SCHOOL OF CIVIL PROTECTION

MODULE BI-4/B

CHEMICAL ACCIDENT MANAGEMENT

HANDBOOK

ACCORD RISQUES MAJEURS • MAJOR HAZARDS AGREEMENT
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CHEMICAL ACCIDENT MANAGEMENT

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1. Main elements of an integrated emergency management system

The main elements of an integrated emergency management system are:

- prevention
- preparedness
- response
- relief

Prevention

Public authority and corporate policies related to hazardous installations should have, as primary objectives, the prevention of accidents involving hazardous substances and limiting any adverse health consequences should an accident occur.

Public authorities should set general safety objectives and establish a clear and coherent control framework with respect to accidents involving hazardous substances. In this regard, they should seek to protect the health of workers and the public through the development and implementation of appropriate laws, regulations, standards, codes and guidance.

Management of a hazardous installation (see Annex 2 of module BI-2/B "Technological risks and effects") has the primary responsibility for designing, constructing and operating the hazardous installation in a safe manner and for developing the means to do so. It should therefore put into place the systems, procedures and structures needed to help ensure the prevention of accidents and, should an accident occur, to ensure timely and adequate response to limit adverse health consequences or other damage. Employees and their representatives should be involved in the development and implementation of such systems, procedures and structures.

Public authorities, including health authorities, in different countries should co-operate and exchange information which could help prevent accidents or human exposure to chemicals.

Health/medical professionals should be involved in decision-making relating to the prevention of chemical accidents.

Emergency preparedness

Public authorities at all levels, and managers of hazardous installations, should establish emergency preparedness programmes concerning accidents involving hazardous installations.

The roles and responsibilities of individuals and organisations expected to be involved in emergency response activities should be clearly defined in emergency plans (including, for example, representatives from public authorities, management, and employees and their representatives).

As part of the emergency planning process, there should be an identification of potential risks and the geographical zones which are likely to be affected in the event of an accident.

Preparedness (and response) decisions should take into consideration the nature of possible clinical, as well as psychological, effects on those potentially affected, including response personnel, workers, and the local population.

On- and off-site emergency plans should be reviewed regularly and kept up-to-date. All aspects of on-site and off-site emergency plans at all levels should be tested under simulated conditions, in conjunction with regular exercises based on the plans.

As part of the emergency planning process, there should be an assessment of the types of emergency medical resources (including personnel, equipment, facilities, supplies and funds) needed to respond to different types of emergencies and the range of possible casualties.

The availability of up-to-date antidotes, as well as other emergency pharmaceutical supplies necessary for the treatment of the number of persons who may potentially be injured by hazardous substances, should be ensured.

Hospitals and other treatment facilities, which may be called up on during response to an accident involving hazardous substances, should develop systems for receiving and handling large numbers of patients at one time.

Since personnel, equipment, and other resources available for response to an accident will often be limited, consideration should be given to pooling of resources among neighbouring communities and neighbouring countries.

As part of the planning process, information and communications needs should be examined. The parties who need information, and the types of information they require, should be identified. The emergency plan should provide for appropriate communication and coordination among all members of the response team.

All information provided for emergency preparedness and response activities should be clear, concise, and geared to the audience to which it is addressed.

Public authorities in each country should ensure that designated information sources are available for use in regard to health/medical aspects of emergency planning and response. Networking among information centres/sources should be promoted.

The personnel who may be involved in emergency response should acquaint themselves with the substances produced, used, transported or otherwise handled in significant quantities in their community. They should also make it their responsibility to be aware of relevant aspects of local emergency plans, and of their own roles within these plans.

Industry should make available, for emergency preparedness and response purposes, health-related information concerning the hazardous substance(s) it stores, handles, processes, manufactures and/or distributes, or which are otherwise used in the workplace.

Public health and education authorities should ensure that health/medical personnel involved in emergency response activities are well trained and educated.

First responders (police, fire and ambulance personnel) should be trained and educated to be able to take appropriate actions to minimise the human health effects of accidents involving hazardous substances.

Management should ensure that everyone employed at a hazardous installation receives appropriate training and education on how to handle hazardous substances, on procedures to follow in order to avoid accidents occurring, and on actions to take, should an accident occur, in order to minimise adverse health consequences for those at the installation as well as the public.

The effectiveness of training and education programmes should be regularly assessed. As part of this process, simulation exercises should be carried out to test the competency of those likely to be involved in accident response.

Emergency response

In an emergency response, all personnel and facilities should be part of the overall response team and part of the information chain, in order to provide and receive information as appropriate.

Systems should be in place for the collection, dissemination and updating of information available to personnel and other parties as the emergency response progresses, including medical information or advisories provided to the public via the media.

The on-site coordinator should decide on the immediate actions to take, including actions intended to avoid or limit the exposure to hazardous substances, based on preliminary information concerning the site, nature of the release, hazardous substance(s) involved, and any related analyses. Health/medical personnel should provide assistance, upon request, in arriving at such decisions.

The on-site coordinator should take measures to avoid the contamination of rescue workers.

Arrangements should be made for the provision of first aid and other medical treatment outside the contaminated area. Initial care should be administered at the accident site, in order to give the injured the treatment necessary to ensure that they are in stable condition before being taken (if necessary) to a main treatment facility.

Triage for victims of accidents involving hazardous substances should follow the rules that apply generally in emergency situations.

Hospitals and other treatment facilities should put their emergency plans into effect as soon as they are alerted that there is a possibility of patients arriving as a consequence of an accident involving hazardous substances. These facilities should be provided, as soon as possible, with information on the hazardous substance(s) involved, the type of accident (spill, fire, etc.), the likely number of victims, and the nature of their injuries.

For the appropriate treatment of exposed victims, emergency medical professionals should have access to specialised information and should be able to consult with specialists.

Following an accident, psychological support should be made available at an early stage.

Appropriate follow-up procedures should be put into place for monitoring and observation of persons seemingly unaffected by exposure to hazardous substances.

Efforts should be made by public authorities and industry to improve public awareness of chemical hazards in the community, and of how to respond in the event of an accident, for example through an understanding of the procedures related to possible evacuations and to sheltering in place.

All members of the response community should coordinate with the media in order to ensure that any health-related information disseminated in regard to accidents involving hazardous substances is accurate and consistent.

If an accident occurs, the public should be given, on a continuing basis, specific information on the appropriate behaviour and safety measures to adopt.

Accident relief

Appropriate epidemiological and medical follow-up to chemical accidents should be initiated following the release of toxic chemicals.

Persons who may have had significant exposure to toxic chemicals during an accident, whether they appear to be affected or not, should be examined and properly registered to allow for short- and long-term follow-up. It may be advisable to take biological samples for immediate and later analysis.

Management should support the active participation by employees and others in accident investigations.

2. Prevention

2.1 General principles

The primary objective of safety-related programmes at hazardous installations is the prevention of accidents resulting in harm to human health, the environment or property (recognising that accidents involving hazardous substances may, nonetheless, occur).

The prevention of accidents involving hazardous substances is the concern of all interested parties including public authorities at all levels, industry, employees and their representatives, and the community. For accident prevention activities to be effective, co-operative efforts should be undertaken among all these parties. This cooperation should be based on a policy of openness, which will help increase public confidence that appropriate measures are being taken to limit the risk that accidents will have off-site effects.

With respect to prevention of accidents involving hazardous substances, public authorities should set general safety objectives, establish a clear and coherent control framework and ensure, through appropriate enforcement measures, that all relevant requirements are being met.

In this regard, public authorities should establish systems for:

- the identification and notification of hazardous installations
- monitoring of such installations
- ensuring that there is adequate reporting and investigation of accidents

Public authorities should be proactive in developing new approaches for accident prevention, in addition to their more traditional reactive role of responding to specific public concerns.

Public authorities should take a leadership role in motivating all sectors of society to recognise the need for accident prevention, in identifying the tools needed, and in developing a national culture which promotes accident prevention. Public authorities should co-operate with and stimulate industry (management and other employees) to carry out industry's responsibility to ensure the safe operation of hazardous installations and to achieve the confidence of the public that these installations are being operated safely.

Management of hazardous installations have the prime responsibility for operating their installations safely and for developing the means to do so. Safety should be an integral part of the business activities of an enterprise, and all hazardous installations should aim to reach the ultimate goal of "zero incidents".

Management should establish a corporate safety culture, reflected in a corporate Safety Policy, and should take appropriate actions to ensure that all employees are aware of their roles and responsibilities with respect to safety.

For effective accident prevention, safety considerations should be incorporated into, among other things:

- planning and construction of installations
- operating policies and procedures, including organisation and personnel arrangements
- monitoring and assessment of safety
- operation shutdown

This responsibility of management applies to all installations which use, handle, store or dispose of hazardous substances, including those installations not considered part of the chemical industry.

Management should take special care to ensure that safety is maintained during periods of stress at a hazardous installation, such as when there is an economic slowdown affecting the industry or when there are staffing problems.

Management should cooperate with public authorities to assist the authorities in meeting their responsibilities.

Producers of hazardous substances have a responsibility to promote the safe management of such substances throughout their total life cycle, consistent with the principle of "product stewardship".

All employees share responsibility for, and have a role to play in, the prevention of accidents by carrying out their jobs with an active regard for safety, by supporting the ability of others to do so, and by contributing to the development and implementation of safety policies and practices.

2.2 Establishment of safety objectives and a control framework by public authorities

Public authorities should ensure that appropriate safety objectives are established as part of a long-term strategy.

Public authorities should develop a clear and coherent control framework covering all aspects of accident prevention.

- The control framework should consist of binding requirements (set out in, for example, laws and regulations) as well as standards, codes and guidance (such as codes of practice, quality assurance guides, etc.). These materials should be designed to enable each interested party to determine whether the appropriate safety objectives are being met.
- The control framework should also include provisions for monitoring the safety of hazardous installations during all phases of their life cycle, and for the enforcement of requirements.

Public authorities should have available appropriate staff to carry out their role and responsibilities in the prevention of accidents, and should ensure that staff is adequately educated and trained.

- If the expertise necessary for public authorities to carry out their role and responsibilities is not available among staff, arrangements should be made for that expertise to be provided as needed, for example by external consultants or industry.
- The contracts of external experts/consultants employed by public authorities should stipulate that they are not to disclose any non-public information obtained except to the public authority which has contracted their services.

A coordinating mechanism should be established where more than one competent public authority exist, in order to minimise overlapping and conflicting requirements from various public authorities.

In establishing safety objectives, as well as the control framework, public authorities should consult with representatives of the other stakeholders including:

- relevant public authorities including, as appropriate, representatives from neighbouring communities or countries
- industry (management and other employees)
- professional and trade associations

- independent experts
- trade unions
- interest groups and the public

Public authorities should consider the establishment of a consultative committee relating to accident prevention, preparedness and response consisting of, among others, representatives of the stakeholders listed above.

Special efforts should be made to provide appropriate opportunities for input by the public into decision-making by public authorities.

Public authorities should establish the criteria for identifying those hazardous installations considered to have the potential to cause major accidents. These criteria may, for example, be based upon the specific substances and/or categories of substances present in the installation and their potential to cause serious harm to human health or the environment.

The requirements established by public authorities should be applied fairly and uniformly to ensure that enterprises of all sizes and types, whether national or foreign, are required to meet the same overall safety objectives.

The control framework should allow flexibility in the methods used to meet the safety objectives and requirements.

- As appropriate, industry should be allowed to establish the methods for meeting the requirements which are best suited to its own particular circumstances.
- In this regard, public authorities should take into account the specific situations of small and medium-sized enterprises.

The requirements and guidance established by public authorities should stimulate innovation and promote the use of improved safety technology and safety practices. The control requirements should be considered minimums: industry should be encouraged to achieve a higher level of safety than would be achieved by adherence to established standards and guidance alone.

The requirements and guidance should be reviewed periodically and, where necessary, amended within a reasonable time to take into account technical progress, additional knowledge and international developments.

Any amendments to the control framework requiring changes in technology or management practice should allow reasonable time for implementation and compliance by industry.

The control framework should include provisions for the enforcement of requirements, and adequate resources should be available to the public authorities for monitoring and enforcement activities.

Enforcement mechanisms should include suitable sanctions, with penalties applicable in the event of non-compliance with any of the requirements.

Public authorities should establish procedures for the notification and reporting to them of certain specified categories of hazardous installations.

Public authorities should also establish a system for the submission of detailed information for certain categories of hazardous installations. Under such a system, management of the relevant installations would be required to submit a report describing the major hazards at the installations, and demonstrating that appropriate steps are being taken to prevent accidents and to limit their consequences. (Such reports are known in some countries as “safety reports”.)

- The public authorities may establish different information requirements for different categories of installations, becoming more stringent for those installations regarded as presenting the greatest potential risk.
- Any such reports should be reviewed regularly and updated as appropriate.
- Public authorities should evaluate the reports received by, for example, examining their completeness, appraising the safety of the subject installation and, as appropriate, carrying out on-site inspections to verify information in the report.
- The information in these reports may be made available to the public, with the exception of legitimate trade secrets.
- As an alternative to this reporting system, the public authorities should consider implementing a system whereby detailed technical codes are established as binding requirements. Such codes may include requirements for the engineering design, the construction and the operation of hazardous installations. Where applicable, public authorities should monitor compliance with the codes.

Public authorities should consider which installations, or modifications to installations, are so potentially hazardous that the installations should not be allowed to operate without the prior and continuing approval of an identified public authority. In these cases, a form of licensing control could be utilised which would require management to submit full details of all relevant aspects of its projected activity to the authority in advance of siting and start-up, and periodically thereafter. There should be an opportunity for public input into these licensing decisions.

Public authorities should establish a requirement for the reporting of certain incidents by the management of hazardous installations.

- ➠ Relevant information in these reports should be made widely available as an aid to the prevention of similar accidents at other hazardous installations.
- ➠ Authorities should also establish a system for maintaining accident statistics, for carrying out analyses of collected information, and for disseminating relevant information derived from the analyses.

In order to assist industry in improving safely at hazardous installations, public authorities should consider whether to undertake such additional activities as:

- provision of technical assistance, considering any specific needs of the smaller enterprises
- promotion of training programmes
- encouragement of research; and fostering of public awareness

These activities should be conducted in such a way as to avoid influencing the impartial judgment of the primary role of establishing and enforcing safety objectives and requirements.

Public authorities in neighbouring countries should exchange information and establish a dialogue concerning installations which, in the event of an accident, have the potential of causing trans-frontier damage. Public authorities should ensure that systems are in place to provide warnings and information to neighbouring countries should an accident occur which can cause harm or damage in these countries.

