Health and Safety Authority
Guidance Document
Safety Report Assessment

S.I.74 European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, 2006.

Preface

This document has been produced in order to provide internal guidance on the assessment of Safety Reports and is designed to be used in conjunction with Safety Report Assessment Proforma, Rev.04, July 05, and within the overall framework of the Health and Safety Authority's approach to this topic.

The guidance attempts to cover the full range of establishments potentially producing Safety Reports, and professional judgement will be required in applying it to any particular establishment – at the beginning of the assessment a view on the "proportionality", in relation to the major accidents presented, will need to be taken.

In line with current Health and Safety Authority practice, these documents are subject to regular review.

HEALTH AND SAFETY AUTHORITY

Descriptive Elements

General

1.1 Are sufficient details provided to allow communication with the competent authority?

The Safety Report **must** include, as a **minimum**:

- The name of the operator;
- If the operator is a company, the address of the registered office;
- If the operator is a trading partnership, the names and addresses of all trading partners, together with the name and address under which the partnership operates;
- The name and address of the establishment and if necessary the installation covered by the report;
- The name(s), address, telephone & fax number for contact(s) within the operator's organisation for communication about the report.

The Safety Report **may** also include:

- The e-mail address;
- Ordnance survey six-figure map reference(s) defining the location of the establishment;
- Details of whether the operator is part of a larger group of companies.

Dangerous Substances

1.2 Are the maximum quantities of every dangerous substance present, or potentially present on the establishment, identified?

The Safety Report must show that the operator has quantified all the dangerous substances present on the establishment, which are either listed in Schedule 1 Part 2 of the Regulations, or which meet the criteria laid down in Schedule 1 Part 2. All dangerous substances should be included. Where certain dangerous substances have not been included in the inventory, the reason for their omission should be provided, i.e.: 1st Schedule, and the 2% rule for susbtances which cannot act as an initiator. This can only be applied when calculating the total quantities on a site and is not relevant to the qualifying quantities. The maximum inventories calculated should take into account fluctuations in business activity.

The Safety Report must provide evidence that all dangerous substances, which may be anticipated to be present on the establishment (including substances present on road and rail vehicles), have been quantified, including:

- Raw materials, intermediates, finished products, by-products and wastes;
- Substances produced during process excursions, or other unplanned but foreseeable events.
- Substances which change classification in processing

1.3 For each dangerous substance identified, has the Safety Report described its chemical name (including common use chemical name) and CAS number, according to IUPAC nomenclature?

The operator must have named each substance systematically. This applies to impurities or additives, to the extent that they are relevant to a major hazard, and to individual constituents of preparations that are themselves dangerous substances.

The Safety Report must include, for each dangerous substance or class of dangerous substances (including those present as impurities or additives or constituents of preparations): -

- Its chemical names (for example, propane, butane) and where appropriate, its common chemical name (for example, LPG);
- Identification of the substance (for example, chlorine) or class of substances (for example poly chloro-di-benz dioxines), according to the IUPAC system of nomenclature;
- The CAS number for the substance or class of substances;
- The concentration of any impurity or additive and proportion of each constituent in a preparation, to the extent that they are relevant to a major hazard.
- Where substances have been provisionally classified, this must be made clear as should the methodology used (e.g. CPL)

The Safety Report should also provide any additional information useful to help identify the dangerous substance.

1.4 Are the physical and chemical behaviours of each dangerous substance identified, described relevant to both normal operating conditions and foreseeable accident conditions?

Suitable information presented may include, for example; flash points (by an identified method), ignition temperatures, flammable limits, vapour pressure, density, boiling point, data on reactions, rates of decomposition, and data on sensitivity of explosives. Relevant physical and chemical properties should be presented in a clear and concise form using appropriate and consistent units of measurement, preferably following the SI system.

Evidence presented in the Safety Report should be sufficient to describe the behaviour of dangerous substances under all normal operating conditions; process upset conditions and foreseeable accident conditions. The range of conditions considered may include, for example:

- Process operating pressures and temperatures during start-up, regeneration, normal process operation, turndown, or other designed mode;
- Production of products, by-products, residues or intermediates as a result of normal operations or through foreseeable accidental conditions;
- Behaviour of reactor fluids during and following a process upset;
- Behaviour of stored materials under normal operation and following loss of utility (e.g. refrigerated storage, heated storage);

- Contamination of products;
- Following loss of containment;
- Stability of inhibitors over time.

1.5 Are the immediate and delayed harms to man and the environment for each dangerous substance identified?

The information presented must include the physical, chemical or toxicological characteristics of the dangerous substances, which may cause harm, and an indication of the hazards posed. The evidence presented should address both the short and long term effects and may include for example:

- Health hazards such as irritation, asphyxiation, cancer or genetic damage;
- Lethal concentrations;
- Harm caused by fire or explosion;
- Effects on the environment, including building damage, land contamination, the ecosystem and relevant sensitive species.

The evidence presented must not only consider the harmful effects on man and the environment, but must also outline the routes to harm: by airborne discharge, seepage into groundwater, formation of an explosive cloud, or accidental initiation of explosives giving rise to a blast. Characteristics such as bio-accumulation, persistence, dispersal mechanisms and known antagonistic or synergistic effects should also be considered. **The MSDS alone is unlikely to satisfy this criterion**.

The Safety Report should present information concerning the acknowledged acceptable limits of exposure to the effects of dangerous substances. The information presented must consider acceptable limits in terms of concentration or any other relevant parameters.

The Safety Report must provide appropriate references to scientific literature to justify the harmful effects, hazardous concentrations and acceptable limits presented. Where information is not known, the operator should evaluate the significance of that lack of knowledge and describe their policy for dealing with it.

Environment

1.6 Is the environment of the establishment described in sufficient detail to allow the consequences of a major accident to be assessed?

The Safety Report must provide factual information describing the environment surrounding the establishment. The surrounding environment includes the natural environment (and the people in it) over, below and around the boundaries of the establishment. The extent of the area described should take account of hazard ranges of the credible worst case events given in the report.

The information is expected to include a map to a suitable scale (usually at least 1:10,000) showing the establishment and its surroundings. The map should identify the Consultation Distance as established for Land Use Planning purposes. Separate maps may be required to identify the surrounding population and the surrounding natural environment. On such maps the land use pattern (i.e. industry, agriculture, urban settlements, environmentally sensitive locations etc) and the location of the most important buildings and infrastructures (i.e. hospitals, schools, other industrial sites, motorway and railway networks, stations and marshalling yards, airports, harbours etc) must be clearly indicated. Also on the maps, access routes to the establishment should be clearly indicated as

well as the escape routes from the establishment and other traffic routes significant for rescue and emergency operations. It may be necessary to have different scale maps when the operator mentions long distance effects. A map of scale ≥ 1:5,000 is required for notification under Schedule 3(i)

People

The surrounding population must be described. The information should include:

- Approximate numbers of residents
- Estimated numbers of people who may use the area (for example: present at workplaces, present as tourists, or to attend football matches or motorway services); and
- Groups of people who may be particularly vulnerable either on account of their sensitivity to the hazards in question (e.g. schools and hospitals) or because of the population density.

Sufficient information should be included to allow assessment of the indirect impact of a major accident on the public. For example: as a result of contamination of drinking water.

Contribution to a Major Accident

The report should describe features of the surrounding environment that may influence the impact of a major accident. Examples may include:

- The topography if it could have an effect on the dispersion of toxic or flammable gases or combustion products, (this should include valleys and hills, buildings, underground workings or other structures where appropriate);
- Historical local weather records, where possible, including: wind speed; wind direction; atmospheric stability and rainfall. The relevance of this information to the behaviour of releases of dangerous substances should be described;
- A description of the underlying and surrounding geology and hydrogeology if it is appropriate to the consideration of a major accident;
- A description of the surrounding water courses (under various flow conditions), underlying aquifers and any drinking water extraction points should be given in relation to the dispersion of liquid contaminants or leachate from solids deposited on the surrounding land;
- Description of surrounding water and land quality; including details of local ecology;
- Information on sewerage and rainwater systems if they could be involved in the dispersal of liquid contaminants off-site;
- Information on tides and currents that might influence dispersion or accumulation, if marine or estuarine habitats are at risk;
- A description of features of the surroundings that may hinder emergency response or mitigation measures.

The Built Environment

The Safety Report should identify:

- Each listed building and monument;
- Any sections of the infrastructure, such as major transport routes or utilities (e.g. electricity, gas, telephone, water sewers and treatment plant);

that may be vulnerable to the effects of a major accident.

Surrounding Natural Environment

An appropriate description of the surrounding natural environment should be given. This must be sufficiently detailed to allow the significance of the impact of major accidents to be assessed. A detailed description of sensitive parts of the environment should be given. This must include any sites designated to be of special interest by a State Agency or local body.

