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Environmental damage limitation from fire-fighting water run-off

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TECHNICAL REPORT

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Environmental damage limitation from fire-fighting water run-off

Limitation des dommages environnementaux dus au ruissellement des eaux de lutte contre l'incendie

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 26368 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 3, *Fire threat to people and environment*.

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Introduction

Fires involving commercial storage facilities and industrial plants are generally controlled by applying large volumes of water. These facilities routinely store or use large quantities of materials and manufactured products, often flammable and combustible. These substances, whether combusted or not, can be transported by uncontrolled water run-off in the event of a fire and could give rise to severe environmental pollution problems.

The latest Organisation for Economic Co-operation and Development (OECD) report in the series *Environmental Outlook for the Chemicals Industry*[1], notes that, in the European Union, chemical accidents that cause ecological harm often involve water pollution; this pollution is frequently the result of fire-water run-off.

The seriousness of these threats depends on various factors, including the nature and quantity of the materials involved, the emergency planning measures in place, and the location of the fire relative to susceptible populations and environments. Contamination far beyond the locality of the fire can result from fire scenarios that generate large quantities of harmful combustion products and fire suppression that involves large quantities of water. The environmental hazard can be worsened by interactions between the product that is burning, the combustion products produced and the extinguishing agent.

This Technical Report provides a summary of current approaches to controlling and reducing adverse environmental impacts caused by fire-water run-off. The intended audience for this Technical Report includes, but is not necessarily limited to:

— Fire-fighters and investigators.

— Building owners and managers.

— Storage facility operators.

— Materials and product manufacturers.

— Insurance providers.

— Environmental regulatory authorities.

— Civil defence organizations.

— Public health authorities.

— Industrial safety authorities.

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Environmental damage limitation from fire-fighting water run-off

1 Scope

This Technical Report provides information for the development of specifications and procedures aimed at limiting adverse environmental impacts caused by fire-water run-off (see References [2] to [7]). The information is applicable to commercial facilities, such as warehouses, chemical storage facilities, refineries, process plants which handle and/or store products with a potential pollution potency, and vehicles for the transport of such substances. It is only applicable to land-based operations (i.e. not oil tankers or off-shore oil drilling platforms), and to wildland fires.

As such, this Technical Report provides a summary of current potential approaches for controlling and eliminating adverse environmental impacts caused by fire-fighting water run-off. It offers relevant information for the design and sizing of water basins to limit the dispersion of contaminated water into the environment at large (see References [8] to [12]). This Technical Report is divided into three main parts: a description of the hazards of fire run-off, environmental damage limitation and details concerning the possible design of water basins.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 13943, *Fire safety — Vocabulary*

ISO 14001, *Environmental management systems — Requirements with guidance for use*

ISO 14050, *Environmental management — Vocabulary*

ISO 26367-1, *Guidelines for assessing the adverse environmental impact of fire effluents — Part 1: General*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943, ISO 14001, ISO 14050, ISO 26367-1 and the following apply.

3.1
fire effluent
totality of gases and aerosols, including suspended particles, created by combustion or pyrolysis in a fire

NOTE For the purpose of this Technical Report, fire effluent also includes run-off water generated during fire-fighting activities.

3.2
fire-water run-off
aqueous fire effluent containing dissolved and waterborne materials

NOTE Materials that may be present include substances affected by the fire, combustion products, and substances used to fight the fire.

3.3
biochemical oxygen demand
BOD
indirect measure of the concentration of biologically degradable material present in water

NOTE This definition is based on OECD documents (References [13] and [14]).

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3.4
chemical oxygen demand
COD
measure of the oxygen required to fully oxidize all compounds, both organic and inorganic, in water

NOTE This definition is based on OECD documents (References [13] and [14]).

3.5
contaminated fire water
water that has become contaminated with process materials used at a facility and the products resulting from combustion or products used as part of the extinguishing process

4 Emission to the aquatic environment

4.1 Contamination pathways

4.1.1 General

The major threat to the aquatic environment posed by fires arises from the direct run-off of contaminated fire-fighting water into rivers, streams, lakes, ground waters and sewage treatment works.

The polluting effects of fire-fighting water run-off, related to both surface water and ground water, are due to one or more of the following:

— direct toxicity or ecotoxicity (i.e. LD_{50} determination on Daphnias);

— an increase or decrease in the biochemical oxygen demand (BOD);

— an increase or decrease in the chemical oxygen demand (COD);

— physical effects such as suspended solids polluting river beds or the gills of fish;

— sanitary quality of public bathing water;

— an increase or decrease in pH;

— metals released in the environment.