National and, where appropriate, regional public authorities should co-operate internationally to improve prevention of accidents involving hazardous substances as well as to improve emergency preparedness and response. This can be done through bilateral contacts as well as through international organisations at different levels.

To avoid duplication of effort among international organisations, national authorities should undertake to encourage coordination and ensure that different organisations do not adopt conflicting approaches.

Cooperation should be promoted in the preparation of guidance documents across countries, industry groups and international organisations.

A worldwide network should be established to promote the sharing among enterprises and countries of information related to the prevention of, preparedness for, and response to accidents involving hazardous substances. This is particularly important as a means of providing access to information for those with less capability with respect to the safe handling of chemicals.

Trade associations, local chambers of commerce and other organisations can be a useful means of disseminating chemical accident prevention information to smaller enterprises which might be unaware of the existence of such information.

2.3 Establishment of a safety policy by industry

Management of a hazardous installation has the primary responsibility for preventing accidents involving hazardous substances, and for developing the means to do so.

Effective overall management of hazardous installations necessarily includes effective management of safety: there is a clear correlation between safely run installations and well-managed operations. Therefore, safety should be an integral part of the business activities of the enterprise, and adequate resources should be made available for taking the necessary measures to prevent accidents and to pay for the consequences of any accidents which do occur.

All installations in an enterprise should aim to reach the ultimate goal of “zero incidents”, and resources must be targeted towards this goal. This goal provides the incentive to achieve the best possible performance and ensures continuous efforts towards greater safety. Progress towards this goal can be furthered by:

- establishing safety-related objectives
- disclosing these objectives
- measuring progress towards achievement of these objectives

If an incident does occur, efforts should be made to learn from it to decrease the likelihood of an accident occurring in the future.

Management should not become complacent if there have not been any accidents at an installation over a period of time; continuous efforts are needed to maintain safety.

Each enterprise should establish a corporate safety culture.

➠ This starts with the visible commitment of the Board members and senior executives of the enterprise, who should set an example and demonstrate leadership by being actively involved in safety issues. In addition to this “top-down” commitment to safety as a priority, there should be a “bottom-up” commitment through the active application of safety policies by all employees.

➠ Essential elements of the safety culture are the belief that all accidents are preventable, and the establishment of policies which set outer limits on acceptable behaviour relating to safety. This culture should encourage initiative and alertness in the interest of safety and guard against complacency, which leads to unsafe acts or practices.

- As part of the safety culture, there should be an obvious commitment to safety in the enterprise. This commitment is evidenced by such practices as:
  - good communication on safety issues among management and other employees
  - positive feedback concerning actions taken to increase safety
  - quick response to remedy identified faults
  - financial and career incentives for good safety performance
  - participation of employees at all levels in developing and reviewing safety management procedures
  - obvious management interest in safety performance through personal involvement in safety matters
  - other actions taken by management directed to having all employees act appropriately with regard to safely
- The corporate safety culture can be enhanced by an open attitude on the part of management towards the public on safety issues.

Each enterprise should have a clear and meaningful statement of its Safety Policy agreed, promulgated and applied at the highest levels in the enterprise, reflecting the corporate safety culture and incorporating the “zero incident” goal as well as the safety objectives established by public authorities.

- The Safety Policy should set out to protect the safety and health of all persons involved in, or who may be affected by, the production, process, handling, use, storage, disposal or elimination of hazardous substances, environment and property.
- The Safety Policy should be widely communicated throughout the enterprise. Management should strive to ensure that the intent of the Safety Policy is understood and appreciated by all employees throughout the enterprise.
- Management and other employees should co-operate to comply with the enterprise’s Safety Policy and meet its safety goal.
- The Safety Policy should be reviewed regularly and amended, as appropriate, in light of experience gained.
- In developing, reviewing and amending the Safety Policy, management should consult with employees at all levels.

The development and implementation by an enterprise of policies and practices relating to accident prevention and preparedness should be coordinated and integrated with its activities relating to occupational safety, health and environmental protection as part of the enterprise’s total risk management programme.

The responsibility for day-to-day management of safety should be in the hands of line management at individual installations.

- Each site within an enterprise should develop its own safety programme which conforms to the enterprise’s Safety Policy and which addresses, in greater detail, safety concerns and requirements specific to that site. This programme should be developed with the active participation of employees at all levels and be subject to regular review.
- Senior management should provide the necessary support to line management for safety-related decisions and actions.
- Line management should respond to, or relate to superiors the proposals and suggestions of other employees related to safety matters.

All employees have a continuing role and responsibility in the prevention of accidents by carrying out their jobs in a safe manner, and by contributing actively to the development and implementation of safety policies and practices. Employees at all levels, including managers, should be motivated and educated to recognise safety as a top priority and its continuing improvement as a main corporate aim.

Producers of hazardous substances have a responsibility to promote the safe management of substances they produce throughout the total life cycle of the substances, from their design through production and use to their final disposal or elimination, consistent with the principle of "product stewardship". Such producers should make special efforts to help prevent accidents during the handling and use of a hazardous substance by downstream users.

- Producers of hazardous substances have a responsibility, legally and/or morally, for their products and, therefore, producers should create a full awareness of any potential hazards which can arise in the use, handling, storage or disposal of their products and should provide assistance and/or guidance, as necessary.
- In this regard, producers should provide technology, information and assistance to their contractors, distributors, transporters, customers and users so they can follow appropriate prevention practices.

Enterprises selling hazardous substances should actively try to determine whether their customers have adequate facilities and know-how to handle the substances (including, as appropriate, processing, use and disposal of the substances). If such determination cannot be achieved, judgment has to be exercised to decide whether to accept such customers. If customers are found to be incapable of safely handling the hazardous substances, the seller of the substances should assist the customer in obtaining this capability or else not accept such customers.

Smaller enterprises with limited resources should examine the need for assistance on safely matters from external consultants, professional trade associations and public authorities as well as from suppliers. Suppliers of hazardous substances should be supportive by ensuring that people are available to provide advice in order to achieve an appropriate level of safety.

Larger enterprises and/or trade associations should offer assistance to small and medium-sized companies in meeting safety objectives.

Enterprises and trade associations should take action strongly to encourage enterprises which act less responsibly to meet the appropriate safety objectives.

2.4 Risk assessment

2.4.1 Hazard identification

When planning, designing and modifying installations and processes, management should ensure that critical examination techniques such as risk analysis, hazard and operability studies (HAZOP) and fault tree and event tree analysis are utilised, in order that hazards are identified and ranked as early as possible at the various stages of the project (including the research stage) and the most suitable means of eliminating or reducing the hazards are instituted. These studies should take into account abnormal external events such as supply failures, power surges, earthquakes and extremes of weather as well as process hazards. Such studies will indicate where hazards may be reduced through engineering design.

The nature and extent of the consequences which could result from each significant hazard and their likelihood should also be assessed, using techniques such as consequence

analysis to ascertain the potential for harm. Reducing either the hazard or its probability of occurrence reduces the risk and increases the inherent safety of the design.

Techniques such as Quantified Risk Assessment (QRA) can provide guidance for decision-making on such safety issues. QRA allows a relative ranking of risks and provides an aid for determining appropriate preventive measures. However, the numerical results of QRA have little absolute value and, therefore, QRA should not be used indiscriminately.

For existing installations which have not been subject to critical safety examinations, the appropriate hazard studies should be carried out in retrospect.

- Such studies will ensure that all hazards have been properly identified and assessed, bearing in mind the current "state-of-the-art". In addition, such hazard studies will indicate where safety can be improved by, for example, substituting hazardous substances with less hazardous substances or less hazardous forms of the substances; reducing storage quantities of such substances or moving them to areas where an accident would have less severe consequences; or making process conditions less extreme.
- Any improvements which would increase the level of safety found to be appropriate should be carried out as soon as practical.

The management of hazardous installations should collate all safety-related information on the process and associated equipment concerning, for example, design, operation, maintenance and foreseeable emergencies.

- Such a file or dossier is essential for training as well as operational purposes, and for developing safety reports which may be required by public authorities.
- This process documentation file or plant dossier should include information concerning:
  - manufacturing procedures
  - process and operating instructions (including safe start-up and shutdown)
  - line diagrams of process flow showing key equipment
  - results of safety tests and safety data on raw materials
  - reaction mixtures and products
  - data resulting from hazard studies
  - waste treatment
- The process documentation file or plant dossier should be kept up to date

2.4.2 Risk analysis

Safety measures should be incorporated at the earliest conceptual and engineering design stages of an installation, to enhance the intrinsic safety of the installation wherever practicable.

- The safety measures should take into consideration the possibility for human as well as technical errors, to make compliance with safety procedures as easy as possible. For example, the design of a hazardous installation should take the human factor into account and be in accordance with ergonomic principles so as to take into account limitations in human performance.
- The engineering design principles concerning safety apply not only to new plant and process design, but also to modifications to existing plants and processes as well as to research activities.

  In designing new installations and significant modifications to existing installations, industry should use the relevant, most up-to-date international standards,

codes of practice and guidance established by public authorities, enterprises, industry and professional associations and other bodies in order to achieve a high level of safety.

Such standards, codes of practice and guidance should, however, be considered to be minimum requirements. Since improving safety is a dynamic process which should reflect advances in knowledge and technology, these standards, codes and guidance should be developed from within the enterprise (embodied in "in-house" engineering design guides and specifications) as a result of operational experience and specialist knowledge.

Existing installations should be assessed to determine whether they meet these standards, codes and guidance. Appropriate improvements should be carried out as soon as practical.

The design of a hazardous installation should integrate the appropriate equipment, facilities and engineering procedures that would reduce the risk from hazards as far as is reasonably practicable (that is, all measures to reduce the risk should be taken until the additional expense would be considered far to exceed the resulting increase in safety).

To the extent that safety in the engineering design of an installation can be enhanced, the design of the installation should, for example:

- minimise, to the extent reasonably practicable, the use of hazardous substances
- substitute hazardous substances with those that are less hazardous, provided this decreases the overall risk of the installation
- reduce inventories of hazardous substances
- simplify processes
- reduce process temperatures and pressures
- separate people from hazardous substances
- include means to contain hazardous substances in the event of an accident

➠ Systems designed specifically to increase process safety dealing with, for example, pressure relief and fire and explosion assessment should be included in the engineering design of new and existing hazardous installations, taking into account possible accident scenarios.

➠ For equipment critical to safety (such as pressure vessels or control instruments), engineering design should be subject to a recognised certification or verification procedure.

➠ Consideration should be given in the design of hazardous installations to the provision of redundant safety-related utility supplies (such as electricity for control systems).

Processes should be designed to contain, control and minimise the quantity of hazardous intermediate substances to the extent that this would increase safety. Where this is not possible, the quantity of hazardous intermediates produced should be reduced to that required for use in the next stage of production so that quantities held in storage are kept to a minimum.

Systems should be designed so that individual component failures will not create unsafe process conditions (i.e. they should be "fail safe") and/or will be capable of accommodating possible human errors.

Although emphasis should be on inherent safety in design, consideration should be given to the need for "add-on" protective systems, thereby assuring safety through mitigation measures.

- Procedures should be designed to minimise the chance of failure and, should there be a failure, to minimise any adverse effects.
- Systems to contain any leaks, spills or fire-fighting waters that might be released (using, for example, containment walls or catch basins) should also be incorporated in the design of hazardous installations, bearing in mind the quantity of hazardous substances which could be released. If there is a loss of containment, adverse effects may be minimised by other mitigation measures such as fire protection equipment and emergency procedures.

In the design phase, management should ensure there is adequate consideration of the site layout as guided by overall safety goals. Particular regard should be given to:

- the establishment of safe separation distances to minimise any "domino effects"
- the location of hazardous processes and substances relative to the location of critical safety-related equipment and instruments; and the local community and environment

Relevant personnel who will be involved in the operation of a hazardous installation should also be involved in the planning, design and construction phases of the installation. Employees, and their representatives where they exist, should participate in decisions concerning the design of their workplace, and should be given the opportunity to provide input in the design, application and improvement of equipment in order to utilise employee "know-how" and experience.

The management of a hazardous installation should pay particular attention to quality assurance during the construction phase of a project.

- Safety checks and inspections should be routinely carried out during the construction phase to ensure that the integrity of the original design is maintained, in that plans are being followed properly, requirements of the hazard studies are being fully implemented, and associated equipment is being correctly installed; and in that the correct materials, methods (such as welding techniques) and tests (such as pressure/leak tests) are being used by suitably qualified employees.
- Any modifications to the original design should be documented, and these modifications should be reflected in quality assurance and safety reviews prior to commissioning and start-up of the installation.

Safety checks should also be carried out at the commissioning and start-up phases of a project to ensure that the design intent has been completely fulfilled. Functional tests should be carried out for all components, controls and safety devices critical to the safety of the installation.

An enterprise should purchase equipment only from reputable suppliers, and should formally inspect equipment to ensure that it conforms to design specifications and safety requirements before being put into use.

- Information concerning reliability of suppliers should be shared among enterprises.
- Quality assurance (QA) systems can provide useful tools to ensure the conformity of equipment with standards and other requirements.

In the construction of a hazardous installation, an enterprise should do business with only those contractors who are able to satisfy the enterprise that their services will be carried out in compliance with all applicable laws and regulations, as well as in compliance with

relevant safety standards and policies of the enterprise, so as not to increase the risk of an accident involving hazardous substances. Contractors should work to the standards set by the management of the installation and, to the extent appropriate, under the direct surveillance of management.

Whenever an enterprise transfers process or other safety-related technology, management of that enterprise should strive to ensure that the technology will be applied in a way which will result in a level of safety equivalent to that achieved in the enterprise's own installations using that technology.

- Enterprises transferring process or other safety-related technology for hazardous installations have a responsibility to develop the technology and associated operating procedures to enable the installations to be operated to an acceptable level of safety, recognising that certain safety technology may not be appropriate in all locations and that practices of management and other employees can be significantly affected by local cultural and administrative conditions.
- All such transfers of technology should be accompanied by related safety information.
- The technology supplier should provide assistance to the technology receiver for education and training.

Prior to transferring process or other safety-related technology, an enterprise should ensure that a hazard evaluation of the application of that technology is carried out incorporating local ecological, social, cultural, economic and demographic data that might affect the possibility, or consequences, of an accident involving hazardous substances.