The significance of these features in either a national or international context must be explained: for example the flora or fauna particularly at risk.

1.7 Is the environment of the establishment described in sufficient detail to allow the contribution of external factors to major accidents at the establishment to be assessed?

Relevance to Initiating Events

The physical environment surrounding the establishment may have an effect on certain initiating events. For example, the underlying geology should be described to allow the consideration of seismic events and subsidence as accident initiators.

Historical Considerations

Land reclamation, previous use, subsidence may be relevant.

The report must consider historical evidence of other external events that might act as accident initiators such as: seismic events; flooding; and extreme weather conditions including: temperature; rain; snow; wind; and lightning.

Other Nearby Activities

The report should identify any other activities in the area surrounding the establishment that might lead to, or exacerbate, a major accident. This information may include, for example:

- Other major hazard installations and pipelines in the area capable of initiating or influencing a major accident;
- Land use under the establishment, including current mining or mineral extraction activities;
- Air traffic movements over and around the establishment, including civilian and military, fixed wing and helicopters;
- Transport activities that may have an impact including shipping, major transport routes and dangerous substance movements;
- Other human activities that might lead to major accidents such as arson, vandalism, theft, and criminal damage
- High voltage overhead electric power distribution lines;
- Radio transmission masts in the area that produce fields that could interfere with safety control systems or communication systems, or initiate electro-explosive devices.
- Forestry Fires

Establishment

1.8 Is an overview of the establishment provided, particularly identifying those parts relevant to major accident hazards?

The Safety Report must give an overview of the establishment, its activities and products. An overview is a general outline, without extensive detail, to set the context for the reader. The overview could include:

- The installations;
- The major accident scenarios;
- The measures for protection and intervention;
- The interrelations between different installations,
- The historical development of activities and production.
- A description of the security arrangements for monitoring access and detecting intruders.

The Safety Report must include scaled plan(s) or map(s) plus descriptions that clearly set out in **overview** the internal geography of the establishment as a whole (suggest a site plan of scale 1:750). The information should include, for example:

- Location of installations with major hazard potential (but no need to describe features of those installations in any depth (e.g. plant, pipework, control rooms, explosive process areas). These **areas should be highlighted on a map.**
- Location of all other installations, including those that do not contain a dangerous substance, with an outline in general terms of what activity occurs there, or what substance is present there;
- Number & locations of people (e.g. in control rooms, office blocks, canteens, security huts), taking into account foreseeable fluctuations which could be due to shift working, maintenance activities, contractors or visitors; these **areas should be highlighted on a map**;
- Location of any activities, which relate to the major accident scenarios given in the report (the activities themselves can be assessed in more depth in section 1.9). Examples include chlorine tanker filling points and on-site emergency control centre;
- Location of any key abatement systems preventing or mitigating major accidents, such as drainage and fire water retention, gas cleaning or liquid treatment works, the extent of paved areas should also be included;
- Location of any key control systems such as computer control systems or isolation systems;
- Location of roads, railways or docks, entrances to the establishment (including those for emergency vehicles only), or any other features relevant to the major accident scenarios in the report, such as flares (or other open sources of ignition);
- Sources of, and key features in, essential utilities, which may be relevant to prevention or mitigation of a major accident and details of any redundancy, diversity and segregation. Examples include: instrument air, steam or electrical networks;
- Matters pertaining to emergency response, such as fire water supply, escape routes and communication systems;
- Systems for monitoring and detecting toxic products in air, water or sewers;
- Systems for fire detection and monitoring potentially explosive atmospheres as well as the

areas with the potentially explosive atmospheres;

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1.9 Are the process(es) being carried out within every installation that could give rise to a major accident, described?

The Safety Report should include descriptions of:

- The purpose of the installation;
- The conditions under which the dangerous substance is normally held;
- What happens to the dangerous substance in terms of physical and chemical changes arising from the designed purpose of the plant;
- What happens to the dangerous substance in terms of physical and chemical changes arising from foreseeable deviations from the designed purpose of the plant;
- The discharge, retention, re-use and recycling or disposal of residues and waste liquids and solids, or the discharge and treatment of waste gases.

A basic Process Flow Diagram (PFD) should be provided for each process.

The Safety Report must clearly identify plant and activities where a major accident could happen. It must:

- Include a plant diagram, which unambiguously identifies key control systems, reaction vessels, storage vessels, pipework systems, valves and significant connections;
- Contain a plan, which unambiguously identifies the location of activities where a major accident could happen (e.g. storage in packages, processing of explosives).

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1.10 Is focused information about each installation provided, in sufficient detail to support the demonstration that major accident hazards will be prevented or the effects mitigated?

The Safety Report must include focused information about all the installations that have major accident potential**.** For each one, there should be a description in enough detail to determine the purpose, location and function of equipment within the installation that has a bearing on major accident prevention and control.

The purpose of the focused information is to provide enough detail to understand the operator's demonstration of safety. Therefore, Safety Reports should provide descriptive information pertinent to the demonstration being made, and at a level of detail for understanding the arguments presented. Has the operator provided enough information to justify their demonstration?

The Safety Report must contain plan(s) or map(s) or diagram(s) plus descriptions that clearly set out detailed information about the installations with major accident potential. In particular, information about items of plant such as:

- Vessels (e.g. location, type, size, pressure, purpose, contents);

- Pipe work systems (e.g. routes, types, size, pressure, purpose);
- Services (e.g. steam, air, electricity, fuel, hot water);
- Drainage (e.g. routes, purpose (e.g. foul water, fire fighting run-off water));
- Stacks, flares and gas cleaners (e.g. location, purpose);
- Safety (or environment) critical valves, instruments, control loops and detection systems;
- Fire fighting and supply arrangements;
- Monitoring equipment, e.g. for toxic products in air, sewers, discharges to water; for fires or explosive atmospheres;
- Zoning and Hazardous Area Classification details.

Safety Reports must also include information about:

- The normal operating parameters of plant;
- The designed maximum working capacities, temperatures, and pressures and maximum explosive inventories;
- Dangerous substance locations, and (at each location) an indication of the chemical and physical state and quantity of the dangerous substance.

Predictive Elements

General Guidance

Risk assessment is a fundamental requirement of the regulations. The risk assessment needs to address risks to people both on and off-site and risks to the environment.

Regardless of whether the approach to risk assessment is quantitative, semi-quantitative, or qualitative, a logical and systematic process needs to be adopted.

It cannot be overstated that the depth of the analysis in the operator's risk assessment should be proportionate to:

- The scale and nature of the major accident hazards presented by the establishment and the installations and activities on it, and
- The risk posed to neighbouring populations and the environment.

A view on 'proportionality' should be taken at the start of the assessment process. For example, a simple site remote from population and sensitive environments with a single dangerous substance of limited hazard may only require a simple qualitative risk assessment to demonstrate that the necessary prevention and mitigation measures are in place. A simple plant with a total inventory of 30te of Chlorine and remote from population and sensitive environments may only need to demonstrate compliance with published guidance / standards for the safe handling of Chlorine, with supporting statements to demonstrate that the risks to people off-site and the environment are sufficiently low. If the qualitative route is taken, the operator still has to demonstrate that all Major Accident Hazards have been identified and that the extent and severity of these have been assessed.

On the other hand, the same chlorine site in a sensitive location and presenting risks which may be tolerable to people and the environment will require a more detailed analysis to demonstrate that the associated risks are sufficiently low. Similarly, complex Pharmachem sites with many processes and several hazardous materials in the vicinity of population and sensitive environments will require a much more detailed assessment and some quantification of the likelihood of hazardous releases and their consequences, and the associated risks. (N.B. All sites will require some quantification of the possible consequences to help develop the emergency plan).

The adequacy of the risk assessment will depend mainly on:

- the degree to which the expertise of those conducting it matches the site-specific circumstances;
- the methods they use;
- the data and assumptions they adopt;
- and the time they invest.

The Safety Report should therefore indicate the competence and expertise of those making the assessment and describe how the risk analysis was done, and how the significance of the risks was assessed.

In evaluating the results of the operator's risk assessment the concept of risk tolerability, is important. Essential considerations are the scope for hazard elimination and the adoption of inherently safer designs and whether good practice has been, or is to be adopted. Where relevant good practice is not yet fully established, they will be expected to apply risk-reducing measures. Operators will need to define the basis for their decisions on *'all necessary measures'* for controlling major accident hazards.

Most decisions on whether risks are sufficiently low are made by exercising professional judgement on whether the risks are reasonable when set subjectively against the cost of further risk reduction. Some companies have adopted this approach and defined their own risk bands. In some cases more stringent risk criteria are set for new plant - typically an order of magnitude lower than the band for existing plant.