4.1.2 Impact modes

The impact that any discharge of fire run-off has on the aquatic environment is determined by a wide variety of factors:

a) The volume of run-off produced, the time of travel from the site of the fire to the receptor, the dilution afforded in the receiving water body, and the temperature and chemistry of the receiving water body.

b) The sensitivity and the distance (time of travel from the site) of the primary and secondary receptors, such as public drinking-water abstraction points, fisheries and all potential aquatic and non-aquatic ecosystems.

c) The chemical composition of the run-off as determined by the source of the fire, e.g. in the case of fires at sites storing chemicals, a complex mix will be involved including:

   — the stored chemicals and their thermal decomposition products washed off the site by the run-off,

   — the solid and condensed decomposition products of combustion of the building and of substances stored on site, and

   — additives to the water used in fire suppression, such as fire-fighting foam.

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NOTE 1 Contamination could be a consequence of interactions between the pollutants and their targets. For example, pollutants can be concentrated at different steps in a food chain and their impact can occur far from the primary affected targets.

NOTE 2 References [15] to [20] give information on the toxicity of chemical fire suppressants.

Contamination can be in the form of pollutants floating on water, pollutants miscible in water, and pollutants mixing with sediment.

4.1.3 Acute effects

The acute effects of a discharge of run-off to surface water usually appear immediately. The impacts, although often short term, can be very serious and can include the contamination of public drinking water supplies during or immediately following the fire. The effects are usually greatest within the immediate vicinity of the site, where the levels of pollutants will be at their highest. Acute effects can be followed by long-term disruption in the ecosystem that can occur up to several years after the contamination event (see A.4).

NOTE Acute effects can also peak at some distance from the fire. For example, an oxygen sag can form downstream of the discharge point when more toxic breakdown products can be formed, such as ammonia forming from the breakdown of protein-based foams. Furthermore, sensitive receptors can be located well downstream of the discharge point.

4.1.4 Long-term effects

Long-term environmental impacts from exposures to large fires (i.e. the impacts occurring after the fire, over a period of years) will be experienced largely within the local environment, within the fire deposition zone and along impacted streams and watercourses and ground waters as defined in ISO 26367-1. Information concerning such incidents can be found, for example, in the Major Accident Reporting System (MARS) described in the Note below.

NOTE The Major Accident Reporting System (MARS) is a distributed information network consisting of 15 local databases on an MS-Windows platform in each Member State of the European Union and a central UNIX-based analysis system at the European Commission's Joint Research Centre in Ispra (MAHB, Major Accident Hazards Bureau) that allows complex text retrieval and pattern analysis. MARS is used by both EU and OECD member countries to report industrial accidents in the MARS standard format and to exchange accident information (see Annex A).

Long-term impacts can also arise from direct ingestion by flora and fauna of toxic/carcinogenic/ecotoxic organic compounds within watercourses contaminated by fire-water run-off. Pollution of ground water can also lead to the long-term (decades) or permanent closure of public and commercial water supplies that are drawn from ground water or taken from surface waters that are fed by contaminated ground waters.

The nature and place of any intervention that occurs has a major effect on the environmental impact of that intervention. Some information is given below concerning what is appropriate to monitor in order to determine the environmental impact of a particular intervention and whether a controlled burn (i.e. allowing a fire to burn out under the control of the fire authorities) is not sometimes a viable alternative to traditional extinguishment. If extinguishing media have been collected, samples should be taken for analysis. Further, samples should also be taken from ground water and surrounding watercourses or lakes.

The exact species that should be monitored in samples taken on site should be determined based on the products stored on site and their likely breakdown products as well as on the fire-fighting agent(s) used. Examples of relevant analyses include: PAH, dioxins, metals, pH, BOD, COD and suspended solids (SS). In some cases, toxicity tests and biological monitoring may also be useful.

In cases where action is required to prevent the fire from spreading, for example by applying cooling water to the area around storage tanks, care should be taken to ensure this water does not become polluted.

4.2 Control of fire-fighting water run-off to surface water and ground water

Fire-fighting water containment should be considered for industrial sites over and above the requirements for ordinary bundings and secondary containment systems. A containment system may be needed to protect both surface and waste-water drainage systems. Lagoons may be constructed whose retention capacity is

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