- The party responsible for carrying out this evaluation – which may differ depending upon contractual arrangements – should have access to all the necessary information and should use currently accepted techniques for the identification of hazard, and evaluation of the risks.
- The responsible party should involve local officials and community representatives and should ensure that local officials are given the results of the evaluation.

Technology should not be transferred unless the supplier is satisfied, having conducted a fact-finding study, that the technology receiver can apply and use the technology in a safe manner, taking into account the legal and administrative infrastructure necessary for its safe operation.

There should be a contract governing the transfer of the technology which, among other matters, clearly defines and regulates the division of responsibilities between the panics involved related to effective control of operations, prevention of accidents, and emergency preparedness and response.

- If appropriate, this contract should also have provisions relating to the procedure for the handover of a turnkey plant.
- The sections of the contract relating to the areas described above should be available, on request, to competent public authorities and to employees and employee representatives, where they exist.

All parties involved should sign a handover document, including contractors, when a hazardous installation involving the transfer of technology has been built to the design specified and its capability to be operated safely, in accordance with specified procedures, has been satisfactorily demonstrated in an acceptance test run.

Prior to the acquisition of, or investment in, an existing or planned hazardous installation, an enterprise should carry out a hazard evaluation to determine the nature and level of hazards at the installation. The enterprise should also determine the requirements for operating the installation in conformity with the standards of the enterprise.

The responsibility should be on the “seller” of an existing installation to disclose all known or suspected safety problems associated with the installation involved.

All relevant corporate safety policies and guidelines for accident prevention, preparedness and response should be applicable to acquisitions. When an enterprise acquiring an existing installation concludes, following an assessment, that the installation does not meet the standards of the enterprise or internationally accepted safety levels, the installation should be brought up to such safety levels within a reasonable period of time. In those cases where retrofitting cannot be accomplished to meet these levels, the investing enterprise should inform the public authorities and employees, and employee representatives where they exist, in a timely manner of the situation and their intended plans.

Financial institutions, in determining the level of funding to be provided to enterprises for investment in a hazardous installation, should take into account the amount of resources needed to comply with safety requirements as well as with corporate safety policies and guidelines.

Where an enterprise has an investment in, but not operational control over, another enterprise operating hazardous installations, the enterprise making the investment should consider, where appropriate, entering into contractual arrangements to assist in the establishment and maintenance of safety standards.

An enterprise should regularly audit the safety performance and emergency response systems of all hazardous installations of subsidiaries and, to the extent possible, affiliates, to assure itself that the level of safety at such installations does not unreasonably endanger employees, neighbouring communities or the environment, and is consistent with acceptable safety standards .

An enterprise should provide each of its affiliates and subsidiaries full access to all safety-related information – including newly discovered information, research results, technology, and management techniques which could reduce the likelihood of major accidents or mitigate the consequences should an accident occur – at the location of the affiliate or subsidiary.

Enterprises should maintain records showing which hazardous substances are produced, used or stored at affiliates and subsidiaries, by location, on a world-wide basis in order to be able to share effectively information concerning the potential for accidents involving such hazardous substances.

In the event of a major accident, an enterprise should immediately inform the management of relevant affiliates and subsidiaries of the accident, its probable causes, and recommendations for immediate safety checks. The accident report should also be provided to the management of these affiliates and subsidiaries.

2.4.3 Risk management

Management should ensure that each installation in an enterprise has written operating procedures and instructions in order to establish the conditions necessary to satisfy the design intent of the installation and maintain its integrity. These should take into account the relevant standards, codes and guidance in order to ensure that equipment, plant and premises provide a safe place of work under both normal and abnormal operating conditions.

Before new products, processes or equipment are handed over from one department to another (for example, from research to production), management should ensure that there are written, agreed operating procedures and safety instructions in order that knowledge and experience gained in research, development, pilot plant and production are passed on. This handover should be formalised by an appropriately signed handover/clearance report.

Appropriate procedures should exist to ensure that effective protection against accidents involving hazardous substances exists during abnormal conditions such as when critical instruments, alarms and emergency equipment are not available, and during periods of stress at the installation (for example, when there are unusual production demands or an economic decline that affects the installation).

Appropriate arrangements should be introduced at a hazardous installation for the prevention of fires, and should a fire occur, for the protection of personnel, buildings and equipment and for fire-fighting. These arrangements should make provision for the necessary equipment, procedures, training, testing and personnel.

Appropriate procedures should exist for the safe shutdown and decommissioning of a hazardous installation to ensure that hazards are controlled during the shutdown process and while the installation is out of operation.

During transition phases of operation of a hazardous installation which involve shutdowns and start-ups – for example, during maintenance of equipment – special efforts should be made to avoid potential causes of risk such as communication problems and split responsibility, since such phases may involve people who are not fully aware of the details of an installation's operation, policies and procedures.

Appropriate arrangements should be in place for maintaining the security of a hazardous installation to minimise the possibility of, for example, sabotage or vandalism. The management of the hazardous installation should specify those areas of the installation to which access should be restricted or controlled, and implement measures to maintain control and prevent unauthorised access.

Management should endeavour to choose the safest practicable means of transport and the safest practicable routing of hazardous substances being taken from or delivered to an installation in order to, for example, minimise the number of people potentially affected in the event of an accident.

A high standard of housekeeping and operational efficiency should be maintained at a hazardous installation since there is a clear correlation between these functions and good safety performance.

Management should ensure that appropriate organisational arrangements for implementing the corporate Safety Policy are established. The line of prime responsibility for the management of safety in the enterprise, as well as individual responsibility for safety, should be clearly defined.

Safety should be a line management responsibility, with accountability for the day-to-day management of safety delegated to local line management at each installation in the enterprise.

- Management responsible for an installation should be actively involved in developing and updating the local safety arrangements for that installation, which should be designed to satisfy the broader corporate safety objectives, with the participation of the employees concerned.
- Supervisory staff should receive the necessary means and training to fulfil any responsibilities delegated to it for the management of safety.

Management should be responsible for ensuring that each operation is staffed in a manner which allows for the safe operation of installations at all times. Included in this responsibility are the following considerations:

- Management should give special consideration to sufficient staffing during nights and weekends, and to controlling overtime work if it may present an increased risk of an accident involving hazardous substances.

- In planning staffing schedules, consideration should be given to avoiding stress and overwork. For example, hours of work and rest breaks should be compatible with safety requirements. Overtime and rest day working by any individual should not be excessive. A record of all such abnormal hours should be maintained to facilitate control on hours worked.
- The possible need for greater levels of supervision during periods of stress should be taken into account. Special staffing requirements and technical skills posed by start-ups, shutdowns, abnormal or unique operating situations, and emergency response needs should be identified and met by management.
- Consideration should be given to the physical fitness of employees for their jobs, including those employees whose activities are largely sedentary such as managers and control room employees. In this respect, employees should not be assigned tasks if such assignments may compromise the safe operation of the installation. For instance, employees who are affected by substance abuse should not be assigned certain safety-critical tasks.
- Jobs which are unsuitable for assignment to disabled or restricted employees, pregnant women or young employees due to the risk of an accident involving hazardous substances should be identified and, where necessary, special arrangements made on a case-by-case basis to ensure such employees can perform their tasks safely.
- Employees, and their representatives where they exist, should participate in decision-making concerning the organisation of their activities and the staffing needs of the installation, to the extent that these may affect safety.

Plans for personnel development and rotation of jobs should always be consistent with maintaining operational safely requirements.

Consideration should be given as to whether certain tasks, because of their relationship to prevention of accidents, should be subject to specific management controls, for example, a requirement for a specific authorisation or license for activities such as pressurising tanks and welding.

Sufficient professional safety personnel should be available within an enterprise. Their role should be to remain impartial and independent of line management, to provide expert advice and, as such, to function as the enterprise's safety conscience.

- In this regard, safety personnel should:
  - have the necessary authority to carry out their responsibilities, and should be seen to have management support
  - interact with. and be respected by, employees at all levels in the enterprise
  - be technically competent, either through specialised training or adequate experience, or preferably both
  - possess good interpersonal and communication skills
- The number of safety professionals should be appropriate to the size, technology and complexity of the enterprise.
- Management should consider rotating employees between line management and the safety function in order to increase understanding of safety-related problems, generate better solutions to safety-related problems, and strengthen the "safety culture" within the enterprise.

Each employee should be responsible for following the procedures laid down by management, and for taking reasonable care for his or her personal safety and for the safety of others who may be affected by the employee's acts or omissions at work.

Each employee should support the ability of others to carry out their jobs in a safe manner, and co-operate actively with management in the application of safety procedures and arrangements.

Safety performance should be considered an essential component of every employee's overall performance and should be reviewed periodically.

The role with respect to safety of each employee, including managers at all levels, should be clearly defined so that safety performance can be appropriately monitored and reviewed.

Management and public authorities should encourage, and facilitate the ability of employees to fulfil their role and responsibility. Employees may require the support of unions, confederations and their international organisations to assist them. Employee-management cooperation is a prerequisite to assuring safe operations at hazardous installations.

Effective two-way communication channels for the transfer of safety information between management and other employees should be established at hazardous installations. This will help create and maintain a high level of motivation for all employees to operate the installation safely.

The regular communication channels should be reinforced by the establishment of Safety Committee (s) to provide a formal mechanism for consultation among employees on safety matters. The Safety Committees should support – but not be a substitute for – direct communication among management and other employees, or for individual and line management responsibilities for safety. The use of such Committees enables the maximum benefit to be obtained from employees' practical experience and knowledge, as well as furthering mutual trust and confidence through the actions taken to improve safety.

- Safety Committees should operate at different levels in an enterprise and consist of:
  - employees at various levels (including Safety Representatives where they exist)
  - managers with the authority to implement the Committee's recommendations
  - safety specialists
  - contractors, where appropriate
- Safety Committee members should receive safety training and specialist advice as necessary.
- Resources should be available for the Safety Committee to undertake its activities.
- Management should act upon the recommendations of the Safety Committee, recognising that the ultimate responsibility for safety remains with management.
- Safety Committee members should not lose any earnings for time spent in activities related to the Safely Committee.

In addition to Safety Committees at individual hazardous installations, the establishment of parallel mechanisms at a corporate, sectoral, national or international level may be considered as a useful means of helping to disseminate safety information and providing input to the relevant decision-making processes concerning safety.

Consideration should be given to the establishment of Safety Representatives at the plant level. Safety Representatives, nominated by employees, represent those employees in consultations with management on matters relating to safety. Safety Representatives should be given specific training related to their role.

No measures prejudicial to an employee should be taken if, in good faith, the employee complains to other employees with responsibilities for safety of what he/she considers to be a breach of statutory requirements or an inadequacy in the measures taken with respect

to safety. Management should support this approach if the necessary "open" attitude to safety matters is to be achieved.

An employee should have the right to refuse to perform any tasks which he/she believes may create an unwarranted risk of an accident involving hazardous substances.

The employee should immediately report to management the reasons for refusing to perform these tasks. In certain cases an employee, or a Safety Representative where one exists, may interrupt hazardous activities in as safe a manner as possible when he/she has reasonable justification for believing that these activities present an imminent and serious danger to safety.

Employees should be required to report forthwith to management any situations which they believe could present a deviation from normal operating conditions, in particular situations which could develop into an accident involving hazardous substances. Management should investigate these reports. If this does not result in an adequate response, the employee should be entitled to refer the matter to public authorities. Employees should not be placed at any disadvantage because of their actions.

Specific policies with respect to personal activities which may affect the safe operation of an installation – such as smoking, substance abuse and similar matters – should be agreed on and included in every individual employee's contract or conditions of employment.

Management should ensure that all employees have appropriate personal protective equipment and ensure that it is maintained in good condition. Management should also ensure that regular training is provided in its use. Employees should be responsible for using the personal protective equipment in accordance with safety procedures and policies.

Management should not engage contractors to perform jobs related to the operation of a hazardous installation if this would compromise safety.

- Management should only hire those contractors who are competent to carry out the contracted work in accordance with all applicable laws and regulations, as well as the safety policies and standards of the enterprise and any additional practices particular to their task.
- Before contracts are given, management should obtain evidence that the contractors are capable of performing their tasks to a sufficiently high standard of safety. Compliance with these laws, regulations, safety policies and standards should be an integral part of the contract with contractors.
- Management should monitor the safety performance of their contractors and, in general, contractors should be subject to the same safety management systems as employees.

Contractors hired to perform duties related to the operation of a hazardous installation should have equivalent rights and responsibilities with respect to safety as employees. If necessary, special measures should be developed to ensure that contractors' employees are well-informed of the hazards when operating at hazardous installations. Specific site safety information should be made available to contractors' employees.

Particular attention should be given to the role of human factors in preventing accidents at hazardous installations, recognising that humans will, on occasion, fail and that the majority of accidents are in some part attributable to human error, meaning human actions which unintentionally exploit weaknesses in equipment, procedures, systems and/or organisations.

- In planning all phases in the design, development, operation, maintenance, shutdown and decommissioning of a hazardous installation, management should lake

into account the possibility that human error can occur so that its effects can be minimised.

- The human factor should be taken into account when hazard identification and assessments are carried out.
- The human factor, including both positive and negative aspects of human behaviour, is applicable to all employees in a hazardous installation including managers and contractors.

The demands of each task which may affect the safe operation of an installation should be carefully analysed in order that employees and their tasks are mentally and physically matched, and employees are not overloaded or excessively stressed, so that they can make the most effective and safe contribution to the enterprise. Mental matching of a task involves consideration of the information and decision-making requirements as well as the perception of the task; physical matching includes consideration of the design of the workplace and working environment.

Employees should be encouraged to share their experiences in order to reduce the risk of human error. This can be accomplished through, for example, safety workshops, discussions of near-misses and other group discussions, as well as by inspection and observation of the workplace by employees and, where appropriate, by Safety Representatives.

Experiences relating to human errors should also be shared among different companies and, to the extent possible, among public authorities.

Training and education programmes for all employees should deal with the issue of human errors, including the underlying causes and prevention of such errors. These programmes should also take into account ergonomics and the employee/machine interface.

Special care should be taken during periods of stress to avoid human errors which could lead to accidents. Management should make it clear that safety considerations take precedence over other considerations. Stress affecting safety could result from pressure on individuals or groups of employees or on the enterprise as a whole (for example, to increase production or cut costs).

In their monitoring activities, both management and public authorities should consider the role human errors might play in increasing the potential for accidents involving hazardous substances. They should consider the potential for errors both in the use of equipment and in following procedures.

