

# The control of fire-water run-off from CIMAH sites to prevent environmental damage

Guidance Note EH70



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This guidance is provided to help operators of sites subject to the Control of Major Accidents Hazards Regulations 1984 (CIMAH) ensure that they have adequate arrangements in place to deal with water used to fight fire on their sites. It may also be useful in other circumstances where water is used to wash away hazardous substances that have been released accidentally.

It is also aimed at the operators of major hazard installations, the emergency services, local authorities and inspectors to provide advice for considering measures to prevent and control fire-water run-off.

In addition, the guidance will also be useful to operators of non-CIMAH sites using or storing hazardous chemicals.

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This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice.

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1 This guidance is provided to help operators of sites subject to the Control of Major Accident Hazards Regulations 1984 (CIMAH) ensure they have adequate arrangements in place to deal with water used to fight fires on their sites. The advice may also be useful in other circumstances where water is used to wash away hazardous substances that have been released accidentally. Operators of non-CIMAH sites using or storing hazardous chemicals will also find it useful. It does not cover pollution as a result of routine process discharges.

2 This guidance deals with mitigating the effects of accidents but operators must consider first how to prevent accidents. The key to accident prevention lies in a good health and safety management system. A well-managed site where policies have been set and implemented, where there is a systematic approach to risk assessment and control, where performance is measured against pre-determined standards and where the whole system is audited will be much less likely to have an emergency to deal with. Advice on health and safety management can be found in the HSE guidance booklet *Successful health and safety management* (see Appendix 3).

## Introduction

3 Water is the most widely used medium for fighting fires. It is cheap, plentiful and very effective; it not only extinguishes flames but also takes heat from the fire which helps reduce the risk of radiated heat, structural damage and reignition. It also has the advantage that, in most circumstances, it is non-hazardous. Large volumes of water are frequently used in fire fighting and, although some will turn to steam in the heat, much will fall to the ground and drain away from the site of the fire. This 'fire-water run-off' does not usually present a serious risk to the environment.

4 If hazardous chemicals are involved, foam might be used to fight a fire rather than water but there may still be a need for water to cool other property or plant nearby, to reduce the risk of it becoming involved in the fire.

5 Water or foam used to fight fires at premises where chemicals are used or stored can become contaminated with the chemicals and become hazardous itself. (For example fire-water run-off from a fire in Basle, 1986, resulted in major pollution of the river Rhine, extending many kilometres downstream and lasting many years; the fire at Allied Colloids, Bradford, in 1992 resulted in severe pollution of the Rivers Calder and Aire from fire-water, severely affecting aquatic life over 50 km.) In these circumstances due consideration must be given to preventing it harming either people or the environment.

### Scope of the guidance

6 The purpose of this guidance is to provide advice to the operators of major hazard installations, the emergency services, local authorities, and inspectors on measures to consider for the prevention and control of fire-water run-off. This is only one aspect of emergency planning and the guidance supplements that contained in other HSE publications and elsewhere (see Appendix 3).

7 Appendix 1 outlines the main legal requirements relevant to this topic. The guidance assumes that all necessary measures have been taken to prevent major accidents. In particular it is assumed that operators are complying with existing HSE guidance on the safe storage of chemicals (see Appendix 3). However, even when all reasonably practicable measures have been taken, incidents may still

occur and this guidance is intended to address those risks which remain, to limit the consequences to people and the environment.

8 This guidance is not intended to specify how fires should be dealt with, or the extinguishing medium to use. These are matters for discussion between the Fire Authority and operators during preparation of emergency plans. The final decisions will rest with the Fire Authority and, of course, the fire officer in charge of dealing with a fire may vary them at the time, depending on the circumstances.

## Fire precautions

9 The primary objective is to prevent the outbreak of fire, rather than have to deal with its consequences. It is important that proper thought is given to appropriate fire precautions. Proper risk assessment will reveal not only the routes by which major environmental damage might occur in the event of fire, but also the areas where fire precautions are inadequate.

