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3.2: MONITORING GUIDE

Local Responders Methodology on Air Quality Monitoring

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The Atlantic Regions' Coastal Pollution Response

Version:	Final
Last updated on:	November 2011
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1 BACKGROUND

This report has been published as part of Activity 3 of the ARCOPOL project and looks at providing guidance on monitoring and sampling for human health exposure in the event of a maritime spill of Oil or Hazardous and Noxious Substances (HNS) close to the shore.

Activity 3 of the project sets out to develop operational tools and guidance aimed to assist local responders in the different aspects of the shoreline response to HNS pollution to shipping.

2 INTRODUCTION

It is essential to put in place a monitoring program at the onset of an oil or HNS spill incident to enable responders to undertake a risk assessment and evaluate the impact of a spill on human health. The data assists the decision making process and enable responders to adapt the response accordingly. For example, real time monitoring will impact on the response strategy decision: either evacuation or sheltering.

During a maritime spill which is close to shore, the risk to health of both responders (occupational health) and the local community (public health) must be considered.

The main risk being considered in this document is the acute risk to the local community. Exposure for responders can be controlled through implementation of health and safety measures and use of PPE, whereas exposure to the public requires wider ranging control measures and communications.

The main route of acute exposure for the population from a chemical release is typically via inhalation. Exposure through contact, absorption and ingestion is less likely for the wider community but needs to be considered for responders. This approach also ties in with the prioritisation under activity 3.1.

The report is intended to provide quick guidance to local responders on protocols to put in place at the onset of the incident. Further guidance and monitoring requirements will be put forward by health agencies during the management of the incident, especially for chronic health exposure assessment.

3 PRE-PLANNING

It is critical to also plan for environmental and public health sampling and monitoring in advance of an incident to ensure responders have knowledge of their responsibilities, resources available (skilled personnel and equipment) and can train and exercise.

During the preparedness stage, local regional and national authorities should devise procedures and guidelines for the activation and undertaking of monitoring following a pollution incident. These can be adapted to both coastal and land based incidents.

Preplanning work will include but not be limited to

- ✓ Activation & notification protocol
- ✓ Identifying roles and responsibilities for monitoring
- ✓ Evaluating capabilities at local, regional and national level in terms of equipment, expertise, trained operators …
- ✓ Putting in place mutual aid arrangements
- ✓ Training & exercise plan including maintenance programme of equipment

The PREMIAM programme (Pollution Response in Emergencies Marine Impact Assessment and Monitoring) is an example of preplanning work which aims to establish expert guidelines in the UK for post incident monitoring and impact assessment as well as developing a mechanism for overseeing the practical aspects of monitoring (e.g. survey design, sampling, analysis, interpretation etc.). PREMIAM has two main objectives:

1. The development of marine assessment and monitoring guidelines (The PREMIAM Plan)
2. The development and maintenance of a network of scientific and logistical partners to deliver the plan (the PREMIAM Network)

The report *Law, R.J., Kirby, M.F., Moore, J., Barry, J., Sapp, M. and Balaam, J., 2011. PREMIAM – Pollution Response in Emergencies Marine Impact Assessment and Monitoring: Post-incident monitoring guidelines*, is available on the website. This document gives guidance and sets standards for post-incident monitoring and is intended to act as a resource for those of the monitoring agencies advising incident Environment Groups and the wider UK monitoring community. Although intended primarily for the use of the UK monitoring community, the principles and approach will be broadly applicable elsewhere. The report however focuses heavily on environmental monitoring and impact assessment with a short section on human health impact.

For more information, go to http://cefas.defra.gov.uk/premiam.aspx

4 WHY ARE WE MONITORING?

4.1 Aim of Monitoring

The aim of monitoring is to enable responders to quantify, assess and act upon the exposure of the population to a chemical substance during an incident.