It should be recognised that human error outside the hazardous installation can contribute to the increased risk of an accident or adverse effects in the event of an accident. For example, public authorities should take into account the fact that human error in land-use planning, in emergency planning, or in emergency response can affect the safety of a hazardous installation or aggravate effects of an accident.

Management of hazardous installations should establish programmes for the regular maintenance, inspection and testing of equipment to ensure that it is at all times fit for the purpose for which it was designed.

- Maintenance programmes should be adhered to strictly and should be reviewed periodically to ensure they continue to be appropriate in relation to safety requirements.
- Maintenance standards should be developed to help guarantee the safety of each operation.
- Maintenance jobs should be performed according to established maintenance procedures.

- Records should be kept of all safety-related maintenance work carried out, and equipment reviews and reliability assurance procedures should be established.
- Records should be kept of any faults found during maintenance of equipment which might materially affect safety, and prompt action should be taken to rectify the faults.

The local management at each hazardous installation should regularly inspect and maintain emergency alarms, protective and emergency devices, and all devices critical to the orderly shutdown of operations in conjunction with the relevant public authorities, where appropriate.

The management of a hazardous installation should establish formal procedures to ensure that no repair work or modifications to plant, equipment, processes, facilities or procedures compromise safety.

- Modification procedures should apply to both permanent and temporary changes, and should be based on appropriate up-to-date process documentation and, where appropriate, a physical inspection of the installation.
- All modification proposals should be registered and assessed so that the necessary hazard studies are carried out, the appropriate design considerations are made, and the changes proposed are properly engineered and recorded.
- Major modifications should be subject to the same notification and reporting requirements as new installations.

Proposals for significant modifications should require a review by competent technicians who are independent of those directly responsible for the proposal.

- The level of management approval necessary for a modification should be based on the associated level of risk.
- Supervisors having the authority to make a modification, for example to a manufacturing procedure or operating instruction, should be fully aware of the hazards involved and should consult the relevant competent specialises) before initialling such a change.

In the case of any changes made to a process which could affect safety – for example, use of different process materials, alterations of conditions, increase in batch size, or use of larger/different equipment – the original hazard analysis should be reviewed and the process documentation file or plant dossier supplemented accordingly.

Techniques should be developed to assess how a series of minor changes, taken together, could affect safety at an installation and what could be done to mitigate any increased potential for accidents.

After repair, modification, and/or overhaul of plant and equipment, the necessary test runs and safety checks should be carried out in the presence of the supervisor responsible for the operation of the installation, who should be required to formally approve the restarting of operations.

Procedures should also exist to ensure that changes in management, other personnel and organisation do not compromise safety. Such changes should trigger review procedures to ensure safety has not been adversely affected.

The management of an enterprise seeking to store hazardous substances off-site – including products, raw materials and intermediates – should satisfy itself as to the suitability of the facility for the storage of such substances, and of the competence of the warehousekeeper to undertake the storage required in a safe manner. This could involve the enterprise monitoring the storage facility and training employees at the off-site facility.

The warehousekeeper should ensure that all relevant legislative requirements and applicable codes of practice for the safe storage of hazardous substances are strictly applied wherever applicable.

The owner/supplier of the hazardous substances being stored should provide the warehousekeeper with the information necessary to prevent accidents and to respond appropriately should an accident occur.

- In this regard, the owner/supplier should provide a material safety data sheet (MSDS) or product data sheet so that the warehousekeeper can ensure that physical, chemical and toxicological, and other properties relevant in the case of an accident are understood by all relevant employees working in the storage facility.
- Particular attention should be given to proper labelling of hazardous substances, indicating any hazardous properties on labels and the appropriate precautions to be taken.
- In addition, the owner/supplier of the hazardous substances should provide information concerning reaction and/or decomposition products formed in the event of a fire.

The owner/supplier of hazardous substances should consider reducing the amount of hazardous substances requiring storage, off-site and/or on-site, if this would reduce the adverse consequences of an accident involving the hazardous substances.

A storage facility should be designed taking into account the nature of the hazardous substances to be stored in the facility.

- The design of the facility should allow for the separation of incompatible substances and subdivision of inventories by the use of separate buildings, fire walls, etc. and, for example, should enable access for inspection of hazardous substances, reduce the likelihood of domino effects should an accident occur, and permit fire-fighting.
- In designing such facilities, particular attention should be given to incorporating automated systems for handling hazardous substances, which reduce the risk of an accident involving such substances.

Storage facilities should incorporate safety features to prevent accidents and to reduce the adverse effects in the event of an accident. For example, security measures should be in place and fire protection equipment should be available. Adequate catchment facilities should be provided to facilitate the activation of spill mitigation procedures to protect the environment in the event of an accident.

A storage plan should be drawn up by the warehousekeeper showing the nature of the hazardous substances in each part of the storage facility.

- The storage plan should be made available to the relevant local public authorities (for example, fire services).
- Information concerning hazardous substances held in a storage facility should be maintained up-to-date.

Procedures should be established at storage facilities to prevent the risk of degradation of hazardous substances or packages as well as labels or other markings. Good housekeeping practices should be initiated to prevent accidents.

In order to prevent explosions and fires, consideration should be given to whether the conditions of storage (including, for example, temperature and pressure) create special risks. Consideration should also be given to avoiding potential sources of ignition such as smoking, welding, and shrink-wrapping equipment. All power equipment should be specially protected, as necessary.

Safety performance in hazardous installations should be periodically reviewed in order to:

- assess achievements with respect to the general goals set
- determine how well specific safety-related policies and decisions have been put into practice
- focus resources where improvements are most needed
- provide information to justify the adjustment or upgrading of goals and achieve further improvement
- demonstrate management's commitment to safety and provide motivation for improvement
- provide a basis for recognising good and inadequate performance
- provide information on safety achievements to the public authorities, community, shareholders and non-governmental organisations
- provide input into education and training activities

Public authorities and industry, with the involvement of employees, should develop proactive/positive indicators of safety performance as well as methods of assessing achievements in risk reduction. While changes in lost-time accident rates have been used and have some value in measuring safety performance, they are reactive indicators and provide only part of the total safety picture.

Systematic safety improvement programmes should be attended by management, with the involvement of other employees, at each installation.

➠ These programmes should be regularly reviewed to ensure an improving trend in safety performance is achieved.

➠ Such proactive safety schemes should be promoted by public authorities.

Management should ensure that every hazardous installation is subject to a comprehensive system for monitoring safety, covering both technical and management aspects, including hardware and procedures. Management should continually review its operations to ensure that no previously unrecognised risks have been introduced and that there is the required degree of compliance with the relevant national and international legislation, standards, codes and guidance as well as the enterprise's own requirements and guidance. By doing this, any needs for additional, new or improved standards, hardware and/or procedures should be revealed.

➠ The approach to monitoring should be systematic. In this regard, a monitoring plan should be developed at each installation, "owned" and primarily implemented by the local management, and with flexibility built in to avoid it becoming routine.

➠ The monitoring plan should include regular inspections at the workplace, periodic detailed checks on specific activities and procedures, and an overall audit of performance.

- The monitoring plan of an installation should form the basis of a hierarchy of annual safety assurance reports, from the manager responsible for an installation to division/business/company/enterprise executives and subsequently to the Chief Executive Officer of an enterprise.
- Emphasis in monitoring should be on those aspects vital to the safety of the particular installation, as revealed by the hazard evaluations. Some general aspects will need to be covered in all monitoring, such as: organisation and management; training; plant integrity; fire protection and prevention; accident/dangerous occurrence investigation and reporting; and emergency procedures.
- The potential level of risk should be a significant factor in determining the frequency of monitoring.

In addition to any changes in response to legal requirements, improvements suggested by monitoring should be made where such improvements are reasonably practicable and contribute to the ultimate goal of “zero incidents”.

Management should, as appropriate, utilize auditors independent of the local management and employees to monitor hazardous installations. Such an approach using, for example, expert consultants or the enterprise’s central safety services can be a valuable means, in certain cases, of raising safety performance by providing another, more independent, viewpoint. Insurance companies may provide a useful service in this respect, especially to small and medium-sized enterprises.

A statement of an enterprise’s safety and health performance should form part of the yearly report to its shareholders and employees.

Public authorities should establish appropriate arrangements for monitoring the safety of hazardous installations in all phases of their life cycle, including planning, design, construction, operation (including maintenance) and decommissioning. When monitoring hazardous installations, public authorities should assess the safety performance of the operation both in terms of meeting technical standards and ensuring that management systems are adequate and effective (that is, systems/procedures as well as the hardware). By proactive monitoring of hazardous installations, public authorities should check, on an equitable basis, industry’s compliance with relevant requirements and practices and help to promote industry action beyond minimum requirements.

- Monitoring of existing installations should be carried out by means of both a planned sequence of unannounced or announced inspections, and visits in response to accidents, complaints and other indicators that safety performance may be inadequate.
- Public authorities should decide on the frequency and nature of planned inspections, commensurate with the resources available to them and the risks presented by the installation, using some form of priority rating system.
- Public authorities should have free access to hazardous installations and be provided with the information necessary to conduct inspections and audits.

Public authorities should be given sufficient resources and personnel to carry out their monitoring function. Public authorities’ inspectors should receive the training and have the necessary expertise to determine, for example, whether the approaches taken in a hazardous installation will achieve the legal safety requirements.

Public authorities’ inspectors should be empowered to initiate enforcement action to remedy any serious defects which they discover during any monitoring.

Public authorities should ensure that guidance is prepared for those with compliance obligations on how they can best meet their obligations and satisfy the monitoring/enforcement authorities.

Public authorities should use monitoring as a means of providing support to the management of hazardous installations, consistent with the authorities' enforcement responsibilities. Monitoring provides an opportunity for the public authorities to help management identify weaknesses in their organisation and in their safety arrangements, as well as to provide advice or details on where further information and assistance should be sought. This may be particularly important in the case of small and medium-sized enterprises.

For monitoring to be effective and credible, the monitoring authorities should be publicly accountable. This can be achieved by making the system transparent. To this end, the monitoring authorities should publicize their objectives, procedures and the results of monitoring the safely aspects of hazardous installations.

Public authorities should establish land-use-planning arrangements to ensure that new hazardous installations are appropriately sited with respect to protection of health and environment, including property, in the event of an accident involving hazardous substances. These arrangements should also prevent the placing of inappropriate developments near hazardous installations and should control inappropriate changes to existing installations.

Land-use planning should consist of two elements: general zoning for hazardous industrial activities, taking into account all aspects of protecting health and the environment, including property; and case-by-case decision-making concerning the siting of a new installation or proposed development near an existing installation.

Land-use planning arrangements, as well as related control mechanisms, should provide a clear indication of the standards to be met, and of the evaluation procedures used by public authorities, both for new hazardous installations and for proposed developments in proximity to existing installations.

Public authorities should establish general guidelines to identify which proposals for new installations or for other developments may increase the risk of a major accident or of any adverse consequences in the event of a major accident.

- In addition to proposals for new hazardous installations, such guidelines should cover significant modifications to existing installations and significant development in the vicinity of existing installations.
- The guidelines should take into account such factors as:
  - the population density in the area under consideration
  - transport routes for hazardous substances
  - ease of evacuation or other measures which may need to be taken in the event of an accident
  - existence of institutions nearby with vulnerable populations (for example, schools, hospitals, and homes for the aged)

Management of an enterprise should select possible sites for new hazardous installations which, in addition to being consistent with the guidance developed by public authorities, would minimise the adverse effects to health and the environment, including property, in the event of an accident at the installation or as a result of transport of hazardous substances to and from the installation.

Public authorities should ensure that the risk of an accident posed by a specific proposed development, including adverse effects in the event of an accident, are assessed taking into account the full range of implications, advantages and disadvantages of the particular location. This should be done both for proposed hazardous installations and proposed developments of other kinds in the vicinity of hazardous installations.

Quantified Risk Assessment (QRA), which is part of a systematic approach to the identification, estimation and evaluation of hazards, is one of a number of tools which can provide guidance to public authorities in land-use planning and be an aid to industry in decision-making. The use of standardized QRA procedures could facilitate the transparency of decision-making processes and allow for a relative ranking of risk. However, since the numeric results of QRA have little absolute value, QRA should not be used indiscriminately.

As part of the assessment process, management of an enterprise making a proposal to construct a new hazardous installation or a significant modification to an existing installation should be required to develop a scale plan of the proposed development showing:

the locations and quantities of the hazardous substances present on-site relative to the surrounding area

- the nature of the land-use in adjacent areas
- the local population and areas of local environmental significance
- the potential off-site hazard effects posed by their proposal

➠ Management should also provide details of the processes, which will involve hazardous substances, the inventory of hazardous substances to be stored, and the conditions under which the hazardous substances are to be handled. Furthermore, management should provide an assessment of the environmental impact of the proposed installation.

➠ These assessment-related activities should be carried out in conjunction with the local authorities as early as possible in the process of planning for the installation, in order to facilitate consideration of cost-effective alternatives.

Land-use planning decisions by public authorities related to hazardous installations should take into account the cumulative risk of all hazardous installations in the vicinity.

➠ Consideration should be given to avoiding intensification of the total risk to the community, recognising that in some cases it may be preferable to centralise hazardous installations in one location, while in other cases it may be preferable to keep hazardous installations apart.

➠ Land-use planning decisions should take into account the possibility of a “domino effect” and the need for “separation distances” to provide a buffer zone between potentially hazardous areas and populated areas in order to reduce the risks of adverse effects in the event of an accident.

The availability of external emergency response capability should also be part of the land-use planning considerations.

Where a specific area with existing hazardous installations may not be able to meet current guidelines for land-use planning in the short-term, measures should be taken to alleviate the risks in the longer term, for example by modifying installations or by phasing out older installations and/or residential buildings near the site. Such a phase-out may involve the need for compensation to property owners.

Land-use planning arrangements should include mechanisms for enforcement of zoning and siting decisions. The mechanisms for applying and enforcing land-use planning for safety purposes will vary from one country to another as a result of differing cultures, population, and legal systems, although some general principles can be identified.

The roles of public authorities with respect to setting of safety objectives for industry, and to land-use planning, should be well-integrated in order to minimise the adverse effects of an accident. Integrated land-use planning decisions can also help to reduce other environmental impacts such as those caused by chronic pollution and nuisance, as well as to address issues of transport risks.

The land-use planning activities of local state/regional and national public authorities should be co-ordinated.