10 Particular attention should be paid to the exclusion of potential ignition sources. There are too many of these to list but, consider carefully for example permitting smoking only in designated areas and exercising proper control over maintenance activities, especially any involving hot-work. Also, consider electrical and heating services in the storage area containing the environmentally hazardous chemicals. Are they really necessary? If they are they must be properly installed and maintained.

11 Consideration should be given as to how a fire can be controlled in its early stages by either a limitation of the fuel available, segregation of flammable or incompatible substances, fire compartmentation, its early detection and extinguishing, or a combination of these. Advice on these matters should be sought from the relevant enforcing authority. Changes to existing buildings can have a serious effect, for example holes in walls for cables or pipes can reduce compartmentation significantly.

12 Consider also the storage of environmentally hazardous chemicals outdoors in a secure compound. Where they are stored indoors the combustibility of the materials used in the construction of the building must be taken into account as should the combustibility of packaging materials, the compatibility of the chemicals themselves and housekeeping. Fire spread from adjacent stacks should also be addressed.

13 The earlier a fire can be tackled, the greater the chance of successfully extinguishing it and minimising the quantity of contaminated water. When considering automatic fire detection (and possibly fire-fighting) equipment, seek advice from the supplier(s), the relevant enforcing authorities and the insurers as to its suitability. As well as its effectiveness, consider the potential of any effluent (ie product carry-over and fire-fighting medium, whether foam or water) to damage the environment. The water from sprinkler or deluge systems must be treated in the same way as any water applied by fire-fighters.

14 A well-designed active fire suppression system can reduce the amount of water which needs to be applied to control/extinguish a fire and this in turn can reduce the scale and cost of other facilities.

# Emergency planning

15 Emergency planning is a matter for teamwork and it is essential to work closely with the appropriate authorities and other bodies with an interest (some of these are identified in paragraph 42).

## Environmental hazard identification

16 The type and extent of the measures implemented at a major hazard installation to protect the water environment from the effects of an accident will depend on the likelihood of an accident occurring and the likely consequences. The likelihood of an accident occurring depends on the nature and quantities of the hazardous substances on site, the activities carried out on site and existing accident prevention measures. The environmental consequences of an accident will depend not only on the severity of the accident but also on the nature of the environment in terms of the flora and fauna which it supports and its ability to recover if damaged.

17 It is essential to assess the risk that major hazard installations pose to the environment on a site by site basis. Installations where similar activities are carried out may pose different risks, depending on the environment around them. Accidents may also cause environmental damage a significant distance away from the installation; all possible routes of transport of contaminants should be identified, for example drains and ditches.

18 The health and safety of people is always paramount and it is important to consider indirect risks to people. Environmental contamination may result in long-term exposure to hazardous substances, which may enter the food chain via the air, water or soil. Decisions may have to balance the risks due to airborne pollution if a fire is allowed to burn and risks to the environment if water is used to control it.

19 It is important to assess the routes by which contaminants can be carried significant distances away from the site, where they may cause serious environmental contamination, for example drainage systems and rivers and it is important that suitable 'water maps' are prepared showing the location of all drains, water supplies and water courses. Smoke plumes may carry significant quantities of pollutants away from the site; knowledge of prevailing weather conditions, including mean wind speeds and directions is required to assess this effect.

20 Even if it can be demonstrated that the likelihood of a major accident is very low or that the environmental consequences of a major accident would be negligible, normal precautions for the safe use, storage and transport of dangerous substances still apply. If, however, one or more dispersion mechanisms are likely to cause serious environmental damage then appropriate measures should be adopted to control the risk.

21 The National Rivers Authority (NRA) or, in Scotland, the River Purification Boards (RPB) should be consulted about the assessment since they hold factual information about neighbouring water resources, ecotoxicology and water quality criteria and should be able to provide information about the location, type, nature, importance and sensitivity of all water resources at risk. These authorities may be able to offer practical advice on the range of strategies and equipment available to protect the environment and their suitability in particular circumstances.