This implies that existing control measures should be periodically reviewed to ensure they are properly applied and still appropriate. This will depend on technological progress, changes in society's perception of the particular risks, changes in our understanding of the risk analysis, the uncertainty attached to the risk estimates, and new lessons from accidents and incidents etc. Such reviews should figure prominently in Safety Report updates (see Regulation 13).

Some of the risk analyses required to assess the impact on the natural environment and people may already have been documented for other purposes and it may be possible for the operator to re-use some of this information. It is not necessary to repeat the work but the original documentation must be clearly referenced and, normally, copies of the appropriate parts of it attached to the Safety Report.

If the risk assessment demonstrates that particular dangerous substances present at an establishment are not capable of producing a major accident hazard the operator may apply for a dispensation, to limit information included in the Safety Report, under the European Union harmonised criteria developed for this eventuality (regulation 12(8)).

Approach to Risk Assessment

2.1 Is the Operator's approach to risk assessment described?

The report must include a summary of the methods used for risk analysis and the criteria used to judge the significance of the residual risks when control measures have been implemented. Ways of eliminating hazards should be considered, then reducing event likelihood and mitigating the associated consequences. The Safety Report should indicate the competence and expertise of those making the assessment and describe how the risk analysis was done and how the significance of the risks was assessed.

The basis on which the operator makes decisions on '*all necessary measures*' should be clearly stated.

The summary should make clear how the operator defines what is, and what is not, addressed in the risk assessment. The depth of the analysis should be proportionate to the scale and nature of the hazards, and the associated risks.

The approach of the operator to the review of risk assessments should be stated.

2.2 Have human factors have been taken into account in the risk analysis?

Plant personnel are an important part of safety systems. They may contribute to the initiation of a major accident as a result of human error (see 2.7) it is widely accepted that virtually all major accidents include human factors among the root causes. The role operators play in controlling hazards and risks therefore need to be identified as part of the approach to risk assessment. Equipment and procedures need to be designed to minimise human error (routine unintentional failures, decision-making failures and violation of rules).

Human Factors issues include:

- Is there a systematic method for identification of the potential role of human failure in accident initiation or escalation;
- Is there a structured approach to identifying all safety-critical and key safety-related human tasks;
- Is the reliability of control measures dependant on human action, realistically addressed;
- Is there a suitable process to determine the minimum staffing levels required to deliver the necessary measures under all reasonably foreseeable conditions, including plant upsets;

- Are risks of undue fatigue in key staff taken into account, allowing for overtime, shift patterns etc.

2.3 Are clear criteria described for eliminating possible hazardous events from further consideration?

The justification must be clearly presented and well argued. In general the Ninth Schedule of the Regulations sets out the criteria whereby a dispensation can be sought. For example for toxic gases, consequence assessment may show that any failure resulting in a release smaller than that equivalent to a 10-mm diameter hole does not produce a major accident hazard to current on-site or off-site populations (see schedule 7 for major accident criteria). However, operators may need to take account of smaller releases that could trigger other events leading to event escalation.

The criteria should be applied at an early stage to limit the scope of the predictive aspects of the risk assessment.

The criteria must take account of high frequency as well as high consequence events.

2.4 Is the information used suitable for the risk assessment?

The information required for risk assessment will be diverse and extensive. The detail required is process and location specific.

Example: the likelihood of lightning strikes is not usually a significant issue for LPG facilities but could be the cause of a warehouse fire. On the other hand cold weather is unlikely to pose a threat to a warehouse, but could cause problems for butane tanks. For many situations involving toxic gas releases an assessment of the consequences in two weather stability/wind speed combinations may suffice (i.e. F2/D5), but for warehouse fires it is the likelihood of high wind speeds (i.e. D10-D15) and the resulting consequences that dominates the off-site risk. The weather data used should be appropriate.

To assess the consequences of hazardous events, a range of harm levels to people and the environment need to be considered**,** particularly for emergency planning purposes. This requires the use of appropriate harm criteria. Harm criteria for the effects of toxic, thermal, and overpressure effects are generally available, and **those to be used in the assessment should be set out clearly.**

Hazard Identification and Major Accident Scenarios

2.5 Have all potential major accidents been identified and a suitable subset selected for detailed risk analysis?

A table listing the identified major accidents, their likelihood and consequences is required. The consequences identified should make some estimate of the number of casualties or environmental effects. Describing consequences, as e.g. 'Catastrophic' does not assist in making transparent the reason for selecting one accident over another for detailed analysis. Where a matrix is used to select major accidents, it should be referenced to an appropriate source to demonstrate it's fitness-for-purpose (or a clear justification presented).

Scenarios need to cover events when protection and mitigation (actual or proposed for further risk reduction) measures fail to operate and need to include the worst case on-site and off-site scenarios both for people and the environment.

The hazard identification methods used should be appropriate for the scale and nature of the hazards.

The way the major accidents have been identified should be made transparent. The approach adopted and the expertise of the team involved should be described.

Methods that might be used include:

- HAZOP (Hazard and Operability Studies)
- Safety reviews and studies of the causes of past major accidents and incidents
- Industry standard or bespoke checklists for hazard identification
- FMEA (Failure Mode and Effect Analysis)
- Job safety analysis (e.g. Task Analysis)
- Human error identification methods.

Note that one technique alone may be insufficient to identify human/management errors and procedural/hardware failures. Programmable electronic systems should not be neglected.

Likelihood, or the Conditions Under Which a Major Accident Scenario May Occur

The following criteria deal with the major accident subset chosen by the operator for detailed analysis. It is important that prevention and mitigating measures identified for the subset are explicitly linked back to the full accident set.

2.6 For the subset selected for detailed analysis, are the likelihood and/or conditions examined?

Is an adequate range of major accidents covered? These may be broadly classified as loss-of-containment accidents, and may be categorised as follows:

- Loss of containment accidents due to vessel or pipe work failures, including bund failure & fire engulfment;
- Explosions (batch reactors runaway, tank explosion due to operator error e.g. wrong contents, BLEVES);
- Large fires (Warehouses, pool fires etc) including toxic impacts;
- Events influenced by emergency action or adverse operating conditions etc (e.g. allow fire to burn rather than apply water (i.e. mitigation); dump reactor contents to drain to avoid explosion (i.e. prevention), abnormal discharge to the environment, etc.

All foreseeable causes (initiating events) of the major accident hazard chosen for detailed analysis must be considered. Insights gained from the study of previous accidents and incidents can be a useful starting point. The scope of such studies should consider the causes of accidents in other industries. The operator must present evidence to demonstrate that the event sequences triggering the scenarios are correctly identified and clearly justified.

Where a sequence or combination of events may lead to a major accident, for example an automatic isolation system fails and the operator fails to respond correctly to an alarm, an assessment must be made of the effects of failure of plant and equipment designed to prevent, detect, or mitigate the hazardous conditions. The purpose of the assessment is to decide if, for very hazardous events, the reliability of the automatic system is sufficiently high to render the risks sufficiently low, allowing that the probability of the operative failing to respond is relatively high. Human error should also be addressed as an accident-initiating event in addition to intervention activities e.g. loading wrong reactants into a batch reactor, or wrong operating procedure leading to an abnormal discharge to a watercourse.

All safety critical events must be clearly identified.

The risk analysis should make clear which events are critical from a safety viewpoint. This requires consideration of the likelihood of the various major accidents and the associated consequences.

Operators need to use appropriate methods for assessing the probabilities of each of the listed major accidents.

Implementation of control and protection measures should reduce the risk arising from these events. The failure of the control measures to prevent the hazard from being realised or to mitigate the associated consequences become critical events. The risk analysis must determine whether the residual risks (determined by the reliability of the control measures etc) are sufficiently low or whether more needs to be done.

If potential control measures are rejected the reasons need to be clearly justified.

Domino events / escalation must be considered.

2.7 Are the reliability and response times used realistic?

If qualitative arguments are made they will need to be based on currently accepted good standards for engineering and safe systems of work. The operator's justification may include quality procedures, plant experience, or other acceptable evidence. These could be verified during subsequent inspection.

In a scrnario where an operator has to intervene to close an isolation valve manually, the release duration will be determined by the time taken to intervene successfully. In such cases a release duration of less than 20 minutes will require justification.

The methods used to generate event sequences and estimates of the probabilities of potential major accidents should be appropriate and have been used correctly. Appropriate methods include the use of relevant operational and historical data, fault tree analysis and event tree analysis, or a combination of these. The methods and assumptions used will therefore need to be described. In particular, any failure rate data used for the base events in the fault tree analysis will need clear justification in terms of the site-specific circumstances. It will not be sufficient to adopt data from published sources without justification as to their suitability**,** unless it is shown (e.g. through a sensitivity analysis) that the conclusions of the risk analysis are not sensitive to such data. When the estimates of the likelihood of the safety critical events are sensitive to the data and assumptions used, suitable and sufficient justification will be needed.