- State/regional and national authorities should develop the overall objectives to be met with supporting technical information and guidance.
- Local authorities, at an appropriate level, are usually in the best position to make the planning decisions, taking into account local social and economic factors. Sufficient flexibility should be built into the process to allow social and economic factors to be taken into account in zoning and siting decisions.

The public should be given the opportunity to provide input into decision-making processes related to siting of hazardous installations.

With respect to land-use planning for proposed hazardous installations capable of causing trans-frontier damage in the event of an accident, a policy concerning the exchange of information and consultation between competent public authorities of neighbouring countries should be applied consistent with OECD Council Decision C(88)84(Final).

3. Emergency preparedness

3.1 General principles

Public authorities, at all levels, and managers of hazardous installations should establish emergency preparedness programmes concerning accidents involving hazardous substances.

- The objective of emergency preparedness programmes should be to localise any accidents that may occur and, if possible, contain them, and to minimise the harmful effects of the accident on health and the environment, including property.
- These programmes should include commonly accepted principles and practices.
- The risk of transport accidents involving hazardous substances should be taken into consideration in emergency planning relating to hazardous installations.

Public authorities should develop guidelines and standards for off-site and on-site emergency preparedness plans. They should also ensure the development, implementation, testing and updating of off-site and on-site emergency preparedness plans in co-ordination with the management of hazardous installations and, as appropriate, with the participation of employees and of neighbouring communities, recognising that the responsibility for the actual development and implementation of the plans will differ among countries.

The on-site and off-site emergency plans should give details of the technical and organisational procedures which are appropriate to reduce the effects on people, property and the environment both on-site and off-site in the event of an accident.

There must be close co-operation between those responsible for off-site and on-site emergency planning.

The off-site emergency plan and all relevant on-site emergency plans must be consistent and integrated, so that, for example, there is effective co-ordination, problems with overlapping responsibilities and complicated interfaces are resolved, and it is clear who has the responsibility for various emergency response functions in the event of an accident involving hazardous substances which may have off-site effects.

To form a basis for both off-site and on-site emergency planning, the management of a hazardous installation should identify and assess the full range of accidents, including low-probability, high-consequence accidents, which could arise at the installation. This information should be available in the safety reports, where such reports have been prepared.

Public authorities should give particular attention to ensuring that all hazardous installations, including small and medium-sized enterprises and commercial users of hazardous substances, undertake this assessment and the appropriate emergency planning. Specific assistance should be obtained, where necessary, to ensure that such enterprises and users fulfil their responsibilities in emergency planning.

Emergency planning should take into account potential complicating factors which could be associated with major accidents at hazardous installations such as extreme weather conditions, natural disasters, loss of power or water supplies, etc., as well as factors which may make response more difficult, such as problems with communication and transportation systems.

During the emergency planning process, there should be a realistic assessment of the capabilities and resources of those who will be involved in emergency response, and the skills and resources required. This assessment will provide insight into what additional skills and resources are needed.

- The planning process should also provide a learning experience concerning, for example, the potential for accident hazards based on: an analysis of a range of accident scenarios; possible implications of such accidents; response needs and capabilities; and the roles and responsibilities of those involved with emergency response.
- Those who will be involved in emergency response should be involved in the planning process.

Emergency plans should provide the necessary guidance to allow for flexible response to a range of possible circumstances. An emergency plan cannot provide prescriptive instructions for response, since accidents by their nature will be different and will often involve a combination of aspects which may not have been considered during the planning process.

Back-up systems should be built into emergency plans. For example, alternative communication lines should be available, relief shifts for key personnel should be assigned, and an alternative command centre should be designated in the event that the primary centre cannot function properly.

All responsible parties should ensure that manpower, equipment (including communication equipment and personal protective equipment), and financial and other resources necessary to carry out emergency plans are readily available for immediate activation in the event, or imminent threat, of an accident. Where necessary, expensive or specialised equipment should be obtained through joint co-operation at a regional level.

Provisions should be made for mutual assistance, in the event of an accident, among neighbouring hazardous installations and public authorities.

Public authorities responsible for emergency response, including fire and rescue services, should familiarise themselves in advance of any emergency with the relevant information concerning a hazardous installation including the chemical and physical properties and the location of hazardous substances, as well as the location of water and foam supply points and other fire-fighting equipment at the hazardous installation.

- On-site managers should ensure that appropriate employees are familiar with the capabilities and response plans of the fire authorities and other emergency responders.
- As part of the emergency planning process, emergency responders together with management should consider response options to various accident scenarios and should agree on appropriate options on a case-by-case basis.

All personnel involved in the emergency response process should be educated and trained on a continuing basis to ensure that a state of readiness for varying contingencies is maintained. Education and training programmes should be tested, assessed and revised regularly, as appropriate.

Exercises should be carried out on a regular basis to test both on-site and off-site emergency plans and their compatibility.

- The use of independent observers facilitates an objective review of any deficiencies or defects in the plans.
- Exercises can test separately different components of a plan and can include simulations through, for example, desktop computer exercises.
- Exercises should also be undertaken in adverse conditions (for example, outside normal working hours, during inclement weather, etc.) which stress the systems and, therefore, reveal the range of limitations and problems inherent in the systems.
- The emergency plans should be revised as appropriate following evaluation of the exercises.

On-site and off-site emergency plans should be reviewed regularly and maintained up-to-date taking into account, for example, changes at hazardous installations and in the residential and commercial developments in the area, improvements in response technology and capabilities, and lessons learned in exercises and tests.

- The recording of the actions and decisions taken during an accident should be required so that the plans can be evaluated and lessons can be learned.
- Following an accident, emergency preparedness plans should be reviewed in light of experience gained and, where appropriate, changes made.

Systems should be in place for the rapid detection of an accident or imminent threat of an accident, and for the immediate notification of emergency response personnel. The channel of communication should flow as directly as possible from the individual discovering the abnormal occurrence to the emergency responders.

Public authorities should consider whether to undertake emergency planning for hazardous installations and emergency planning for natural disasters and civil defence in an integrated way, since these activities involve most of the same requirements.

Public authorities and management should consider what requirements might be needed to avoid pollution of nearby water sources, both surface and underground, in the event of an accident at hazardous installations.

The "Polluter-Pays Principle" with respect to emergency preparedness, as well as to emergency response, related to accidents involving hazardous substances should be applied, as appropriate, in accordance with OECD Council Recommendation C(89)88 (Final).

Multinational and regional co-operative activities should be undertaken by public authorities in order to improve emergency preparedness planning and ensure appropriate co-ordination of emergency response in the event of an accident.

3.2 On-site emergency preparedness plans

All hazardous installations should have an adequate on-site emergency plan which is appropriate for that installation and is based on a complete range of credible accident scenarios.

- The preparation and implementation of this plan should be the responsibility of management, financed by the enterprise.
- These plans should be subject to review by public authorities.

An on-site emergency plan should contain a scale plan of the site together with a list of all hazardous substances handled, indicating the quantities involved and their locations on the site relative to the surrounding area and population. The plan should also contain an evaluation of the hazards involved and include information regarding each hazardous substance, and the conditions under which the hazardous substance is processed, handled and stored.

Emergency plans should provide for the orderly and phased shutdown of an installation when necessary.

Information and equipment for generating data, which may be needed in the event of an accident, should be readily available. This would include, for example, analytical methods and equipment for detecting hazardous substances and the protective measures to be taken in the event of loss of containment of a hazardous substance. Models should be prepared for the most likely accident scenarios and their possible effects in order to facilitate rapid response.

In establishing the responsibilities for various employees in the event of an accident, the on-site emergency plan should take account of such matters as absences due to sickness, holidays and periods of installation shutdown, and should be flexible so as to be applicable to all foreseeable variations in staffing.

On-site emergency plans, in identifying the roles and responsibilities of all parties concerned, should clearly indicate:

- the chain of command and co-ordination among the parties
- lines of communication
- the means of obtaining necessary information.

- As part of the emergency plan, individuals should be nominated for the following roles, among others:
  - a site incident controller to take control on scene in the event of an emergency
  - a site main controller to take overall control of an emergency from the emergency control centre

- The role of these controllers in relation to community emergency response personnel should be clearly spelled out in order to avoid any potential conflicts.

All employees and contractors at a hazardous installation should be made fully aware of the relevant provisions of the on-site emergency plan. In particular, they should be made aware of what to do in the event of an emergency such as taking action to limit the release of hazardous substances and/or evacuating the installation and gathering at a previously designated assembly point.

Visitors to a hazardous installation should be provided with relevant information concerning what they should do in the event of an emergency.

All employees should be informed of the procedures for raising the alarm in the event of an accident or threat of an accident to ensure that earliest possible action is taken to control an incident.

The organisation of activities related to emergency preparedness and those related to prevention of industrial accidents should be integrated with the normal operation of a hazardous installation, in order that the organisational structures for these activities are compatible.

3.3 Off-site emergency preparedness plans

Public authorities should ensure that there is an adequate off-site emergency plan wherever there is a hazardous installation. Such a plan should:

- set out its objectives
- provide relevant information on the hazardous installations and surrounding areas
- evaluate the hazards (including transport hazards) which may result in emergency situations in the community
- establish the procedures to be followed, and identify the officials responsible, in the event of an accident

Public authorities at various levels have responsibilities related to the off-site emergency planning.

- Central authorities should establish the general principles concerning such planning, provide advice and assistance, where appropriate, to local authorities and ensure that officials at all levels are motivated to develop appropriate emergency preparedness and response capabilities before an accident occurs.
- Public authorities at the local level should ensure that off-site emergency plans are developed, consistent with the general principles.
- The responsibility for the actual development and implementation of the off-site emergency plan may rest with local officials or with a designated committee, depending on the laws and policies which are applicable in the locality, and may include involvement by regional or national authorities. It should be clear, however, who has the decision-making responsibility for the development and implementation of the plan.

Management of a hazardous installation should provide, without reservation, information it has which is necessary to assess hazards and to develop the off-site emergency plan to those responsible for preparation of the off-site plan.

In addition to information concerning the installation, management should co-operate with public authorities in the routing and identification of pipelines which carry hazardous substances outside the boundary fence of the hazardous installation across public land to another part of the site.

Highly technical and specialised information in emergency plans should be presented in a form appropriate for emergency responders. Technical details on a specific chemical should be expressed in terms which provide clear guidance as, for example, in the case of an acute exposure to a high dose.

In the development of an off-site emergency plan, all emergency response participants should be identified. In addition, their roles, resources and capabilities should be realistically established and their commitment and participation obtained. These participants should include, among others:

- police, fire, medical (including hospitals), transport and welfare services
- emergency management or civil defence agencies
- public works and utilities
- the management of the hazardous installations
- public information/communication outlets; and public health and environmental agencies

Emergency preparedness plans, in identifying the roles and responsibilities of all the parties concerned, should clearly indicate the chain of command and co-ordination among the parties, the lines of communication and the means of obtaining the necessary technical, meteorological and medical information.

The plan should identify an emergency co-ordination officer with the necessary authority to mobilise and co-ordinate the emergency services.

Emergency planning must take into account the special situation of local institutions which may have particularly vulnerable populations such as schools, hospitals and homes for the elderly.

The emergency plan should provide guidance on when the potentially affected public should shelter indoors and when they should be evacuated.

The public should be given, on a continuing basis, specific information on the appropriate behaviour and safety measures they should adopt in the event of an accident involving hazardous substances.

The predictable reactions of the public should be taken into consideration when developing emergency response instructions. For example, the reactions of the public to stressful, unanticipated events are often determined by instincts rather than as a consequence of training and information and, therefore, parents will instinctively want to collect their children from school even if this will put them and their children at a greater risk of harm.

Procedures should exist for public input in the development of off-site plans.

For cases in which an accident at a hazardous installation may have effects in neighbouring communities, emergency planning and response should be co-ordinated among the potentially affected communities. Where an accident may have trans-frontier effects, emergency planning and response should be carried out in co-operation with neighbouring countries. Careful planning is necessary to overcome differences between response systems and administrative cultures in the countries concerned.

3.4 Community awareness

Public authorities should ensure, through the legal and procedural means they deem appropriate, that the potentially affected public:

- is provided with general information on the nature, extent and potential off-site effects on human health and/or the environment, including property, of possible major accidents at planned or existing hazardous installations

- is provided with specific and timely information on the appropriate behaviour and safety measures they should adopt in the event of an accident involving hazardous substances
- has access to other available information needed to understand the nature of the possible effects of an accident (such as information on hazardous substances capable of causing serious off-site damage) and to be able to contribute effectively, as appropriate, to decisions concerning hazardous installations and the development of community emergency preparedness plans

The activities of public authorities and industry related to communication with the public should be co-ordinated to optimise the value of the communication and to build up trust and credibility.

Information concerning the potential adverse effects of hazardous installations should be shared openly and actively and should be comprehensive, correct, credible, clear and consistent.

- ➠ Care should be taken not to underestimate the ability of the public to deal with information concerning hazardous installations, and not to be condescending in providing information to the public.
- ➠ Public authorities should ensure that essential information is provided, and should not omit information out of a concern that it might generate fear or inquiries.
- ➠ The public should be made aware of the information and documents available to them related to hazardous installations, and where these can be examined.
- ➠ Highly technical documents should include meaningful and comprehensive summaries in language which is generally understandable.
- ➠ Public authorities should not infer a lack of interest on the part of the public if the public rarely consults such documents.

Public authorities should take steps to provide the public with information which will allow them to understand, and develop confidence in, the regulatory system's ability to ensure that hazardous installations are operating safely. Such communications should be two-way, providing an opportunity for public input to the authorities as well as providing information to the public from authorities. This will allow the public, public authorities and other interested parties to learn from each other.

Certain information concerning hazardous installations, for instance that related to emergency response, should be provided actively, without request, to members of the public potentially affected in the event of an accident. In defining the targeted audience for such information, natural community groupings or boundaries should be used to avoid disseminating different information among members of the same community.

The members of the public potentially affected by a major accident should be carefully delineated, and the information should be targeted so that all potentially affected people have adequate and appropriate information presented in an easily understandable manner.

The information should permit all relevant individuals to understand their responsibilities (for example, teachers require special information and training in view of their responsibilities in the event of an accident and to assure parents that their children will be safeguarded).

In order to avoid confusion and facilitate information exchange, the mechanisms for obtaining and delivering information should be as clear as possible and use, to the extent possible, known and existing channels.

Information concerning hazardous installations which is provided to the potentially affected public should be provided in timely fashion, be reissued periodically, as appropriate, and updated as necessary.