22 For sites subject to the top-tier requirements of CIMAH the nature of risks posed to the environment and details of that environment should be described in the safety report. Guidance about the information required in a safety report is

contained in the HSE publication *A guide to the Control of Industrial Major Accident Hazards Regulation 1984* (see Appendix 3). Consideration of the pollution risks to water resources from contaminated fire-water should include:

- the sources of release of dangerous substances in the event of a fire and the potential consequences;
- the properties of the substances present on site, for example toxicity, flammability etc, and the potential for adverse reactions between them;
- the environmental behaviour of the substances such as solubility, volatility, persistence, potential to bioaccumulate in the food chain and environmental toxicity. Consider also products formed as a result of complete or incomplete combustion of substances in fire or degradation in water. These may be more persistent and harmful than the parent compounds;
- information about the location, inventories and process conditions, with reference to facilities such as bunding, entry points to storm and foul water drains, protective equipment associated with them, and the routes of water flows to containment and treatment plants;
- information about the type and vulnerability of relevant water sources (obtained from the NRA/RPB) which will include:
  - (i) sites within river catchments above public water supply intakes and/or reservoirs where the discharge following an incident is likely to lead to levels above agreed acceptable maxima for drinking water abstraction (time of travel to intake, the importance of the intake and other similar factors may need to be considered);
  - (ii) sites in close proximity to aquifers or close to water courses that flow to, and can contaminate aquifers, particularly those used for public water supplies;
  - (iii) sites which pose a threat to waters of particular ecological value such as sites of special scientific interest (SSSIs);
  - (iv) sites where surface water, contaminated with hazardous substances, discharges into a foul sewerage system. This could either damage the filter beds of any receiving treatment works or, where receiving treatment works do not have sufficient storage capacity to contain the fire-water run-off, result in its diversion directly into the water environment, causing significant environmental harm.

23 The NRA/RPB is able to offer advice and assistance to HSE inspectors and manufacturers on assessing the potential risks of the site to the water environment.

### The fire hazard

24 While this guidance is principally concerned with preventing serious accidental damage to the water environment, it is also important to consider other routes by which such major environmental damage might occur, for example by the ejection of chemical containers as missiles during the fire, and smoke borne contaminants, including the principal combustion products of the chemicals involved.

## Control measures

25 If the assessment shows that the fire-water run-off is likely to cause serious damage to the environment, means to minimise the risk should be provided. This should comprise arrangements for containing the run-off, although in certain circumstances alternative approaches to remove or minimise the risk might be more appropriate. Some of these are discussed later but decisions should be taken

only after full discussion with all the appropriate authorities; there is rarely, if ever, a single correct solution.

### **Containment systems**

26 There is a variety of containment measures which may be employed, ranging from permanent structures to temporary systems. The following paragraphs are intended to assist occupiers select the most appropriate measures for their particular sites.

27 To size any containment system, knowledge of the anticipated quantity of run-off from a fire is required and although this cannot be calculated with any precision it should still be estimated. The size of the bund needs to be considered on a site-specific basis having regard to the size of fire that is possible. Advice on this and the fire-fighting arrangements in general should be obtained from the Fire Authority. In discussing these matters, take account of the flammability of the building structure and contents as well as any fire detection/suppression system; to tackle a small fire may require only a few tens of cubic metres of water whereas a large fire may require in excess of several thousand cubic metres of water.

28 It may be concluded that the provision of a permanent containment system is the appropriate solution to deal with the run-off expected from a small fire. This would also provide sufficient time to put in place larger, temporary, containment measures in the event of a major fire. Provision for such temporary measures would, of course, have to be previously agreed and arranged.

29 When deciding on suitable control measures to prevent or limit environmental damage it is important to consider not only their effectiveness and cost but also their compatibility with operator health and safety, ease and cost of maintenance, how their installation will affect the overall safe running of the plant and how they will be emptied if they ever need to be used. It is important that the contents of a containment facility can be disposed of safely after an accident, without posing further risks to people or the environment. Where it is proposed to use pumps to transfer run-off water, consider back-up power supplies in case normal power is interrupted as a result of an accident.

30 A potential benefit of a permanent containment system is that it is possible the water may be reusable to tackle the fire, though this requires prior discussion with the Fire Authority to determine any restrictions and whether there is a need for any special equipment. It may also be necessary to arrange for this water to be monitored for its suitability. This should be detailed in the on-site emergency plan.