The Safety Report must provide adequate justification for event probabilities that are not consistent with historical or relevant generic industry data. The estimates given are to be compared with values commonly used (for example in the Purple Book) and accepted by experienced risk analysts. Here are some other failure frequencies that might be helpful (from HSE) –

Failure of a ROSOV on demand	3×10^{-2} / demand
Failure of an excess flow control valve on demand	1.3×10^{-2}/demand
Failure of an automatic shutoff valve to close	1×10^{-2}/demand
Failure of a level sensor (sticking)	50 per 10^6 hrs
Failure of a flow sensor	40 per 10^6 hrs

Consequence Assessment

2.8 Has suitable and sufficient consequence assessment been carried out?

A Range of severities will need to be considered so that corresponding 'hazard zones' defining the extent of affected areas can be mapped out. For people, the harms considered should include fatality, serious injury and hospitalisation. A range of potential harms to the environment need to be considered. The most recent amendment to the directive states this 'includes maps, images or, as appropriate, equivalent descriptions, showing areas which are liable to be affected by such accidents..'

The accident consequence analysis must be a systematic process. In the case of LPG for example, the following steps would be expected: -

- List the assumptions that will be made about containment failures (size, location).
- Describe the essential features of the model that will be used to calculate the rate of outflow of LPG and the duration of the release.
- List the assumptions used in the assessment.
- Present the results of the assessment to characterise the LPG release.
- Identify the model that will be used to determine the characteristics of the thermal radiation source for scenarios involving immediate ignition (fireball and jet fire and pool fire).
- List the assumptions used to calculate the radiant flux from the burning gas (emissive power, wind speed, etc).
- List the assumptions about the dose received by individuals indoors and outdoors.
- Present the results of individual dose calculations.
- List the assumptions for LPG gas dispersion (flash fire calculation).
- List the assumptions used in the dispersion analysis (stability, wind speed ground roughness).
- Describe the essential features of the model used to calculate the dispersion of release of LPG.
- Present the results of calculations of the dimensions of a flash fire.
- Describe the effect of accidents on local populations and the environment.
- Justify, if excluded, why a VCE will not occur.

In the case of an LPG facility the risk-dominating event will usually (mounded vessels excepted) be whole tank failure followed by immediate ignition, resulting in a fireball. If the cloud resulting from the BLEVE event does not ignite immediately it will drift on the wind. Subsequent ignition may result in a flash fire or vapour cloud explosion. If no ignition sources are encountered before the cloud is diluted below the lower limit of flammability, no serious consequences arise. The possible outcomes following an LPG release are usually developed by Event Tree Analysis.

The worst-case scenarios need to be addressed.

Operators will need to state which models have been used and justify their suitability. When the scale of the hazards is significant, well-validated models should be used throughout the assessment. Models which might be suitable (non exhaustive list) include ALOHA, CAMEO, FRED, RMPComp, SCREEN/T-SCREEN, DEGADIS, SLAB, HGSYSTEM, SAFETI, PHAST, BP CIRRUS, methods specified by CCPS in their publications, methods in the TNO yellow books and software implementing these methods.

Source terms used should be appropriate and to have been used correctly for each relevant major accident hazard (the source term defines the nature, size, and duration of the release).

A range of weather conditions usually needs to be considered for toxic releases (remember that toxic

releases can also result from a fire). A basic set is the F2/D5 pair. For the more significant events it may be necessary to use a larger set (depending on the nature of conclusions being made).

Other consequence assessment models (e.g. BLEVE, Warehouse fire etc) used must be appropriate and need to have been used correctly for each relevant major accident. The models must be named and described, and their suitability justified. Modelling should not be based on excessively optimistic assumptions. (In the case of catastrophic failure of a bulk tank, it is reasonable to assume 50% overtops the bund. In the case of fires, the surface emissive power [SEP] used should be justified – 50-150 kW/m^2 for hydrocarbon fires are usual, and 150-300 kW/m^2 for fireballs. For a Jet Fire 200 kW/m^2 is often used. The TNT equivalent for hydrocarbons should be 0.3 – 0.42 times the vapour mass in the cloud).

Sensitivity tests of the results to the choice of harm criteria or model, or the way it is used, may be needed, particularly when the scale and nature of the hazard and risk is significant**.** In the case of thermal effects, an endpoint not more than $4kW/m^2$ should be used. Other important endpoints are for piloted ignition of wood (14.7 kW/m^2) and spontaneous ignition (25.6 kW/m^2). For toxic gases, fatality, dangerous dose, IDLH, ERPGs 1-3 and AEGL are all suitable for use, but the full spectrum of casualties should also be estimated. Harm criteria for the environment may not be specifically defined and should be assessed on a case by case basis, referencing appropriate standards. Justification for the approach to environmental impact assessment and the data used is needed.

An essential requirement is that the operator's controls meet the relevant environmental quality standards.

The sensitivity of the results to assumptions that are pivotal to the analysis must be tested (e.g. release rate/duration, weather frequency), particularly when the scale and nature of the hazard or risks are significant.

Risk Assessment

2.9 Does the Safety Report demonstrate that the risks are sufficiently low?

The findings and conclusions from the risk analysis must summarise the relationship between the hazards and risks, and demonstrate that the measures adopted to prevent and mitigate major accidents make the risks sufficiently low (or identify measures to reduce this risk to a tolerable level).

The analysis and the comprehensiveness of the presentation of the risk assessment will generally be proportionate to the scale and nature of the site, and should be sufficient for demonstrating that all necessary control measures have been taken. There must be clear links between the conclusions and:

- The analysis of the risks, including hazardous event likelihood and the associated consequences; and
- The measures (technical or procedural) taken to make the risks sufficiently low.

The 'all necessary measures' arguments may be made qualitatively and focus on relevant good practice and sound engineering principles. Several sources of authoritative indications of good practice exist:

i) Legislation

ii) Guidance

iii) Standards produced by Standard-making organisations

iv) Guidance produced by a Technical Body, e.g: IChem E

v) Guidance agreed by an organisation representing a particular sector of industry

vi) Standard good practice adopted by a particular sector of industry.

Should any conflict arise between these sources of good practice the safety report should demonstrate the appropriate source is being used.

If good practice is used as the sole justification of 'all necessary measures', several stringent requirements need to be met. These include:

i) The practice must be relevant to the operator's situation;

ii) Any adopted standard must be up-to-date and relevant; and

iii) Where a standard allows for more than one option for conformity, the chosen option make the risks sufficiently low.

iv) Any adopted standard must be relevant in the context of major accident hazards.

More complex situations may require the presentation of quantitative arguments coupled with cost benefit analysis in order to provide the justification that all measures necessary have been taken. If quantitative arguments are used the methods, assumptions and the criteria adopted for decision-making should be explained. Major accident risks are additional to 'normal' industrial risks. Therefore operators should be challenged on the use of unacceptably optimistic criteria. And remember risks should always be as low as reasonably practicable. For new plant a lower maximum tolerable risk level may be adopted. Operators need to state and justify the benchmark criteria adopted for their environmental impact assessments.

The Safety Report must demonstrate that a systematic and sufficiently comprehensive approach to the identification of risk reduction measures has taken place. It is not in the spirit of risk assessment to use it solely to demonstrate that existing controls or the adoption of current good practice make the risks sufficiently low. Risk assessment is an opportunity to systematically assess the current situation or decide the best option for designing a new facility. It is a chance to take account of technological advance, to seek inherently safer designs, and to take account of improvements in assessment methods and views on good practice etc. Whatever additional measures are identified as being reasonably practicable should be implemented. The justification for rejecting possible risk reduction measures needs to be well argued and supported with evidence (see also the SMS elements).

Explicit links must be made from the detailed risk assessment to the measures in place for all major accidents.

2.10 Are the conclusions drawn from the risk analysis with respect to emergency planning soundly based?

The worst-case scenarios for people and the environment must be considered. The analysis of these should not be overly optimistic or pessimistic as this could have resource implications for the emergency services. The consequence models and assumptions used therefore need to be appropriate for the scale and nature of the hazards. The range of hazardous scenarios considered needs to be representative and suitable for emergency planning purposes. The consequences of catastrophic vessel failure and guillotine fracture of pipework need to be included. The levels of harm considered and the impact criteria/vulnerability models used need to be suitable for predicting the extent of areas where people might be fatally or seriously injured or require hospitalisation. For environmental impact assessment, corresponding levels of harm to the environment should be considered. For releases resulting in environmental damage a range of representative conditions need to be considered e.g. to cover the range of flow rates in watercourses.

MAPP and SMS Elements

General Guidance

The assessment criteria and supplementary guidance given in this section are intended to help generate a consistent approach to assessment in relation to:

- The constitutent elements of a MAPP;
- The elements of a SMS required for implementing the MAPP.