The responsibility for communicating information concerning hazardous installations should be assigned to persons who have the necessary knowledge and skills, are viewed as knowledgeable and credible, strengthen confidence, and enjoy respect in the community.

Individuals responsible for communication of information related to hazardous installations should be specifically trained to understand how to develop information for target audiences and how to deliver information effectively, particularly in an emergency.

The effectiveness of communication with the public should be assessed to ensure that the information is understood and retained, in order that the appropriate actions are taken during an emergency. Consideration of the public's reaction to information concerning hazardous installations and accidents should be part of the testing and feedback stage of the communication process.

Mechanisms should be established to facilitate consultation with the public concerning the type of information it would like to receive and the information which should be made available regarding hazardous installations.

- Public authorities should initiate discussions with interested parties on the acceptability/tolerability of risks so that the public becomes familiar with risk concepts and is better able to participate in the decision-making processes. Public authorities should consider the possibility of creating community groups for this purpose.
- Industry can help promote this education process by maintaining close relations with the local population, community leaders and groups, education facilities, etc.
- Non-governmental organisations may play a role in increasing public awareness by providing information concerning hazards and the need for safe practices, procedures and equipment.

Communication of information by industry to the public on plant safety, safety industry measures and the characteristics of substances should not be unduly hampered by reference to "trade secrets". As a general rule, multinational enterprises should not claim trade secret protection in one country for types of information they release in another country.

An effective internal communication system within a hazardous installation is a prerequisite for industry to achieve effective communication with the public. In addition, employees from hazardous installations can play an important role in communications with the public since they have a working knowledge of the installation and a strong incentive to ensure its continuing safe operation in order to protect themselves and their families.

As the media are a primary channel of information to the general public, media representatives should be involved in the development and implementation of the communication process. Industry and public authorities should provide representatives of the media with background information, in order that the media can be more effective in providing information to the public.

3.5 Communications

Emergency warning alert systems should be available to warn the potentially affected public that an accident has occurred or that there is an imminent threat of an accident.

- The system chosen can vary depending on local culture and conditions providing that it is effective and timely. Suitable warning systems could include, for example, sirens, automatic telephone messages, mobile public address systems or a combination of systems.

- The potentially affected public should be notified of the systems which will be used in an emergency, and the systems should be tested in advance so that their significance is fully understood by the public and the public knows how to respond appropriately in an emergency.
- In order to increase public understanding of warning systems, new approaches – such as public education through schools and greater use of audio-visual materials – should be explored.

Designated spokespeople for emergency situations should be carefully chosen in order that they have the necessary knowledge, skills, authority and credibility to effectively communicate with the public.

- They should be specifically selected and trained to understand how to develop information for target audiences and deliver information effectively.
- Since effective communication with the public during an emergency requires the co-ordinated involvement of a number of relevant parties – including, for example, local response officials, corporate spokespeople, employee representatives, community representatives, public authorities, technical experts and the media – the duties of these parties should be established during the preparation of emergency plans.

The media should be involved during the development of emergency plans and should be given information concerning the emergency plans in order that they have the necessary background to be an effective and reliable source of information should an accident occur.

Public health authorities should establish their own health sector plans at national, regional and local level as part of the overall emergency preparedness plans.

- Each country should establish an information centre capable of providing relevant information in an emergency on the diagnosis, treatment and rehabilitation of persons injured by chemicals.
- This information should be available on a 24-hour-a-day basis throughout the year.

Public health authorities, including experts from the information centre, should be involved in national and local emergency planning related to accidents involving hazardous substances.

- They should take part in exercises with the other relevant authorities involved in emergency response, in order to test emergency plans and train emergency response medical staff.
- They should be consulted when issuing statements to the media concerning health aspects of chemical accidents.

As part of emergency planning, it should be ensured that adequate medical facilities are available including transportation facilities, which may mean in an emergency the rapid transformation of facilities normally used for other purposes.

- The availability should also be ensured of up-to-date antidotes and other pharmaceutical substances, including oxygen, necessary for the treatment of persons injured by chemicals.
- Where suitable antidotes exist for treatment of persons injured by chemicals produced or used by industry, the industry should be required to ensure their availability locally if this is a problem for the health authorities. Necessary relevant emergency medicines, kept updated, should be available at installations handling toxic chemicals.

- Decontamination equipment for on-site and hospital use and, as appropriate, protective equipment for the medical emergency response personnel should also be available.

Public health and education authorities should ensure the basic training of all medical and paramedical professions, as appropriate, in the principles of medical toxicology and emergency medicine. Specialist courses should be provided for those involved in emergency response work.

Industry should be encouraged to provide to the appropriate information centres adequate data for emergency medical response and follow-up, including information on the composition and the lexicological and other relevant properties of chemical products which they produce, use, store, dispose of, or transport. Arrangements should be made to guarantee the confidentiality of data where appropriate.

The health authorities and the relevant sectors of industry should encourage research into new antidotes and decontamination procedures for toxic chemicals.

3.6 Emergency equipment, medicines and antidotes

The types of emergency equipment needed to meet specific types of emergencies should be determined, and this equipment (for example, specially designated emergency response vehicles) obtained. All emergency equipment should be in working order, highly reliable, effective, and available when an emergency occurs.

The best storage areas for emergency equipment should also be determined. The value of storing such equipment near the sites of possible emergencies should be assessed, with consideration given to ease of accessibility and protection from unauthorised use. Periodic checks need to be carried out on the equipment's adequate functioning.

As part of emergency preparedness planning, it should be ensured that adequate medical facilities are available, including transportation facilities. In an emergency, this may mean the rapid transformation of facilities normally used for other purposes.

Where suitable antidotes exist to chemicals produced by industry, industry should be required to ensure the availability locally of the antidotes if obtaining them is a problem for the health authorities. Essential emergency medicines, kept up-to-date, should be available at or near installations handling toxic chemicals for use by authorized health professionals. Emergency medical facilities, medical centres or hospitals in proximity to such installations – or, if necessary, poisons information centres in the region – should also stock appropriate emergency medicines, antidotes and equipment to deal with the consequences of a major chemical accident (see Annex 1).

For a limited number of poisonings (for example, by cyanides, organophosphates) and under certain circumstances (long distances to treatment facilities, limited means of transport) it is desirable to be able to begin antidote treatment at the accident site. Vital supportive treatment should always be started as soon as possible.

3.7 Education and training

Management should take all reasonable measures to ensure that all those employed at a hazardous installation, including temporary employees and contractors, receive appropriate education and training and are competent in the fulfilment of their tasks under both normal and abnormal conditions. This education and training should cover:

- hazard identification and necessary corrective measures
- basic emergency procedures

- correct materials handling procedures
- any special hazards unique to their job

➠ Arrangements should be made to ensure that the specialised training needs at all levels are properly identified, form part of a programme aimed at improving safety, and are appropriately satisfied.

➠ Employees, and their representatives where they exist, should be involved in the development of education and training programmes, the testing of these programmes, and their subsequent revisions.

➠ This approach to education and training should create the high level of awareness necessary not only to prevent accidents but also to respond to abnormal occurrences quickly and effectively. Ignorance or inadequate information can be a cause of incorrect action.

Safety considerations should be part of the initial induction training given to all new employees to create safety consciousness and commitment.

➠ In addition to the education and training given before taking up normal duties, follow-up education and training should be given regularly.

➠ During slower work periods, consideration should be given to using employees' free time for education and training activities.

Training should be well-structured to give all employees the skills they need to do the job to which they have been assigned, and be sufficiently broad-based so that employees understand the working of the plant, equipment and processes.

➠ All employees should be encouraged and trained to think through their assigned tasks and how they can be carried out most safely, rather than just carrying them out mechanically.

➠ Employees are likely to be more conscientious in their work, and in the application of safety systems and procedures, if their training makes it clear not only what they are required to do but also why the various systems and procedures are necessary.

Consideration should be given to training employees in groups rather than individually, where appropriate, since group training can be an effective way of instilling good safety attitudes in employees, developing positive group behaviour, and establishing increased ability for group members to predict potential safety problems and to develop solutions.

Where appropriate, education and training should be available in languages other than the primary language used at the installation, for example where there are foreign employees or where the installation is located in a multilingual area. Where employees speak different languages, management should consider the need to establish a language as the one used in the event of an emergency, and then to provide the appropriate education and training so all employees can understand and respond correctly to commands during an emergency.

Records should be kept, and maintained up-to-date, of all safety-related education and training of employees including managers, supervisors, technicians and Safety Representatives.

The effectiveness of safety education and training should be regularly assessed to ensure that all employees could carry out the duties for which they are responsible in a safe manner. This assessment process is particularly important in times of change, such as when employees, including managers and supervisors, are being assigned to a new or different installation.

Education and training programmes should be modified to reflect changes in processes used, technology applied, and procedures followed at an installation.

Training should be considered part of employees' jobs for purposes of calculating working time and wages.

The management of hazardous installations should take all reasonable measures to inform on-site employees and contractors of the hazards to which they may be exposed related to accidents involving hazardous substances. Adequate information on hazards (including emergency exposure levels) and on the procedures to be followed for safe handling of all substances used at the installation, manufactured as intermediates, or available for sale, should be obtained, kept up-to-date and disseminated widely, in a language(s) which all employees can understand.

Technological information and assistance related to safety of hazardous substances should be provided by management of hazardous installations to contractors, distributors, transporters and users as well as to employees.

Managers and supervisors should be made aware that they have a special obligation to keep informed about safety standards and risks. They should know and fully understand the properties and behaviour of the hazardous substances being used and the limitations of the equipment and technology. They should be competent to implement the measures to be taken in an emergency.

Every supervisor should ensure that those on his or her team know how to carry out safely the tasks entrusted to them and how to maintain a high level of safety awareness. To achieve this, each supervisor should receive training in communication techniques, safety leadership, accident investigation and reporting procedures, safety and health analyses, and the conduct of safety meetings.

Safety training should be included in the education of engineers and other technical specialists at both universities and schools. To this end, the safety aspects of the design and operation of hazardous installations should be integrated into the relevant curricula. Industry and public authorities should promote this.

4. Emergency response

The onset of an emergency creates a need for time-sensitive actions to save lives and property, as well as for action to begin stabilising the situation so that the jurisdiction can regroup. Such response actions include notifying emergency management personnel of the crisis, warning and evacuating or sheltering the population if possible, keeping the population informed, rescuing individuals and providing medical treatment, maintaining the rule of law, assessing damage, addressing mitigation issues that arise from response activities, and even requesting help from outside the jurisdiction.

4.1 General principles

Management of hazardous installations should promptly notify emergency response authorities of all incidents involving hazardous substances which result, or threaten to result, in potential harm to human health or the environment.

In an emergency response, health/medical personnel and facilities should be part of the overall response team and of the information chain, in order to provide and receive information, as appropriate.

The following types of information should be collated, disseminated and updated regularly:

- the nature of the incident
- the hazardous substances involved
- the potential severity of the incident
- the incident's potential off-site effects
- risk possibilities at the accident site
- personal protection needs of emergency responders
- first aid possibilities and limitations
- the quantity and type of the hazardous substance(s) involved
- treatment facilities available for emergency response
  - means (ambulances, helicopters, etc.) of transporting victims from the site to treatment facilities
  - medical information related to symptomology, delayed effects, specific treatments required, and decontamination
  - resources that are available or that can be obtained rapidly (for example, pharmaceutical supplies, decontamination and hospital facilities, additional medical staff, biological monitoring services, laboratory facilities, and information sources)
  - the registration and triage system being used
- identification of the hazardous substance(s) involved or, if this information is unavailable, of the category of substance(s) involved, together with information on the likely symptoms of those exposed and the best treatment approach
- the expected number and type of patients, the nature of their injuries, and the severity of exposure

The notification from the hazardous installation should trigger the implementation of the off-site emergency response plan, beginning with an initial assessment of the situation leading to a decision on which response actions are required.

In the case of the release of a toxic substance, the decision on whether the potentially affected public should shelter indoors or be evacuated should be taken by the responsible person designated in the emergency preparedness plan. The decision made should be based on likely exposure and possible health effects.

Triage for victims of accidents involving hazardous substances should follow the rules that apply generally in emergency situations.

The on-site co-ordinator should decide on immediate actions to take, including those intended to avoid or limit the exposure of individuals to hazardous substances, based on preliminary information concerning the site, the nature of the release, the hazardous substance(s) involved, and any related analysis of such information. Health/medical personnel should provide assistance, upon request, in arriving at such decisions.

- Such immediate actions might include ensuring that shelters for the potentially affected public are in place, or that those persons most at risk are evacuated.

  Sheltering should be considered when the population would be placed at increased risk if evacuated during the initial phases of the release or threatened release. Decisions concerning sheltering in place should be based on consideration of the substance released; anticipated concentration; toxicity of the substance; duration of the release; release conditions; shelter ventilation; the population to be sheltered; environmental monitoring capabilities; warning time; communication systems; availability of transportation; and citizen training.

- Appropriate monitoring equipment should be available in order to assist decision-making concerning evacuation and sheltering, as well as on whether the population can freely return to affected areas. If such equipment is unavailable, a risk assessment based on toxicological information should be undertaken.
- It should be taken into account that, after a plume passes, the concentration of hazardous substances in the shelter can be higher than the concentration outside. In such a case, the population should be instructed to vacate the shelter if the risk of further release of hazardous substances is minimal.

The first responders to an accident should have sufficient information, training and experience to be able to assess quickly whether they can deal with the situation, or whether additional equipment and/or persons with particular expertise should be summoned. Mechanisms should be in place for the first responders to obtain whatever additional personnel and equipment are needed for responding to the accident.

- Systems should be available to allow immediate, on-the-spot access to the information necessary to assess and respond to an emergency and, in particular, information regarding:
  - all hazardous substances in the installation
  - how to deal with these substances and their effects
  - as appropriate, related transport activities
- Systems should be in place for obtaining assistance, as needed, from emergency responders in neighbouring or other appropriate communities.

The on-site co-ordinator should take measures to avoid the contamination of rescue workers if there is a possibility of continuing exposure.

- In this regard, the on-site co-ordinator should determine whether there is a contaminated area that should be entered only by personnel wearing protective clothing. This decision may need to be made in co-operation with a medical co-ordinator or industrial hygienist, if available.
- It should also be determined at an early stage whether there is a need for decontamination facilities at the accident site or at hospitals and other treatment facilities.
- Consideration should also be given to whether there is a danger that response personnel will be contaminated by exposure to accident victims.