### **Bunds**

31 It is a sensible precaution to store environmentally hazardous chemicals in banded areas. Bund sizes need to be considered on an individual basis, taking into account industry guidance such as British Wood Preservers and Damp-proofers Association (BWPDA) guidance on timber treatment. The floors and walls of banded areas should be substantially impervious and provide for the localised containment of spills irrespective of whether there is a fire or not, for example failure of a container.

32 Ideally the capacity of the bund would be sufficient to take the entire inventory of the chemicals stored within it, plus the foam or water from initial fire-fighting or fire protection activities, but this may not always be achievable. An additional 10% of the nominal chemical inventory may be adequate to provide for coverage of the

chemical with foam or water in a drum storage area, for example, but much more than this could be required in other circumstances and a bund sized to take 110% of the entire chemical inventory would not provide sufficient capacity to prevent fire-water run-off. However, it may provide sufficient time for emergency, temporary containment measures to be brought into operation.

33 There are a number of situations where such sizing of the bund to take the entire inventory is not normal practice, nor perhaps, reasonably achievable. For example bunds enclosing a number of storage tanks will usually only have a capacity equivalent to 110% of the largest tank present. Similarly in the case of very large storage tanks the bund capacity may be less than that of the tank. In such cases particular consideration is required for dealing with fire-water run-off and would be expected to include the provision of permanent containment measures to prevent pollution. In these or other unusual or difficult circumstances, further advice may be sought from the relevant enforcing authority.

34 Particular attention should be paid to the ability of the bund walls to withstand the hydrostatic pressure from the contained liquids and resist attack by the chemicals as well as their structural integrity under fire conditions. Shallow bunds may be provided with sloping kerbs to allow access by fork lift trucks.

35 It is essential that bunds are properly maintained. This includes keeping drain valves closed, except for regular draining of rainwater, as well as checks on the physical structure. Consider the possibility of the presence of dangerous levels of toxic or flammable gases in confined spaces between high bund walls and tanks before anyone enters the bund.

### Lagoons and tanks

36 Permanent provision for the containment of large quantities of fire-water run-off, typically several thousand cubic metres and above, may be achieved by lagoons and tanks. These can be remote from, and may serve, several storage areas, receiving the run-off via a gravity flow or pumped drainage system.

- **Lagoons** should be provided with an impermeable surface membrane to prevent pollutants soaking into the ground. They cover a relatively large area, enhancing evaporation and the settling out of suspended solids.
- **Tanks** have the benefit of providing a relatively large storage volume in a small area, though they are expensive compared to lagoons, particularly for the larger volumes. Where available, an economical option might be to make use of a redundant or spare tank.

37 Where there are a number of sites in close proximity it may be possible to install shared facilities and reduce the cost.

38 In the event of an incident necessitating the use of a lagoon or tank it is important that the emergency procedures ensure that any outlets from these, such as surface water, sewer or foul/trade effluent, are isolated.

### Emergency temporary containment

39 Emergency temporary containment of fire-water run-off may be provided by a sacrificial area, site containment or portable flexi-tank. As discussed in paragraphs 31-35 the provision of bunds should always be a prime consideration, but if reliance is placed on any of the following emergency systems, bunds would be considered essential to provide sufficient time for these secondary containment measures to be made ready.

- **Sacrificial areas** might be natural depressions, or ones specially created to fulfil this function, for example a car park. They may be designed to have inherent containment provision, or be readily adaptable in an emergency, for example by the use of booms and similar devices. An aspect to consider is the permeability of the ground and how to minimise soaking of the pollutant into it. Discharge to the area may be by gravity or pump<sup>1</sup>.
- **Site containment** may be achieved by either a low kerb around the entire site, or just the sensitive area. It essentially serves as a secondary containment system to the bunding, should this overflow. The possible effects of this containment on process operations and emergency services will need to be assessed.
- **Portable flexi-tanks** range in size from about 10m<sup>3</sup> up to around 250m<sup>3</sup>. Important matters to consider include the compatibility of the tank material with the chemicals it will contain, the time it takes to bring it into use and the location of the tank and pumping arrangements. All these factors should be detailed in the on-site emergency plan. Regular examination and maintenance of such tanks is essential. Consideration might also be given to whether the collected water can be re-used to tackle the fire.

