam systems and from mobile foam apparatus, see DEP 80.47.10.30-Gen., Section 4.1.2 and Section 5.

2.3.10 Properties and quality of foam

Properties of foam, i.e., physical properties, fuel tolerance, burn back resistance, heat resistance, expansion and drainage time (foam quality) are discussed in the DEP 80.47.10.32-Gen. Informative.