Not all of the assessment criteria will be relevant to every operator and establishment. However the onus is on the operator to demonstrate that the MAPP and SMS are adequate in the context of the major accident hazards at the site.

The safety management system described in the Safety Report should cover the part of the general management system that includes the organizational structure, responsibilities, practices, procedures, processes and resources for determining and implementing the MAPP as outlined in Annex III of the Directive and the 2nd Schedule of S.I. 74.

Schedule 2 of the Regulations describes the elements that should be included in a SMS for implementing the MAPP. The Safety Report should provide an account of the general management arrangements for determining and implementing the MAPP and evidence of the existence of those management risk control systems which are important for preventing major accidents and limiting the consequences for people and the environment.

General Assessment Tests

The purpose of the assessment process in relation to the MAPP and the rest of the SMS is to provide answers to 5 essential questions.

- Does the Safety Report contain a MAPP?
- Does the information in the Safety Report demonstrate that there is a SMS for implementing the MAPP?
- Does the information provided in the Safety Report as a whole demonstrate that the MAPP and the rest of the SMS have been put into effect?
- Does the information demonstrate that all necessary measures have been taken to prevent major accidents and to limit their consequences for people and the environment?
- Has the assessment revealed any serious deficiencies in the measures taken for the prevention and mitigation of major accidents?

The SMS should not be assessed in isolation. The rest of the Safety Report describes a series of outcomes that are themselves determined or influenced by the SMS. These include the technical descriptions and predictive elements. The assessment team's conclusions in relation to these should therefore be taken into account when deciding if the report demonstrates that the MAPP and SMS have been **put into effect.**

It is also important that the individual elements that make up the SMS are not considered in isolation from each other.

The SMS should be assessed as a whole.

MAJOR ACCIDENT PREVENTION POLICY

3.1 Does the MAPP include a commitment to achieve a high standard of protection for people and the environment?

The MAPP should include a statement showing the operator's commitment to achieving high standards of safety for man and the environment as well as an indication that the necessary resources will be made available. It should include reference to compliance with S.I. 74.

3.2 Is it demonstrated that the MAPP sets out the operator's overall aims and principles of action with respect to the control of major accident hazards?

There should be a recognition in the MAPP and/or Safety Report that the nature of the operator's activities gives rise to major accident hazards to employees, contractors, visitors, members of the public and the natural and man-made environment as appropriate and therefore that the operator has a special obligation to employees, neighbours and the environment.

The MAPP / SMS should be referred to in the operator's Safety Statement. This may be confirmed during inspection on site.

The MAPP must include statements explaining the operator's overall aims and principles of action in relation to the control of major accidents. Reference may be made to Regulation 9 of S.I. 74.

3.3 Does the MAPP include a commitment to provide and maintain a management system which addresses the following issues?

a) The roles and responsibilities of personnel involved in the management of major hazards at all levels in the organisation, including contractors where appropriate, and the provision of training to meet identified training needs.

b) Hazards arising from normal and abnormal operation and the assessment of their likelihood and the adoption and implementation of procedures for systematically identifying major accident severity;

c) The adoption and implementation of procedures & instructions for safe operation, including maintenance of plant, processes, equipment and temporary stoppages;

d) The adoption and implementation of procedures for planning modifications to, or the design of new installations, processes or storage facilities;

e) The adoption and implementation of procedures to identify foreseeable emergencies by systematic analysis and to prepare, test and review emergency plans to respond to such emergencies;

f) The adoption and implementation of procedures for the ongoing assessment of compliance with the objectives set out in the MAPP and SMS and the mechanisms for investigation and taking corrective action in case of non-compliance. These procedures should include the operator's system for reporting major accidents and near misses, particularly those involving failure of protective measures, and their investigation and follow up on the basis of lessons learned;

g) The adoption and implementation of procedures for periodic systematic assessment of the MAPP and the effectiveness and suitability of the SMS, including the documented review of performance of the MAPP and SMS and their updating by senior management.

The MAPP must show that the operator has considered all the elements and made convincing commitments to achieving the stated aims.

The MAPP should include aims that are realistic and appropriate for the establishment.

The MAPP must include a commitment to periodic review by senior management.

3.4 Is the MAPP set at a senior level in the operator's organisation?

The current MAPP must be included in the Safety Report.

The written statement of the operator's MAPP should be signed and dated by the most senior manager or managers with the authority for its implementation.

SAFETY MANAGEMENT SYSTEM

3.5 Is it demonstrated that all necessary roles in the management of major hazards have been clearly allocated?

The SMS as described in the Safety Report should reflect the top-down commitment, environmental awareness and safety culture of the operator's organisation. It must then describe how this is translated into the direct responsibilities of personnel involved in the management of major hazards at all levels in the organization.

The Safety Report should include sufficient explanation of how the SMS fits into the overall organisational arrangements.

The Safety Report must include organisational charts, outlining the allocation of roles and responsibilities for **all** aspects of the management of major hazards from company directors, or senior executives, down to operators and maintenance fitters. The SMS must indicate that roles have been allocated to production and technical directors, site managers, operations managers, production personnel, process development managers, design teams, project managers, maintenance managers, personnel managers, training staff, safety professionals, environmental professionals, risk assessors etc. where appropriate.

The operator must be able to provide documented proof that individuals identified have received adequate training to fulfil their roles and responsibilities.

Information to confirm that the control of major accident hazards is a management function;

The Safety Report must identify the key managers and post-holders for each of the following responsibilities:

- Providing resources, including human resources, for developing, implementing and maintaining the SMS;
- Identifying major hazards and assessing associated risks during the life cycle of the installation;
- Ensuring that employees, contractors and others are aware of the major accident hazards and are competent in the systems for controlling them;

- Designing new installations and planning modifications;
- Identifying, recording and following-up corrective and improvement actions;
- Controlling abnormal situations and emergencies;
- Identifying relevant training needs, providing training and evaluating its effectiveness;
- Implementing the key risk control systems necessary for the control of major hazards;
- Coordinating implementation of the SMS and reporting to senior management;
- Monitoring performance and carrying out audits and reviews.

3.6 Does the Safety Report show how the operator has allocated sufficient resources to implement the MAPP?

The Safety Report must include brief explanations of how the overall management of major accident hazard resources, including people, equipment, time and financial, are determined and allocated (including arrangements to be implemented following a major accident).

Reference should be made to the arrangements for filling key posts.

Explanations of systems for identifying absences of key personnel and arranging competent cover should be included. The operator must demonstrate that an adequate level of supervision is maintained and that personnel are competent to carry out their roles.

3.7 Is it demonstrated that the performance of people having a role to play in the management of major accident hazards is measured and that they are held accountable for their performance?

Responsibilities for management of major accident hazards must be made clear to the jobholder e.g. in job descriptions.

The Safety Report should reference any formal personal performance review and appraisal systems, which set objectives relevant to the control of major accident hazards, measure the extent to which objectives are achieved and identify procedures for corrective actions if objectives are not reached.

The Safety Report must show that the operator has in place a system for providing and maintaining appropriate levels of management and employee competence. The Safety Report must show that safety personnel report to an appropriate level.

Reference must be made to the arrangements for identifying the competence and training needs of all those having a role to play in the control of major accident hazards, including their deputies, from directors or senior executives, down to operators and including contractors and their employees. Training assessment should be performed as appropriate to determine effectiveness and refresher training carried out as necessary.

3.8 Has the operator systems for ensuring that employees are actively involved in the control of major accident hazards?

The Safety Report must contain summaries of systems to secure the continued participation, commitment and involvement of employees at all levels. This might include how the workforce is involved in consultative bodies, health, safety and environment committees, safety circles and safety

teams. Descriptions of how the organization encourages and supports employee or safety representatives should be outlined.

Arrangements for upward reporting of information relevant to the control of major hazards must be addressed (e.g. are employees involved in HAZOP or risk assessment studies, accident / near miss investigations, audit and review activities etc.)

3.9 Has the operator arrangements in place for communicating with, co-operating with, and securing the co-operation of other organisations?

The Safety Report must outline the operators arrangements for co-operation and communication with organisations external to the operator who may have key roles to play or may be able to provide information (such as change in legislation, technical standards or information on accidents in similar sites), necessary for the prevention and mitigation of major accidents. These external organisations include neighbouring establishments, contract personnel, emergency services, authorities responsible for preparation and maintenance of external emergency plans, enforcing authorities, employers associations, local authorities or other relevant bodies.

The operator must outline its arrangements for supplying to those people and institutions off-site liable to be affected by a major accident, with the information required under Regulation 18.

The operator should demonstrate it has systems for gathering information from external sources necessary for the control of major accident hazards.

3.10 Has the operator arrangements for communicating information, important for the control of major accident hazards, <u>within</u> the operator's organisation?