40 With respect to sacrificial areas and site containment systems, particular consideration needs to be given to how surface water, sewers and foul/trade effluent systems will be sealed off, to prevent run-off water getting off site.

### Other containment systems

41 Other containment systems which may be used include those below. All have limited capacity, and their use needs to be discussed with the Fire Authority beforehand to ensure they would have sufficient capacity in the event of fire.

- **Catch-pits and interceptors** provide for the rudimentary separation of solids and also aqueous from non-aqueous solutions. They may also be used to provide transitional containment for water-miscible products. They may be used singly or as a series.
- **Separators** provide a specified design performance for removal of named non-miscible hydrocarbons from water, allowing the subsequent discharge of the water.
- **Booms** can be used to provide total containment, either by themselves, or to fill gaps in other containment areas. They may be used as flotation devices to contain lighter non-water-miscible hydrocarbons.
- **Drain seals** can be used to cover or block a drain, allowing the site sewer system, or part of it, to be sealed and thus employed as an emergency containment system.
- **Sand bags** while effective, have limited use. They are often not available and take time to deploy.

### Alternatives to containment

42 There may be cases, depending on the location of the site, where it may be appropriate to allow a fire to burn under control. This option may minimise the risk of a major environmental accident resulting in contamination of the water environment but may cause other risks. There are a number of highly sensitive issues to consider and forward planning is essential. Decisions on controlled burning should be taken in consultation with relevant parties which will include the manufacturer and their insurers, Fire Authority<sup>2</sup>, Environmental Health Authority, HSE, NRA/RPB, HMIP, Ministry of Agriculture, Fisheries and Food (MAFF) and others. Factors to consider will include the effects on local populations, the risk

of fire spreading to nearby property and the impact of deposition from the smoke plume. Where controlled burn is considered to be appropriate the criteria for the decision should be described in the CIMAH emergency plans. It must be remembered that some application of water is likely to be required to ensure that the fire burns in a controlled manner and adequate provision should be made to contain the estimated run-off.

43 In certain circumstances, especially in areas where the risk of serious damage to the water environment is identified, the re-location of any environmentally hazardous chemicals to an alternative site may be worthy of serious consideration. However, the advantages from this have to be balanced against the risks involved in the transport operation.

## Further advice

44 Further advice may be obtained from the HSE, Department of the Environment (DOE), NRA or Fire Authority.

45 Advice about any operational aspect or the scope of the CIMAH Regulations may be obtained from the local HSE Area Office.

- 1 Note comments in paragraph 29 re back-up power supplies for pumps
- 2 See note in Appendix 1 on Fire Services Act 1947

## Appendix 1: legal requirements

1 Discussed below are the main legal requirements which apply to sites where serious contamination of fire-water run-off is a possibility. There is, however, much other legislation covering health and safety.

### **The Control of Industrial Major Accident Hazards (CIMAH) Regulations 1984, as amended (1988, 1990 and 1994).**

2 The aim of CIMAH is to prevent major accidents affecting both people and the environment and to limit the effects of any which do occur. For the purposes of this guidance a major accident is a major emission, fire or explosion resulting from uncontrolled developments leading to serious danger to people or the environment.

3 CIMAH applies two levels or tiers of controls, depending on the nature and quantity of dangerous substances present on site. At the lower tier, manufacturers have the general duties to identify the major accident hazards, take adequate steps to prevent major accidents, and to limit the consequences of any which do occur. These duties include the provision on site of appropriate information, training and equipment. Major accidents which do occur must be reported to the HSE, the enforcing authority for the CIMAH Regulations.

4 At the so called 'top tier', where hazards are greater, additional duties apply. Manufacturers must:

- prepare a written safety report which includes an assessment of the risks and the precautions to be taken;
- prepare an on site emergency plan;

- provide information to the Local Authority sufficient to enable an off site emergency plan to be prepared;
- inform the public who may be affected by a major accident about how they will be warned of major accidents and advised what they should do.