4.2 Objectives

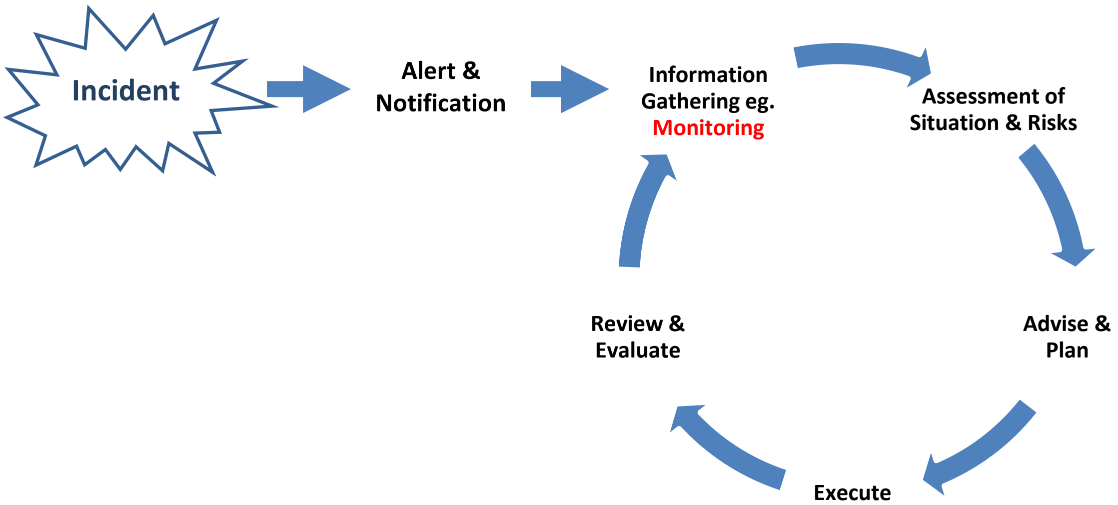
The benefits and objectives of setting up a monitoring program at the onset of an incident are to:

- Supply enough information to determine population at risk from exposure to spilled substance in order to evaluate potential and actual health effects in a given area.
- Inform response strategy, operations and decision making process

- Ensure safe working conditions of responders and health and well being of residents and visitors
- Provide reassurance to members of the public – Note that this is not a sufficient reason to justify monitoring for cost recovery purposes.
- Evidence for any enquiries and claims
- Link health complaints with monitoring data
- Assess potential exposure routes to establish mitigating measures for each potential route

4.3 Monitoring as part of response and assessment

The following diagram identifies the position and purpose of monitoring as part of the response to a pollution incident.



5 MONITORING STRATEGY

At the onset of an incident, decision makers must identify early on the strategy for monitoring exposure to contaminants. The strategy should highlight the aim and objectives to enable responders to successfully select monitoring methods, locations, equipment and look at the different factors influencing the monitoring.

It is therefore essential to develop a plan, which can be reviewed as the incident progresses. The plan should be developed and agreed by a multi agency panel. Public health authorities/agencies will provide advice and guidance on the monitoring methods, locations and equipment.

The monitoring program must take into account the potential for both acute and chronic effects on the population and provide the opportunity to make a quick assessment of the situation to inform decision making process.

A basic template for a monitoring strategy is included in the Appendix section.

6 EXPOSURE ROUTES

Before establishing a monitoring program, responders should develop a conceptual model establishing the source, the different pathways and the receptors at risk and look at how residents may be affected including the short and long term risks. This process ensures that the monitoring program is adequate, proportionate to the requirements and can also be justified for claims purposes.

It will also enable responders to decide on the most suitable course of action to break a section of the cycle and prevent exposure.

The main exposure route being considered in this report is the inhalation of vapours and particles hence the air quality for human health.

This follows the thought process of Activity 3.1 on the prioritisation matrix of chemicals. The chemicals of concern are either classified as gas or evaporators.

7 WHEN TO MONITOR?

- ✓ At Onset of incident – At scene and likely impacted communities
- ✓ During the incident response and clean up operations if there are concerns over exposure to specific substances. Implement
- ✓ After – once clean up operations are over or until levels have receded to background levels

Monitoring must be put in place at the onset of the incident, as soon as practicable. Assessment by health authorities on safe exposure can only be carried out based on actual readings. Early and frequent readings from the scene by emergency responders must be promoted. The only opportunity to obtain samples and assess exposure levels, in certain cases, is during the emergency and not a few days later.

Visual assessment of conditions during this phase can also assist decision making. It is also vital to establish prevailing and forecast meteorological / tidal conditions at an early stage in order to identify areas likely to be affected and locate monitoring teams accordingly. As an incident develops beyond the initial few hours of response monitoring will be typically taken over by specialist bodies.

Monitoring at the start and during the cleanup operations is essential both in terms of health and safety of responders but also in assessing likely impact on the local community, if any.

The implementation of an early monitoring programme will assist responders in communicating risks to members of the public and reassuring them that decisions on evacuation/sheltering are based on actual live readings and sampling.

The length of time of monitoring will depend on the scale and nature of the incident. Monitoring may be ongoing until all clean up operations have been undertaken.

> The window of opportunity may be small for assessing public health exposure and impact on local community - Monitoring requirements must be addressed at the onset of the incident

The **frequency** of monitoring is an **important factor** which must be considered. Frequency of monitoring should be high to enable an assessment of acute risk and to ensure peaks and average concentrations are identified. However the frequency of monitoring/sampling may need to take into account funding.

8 WHAT TO MONITOR? SUBSTANCES

One of the first questions to be raised is do we know what substance to monitor for? This information may not be readily available as the manifest for the ship may not have been communicated to the response groups or/and there could be a number of scenarios to consider.