The Safety Report must identify arrangements in place for the effective communication of issues relevant to the MAPP within the operator's organisation. The operator must demonstrate how the process of communicating the MAPP statement is performed e.g. The Safety Statement should refer to the MAPP and SMS and the fact that the site is a Seveso site.

The Safety Report should outline what arrangements are in place to demonstrate line managers' commitment to the MAPP through their visible behaviour e.g. participating in safety meetings, accident investigations and participating in active monitoring activities.

Written communication relevant to implementation of the MAPP might include documenting:

roles and responsibilities of relevant personnel, procedures and instructions for safe operations, information on safety performance, safety meetings, shift meeting where employee feedback is obtained.

3.11 Has the operator arrangements for systematically identifying major hazards, assessing the risks arising from normal and abnormal operations and determining necessary control measures?

The Safety Report must describe arrangements in place for systematic identification of major hazards, risk assessment and determination of necessary control measures.

These arrangements should include references to procedures for identifying and evaluating the major accident hazards arising from the operator's activities and from the substances and materials purchased, stored, processed or produced.

Outlines should be included of the operator's arrangements for determining the skills and knowledge required and, where appropriate, the team approach needed to provide the necessary range of theoretical and practical knowledge to implement appropriate hazard identification and risk assessment procedures.

There should be an explanation of the formal hazard identification and risk assessment techniques actually used at each stage of the life cycle of the process plant or storage facility including:

- Selection of the site and the siting of buildings within the establishment;
- Plant and process design and modification, including historical reference to HAZOPs and other methods of risk assessment used at the time the plant/processes were designed. (A guide produced by the IChem E. illustrates best practice within the process and chemical industries, in the area of Hazop study methods.)
- Construction, installation and commissioning;
- Start-up, steady state running and shutdown under normal and abnormal conditions;
- Routine and non routine maintenance;
- Incidents and possible emergencies including those arising from component or materials failure, external events, human factors and failures of the SMS itself;
- Decommissioning, abandonment and disposal.

The Safety Report should reference the techniques used to identify the hazards and assess the risks arising from external factors such as:

- Abnormal temperatures, fire, lightning strike, seismic activity, wind, subsidence and land slip, flood, aircraft and projectile impact;
- Transport, civil engineering and lifting activities;
- Neighbouring activities;
- Malevolent or unauthorised action including trespass.

Descriptions of how the operator's arrangements for risk assessment must take account of human factors including human behaviour and reliability and the potential for human error in relation to safety-critical activities.

3.12 Has the operator systems for determining priorities to achieve the objectives of the MAPP and scheduling necessary improvement work in relation to the control of major accident hazards?

The Safety Report must indicate how priorities are decided i.e. based on considerations of hazard or risk. Explanations of how improvement work relevant to the control of major accident hazards is scheduled, how the work is resourced, co-ordinated, allocated to individuals or teams to carry out and how timescales for completion are set must all be outlined.

3.13 Has the operator adopted and implemented procedures and instructions for safe operation, including maintenance, of plant, processes, equipment and temporary stoppages?

The Safety Report must contain descriptions of the risk control systems, which the operator has in place for controlling the risks, which arise at each stage of the life cycle of the plant, processes or storage facilities in question. These would include the systems for controlling the risks at each of the following stages as appropriate, i.e. an outline of:

- Construction and commissioning of plant, processes, equipment and facilities;
- Operation of plant and processes (including as appropriate, start-up, steady state running, normal shutdown, detection of departures from normal operating conditions and responses to them including emergency shutdown and temporary and special operations);
- Safe operation under maintenance; (e.g. Permit to work, Hot work, Confined space entry);
- Selection and management of contractors;
- Inspection, test and maintenance of plant, equipment and facilities. Identification of safety critical items of equipment;
- Decommissioning of plant, processes, equipment and facilities;
- SOP's - an SOP list of all safety related procedures should be included.

3.14 Has the operator adopted and implemented procedures for planning modifications to, or the design of new installations, processes or storage facilities?

The Safety Report should outline descriptions of the operator's system for planning and controlling all changes in staffing levels, people, plant, processes and process variables, materials, equipment, procedures, software, design and, where appropriate, external circumstances (e.g. fire water, neighbours etc.) which are capable of affecting the control of major accident hazards.

The Safety Report must describe the systems in place for ensuring modifications are adequately assessed, designed, installed and tested. Modifications to a process and its associated equipment, to structures or to operations and procedures, which could affect the safety of the installation, must be subject to a formal modification system. This includes both hardware (e.g. pumps, piping arrangements and structures) and software (e.g. control system software, operating procedures). Decommissioning of facilities should also be addressed in this area.

Systems of management for the control of modifications must be clearly addressed in the SMS part of the report, outlining responsibilities, risk assessment and reduction, construction considerations,

testing and commissioning and documentation.

The operator's management of change system must address permanent (including new plant or process), temporary and urgent changes.

Descriptions of the management of change system must be outlined, as appropriate, including how:

- Decisions about what constitutes a significant change are made;
- Change has been defined;
- Responsibilities for authorising and initiating change have been allocated;
- Proposed changes are identified and documented;
- Safety and environmental implications of proposed changes are identified assessed, and prioritised;
- Safety and environmental control measures deemed necessary as a result of change, including provision of information and training and amendment of procedures are defined, documented and implemented (e.g. P & IDS updated);
- Post-change checks and reviews are carried out and corrective action implemented.

3.15 Has the operator arrangements in place to identify foreseeable emergencies by systematic analysis and to prepare, test and review emergency plans?

The operator must demonstrate he has drawn up on-site emergency plans in order to take all necessary measures to limit the consequences to people and the environment of the foreseeable emergencies that could occur.

The Safety Report must contain descriptions of the operator's procedures for systematically identifying the consequences of any major accidents that could occur

Included must be descriptions of the operator's procedures for preparing, reviewing, testing and keeping up to date emergency plans, at suitable intervals of no longer than three years.

The operator must show he has taken account of likely human behaviour and response under emergency conditions, when developing emergency plans.

3.16 Has the operator adopted and implemented a system for reporting major accidents and near misses, particularly those involving failure of the protective measures for control of major accident hazards?

The Safety Report must outline descriptions of the arrangements, which the operator has in place for reporting accidents, incidents and near misses.

Reference should be made to Schedule 7 and 8 of S.I.74, which sets out the criteria for notifiable accidents and incidents.

3.17 Has the operator adopted and implemented mechanisms for investigation and taking corrective action?

(a) In cases of non compliance with the objectives set by the MAPP and

(b) In relation to major accidents and near misses.

The Safety Report must describe the operators systems for investigation to determine the immediate and underlying causes of failure. The operator must demonstrate that this information is used to determine the necessary corrective actions.

These systems might include descriptions of the arrangements for both active and reactive monitoring. Active monitoring measures might include arrangements for identification, inspection and test of critical plant, premises, equipment, control systems and instrumentation as well as assessment of compliance with training, instructions, safe operating procedures and working practices important for the prevention and mitigation of major accidents.

Reactive monitoring measures include arrangements for accident, near miss and incident reporting and investigation.

These systems should ensure that all circumstances surrounding the failure, including human factors, are considered.

3.18 Has the operator adopted and implemented (a) a procedure for systematic independent assessment of the MAPP and effectiveness and suitability of the SMS and (b) a review process of the MAPP and SMS which uses information from performance measurement and audit?

Audits are needed to ensure that the operator's organisation, processes and procedures as defined and as actually carried out in practice are consistent with the SMS, and that they are effective.

Audits must be carried out by people who are competent and sufficiently independent of the operational management of the unit being audited, to ensure that their assessment is objective.

The Safety Report must contain descriptions of the operator's arrangements for ensuring that the operator's management arrangements, risk control systems and physical controls for the prevention and mitigation of major accidents, are assessed periodically by independent auditors.

The descriptions must include an explanation of the audit system which the operator adopted including the purpose, responsibility, resources, audit plan, procedures for reporting and follow up of the audit.

Review is an essential process for determining if the SMS is appropriate to fulfil the operator's MAPP and the objectives set within it. It may involve considering whether the MAPP and objectives should themselves be modified. Review is necessary for determining required improvements to management systems, physical controls or the MAPP itself.

The Safety Report must contain summaries of the operator's arrangements for carrying out reviews explaining who carries them out, when they are carried out and how they are carried out.

How corrective actions are decided and responsibilities assigned must be addressed. The operator

must show that results of reviews are communicated within the organisation.

Any system of updates to the MAPP or SMS must include a review by senior management.

Technical Elements

General Guidance

The Safety Report is required to demonstrate that adequate safety and reliability have been built into the design, construction, operation and maintenance of the installation. The assessment criteria apply equally to environmental protection and the safety of people.

Some of the criteria have particular relevance for Safety Reports relating to establishments under construction or newly-built and about to come into operation.

Design

4.1 Is it demonstrated that the establishment and the installations have been designed to an appropriate standard?

Have adequate provisions for safety been included in the design of the installation?