The emphasis throughout is on the need to consider risks in advance and to take appropriate preventive and mitigatory action.

### Other legislation

5 In England and Wales, the National Rivers Authority (NRA) is responsible for the protection of the water environment from pollution under the Water Resources Act 1991 and the Water Industries Act 1991 (in the case of trade effluent consents). In Scotland, the River Purification Boards (RPB) are responsible for the water environment, enforcing the Control of Pollution Act 1974. Some major hazard sites may also be subject to Integrated Pollution Control (IPC) which is enforced under the Environmental Protection Act 1990 by Her Majesty's Inspectorate of Pollution (HMIP) in England and Wales, and Her Majesty's Industrial Pollution Inspectorate (HMIPI) in Scotland.

6 The Fire Authority which is set up under the Fire Services Act 1947 has responsibility for tackling fires within its geographical area. The Fire Authority has a duty under the Act to protect life and property, so prior discussion is essential to avoid the potential for conflict between this duty and protection of the environment.

## Appendix 2: Glossary of terms

Most terms used in this guidance are either self-explanatory or are explained in the text but the following may be useful.

### **hazard**

anything that can cause harm (eg chemicals, electricity, working with ladders etc)

### **risk**

the chance, great or small, that harm will be caused by the hazard

### **bund**

a low-walled area surrounding a tank(s) or other vessel(s) to retain spillage

### **boom**

an inflatable barrier to contain spillage or divert its flow

## Appendix 3: Bibliography

The following publications will provide additional information on some of the matters raised in this document:

*The Control of Industrial Major Accident Hazards Regulations 1984 (CIMAH): further guidance on emergency plans* HS(G)25 1985 HSE Books ISBN 0 11 883831 8

*The fire at Allied Colloids Limited: a report of HSE's investigation into the fire at Allied Colloids Ltd, Low Moor, Bradford on 21 July 1992* HSE Books ISBN 07176 0707 0

*A guide to the Control of Industrial Major Accident Hazards Regulations 1984*  
HS(R)21 (rev) 1990 HSE Books ISBN 0 11 885579 X

*Her Majesty's Chief Inspector of Fire Services guidance letter to brigades (DCOL 5/1987) Fires Involving Pesticides* Home Office (available from the Home Office, Fire Safety Division, Horseferry House, Dean Ryle Street, London SW1P 2AW, Tel: 01712178730, Fax: 0171 217 8722)

*Interpretation of major accident to the environment for the purposes of the CIMAH Regulations (usually referred to as The Green Book)* 1991 DoE guidance note

*Memorandum of understanding between the CACFOA and the National Rivers Authority* 1993 National Rivers Authority, Bristol (available from Colin Harriman, Operations Directorate, NRA, Rivers House, Waterside Drive, Aztec West, Almondsbury, Bristol BS12 4UD, Tel: 01454624400)

*Pollution prevention measures for the control of spillages and fire-fighting run-off* PPG18 1994 National Rivers Authority, Bristol (available from Colin Harriman, Operations Directorate, NRA, Rivers House, Waterside Drive, Aztec West, Almondsbury, Bristol BS12 4UD, Tel: 01454 624400)

*Storage and handling of ammonium nitrate* CS 18 1986 HSE Books  
ISBN 0 11 883937 3

*The storage of flammable liquids in containers* HS(G) 51 1990 HSE Books  
ISBN 07176 0481 0

*The storage of flammable liquids in fixed tanks (exceeding 10000 m<sup>3</sup> total capacity)*  
HS(G) 52 1991 HSE Books ISBN 0 11 885538 7

*The storage of flammable liquids in fixed tanks (up to 10000 m<sup>3</sup> total capacity)*  
HS(G) 50 1990 HSE Books ISBN 0 11 885532 8

*The storage and handling of organic peroxides* CS21 1991 HSE Books  
ISBN 0 11 8856022

*Storage of packaged dangerous substances* HS(G) 71 1992 HSE Books  
ISBN 0 11 885989 7

*Successful health and safety management* HS(G)65 1991 HSE Books  
ISBN 0 7176 0425 X

## Further information

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