The incident may involve:

- ✓ One substance which does not react with its environment i.e. air or water
- ✓ One substance but which reacts with either water or air to create a secondary substance.
- ✓ Multiple substances
- ✓ Substances resulting from combustion/fire

Therefore in order to identify the substance(s) to monitor, it is essential to establish early efficient and speedy communication between response groups. Advice must be sought from scientific cells/environment and public health group set up as part of the response to initiate monitoring, as well as at scene.

Key considerations:

- Obtain information from appropriate cell including quantity, type of chemicals, weather conditions, shipping manifest...
- Understand behaviour and physical properties of the substance(s)
- Consider interaction with other substances and reactivity of substances with environment

> Risk prioritisation may help to predict chemicals likely to be involved in incidents and hence enable procedures and resources to be in place in case of such an event

9 HOW TO MONITOR?

9.1 Monitoring/Sampling Methods

The selection of monitoring or sampling method will depend on the objectives set at the start. This may involve more than one method should be implemented in order to assess both short term (acute) and long term (chronic) exposure.

Assessment of the concentration of a substance (in this case gases, vapours and / or airborne particulates / dusts / smoke) can only be achieved with the use of specialist sampling equipment and gas measurement device. However it must be noted that measuring the concentration of a pollutant is not sufficient to evaluate the level of hazard. Other factors may impact.

The methodology must consider: the required time, duration, frequency of monitoring and the most appropriate sampling methodology in order to get an accurate picture of the situation.

There is not one instrument that measures all gases and vapours. The variety of substances is too wide for a single technique to measure all possible air pollutants. The more chemically complex a substance is, the more complex the gas measurement technique.

On site real time monitoring method is essential to provide an instant assessment, inform the response and put in place mitigating measures for protection of local community and responders. In some cases follow-up laboratory testing may be needed to obtain more accurate data e.g. to achieve lower levels of detection or speciation or to eliminate interference from other chemicals.

9.2 Equipment

Advice on monitoring equipment will be provided by health agencies and specialist companies but it can also be provided through groups of experts which are made available to the national agencies such as the National Chemical Emergency Centre, MAR-ICE network.

The following list some examples of monitoring equipment available commercially. These devices can be used individually or in combination. However not all instruments and methods will be accessible to local authorities and responder agencies in the event of a major pollution incident.

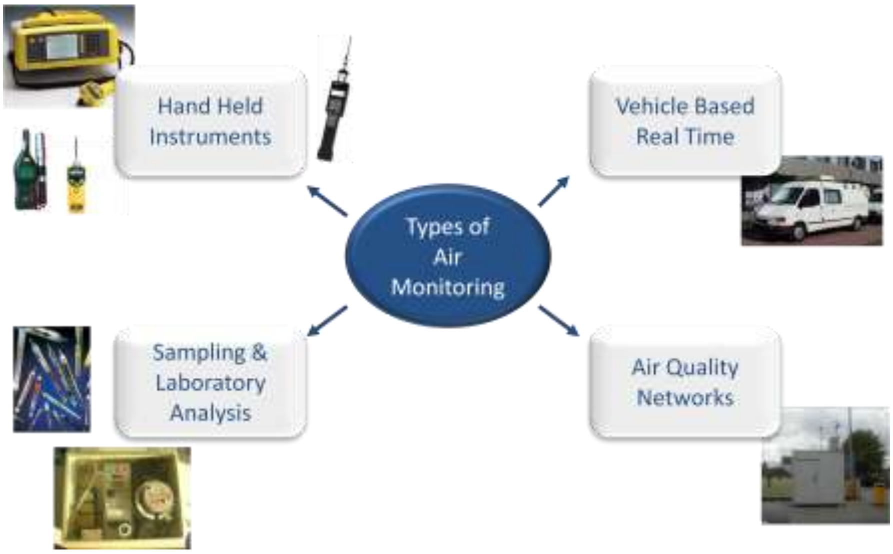
- Flame ionization detectors
- Photo ionization detectors
- Gas chromatographs
- Infrared spectrometers
- UV-VIS photometers
- Warning devices for explosion hazards
- Drager-Tubes
- Laboratory analysis in conjunction with sampling tubes, carbon filter or gas wash bottles (impinger)

- Mass spectrometers

Each of the aforementioned devices have advantages but also a number of limitations, which responders must be aware of. For example, certain instruments readings will be influenced by other substances present in the ambient air.