The main areas of concern are as follows:

- Containment - Safety Report must demonstrate that the design has taken account of this to minimise the effect on the environment and, in most instances, man.
- Redundancy, Diversity, Separation and Segregation - the Safety Report must detail how these principles have been applied to reduce the risk of common mode failure. It must also identify how the behaviour of failed equipment has been addressed, including events, which may disable protective systems.
- Multiple effects - Internal and external events that can affect an entire site at once, such as power failure, flood etc. have to be considered from the viewpoint of cumulative effects.

The Safety Report must demonstrate that the design of all structures important to safety has been based on sound engineering principles. This includes process and storage vessels, pipework and other items that form the primary containment boundary. All key structural items such as support structures, bund walls, civil foundations, control rooms, buildings or barriers should be designed to withstand the effects of accidental explosions.

The Safety Report must refer to any relevant design codes or standards, which have been used. Sufficient evidence should be provided to show that these design standards and codes are appropriate. A higher burden of proof will be expected where "in-house" company standards have been used as a basis for design; demonstration of equivalency with an internationally recognized standard should form the basis of this proof. In general design codes / standards should have been applied in their entirety and the combining of different standards avoided. Deviations from the principal design used must be highlighted and described in the Safety Report (a gap analysis may sometimes be appropriate).

4.2 Is it demonstrated how safety-related control systems have been designed to ensure safety and reliability?

Any safety-related control system, which is required to prevent or limit the consequences of a major accident, must be designed in accordance with an appropriate code or standard.

The evidence presented should show that the complete system from sensor to final element, including software has been considered. Safe operating limits are determined primarily by the process design and material specification but are also influenced by the age and condition of the plant and equipment. Where a control or alarm system has a role in the defence against excursions beyond safe operating limits, it must be assessed as a safety-related control system.

The Safety Report must show how an appropriate level of safety integrity has been incorporated in the design of these control and protective systems, and how this level of integrity was derived from risk assessment. The report must also demonstrate how this level of integrity was achieved, i.e. Codes and standards, diversity, redundancy etc.

The Safety Report must detail how the following have been identified and accounted for in the design:

- Safe operating limits, set points for safety functions, accuracy of instrumentation.
- Independance and separation from other systems (The report should demonstrate how failure of a component of a safety system cannot affect overall performance).
- Operating conditions, including start up and shut down.
- Environmental conditions including requirement to work in flammable atmospheres.

The Safety Report must identify support systems and back up measures for control and protective systems and provide evidence that these support systems have adequate reliability and safety.

4.3 Is it shown how a hierarchical approach to the selection of measures has been used?

The design stage in an installation's life provides the best opportunity to reduce risk. However, prevention cannot be guaranteed in all circumstances and it is therefore necessary to identify other measures to control and mitigate the consequences of any major accident to reduce risks to as low a level as is reasonably practicable. The principles can also be applied to the design and modification of older plants. Operators should be alert to the possibility of taking advantage of technical advances in their industry to improve safety. The Safety Report should show how these principles have been applied to new (modified) facilities, and what procedures there are for applying these principles to new plants or modifications to existing ones.

The Hierarchy levels are as follows:

- Inherent Safety - Removal / reduction of the hazard at source e.g. substitution of a less hazardous process, use of corrosion resistant materials of construction, fail-safe design principles, appropriate plant layout;
- Prevention Measures - Intended to prevent the initiation of a sequence of events leading to a major accident. They can include management systems, features of the design of the installation, secondary containment. Measures taken to prevent equipment failure or human error;
- Control Measures - Intended to prevent a hazardous event from escalating into a major accident, e.g. Relief valves, safety-related control systems, deluge systems, venting to scrubber systems, manually initiated emergency shutdown procedures;
- Mitigation Measures- Intended to reduce the consequences of a major accident once it has occurred e.g. bunding systems, safety refuges, and fire-fighting facilities.

For existing long-established facilities, the information may not be available to show that these principles have been applied at the design stages.

4.4 Is it demonstrated how the layout of the plant contributes to the minimisation of risk during operations, inspection, testing, maintenance, modification, repair and replacement?

The Safety Report must demonstrate that due attention has been given to ensuring safety in the design

of the layout of the installation. It must show how the layout prevents or reduces the development of major accident scenarios. Examples of this include:

- Adequate ventilation to aid rapid dilution of flammable atmospheres
- Low congestion of structures or lack of obstacles to gas flow to prevent the pressure effects arising from the ignition of a released flammable substance.
- Separation of known ignition sources from large potential inventories.
- Adequate shelter for use during a toxic release, and adequate means of escape.
- Access for emergency services
- Access for inspection, testing, maintenance and repair at all times during the life of the plant.
- Safe positioning of occupied buildings, including control rooms
- Safe positioning of Emergency Control Centre.

Particular regard must be given to minimisation of risk, in relation to on site secondary and domino effects.

4.5 Is it shown that the utilities, that are needed to implement any measure defined in the Safety Report, have suitable reliability, availability and survivability?

The Safety Report must justify the steps that have been taken in design, construction, operation and maintenance, to ensure that the site utilities and facilities will be available when required. These utilities include:

- Water
- Steam
- Air
- Electricity (total or partial loss, and power surge)
- Cooling / Heat Transfer systems
- Emergency Facilities such as fire water
- Inerting Media

The type of justification involved could be as follows:

- The routing of services
- Provision of physical barriers
- Provision of separate independent sources
- Means of managing changed demands for example at start up and shut down; these would include "soft starts" on large drives, restrictions on non-essential usage etc.
- Procedures for ensuring the availability of essential services during maintenance or modifications.

Where there is a person in the system the Safety Report must show that the performance claimed for the system fully takes into account human performance, including reliability, availability and speed of response. The Safety Report must show what measures are in place to ensure adequate performance by human operators, by describing operating procedures, selection procedures, training (including refresher training) and systems for monitoring and auditing. The Safety Report must also show how human factors have been taken into account in the design of equipment and systems i.e. ease of use, detectability of errors, alarm handling systems etc.

The Safety Report must include details of containment control systems designed to manage unplanned

releases including:

- Venting Systems – The Safety Report should justify the design basis for the venting system taking account of foreseeable hazards (including loss of utilities or the effects of fire) and consequences of venting to the environment;
- Isolation Arrangements – The report should describe and justify the emergency (automatic and manual) isolation arrangements to manage a release including consideration of the length of time required for isolation;
- Detection of releases

Where the potential for loss of containment of a significant quantity of hazardous substances can be foreseen, measures to limit the consequences should be taken i.e. bunding, catchment pits etc. The Safety Report must demonstrate the adequacy of design of such measures, taking into account the maximum expected spill.

4.6 Are the materials of construction used in the plant suitable for the application?

The Safety Report must provide evidence of a system to ensure that materials employed in the manufacture and construction of the plant are suitable. Particular attention should be given to the selection of materials used in the primary containment of hazardous substances. Evidence must be provided to show that the materials have been selected with regard to the nature of the environment in which they are being used. The report must specifically address the issues of corrosion/erosion and also the effect of the external environment, such as sea air in coastal areas.

If a design code or standard has been used which includes material selection criteria, any deviations from the materials specified in the code must be justified in the report. Where the material selection is critical to safety, the Safety Report must include a description of the materials selection philosophy.

All foreseeable direct causes of loss of containment accidents must be considered at the design stage, areas for consideration are as follows:

- Corrosion - The Safety Report must identify particular areas where corrosion may occur and the measures taken to prevent and monitor such effects e.g. design codes, construction standards, protective systems such as lining, cathodic protection, and periodic inspection;
- Erosion - Particular areas to be considered are fluid velocity, cavitation, presence of particles / impurities, periodic monitoring and inspection;
- External Loading - Extreme weather, ground seismic activity, failure of supports of nearby vessels, effects of common-bund filling on empty vessels;
- Impact - Consideration to be given to the possible effects of road / rail impact, blast wave implications from neighbouring plant, missiles and projectiles etc;
- Pressure - Details should be provided on how excess pressure will be prevented during foreseeable failures, i.e. failure of overpressure safety systems, external fire, excessive reaction rate, and exothermic reaction;
- Temperature - Precautions in place to protect against the effects of over / under temperature affecting the structural stability of materials should be outlined in the reports. Such precautions might include: separation, water deluge, insulation, heat tracing, firewalls.

4.7 Have the installations been constructed to appropriate standards to prevent major accidents? Is it demonstrated how the construction of all plant and systems is addressed and verified against the appropriate standards to ensure adequate safety?