Handover of responsibility from management to public authorities, in the case of accidents with potential off-site effects, should be based on criteria contained in the emergency plan. These criteria should make it clear at what stage the handover should take place, and to whom.

Arrangements should be made for the provision of first aid and other medical treatment outside the contaminated area. In principle, medical personnel should not enter contaminated areas. They should work at casualty assembly points where accident victims are brought after decontamination. Only exceptionally should medical personnel need to enter the accident area, for example to carry out triage or give life-saving treatment.

- If medical personnel are needed to assist in the contaminated area, or during decontamination procedures (either near the accident site or at a treatment facility), they should, when indicated, wear protective equipment.
- As a rule, medical personnel treating victims in contaminated areas should be guided by rescue personnel who have been trained to work in such areas.

Where the safety of the first emergency responders is at risk, or where other difficulties exist in responding effectively, specialists should be called in to assist with such matters as:

- identification of the hazardous substances involved
- evaluation of the hazard
- need for protective equipment
- control and containment of the hazardous substances
- decontamination and emergency termination activities

Such specialists should be able to provide fast, reliable information under stressful conditions so that it can be understood and immediately acted upon by emergency services personnel.

➠ Supporting vital functions should have priority over decontamination.

➠ Triage should be a continuous process, with each victim being re-evaluated at regular intervals where possible, taking into account changes in the victims' conditions and the available resources.

➠ Since children are generally more sensitive to hazardous substances than adults, they should normally be given higher priority for medical care.

➠ It should be recognised that exposed persons with no obvious symptoms may have delayed symptoms and, if so, will require observation, possible immediate treatment, and transport to treatment facilities.

Hospitals and other treatment facilities should put their emergency plans into effect as soon as they are alerted that there is a possibility of patients arriving as a consequence of an accident involving hazardous substances.

Hospitals and other treatment facilities that may be involved in responding to an accident should be provided, as soon as possible, with information on the hazardous substance(s) involved, the type of accident (spill, fire, etc.), the likely number of victims, and the nature of their injuries.

➠ This information should be used to make an early determination of possible human health effects, as well as of the most appropriate therapy or care.

➠ Protocols for treatment should be available and in most cases should be followed, particularly if accident victims are taken to a number of separate treatment facilities (recognising, however, that some flexibility is necessary to account for individual sensitivities to hazardous substances).

The systems used for communicating with the public in an emergency to provide initial and continuing information should be well-known and readily accessible and understood.

The media should have ready and continuous access to designated officials with relevant information, as well as to other sources, in order to provide essential and accurate information to the public throughout the emergency and to help avoid confusion. Efforts should be made to check the clarity of the information as it becomes available, before it is communicated to the public.

Official spokespeople should be as open as possible in providing information during an emergency. In this regard they should, for example, admit when information is not available, avoid making promises which cannot be fulfilled, be the first to give bad news, and ensure that the messages provided are consistent with actions taken.

Public authorities should ensure that systems are in place to provide information to the public following the accident and the immediate emergency response.

- Such information should cover the off-site effects of the accident, the risks of further adverse off-site effects, and related follow-up information.
- Counselling services should be made available for victims of the accident as well as victim's family, friends and fellow employees.

During the transition between emergency response/rescue operations and clean-up activities, all those involved should co-operate and exchange information in order to maintain safety and protect and/or restore the environment.

4.2 Treatment of victims

Initial care should be administered at the accident site in order to give the injured the treatment necessary to ensure that they are in stable condition before being taken to a main treatment facility, if necessary.

- The most critical action is to remove the individual from further exposure to the hazardous substance(s). Physiological (clinical) and psychological effects may then be addressed.
- In addition to general first aid measures, it may be necessary to begin other treatment at the accident site. In a few cases, specific antidotes may be required. For this reason, special equipment and pharmaceutical supplies should be readily available at the site, as appropriate.
- Treatment of the injured should normally follow standard principles for the management of casualties, recognising the need to take account of the special conditions following the accident.
- It should be noted that the majority of those exposed to hazardous substances require only supportive therapy until their symptoms abate.

For the appropriate treatment of exposed victims, emergency medical professionals should have access to specialised information and should be able to consult with a variety of specialists (for example, toxicologists, internists, lung and respiratory specialists, ophthalmologists, haematologists, and occupational health physicians).

- Preparedness planning should provide for access to information concerning, inter alia, likely symptomology, availability of appropriate biomarkers (or other exposure or effect monitoring procedures), and specific emergency medical procedures.
- In addition, provision should be made for obtaining specialised consultations and toxicological information that may be required during patients' care including, as appropriate, assistance from information sources, academic institutions and chemical manufacturers, as well as access to specialists should any long-term health effects be anticipated.

Decisions concerning the decontamination of exposed persons should include consideration of the type and severity of their injuries, the nature of the contaminants, and whether decontamination may interfere with vital medical treatment.

- Adequate provisions for decontamination of patients should be available and defined in the emergency plans.
- Appropriate decontamination facilities should be available for use at the accident site, and at designated hospitals and other treatment facilities to which contaminated patients might be admitted.
- If decontamination cannot be performed, every effort should be made to reduce the possibility of secondary contamination of the emergency services and treatment facilities.

- Off-site emergency medical personnel should be alerted to potential contamination and to specific decontamination procedures.

Following an accident, there should be psychological support at an early stage.

Specifically, health/medical professionals with psychiatric, psychological or psychosocial training should be available in a timely manner.

- The role of these health care workers, among others, should be to:
  - provide emotional support to victims, relatives and friends of victims, and response personnel
  - collaborate closely with information services
  - assist in screening for potential mental health problems in groups involved with the accident (including response personnel, workers at the installation, and the affected public)
  - assist in establishing a follow-up network to identify and treat those with psychological reactions such as stress

- The planning process should take into account the role of other care-givers (including, for example, clergy and funeral directors) in helping a community address the psychological impacts of an accident. Their role is likely to be particularly important in communities which do not have access to an adequate number of psychologists or psychiatrists.

Appropriate follow-up procedures should be put into place for monitoring and observation of persons seemingly unaffected by exposure to hazardous substances.

- Following exposure to certain hazardous chemicals, individuals may not immediately manifest symptoms of exposure. However, they still may be affected by sub-acute exposures and so should be placed under observation for one or more days in case of delayed health effects. Plans should make provision for setting up suitable observation units in, for example, hotels or schools.
- Samples should be taken as soon as possible from everyone who was exposed, or may have been exposed, to the hazardous substance(s), for both treatment and follow-up.
- All reasonable efforts should be made to determine the level of exposure and detect latent symptoms. These efforts should include the following:
  - **air and environmental monitoring** should be carried out to assess potential exposure (through inhalation, skin or eye absorption, water or food ingestion) to the ambient chemical concentration at the time of exposure. Sometimes, if not frequently, measurements of the ambient chemical concentration are not possible due to the amount of time which has elapsed
  - **biological monitoring** may still be undertaken. This type of monitoring is used to assess overall exposure to chemicals that may have been present, through the measurement of appropriate determinants in biological specimens (urine, exhaled breath, blood) collected within a specified time frame
  - If competent public health experts at the scene still have reason to suspect exposure, the acute and sub-acute symptoms of overexposure to the chemicals in question should be identified and the individuals **placed under observation** for a suitable period

When the release of a hazardous substance results in death, personnel handling the remains (pathologists, morticians, medical and legal examiners, volunteers, etc.) should be suitably protected. If decontamination has not already taken place, the body should be

decontaminated in a properly ventilated and protected area prior to transportation, release or disposal (including burial).

4.3 Decontamination

Decontamination must be conducted in an organised, stepwise manner. If certain pieces of the protective equipment are removed prior to the elimination of potential problems by decontamination, the worker may suffer damage due to inhalation or skin contact with contaminants. It is therefore important that persons doing the decontamination work know the proper procedures and the order in which to perform them to insure that such potential personal injuries do not occur. It is also important that site workers avoid contaminating themselves until after they have been cleared to exit the contamination reduction zone.

Decontamination procedures will generate a quantity of hazardous waste (for example, contaminated solvents, disposable equipment, etc.) called investigation derived waste - IDW.

4.3.1 Level A decontamination procedures

Level A operations pose a possibility of hazardous exposure to decontamination workers. Due to the nature of Level A work, personnel in the exclusion zone are likely to have contacted high concentrations of hazardous materials which remain on their protective equipment. Therefore, decontamination workers are required to perform their duties in Level B protection. Following are the Level A decontamination procedures:

- Immediately upon leaving the exclusion zone, site workers will place all sampling equipment at a designated area provided at the first station. The area will be covered with disposable plastic. Site workers will then proceed to the first decontamination washtub where their suit, boots, and outer gloves will be thoroughly scrubbed with the appropriate cleaning solution (usually alkaline soap and water). Long handle brushes will be provided for use by the decontamination workers. Decontamination workers should avoid touching the site workers until after they have cleared the rinse station.
- Site workers' boots and outer gloves will usually be the most contaminated items. Therefore, this step of the decontamination procedure will be accomplished by using soap and water from the washtub/bucket and a brush which is stored in the tub/bucket. In this step, only the boots and gloves of the site worker will be scrubbed. The site workers' suits will be scrubbed using a cleaning solution from a pump sprayer and a brush which is not allowed to contact the more contaminated contents of the washtub/bucket.
- After clearance from the decontamination personnel, the site worker will proceed to the rinse water washtub/bucket. At this location, the decontamination personnel will scrub the site workers' boots and outer gloves with water from the washtub/bucket using a long handle brush. The site workers' suits will be rinsed with water from a pump sprayer, scrubbed with a brush which has not been allowed to contact the contaminated water in the washtub/bucket, and finally rinsed a second time with water from a pump sprayer.
- Once cleared by the decontamination personnel, the site worker will exit the rinse tub/bucket area and proceed to a location where the outer gloves and boot covers (if used) will be removed and discarded. Having been decontaminated, the site worker will exit the contamination reduction corridor and enter the support zone. The support zone will be located a distance of at least 25 feet upwind of the last station in the contamination reduction corridor.
- Once in the support zone, the site workers may receive a fresh cylinder of air, new outer gloves, and new boot covers and return through the contamination reduc-

tion corridor to the exclusion zone. If there is to be no immediate return to the exclusion zone, site workers will proceed to the last station. At this location, site workers will remove their boots first, and then remove the suit. Following this, self-contained breathing apparatus (SCBA) and cool vests (if used) will be removed. Each site worker will then clean their SCBA masks with a soap and water rinse, followed by cleaning the inside of the mask with an alcohol wipe. Finally, the site workers will remove their inner glove systems which will be discarded.

- Decontamination personnel for Level A operations will themselves require decontamination prior to entering the support zone. Decontamination personnel will perform decontamination on each other. A decontamination line separate from the Level A decontamination line will be set up for this purpose. Procedures used on this decontamination line will be those given for Level B decontamination. Under no circumstances will decontamination personnel attempt to perform personal decontamination in the Level A decontamination line.

4.3.2 Level B decontamination procedures

Level B operations pose a limited risk of exposure to decontamination personnel. Level B site workers often exit the exclusion zone with moderate levels of contamination on their outer gloves and boots. To a lesser extent, contamination may be present on their splash suits. To protect against exposure to this contamination, decontamination workers will perform their functions in Level C protection.

- Upon exiting the exclusion zone, site workers will place all equipment in a designated area provided at the first station. The area will be covered with disposable plastic. Following the equipment drop, site workers will proceed to the first decontamination washtub/bucket area where their boots and outer gloves will be thoroughly scrubbed with the appropriate cleaning solution (usually alkaline soap and water). Long handle brushes will be provided for use by the decontamination workers. While at the first decontamination washtub/bucket area, decontamination workers will not attempt to scrub the site workers' suits above chest height. This procedure is to prevent the cleaning solution carrying contaminants from splashing into the open facial area of the impermeable suit. When scrubbing the impermeable suit and SCBA equipment below chest level, decontamination workers will apply water from a pump sprayer and use long handle brushes which have not come into contact with the water in the washtub/bucket. Following this step, decontamination workers will clean areas of the impermeable suit and SCBA above chest level as necessary with paper towels wetted with the cleaning solution from the pump sprayers. Immediately following this step, the decontamination workers will discard their outer gloves and don clean ones. Areas above chest level of the site workers will then be rinsed with clean water from a pump sprayer.
- Once cleared from the first decontamination washtub/bucket area, site workers will then step into the rinse water washtub/bucket. At this location, decontamination workers will thoroughly scrub the site workers' boots and gloves with water from the washtub/bucket using a long handle brush. The site worker will then be rinsed with water from a pump sprayer. Following this, the decontamination workers will thoroughly scrub site workers (below chest level only) with a long handle brush which is not allowed to contact the contaminated water in the washtub/bucket. Site workers will be rinsed a second time with water from a pump sprayer.
- Once cleared by decontamination personnel, site workers will exit the rinse tub/bucket and proceed to a location where the outer gloves and boot covers (if used) will be removed and discarded. Having been decontaminated, site workers

will exit the contamination reduction corridor and enter the support zone. The support zone will be located a distance of at least 25 feet upwind of the last station in the contamination reduction corridor.

- Once in the support zone, site workers may receive a fresh cylinder of air, new outer gloves and boot covers then return through the contamination reduction corridor to the exclusion zone. If there is to be no immediate return to the exclusion zone, the site workers will proceed to the last station. At this location, site workers will remove their boots first, and then remove their SCBA. Following this, the impermeable suit and cool vest (if worn) will be removed. Each site worker will then clean their SCBA mask with a soap solution and water rinse, followed by cleaning the inside of the mask with an alcohol wipe. Finally, the site workers will remove their inner gloves and discard them.
- Decontamination personnel for Level B operations will require a minimal amount of decontamination before exiting the contamination reduction zone. This decontamination will consist of a boot rinse in the rinse water washtub/bucket (not the decontamination cleaning solution washtub/bucket), followed by removing the outer gloves and discarding them. If decontamination personnel wear boot covers, the boot rinse can be eliminated and the covers can simply be removed and discarded. Decontamination workers can then enter the support zone where new respirator cartridges, outer gloves, and boot covers can be obtained for return to the contamination reduction corridor. If no immediate return to the corridor is anticipated, decontamination workers can remove their respirators and clean them in a soap wash and water rinse, followed by cleaning the inside of the mask with an alcohol wipe. Their inner gloves will then be removed and discarded.

4.3.3 Level C decontamination procedures

Level C operations do not pose a significant risk of exposure to decontamination workers. Therefore, Level D protection is all that is required to be worn when performing decontamination functions.