In addition, responders will be able to access National/regional initiatives and strategically placed monitoring units/teams such as:

- The Environment Agency Air Quality Monitoring units in the UK
- Specialist units from the Fire Services – Detection, Identification and Monitoring (DIM) Teams in the UK. The role of the DIM teams consist in the
    - Detection of a range of chemical or radiological hazardous substances.
    - Identification of hazardous substances whether chemical, biological or radiological.
    - Monitoring of the levels of contaminate present and to establish and maintain cordons.
- Air Quality network: Automatic air quality monitoring stations, Automatic Urban Rural Network (AURN) in the UK. In the UK, there are around 300 monitoring sites gathering particular data for compliance of specific pollutants to national health based air quality standards. The pollutants measured and method used depends on the criteria set up and the area.



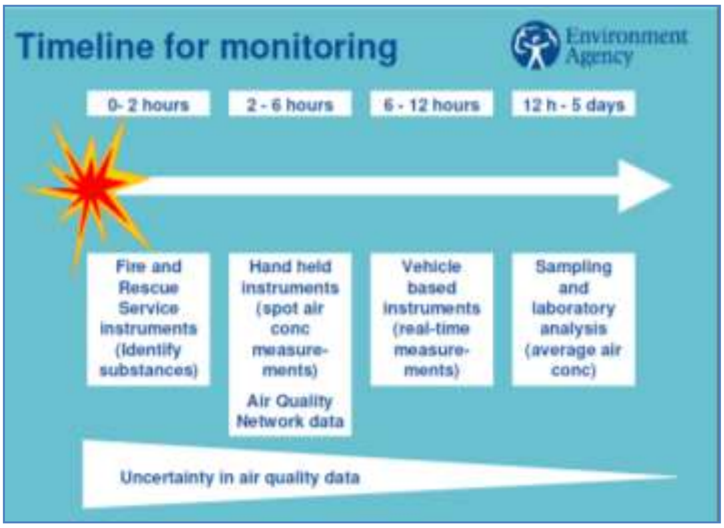
9.3 Factors to consider

- Equipment cannot be used off the shelf in many cases. Agencies and responders need to consider training of personnel, calibration, maintenance of the equipment including regular services and keeping batteries charged. Record of maintenance programme and calibration should be kept as evidence.
- Be aware of interaction with other chemicals and also if doing spot checks consider what other chemicals in the environment could be impacting on the readings. Eg. hairspray and cleaning products will release vapours, influencing indoor readings.

- Consider using a range of monitoring methods to enable a comprehensive assessment of situation and evaluation of short as well as long term exposure.
- Consider the frequency of monitoring especially when using portable equipment giving instant reading to evaluate peaks and average concentrations for acute risks
- Measurements should be of a suitable time duration to be comparable to relevant standards as discussed later.

9.4 Timeline versus equipment used

The picture below describes the type of equipment which may be used according to the timeline of the incident.



10 WHERE TO MONITOR?

Locations must be selected to give a good representation of exposure and allow for comparison of results. Depending on the area being impacted upon and the availability & cost of equipment, a monitoring locations grid should be established. The choice on the monitoring locations will be established following consultation with relevant health agencies, local authorities and environmental organisations with a responsibility in air quality monitoring.

The location of sampling and monitoring will be influenced by:

- Wind direction and weather forecast
- Air modelling of the plume, including grounding & atmospheric deposition
- Location of key receptors especially vulnerable ones
- Reported health effects or complaints by member(s) of the public
- Visual assessment where relevant
- Location of response and recovery efforts

Monitoring should be carried out within affected area and away from the scene in similar types of locations/conditions. Those locations will provide background data and allow for comparison of results to assess impact from other potential sources e.g. local industry, wider meteorological events etc

Meteorological data and forecasts are important to determine location of monitors, as well as safety isolation zones. It is also important to be aware that atmospheric changes between day and night time can effect behaviour of plumes and hence locations of safety zones and monitoring sites.

Monitoring within affected area should be carried out by skilled and well protected personnel, usually from the Fire Services at the onset. This will change as the incident progresses and a long term monitoring program is put in place.

Monitoring Locations should include:

- ✓ Inside residential houses, commercial premises and outside including garden and public spaces
- ✓ Away from affected area both inside residential houses, commercial premises and outside to act as reference points
- ✓ A mix of urban and rural locations where required
- ✓ At the source (monitoring undertaken by responders/salvors)

If possible, monitoring at the source must be considered in the strategy to evaluate any changes in the concentration of pollutant being emitted and assess dispersion and likely impact and cordons. Air quality monitoring at the scene may be conducted by responders and salvors as part of health and safety procedure. Therefore it is essential to establish effective communication with responders to access this data and be informed of any changes in concentration. The information will feed into the risk assessment and decision making process.

> When considering indoor monitoring, responders must be aware that there are many potential confounding factors that can affect interpretation of data. However it may be useful when making decisions on sheltering and evacuation.

11 DATA MANAGEMENT

Quality assurance of monitoring data is intimately linked to the entire air quality monitoring process, from the choice of site, choice of instrumentation, proficiency of staff, calibration and maintenance processes, data storage, and retrieval and analysis systems. The final product (ambient air quality monitoring data) will only ever be as good and reliable as the systems that produce it.

Database and protocols to store, analyse and manage data both for real time readings as well as the results of sampling and laboratory analysis must be put in place at an early stage.

A number of monitoring equipment have data storage and download features which provide instant continuous electronic recording that can be downloaded to a computer upon return in the office.

However, electronic data download must be linked with GPS positioning wherever possible and officers must annotate any other factors potentially impacting on the results. It may be good practice to use monitoring forms as backup.

A monitoring form template is included in the appendix as an example of manual field recording, which can be adapted to suit requirements.

All results should be entered into a database and the forms should be logged and saved for evidence purposes. The database system should allow for rapid evaluation of the results by summarising key information ready for interpretation. Graphical representations of results are often useful for rapid assessment of trends etc.

12 LABORATORY ANALYSIS

Unless sampling is undertaken using equipment providing an instant result, samples have to be sent to laboratories for analysis.

It is essential that samples are sent to accredited laboratories to ensure validity of results. Accreditation (e.g. by UKAS) means that evaluators i.e. testing and calibration laboratories, certification and inspection bodies have been assessed against internationally recognised standards to demonstrate their competence, impartiality and performance capability.

13 INTERPRETATION OF THE RESULTS

Results are analysed and interpreted by health agencies professional and specialist against standards, taking into account a range of impacting factors and based on the established conceptual model and human health standards and guidelines. It is important that data are in the right form for comparison to relevant standards i.e. reflect the relevant averaging times used by the standards e.g. 24 hour means, running means etc.

13.1 Standards

There are a range of air quality standards suitable for application to chemical incidents where airborne contaminants may reach concentrations detrimental to health. These include acute exposure standards such as AEGLs and ERPGs, occupational exposure standards such as IELVs and standards for longer term chronic exposure, such as Air Quality Objectives and WHO guidelines.

The standards can be factored into emergency planning for protective actions, such as evacuation or sheltering.

When monitoring for community exposure and assessing risk to the population, public health standards should be applied. In the absence of public health standards, health agencies may decide to derive conservative standards based on occupational health standards, toxicological data and situation. As occupational health standards are aimed at healthy adult workers standards derived from occupational limits will need to account for vulnerable population such as the elderly and children by incorporating uncertainty factors.

When to use and What to use

In the case of chemical incidents, it is recommended that the following hierarchy of standards is applied (if chemical is not in first band then proceed down hierarchy)

Acute exposure	Chronic exposure
AEGLs Acute Emergency Guideline Levels	**EU Air Quality Objective/Target** European Directive 1999/30/EC
ERPG Emergency Response Planning Guidelines	**WHO EU Air Quality Guideline**
UK EAL (15 Minute STEL) - UK Environmental Exposure Limit **Or** National Environmental Exposure Limits	**UK EAL - Environmental Exposure Limit** **Or** National Environmental Exposure Limits
IOELVs/BOLVs (15 minute STEL) Indicative or Binding Occupational Exposure Values	**IOELVs/BOLVs (8 hour TWA)**

In the absence of standards or guidelines for a particular chemical, then details of chemical toxicity should be reviewed using relevant toxicological sources e.g. REACH, ATSDR, WHO/JECFA, IRIS.

Where chemical toxicity is uncertain, exposure should be reduced as low as reasonable practicable.

13.1.1 AEGL - Acute Exposure Guideline Levels

Acute Emergency Guideline Levels (AEGLs) are developed by the National Advisory Committee to USEPA. AEGLs represent threshold exposure limits for the general public and are applicable to emergency exposures ranging from 10 minutes to 8 hours. Three levels are developed for each of five exposure periods (10 minutes, 30 minutes, 1 hour, 4 hour and 8 hours) and are distinguished by varying degrees of severity of toxic effects. The three AEGLs are defined as follows:

AEGL-1 is the airborne concentration (expressed as ppm [parts per million] or mg/m3 [milligrams per cubic meter]) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, nonsensory effects. However, these effects are not disabling and are transient and reversible upon cessation of exposure.

AEGL-2 is the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting, adverse health effects or an impaired ability to escape.

AEGL-3 is the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening adverse health effects or death.

www.epa.gov/oppt/aegl/

13.1.2 ERPG Standards

Emergency Response Planning Guideline Values (ERPGs) are developed by the American Industrial Hygiene Association(AIHA). ERPGs provide estimates for concentration ranges 'where a person may reasonably anticipate observing adverse effects as a consequence of exposure to the chemical in question'.