- Upon exiting the exclusion zone, site workers will place their equipment in a designated area provided at the first decontamination station. The area will be covered with disposable plastic. Following this, they will proceed to a decontamination cleaning solution washtub/bucket area where decontamination personnel will scrub their boots with a long handle brush. Once cleared from the cleaning solution washtub/bucket area, the site worker will step into a water rinse washtub/bucket. Upon leaving the water rinse tub/bucket, site workers will remove their outer gloves and boot covers (if used) and discard them.
- Site workers are then clear to enter the support zone where they may obtain new respirator cartridges, outer gloves, and boot covers for return to the exclusion zone. If an immediate return is not anticipated, site workers may remove their respirators. Respirators will be washed in soap solution and rinsed in water. Following this, the inside of the respirators will be cleaned with an alcohol wipe. Finally, site workers will remove and discard their inner gloves.
- Decontamination personnel may exit the contamination reduction corridor without having to conduct any decontamination upon themselves other than to remove and discard their gloves.

4.4 Personal protection of those responding to chemical accidents

4.4.1 Personal protective equipment

In the case of accidents such as explosions or fires, personal protective equipment may have to be used to afford full protection to personnel responding to them. In all situations, protective clothing should be leak-proof and made of chemical-resistant material(s) that combine the greatest degree of comfort with the maximum level of protection.

Two categories of protective clothing exist:

- chemical protective clothing (CPC)
- respiratory protective equipment (RPE)

CPCs include garments, gloves, boots, coveralls with head gear, and fully encapsulating suits. These are available in three categories: 1) light duty (for exposure to dilute acids and alkalis), 2) medium duty (adequate for most chemicals), and 3) heavy duty (for exposure to extremely hazardous and corrosive chemicals). It should be remembered that chemicals may penetrate suits over a period of time, and that subsequent exposures to different chemicals may lead to reactions within the material of the suit, diminishing its effectiveness. Consideration should be given to providing single-use (disposable) suits, in order to avoid the risks of using suits previously contaminated.

There is also a range of RPEs, to be used in toxic or oxygen-deficient environments. This equipment can be divided into two types: 1) emergency escape units, which can be used for short periods to allow escape from toxic atmospheres; and 2) self-contained breathing apparatus (SCBA), which gives a longer period of protection to individuals either entering or escaping from dangerous or toxic situations.

Contaminated protective clothing should always be washed, or hosed down, before the user or rescue worker takes it off. This will ensure a longer service life, and prevent contamination of the next person who uses it.

All protective equipment should be:

- stored in a manner that prevents it from being damaged by an accident
- easily accessible
- regularly inspected and maintained, with replacement as necessary

Appropriate selection of protective clothing is critical, and therefore should be undertaken by qualified personnel such as an industrial hygienist or safety officer. Where this is not possible, advice should be sought from the fire service, poisons information centre or chemical emergency centre. Personnel designated to use protective equipment should be well trained in how to use it correctly. This training should be reinforced by being included in regular disaster simulation exercises.

4.4.2 Protection of rescue workers and medical personnel

In responding to chemical accidents, there may be a danger that rescue personnel will be exposed to toxic chemicals. For this reason, protective equipment needs to be available for use. Personnel from rescue (fire) services should be familiar with different types of protective equipment, and should use it as required (for example, to work in a contaminated area or to rescue victims).

Medical personnel should, in principle, never enter a contaminated area. They should only work at casualty assembly points, to which the injured are brought after decontamination. Only exceptionally should medical personnel need to enter the accident area, for example

to carry out triage or give life-saving treatment. They may need to assist in decontamination procedures, but in that case they should be properly equipped, for example with a gas mask in case there is a change in wind direction that would expose them to a toxic chemical. Rubber gloves, a protective suit, rubber boots and other protective equipment should also be available.

As a rule, medical personnel should be guided by rescue personnel who have been trained to work in such an environment. When indicated, they should wear protective equipment all the time they are working under adverse or toxic conditions. They may also need protective equipment at hospitals or other treatment facilities, especially during decontamination of victims.

4.5 Communication with the public

Efforts should be made by public authorities and industry to improve public awareness of chemical hazards in the community and of how to respond in the event of an accident (for example, how to understand procedures related to possible evacuations and sheltering in place).

- Information given to the public should emphasize avoiding exposure to, or any type of contact with, hazardous substances.
- Members of the health/medical professions should be prepared to contribute to the provision of information to the community (including public health advisories).

All members of the response community, including members of the health/medical professions, should co-ordinate with the media in order to ensure that any health-related information disseminated in regard to accidents involving hazardous substances is accurate and consistent.

- Public health authorities should participate in the preparation of statements issued to the media concerning health aspects of such accidents.
- Relations with the media in this regard should be addressed in the emergency plan, and should be tested.

Should an accident occur, the public should be given, on a continuing basis, specific information on the appropriate behaviour and safety measures to adopt.

- There should be regular reports on developments, even if the situation has not changed measurably.
- It is critical for industry and public authority officials to be truthful and straightforward in the provision of information to the public, and to admit when information does not exist or is unavailable.
- To the extent possible, information should come from a “credible” source, recognising that differences will exist among communities concerning who should be the focal point for provision of information to the public.

5. Accident relief

5.1 General principles

Persons who may have been exposed to toxic chemicals during an accident, whether they appear to be affected or not, should be examined and properly registered to allow for short- and long-term follow-up.

- It should be recognised that, following exposure, the onset of symptoms may be delayed for hours or days and that early examination will assist health/medical personnel to diagnose and treat any symptoms as they arise.
- Biological samples of those directly exposed or likely to have been exposed should be taken as soon as possible after exposure and, where appropriate, at regular intervals even if these persons do not have any symptoms. It is advisable to store some of the collected samples for future investigations.
- It may be necessary to seek out, in various ways, individuals likely to have been exposed in order to ensure adequate observation and, where necessary, appropriate medical treatment.
- The follow-up of those exposed to hazardous substances is very important for medical reasons, as well as in order to increase toxicological knowledge, since for many chemicals little or no information is available regarding short- and long-term human health effects of acute exposure.
- Epidemiological studies should be undertaken during the follow-up to a chemical accident, if appropriate, and should consist of: 1) design and maintenance of surveillance programmes for exposed populations; 2) determination of the incidence, pattern and severity of health effects linked to specific exposures; 3) assessment of dose-response and dose-effect relationships; 4) revision of contingency plans; and, 5) provision of reference information for the management of similar future incidents.
- There should be an accurate record of follow-up activities, including notes of interviews and the identification of subsequent health (including psychological) effects. This record should be kept for future reference and should be available for public inspection.

Efficient reporting and investigation of all significant incidents should be undertaken by industry and public authorities, as they can provide an important contribution to the safe operation of hazardous installations. Incident reporting and investigation can also help to strengthen public confidence that proper actions will be taken to avoid similar incidents, or incidents with similar consequences, in the future.

- Reporting and investigation should identify causes of incidents and lead to remedial action to correct any deficiencies in technology or procedures which led to the incident.
- All interested parties should encourage, and management should promote, the full reporting and critical examination of accidents and near-misses.

5.2 Reporting

All fatalities, regardless of cause, all significant incidents, and other “reportable” events as determined within the enterprise, should be immediately reported by local management to the appropriate members of management of the enterprise.

Reportable events should include those which occur in conjunction with work by contractors.

Employees and contractors should be positively encouraged by their management to report all incidents to appropriate managers in the enterprise so that the causes can be established.

- Employees should be given the appropriate training in hazard identification to facilitate this.
- Employees should also be encouraged to discuss near-misses among themselves immediately after they happen.
- Efforts should be made to foster an environment where reporting incidents and discussing them are considered to be positive activities.
- Employees should be given the assurance that there will be no adverse repercussions for reporting incidents to management or discussing incidents among themselves.

Public authorities should require prompt notification to an appropriate authority of the key elements of major accidents involving hazardous substances. This notification should be followed up by formal written reports.

- Public authorities should encourage the voluntary reporting by enterprises to public authorities of accidents and significant near-misses beyond that legally required.
- Similar information on incidents should be provided to relevant trade associations.

Mechanisms to foster the open and frank exchange of information related to accidents and near-misses, both within an enterprise and among enterprises, should be further developed and encouraged. There is an obvious need to capture and share such information widely throughout industry, so that enterprises can team from the experience of others.

In addition to the sharing of information within industry, means should be developed to involve public authorities in this information sharing without jeopardizing the enterprises' interests.

Public authorities and industry should promote further efforts to improve the international exchange of information on significant accidents and near-misses in order to promote safety.

Efforts should be made to co-ordinate reporting by industry at the national and international level, in order to facilitate information sharing.

Public authorities should also establish a structured national system for maintaining statistics on accidents involving hazardous substances. This will facilitate: 1) exchange of information; 2) analyses of this information; and 3) dissemination of the results of the analyses.

5.3 Investigation

The local management of an installation should be responsible for ensuring the prompt investigation and thorough analysis of all incidents.

- The emphasis should be on identifying the underlying causes, the lessons to be learned, and ways to prevent future accidents rather than identifying the person(s) responsible.
- The use of a computer database for storing the key elements of incidents can facilitate their analysis. By this means, particular trends can be highlighted and historical data can be used proactively in accident prevention, for example by orienting safety training towards the avoidance of the type of incidents which have occurred.

Public authorities should independently investigate all major accidents.

- Where appropriate, this investigation should be conducted by a group of experts (for example, a specially designated commission) which includes different individuals than those responsible for inspection of installations and enforcement of the control framework.
- All appropriate interested parties should have an opportunity to be involved in this investigation.

In all accident investigations, efforts should be made to determine the underlying cause(s) in a chain of events leading to an accident, and not to limit the investigation to determining the apparent cause(s).

Where "human error" is involved, the cause should not simply be so recorded. Rather, investigators should determine exactly what elements contributed to any human error. Such elements could include boredom, stress, overwork, lack of training, inadequate procedures, poor ergonomic design, poor system/technology design, communication problems, management inadequacies, inappropriate safety goals, and similar factors.

Public authorities should publish accident investigation information for as wide dissemination as possible. This should include sufficient information to enable it to be useful in other situations, as well as any conclusions arising from the analysis of accident data.

Public authorities are in a unique position to correlate information, foster exchange of information, and provide credible analyses. Such information is important in order to gain knowledge useful for public authorities and management in their role in evaluating and making decisions related to, for example, regulation, monitoring, preparation of emergency plans, and development of risk assessment and management techniques.

As part of accident investigations, victims should be interviewed as soon as possible after the accident.

Management should support active participation by employees and others in accident investigations.

Professionals trained in evaluating human behaviour should be included as part of the team investigating the causes of an accident (in particular, to consider the "human factor"). They may be able to provide insights which could help avoid future accidents.

6. Conclusion

This training course provides the main information on emergency prevention, preparedness, response and relief in the case of chemical or radiological accident. The main goal is to refresh basic knowledge on nature and the sources of chemical risk as well as approach to it minimization.

Authority, responsible for emergency management, should take all reasonable measures to ensure that all those employed in emergency management and risk assessment, including temporary employees and contractors, receive appropriate education and training and are competent in the fulfilment of their tasks under both normal and abnormal conditions. This education and training should cover:

- hazard identification and necessary corrective measures
- basic emergency procedures
- correct materials handling procedures
- any special hazards unique to the job

Annex 1: Basic portable facilities, equipment, antidotes and other drugs necessary for emergency treatment of poisoned patients

Basic portable facilities and equipment needed for emergency treatment of poisoned patients

For maintenance of respiratory function	For maintenance of cardio-circulatory functions
• Oxygen supply • Laryngoscopes • Endotracheal tubes • Masks (oxygen) • Suction system (mechanical) • Self-inflatable bag • Tracheostomy set (including tubes) • Mechanical portable ventilator	• Cardiac monitor • Defibrillator • External pacemaker
For symptomatic and specific treatment	**For decontamination**
• Fluids (colloids and crystalloids) • Pharmaceuticals (including antidotes and electrolytes)	• Portable showers • Water supply • Soap and specific washing solutions • Eye-washing equipment (including local anaesthetics)
Other necessary items	
• Bladder catheters • Containers for samples (chemical and biomedical) • Liquid disinfectants • Wound dressing material • Blankets, bed sheets, robe (for patients following decontamination) • Plastic bags (for contaminated clothing and other material) • Protective equipment for emergency personnel	

Antidotes and other drugs that may be needed in the event of a chemical accident

Antidote/drug	Indication
Amyl nitrite (for inhalation) 1	Cyanides, nitriles
Atropine (for injection) 1	Organophosphates, carbamates
Budesonide (for inhalation)* 1,2	Irritant gases
Betamethasone (for injection) 1,2	Irritant gases
Calcium gluconate (topical) 1	Hydrofluoric acid
Calcium salts (for injection) **	Hydrofluoric acid
Cobalt edetate	Cyanides (nitriles)
Copper solution ** 1	Phosphorus white (yellow)
Dimercaprol *	Arsenic, mercury
Dimercaptopropane sulphonate (DMPS) * (for injection) (tablets)	Arsenic, mercury
Dimercaptosuccinic acid (DMSA) * (for injection) (tablets)	Arsenic, mercury
Hydroxocobalamin (for injection) 1	Cyanides, nitriles
4-Dimethylaminophenol (4-DMAP)	Cyanides
Methylthionine (methylene blue) (for injection) *	Nitrites, nitrobenzene (and other methaemoglobin-forming agents)
Obidoxime (for injection) * 1	Organophosphates
Oxygen 1	Carbon monoxide, cyanides, hydrogen sulphide, irritant gases, nitriles
Polyethylene glycol 400 (topical) 1	Phenol
Potassium permanganate + sodium	
Bicarbonate (topical) * 1 Phosphorus, white (yellow)	
Pralidoxime (for injection) * 1	Organophosphates
Salbutamol (for inhalation) * 1	Irritant gases
Sodium nitrite 1	Cyanides, nitriles
Sodium thiosulphate (for injection) 1	Cyanides, nitriles
Terbutaline sulphate (for inhalation) * 1	Irritant gases
Tetracaine hydrochloride (eye drops) * 1	For eye irrigation
Toluidine blue (for injection) *	Nitrites, dinitrobenzene (and other methaemoglobin-forming agents)
Xanthine derivatives	Irritant gases

The choice and availability of antidotes may vary from country to country

* Can be replaced by an equivalent substance or preparation

** Excluding calcium chloride

1 Use may be required at the accident site

2 These indications for the use of corticosteroids remain controversial

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