ERPGs are air concentration guidelines for single exposures to agents and are intended for use as tools to assess the adequacy of accident prevention and emergency response plans. Values are primarily based on acute and subacute toxicology data sets for inhalation, acute lethality data, skin corrosivity, sensitization and irritancy studies. Subchronic and chronic animal data, along with epidemiological data are also considered for exposure periods longer than 1 hour. Cancer data are included when the risk from a single exposure at the ERPG-2 level would exceed 1 in 1 million.

There are three ERPG levels:

ERPG–3

The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

ERPG–2

The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.

ERPG–1

The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.

ERPG values (ppm by volume) for some widely used chemicals are provided in table below

		ERPG		
Chemical	**Chemical Formula**	**1**	**2**	**3**
Ammonia	NH_3	1000	200	25
1,3 Butadiene	C_4H_6	5000	500	10
Chlorine	Cl_2	20	3	1
Ethylene Oxide	C_2H_4O	500	50	N/A
Hydrogen Chloride	HCl	100	20	3
Hydrogen Fluoride	HF	50	20	5
Hydrogen Sulfide	H_2S	100	30	0.1
Methanol	MeOH	5000	1000	200
Phosgene	$COCl_2$	1	0.2	N/A
Sulfur Dioxide	SO_2	15	3	0.3
Vinyl Acetate	$C_4H_6O_2$	500	75	5

A key feature of all ERPG levels is that exposure is measured over a period of one hour. In practice, a worker who is exposed to one of these chemicals is not going to stay in the same place for an hour; he or she is going to move to a safe place (assuming that he is conscious and mobile).

Limitations

Human responses do not occur at precise exposure levels but can extend over a wide range of concentrations. The values derived for ERPGs should not be expected to protect everyone but should be applicable to most individuals in the general population. In particular, industrial workers are generally quite healthy and they know what to do and where to go in the event of an emergency. Hence there is not usually a justification for using very conservative exposure limit values for short-term exposure to a toxic gas release. For this reason the ERPG-2 value can be used rather than the more conservative ERPG-1 level. If members of the public could suffer short-term exposure effects then the ERPG-1 value would be used, particularly if some of the public could be in ill health, or if they could have trouble in evacuating the affected area.

On the other hand, in the general public there will be hypersensitive individuals who will show adverse responses at exposure concentrations far below levels where most individuals normally would respond.

13.2 IOELVs & BOELVs

Occupational Exposure Values (IOELVs / BOELVs) were developed on a European basis to be implemented as occupational / workplace exposure levels .

Whilst these limits can assess acute risks they are essentially derived for adult workers and are not necessarily protective to more susceptible receptors such as children or persons with underlying medical conditions.

Indicative occupational exposure values IOELVs are derived based upon a chemical having a defined threshold, below which there will be no harm from exposure. Where there is no safe level, Binding limit values are proposed (BOELV). Exposure is primarily based upon inhalation and is typically applied to an 8 hour time weighted average exposure, to reflect worker shifts, although short-term, 15 minute limit values (STEL) are presented for chemicals that can have acute effects. Where an STEL is not available, it can be estimated as 3 times the 8 hour value as defined in EU guidance.

> Refer to European Agency for Safety and Health at Work for guidance on other European member states Occupational Exposure Limits:
>
> http://osha.europa.eu/en/topics/ds/oel/members.stm/#fr

13.3 Environmental Exposure Levels

EALS are UK derived values for industrial regulation. EALs are calculated from occupational exposure limits to apply to the wider population by correcting the exposure time from an occupational scenario to an ambient scenario and including uncertainty factors to reflect effects to susceptible populations. Again these include short term, 15 minute, values for potential acute effects.

13.4 Chronic exposure standards

AIR

Chronic issues associated with wider public health are generally addressed by national or international policy based standards. Typically air quality standards are expressed as 24 hour average concentrations and are derived to be protective of the most vulnerable groups. In addition to legislative requirements, the World Health Organisation provides a range of health based international air quality guideline values, derived for chronic exposure. Again these are derived to be protective of susceptible groups and relate to concentrations measured over defined periods from 15 minutes to annual averages.

WATER

Standards and guidelines are derived for drinking water quality based upon chronic human health risks as well as aesthetic factors. Again these are often based upon policy decisions and appear as national or international standards. In addition the WHO provides health based guidelines for water quality. Values are typically presented as milligrams or micrograms per litre of water. Standards are also derived for water as an amenity. Acute and sub-chronic guidelines are also produced for water quality including in the EU MACs (maximum allowable concentrations) and UK SNARLs (Suggested No Adverse Response Level).

LAND

Land contamination is again typically covered by national and international policy based upon chronic human health risks or risks to ecosystems e.g. UK soil guideline values, Dutch soil and sediment intervention values and USEPA minimal risk levels. These are typically reported as mg/kg and derived using chronic exposure models often for specific end-uses.

ECOTOXICITY, FISHERIES, CROPS AND AGRICULTURE

Sources for health based limits for foodstuffs include WHO / JECFA, as well as those set by national food standards agencies e.g. EFSA, UK FSA. Ecological standards are available for soil, water and in some cases air. In addition data on ecotoxicity such as lethal doses to animals and data on degradation are widely available on material safety datasheets.

13.5 Interpretation/Risk assessment

Interpretations of the results will be undertaken based on the review of monitoring data, the location of monitoring, the status of the response and the review of impacting factors such as weather, plume modelling, exposure duration and receptors identified.

Scientific/health experts will be analysing and interpreting the field data. Results will be compared to health standards and a decision and advice issued to responders.

> A robust integrated procedure for reporting and interpretation of monitoring data and other contributing factors must be put in place.

13.6 Reporting & decision Making

Following risk assessment and consideration of monitoring data, advice can be given to feed into decision making process and identify best course of action.

Advice will be revised on a continuous basis with regard to monitoring data, modelling, weather reports and any reported health effects.

For longer term human health impact assessment, monitoring data will be linked with social impact assessment.

Based on the interpretation of the results and risk assessment process, decision will be reached on either sheltering/evacuation/no actions are required.

The process is dynamic and will be continuously reviewed as demonstrated in 4.3. Monitoring data is a key element of the response procedure

14 OTHER TYPES OF MONITORING

Health agencies and public & environmental health organisations will provide guidance on other types of monitoring required based on the incident.

For further information and detailed description of the monitoring, reference must be made to the PREMIAM project which has developed comprehensive guidance on environmental sampling following a shipping incident resulting in the pollution of the maritime and shoreline environment.

Additionally, as previously mentioned in the standards section, other monitoring will be implemented to provide an accurate picture of the incident's likely public health impact.

WATER

Monitoring of safe drinking water supply, where required, as well as bathing water quality on a seasonal basis. Water Quality will also impact on the food chain and will need to be considered in the overall human health impact assessment.

If restrictions to access the shores are not enforced, water quality monitoring programme should be put in place

CLINICAL SAMPLING

Members of the public presenting themselves to hospitals after exposure to chemicals may need to be tested. This will be the responsibility of health agencies. Biomarkers are provided in the scientific literature for a number of common pollutants e.g. ATSDR Toxicological profile reports.

Guidance and protocols are in place in each country to investigate and manage clinical sampling. In the UK, the Health Protection Agency has issued guidance and clinical sampling kit to hospitals and also

- produced standardised National protocols for collection, transport and analysis of biological samples following a chemical incident.
- developed a database of methods for the analysis of biological samples for priority chemicals of concern (acute and chronic exposure)

- developed a functional network of expert laboratories offering routine and emergency response to chemical incidents (acute) and environmental exposures (chronic); thus offering surge capacity in an emergency.

After samples have been analysed, the results produced need to be interpreted to identify potential health risks and to determine if medical management is needed. Development of a system for the provision of appropriate interpretation of results must be planned and integrated into the overall response to the incident. When dealing with medical data it is essential that adequate data protection and security is employed to protect patient confidentiality.

There is potential for casualties and fatalities to become sources of secondary contamination for health workers and other persons exposed. Advice should be provided to health centres regards manotiring of casualties and fatalities to prevent or minimise secondary exposure.

SOIL

Certain chemicals, if grounded after atmospheric deposition, could impact on the quality of soil and result in contamination of the land and contamination of the food chain.

There are established protocols and guidelines on the sampling and analysis of soil as part of contaminated land legislation.

FOOD

Depending on the scale and nature of the incident, responders may implement sampling and analysis on the food chain such as seafood, crops, animals to ensure safe consumption for human. Ban and restrictions can be imposed where required until results are satisfactory.

The monitoring would allow enforcing a ban on commercial and ad hoc collection/fishing of sea foods.

NUISANCE

Nuisance is linked to the response to an incident. Nuisance may affect local communities and impact on their well being. Activities which are likely to create a nuisance should be monitored and taken into consideration in the risk assessment process.

Nuisance monitoring relates to noise, dust, odour likely to arise from clean up operations, transportation or waste management and processing.

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APPENDICES

Summary Note – Monitoring

Whilst risks from chemicals can be assessed by environmental modelling of sources these are not as accurate as assessments based upon actual monitoring data (measurements). Key aspects for monitoring are summarised below:

When to monitor?

- Monitoring should be established as soon as is practicable. The sooner data is obtained the better the assessment will be.
- On scene monitoring by Fire Services can be extremely useful until specialist monitoring teams arrive. Such monitoring is needed for health & safety of responders.
- In addition local authority monitors, already positioned for general environmental assessment, may also provide useful immediate data.

Where to monitor?

- Monitoring locations should be sited with consideration to wind direction (air), tidal flow (water) and key receptors, as well as health and safety of teams.
- Monitoring of airborne contaminants should consider where plumes are grounding i.e. where they will result in exposure to receptors.
- Grounding of plumes and or wet deposition (rainfall) will also be useful if longer term monitoring for chronic risks is relevant – soils, vegetation etc.
- Where dense vapours are present monitoring should be undertaken in voids, confined spaces, drains etc. Similar steps should be taken where liquids may accumulate.

What to monitor for?

- Consider any specific harmful chemicals involved, potential reaction products from mixtures and whether the incident involves combustion/fire. On site real-time monitoring is the preferred option, although sampling and laboratory analysis is also useful to provide specific information.
- Whilst it is ideal to obtain chemical specific data it is not always possible to have extensive ranges of equipment for this and other less specific methods may need to be used e.g. if benzene has been released into the atmosphere it is possible to obtain indicative data using photoionisation detection to measure volatile hydrocarbons if chemical specific hand held pumped tubes or portable gas chromatography equipment is not available.
- Consider other risks such as flammable and explosive environments and oxygen depletion.
- Consider airborne solids / particulates as well as gases and vapours, particularly where fires are involved or chemicals are fine powders.

Interpretation / Data Quality

- Most standards are based upon specific averaging times and these should be considered when undertaking monitoring and assessing data.
- For acute risks it is useful for monitoring to be sufficiently frequent to identify peaks as well as average concentrations.

Methods / Equipment

- Equipment should be suitably calibrated and methods suitably approved e.g. USEPA, UKHSE etc.
- Ensure equipment is intrinsically safe where explosive atmospheres are suspected.

Checklist for Monitoring

The checklist briefly outlines work which should be done in preparedness stages, before an incident actually occurs.

Pre Incident – Preparedness

- Identify responsibilities of responder agencies
- Identify main risks
- Identify skilled workforce and put in place training program for personnel
- Produce an asset inventory of resources: equipment and trained personnel
- Produce maintenance program for all the equipment listed on the asset inventory
- Investigate mutual aid partnership arrangements between neighbouring counties/regions and with public & private organisations.
- Make a list of accredited contractors(equipment/personnel) including laboratory
- Include arrangements into contingency plans
- Exercise arrangements and call off of monitoring equipment

During Incident - Response

- Organise meeting between emergency responders, public health authorities, and local government to discuss environmental sampling and monitoring if potential risk of human health exposure
- Develop and agree strategy for monitoring acute and chronic exposure
- Obtain advice from health agencies and equipment supplier on suitable monitoring method based on situation, funding, resources and receptors
- Implement monitoring and sampling programme ensuring consistency and timely frequency of monitoring. The programme must be linked with the overall response to the incident and procedure for assessing risk of exposure and prevailing background data.
- Assess and raise awareness of concentration trigger health levels of the polluting substance(s) amongst monitoring officers and responders
- Provide data to feed into risk assessment process
- Implement procedure for interpretation of results and decision making process
- Put in place effective reporting and communication arrangements between all relevant parties to continuously review the situation & monitoring programme and to enable advice to be issued to specialists and the public in a timely fashion. Set up robust data management process and record keeping
- Review the procedure at all stages especially following significant changes in situation

Post Incident - Study

- Provide data and all evidences to report on effects and likely impacts of incident on human health.
- Identify lessons learnt to implement into review of procedures, training and exercises

Monitoring Strategy

When establishing a monitoring strategy at any levels, the following aspects need to be considered and agreed on a multi agency basis.

1. Aim of Monitoring
2. Objectives
3. Substances to monitor – wide spectrum or specific
4. Role & Responsibilities of responder agencies
5. Sampling method and monitoring equipments
6. Location of sampling & time monitoring period
7. Calibration of equipment
8. Data Management
9. Analysis of samples- Laboratory
10. Interpretation of the results and risk assessment process
11. Decision procedure – Execute
12. Cost

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IN-SITU AIR QUALITY MONITORING FORMS					
Monitoring Officer		**Company**			
Incident Name					
MONITORING					
Date		**Start Time:**		**End Time:**	
Weather condition:		**Wind** (force/direction)			
Location					
EQUIPMENT					
Type					
Calibrated	**Yes** ☐	**No** ☐	**Comments**		
Substance(s) being monitored					
Standards Used:					
H&S	Is equipment intrinsically safe? Are you wearing right PPE?				
READINGS					
Location	**Time**	**Reading**	**Unit**	**Comments**	

Form No……../……..