The Safety Report must describe how the construction was managed to ensure it was built in accordance with the design intent. Evidence should be provided that the work was carried out by suitable personnel in accordance with appropriate procedures. The Safety Report must refer to any relevant construction codes or standards, which have been used. This type of evidence may not be available for existing facilities: in this event the Operator must state the policy of the organisation in relation to "Construction Management" particularly in relation to any work carried out since the original construction phase. The report must outline the current procedures adopted to ensure construction work is carried out in accordance with design intent.

The Safety Report should describe the arrangements used to control and record changes to the original design, made during construction. Evidence should show that the construction of the plant, including deviations from the original design, have been documented to give an assurance of conformity.

The Safety Report must provide evidence that suitable assessment and verification of the construction work has been carried out. The evidence presented should detail the main assessment criteria employed and the stages at which they were undertaken. Suitable evidence might include:

- How the required standard of workmanship was achieved
- Hydraulic pressure testing of containment structures, if this was identified in the report as being safety critical.
- Examination of engineering structures using appropriate non-destructive testing techniques.
- Leak testing
- Mechanisms to ensure conformity of control systems including valves, instruments, software, trips and alarms, and demonstration of the basis of safety for the elements.
- The role and competence of any inspection authority employed.
- Reference to relevant quality control procedures.

Evidence must show that commissioning trials have been conducted to confirm the safety provisions relating to plant design. Evidence must be provided to show that any initial inspections and tests have been documented and that the information is retrievable.

Operation

4.8 Have Operating Procedures been established for all reasonably foreseeable conditions?

The Safety Report must show that safe operating procedures have been established and documented for all foreseeable normal (including start-up and shut-down) and abnormal/unusual operating conditions. The report must detail how reviews of operating procedures are undertaken and recorded to take account of operating experience or changing conditions in the plant. It must also address the procedures in place to control abnormal operations such as overriding of safety devices to allow for maintenance work, running automated systems in a manual mode, emergency shut down of equipment, isolation or part-isolation of manifolded systems, operating single trains of a multi-train process.

Maintenance

4.9 Has an appropriate maintenance regime been established to prevent major accidents or reduce loss of containment in the event of such accidents?

The Safety Report must show that maintenance procedures are sufficiently comprehensive to maintain the plant and equipment in a safe state. The Safety Report must also show that maintenance activities will not compromise the safety of the installation and that the maintenance staff will not be exposed to unacceptable risks.

The organisation of the maintenance activities must be described, including:

- Fault reporting systems;
- Availability and deployment of suitable personnel;
- Scheduling and ranking of maintenance activities, particularly in relation to safety critical activities;
- Auditing for compliance with schedule for safety critical activities and procedures in place in the event of non-compliances;

The Safety Report must identify those items and systems for which maintenance is considered to be a **safety critical activity**. Demonstration of the selection criteria must be given, which may include:

- Arrangements for periodic inspection and calibration of pressure relief devices;
- Monitoring of corrosion;
- Maintenance of utilities systems, where failure may lead directly to a hazardous situation;
- Installed spare equipment or spares in stock;
- Arrangements for proof testing of safety related control systems e.g. sensors, transmitters, alarms, and trips;
- Inspection and maintenance of lightning protection and electrical earthing systems.

The Safety Report must show that the impact of maintenance work on the safety of the installation has been adequately considered, e.g. systems of work, permit systems, isolation systems. This must include auditing arrangements to ensure that the permit to work system is been properly used. It must also address issues such as making safe electrical power supplies, hot work and associated testing for flammable gases. It should also address the issue of vibration attributable to poor piping design, pump location / alignment etc. The Safety Report should explain how this issue is addressed in the plant.

The Safety Report must provide evidence to show that the maintenance organisation has access to competent persons that have the necessary skills, knowledge and degree of independence from the production activity.

In the case of electrical equipment, there must be evidence of examination arrangements for equipment provided for use in hazardous areas. The repair of such equipment should also be addressed.

Wrong Equipment - If the wrong equipment is specified or installed, there is potential for failure. The Safety Report must identify the management controls in place to ensure correct specification, supply and installation of equipment, including spare parts.

Emergency Response Elements

General Guidance

The Safety Report is required to demonstrate that adequate

a) On-site arrangements to respond to a major accident,

b) The interface of these arrangements with the off-site emergency plan, and

c) The resources that can be mobilised by the operator to take mitigatory action to minimise the consequence of a major accident

are in place.

5.1 Is the organisation of the alert and intervention in the event of a major accident described so as to provide evidence that the necessary measures have been taken on-site?

The operator must be able to provide the following information:

- The arrangements for alerting individuals on site, neighbouring establishments (where relevant), downstream water abstractors (where relevant) and the general public to the hazardous situation; the nature of the alarms and the plant conditions required to activate them; and the initial actions required both on-site and off-site in response to alarms/warnings;
- Suitable and sufficient provisions for establishing and maintaining communications during the emergency response;
- The arrangements and conditions for alerting and mobilising:
    - individuals or groups with defined responsibilities under the emergency plans including essential personnel on-site and off-site;
    - the emergency services (including arrangements for briefing the emergency services of the nature of the incident and of any special problems they might face);
    - neighbouring establishments (where mutual aid agreements exist);
    - off-site agencies;
- The nature and location of any installations which may require special protection, or rescue intervention;
- The location of:
    - access routes for emergency services;
    - rescue routes;
    - escape routes;
    - any restricted areas;
- The evacuation arrangements and any transport requirements;
- The roll call and search and rescue arrangements;
- The arrangements for unmanned sites and sites that are not continuously manned, and sites with varying manning levels at different times;
- Consideration of the effects of emergency response actions, including fire fighting activities, in order to minimise the overall impact on people and the environment (for example, due to contaminated firewater). This should include short term and long term effects and alternative options for disposal

or discharge together with the least damage solutions and the circumstances in which they apply;

- Suitable and sufficient provision has been made for monitoring wind speed and direction, and other environmental conditions, in the event of a major accident, where relevant.

5.2 Are the on-site and off-site resources, which can be mobilised by the operator, described?

The description must be referenced to the major hazard scenarios described in the report (taking into account the type and magnitude of the foreseeable consequences) and it must cover both human resources and hardware e.g. fire fighting equipment, the nature and location of:

- emergency control centres (integrity maintained in the event of a major accident or, if not, a reserve facility available);
- medical/first aid centres;
- emergency refuges, sheltering buildings, muster points, pre-defined forward control points, etc. as well as any ancillary equipment which is required to enable the mitigatory action to be carried out e.g. the nature and location of any pollution control devices and materials, personal protective equipment, vehicles to transport equipment to the site of the accident.

It must include:

  - resources located on-site;
  - resources provided by the emergency services;
  - resources located at neighbouring establishments with which mutual aid agreements may exist; resources which can be brought in by the operator from elsewhere;
  - a description of how the on-site response will be complementary to, and co-ordinated with, the role of the off-site emergency services.

The Safety Report must demonstrate that sufficient personnel can be made available within appropriate timescales to carry out the mitigatory actions required by the on-site emergency plans.

The Safety Report must demonstrate that the following factors have been taken into account in the context of the site conditions:

  - The functions of key posts and groups with duties in the emergency response and the arrangements for deputies (including supporting procedures where appropriate): e.g.
  - the posts authorised to set the emergency procedures in motion and the conditions for doing so;
  - the post responsible for the co-ordination of the on-site mitigatory action;
  - the post responsible for liasing with the off-site emergency services;
  - the role of any specialist groups required under the on-site emergency plans e.g. operations staff, emergency engineering/repair teams, riggers, drivers, medical staff, special technical expertise (such as chemists, toxicologists, ecotoxicologists), fire fighters, spillage treatment teams, etc.;

- That the numbers of personnel, with the appropriate expertise and training, required to achieve the necessary level of response have been determined, and that these numbers of staff can be assembled within the necessary response time;
- That the mitigatory actions are achievable in practice, particularly in the early stages of the incident, given the rate at which the accident could escalate;
- Potential incapacity of personnel (e.g. due to sheltering from accident, casualty of the accident,

absence from site, etc), where they have a key role in the emergency plan, and consideration for nomination of deputies as required.

5.3 Are suitable and sufficient arrangements in place to ensure that the equipment to be mobilised for mitigating the consequences of reasonably foreseeable major accidents will be fit for purpose when called upon for use?

The Safety Report must demonstrate that necessary measures have been taken to ensure that the equipment is fit for purpose when called upon for use. The demonstration may be:

- That sufficient quantities of appropriately specified equipment can be made available within the required timescale and the relevant mitigatory action sustained for the necessary length of time;
- That relevant Regulations, Standards and Code of Practice have been followed;
- That the equipment is capable of operating in the ambient conditions, e.g. that it has (where necessary) adequate weather protection, including protection from frost;
- That the equipment is capable of operating in the local environmental conditions expected to be experienced during a major accident;
- That emergency equipment is stored in an appropriate manner and location, that it is accessible at all relevant times, and that it is suitably protected from the consequences of a major accident (e.g. fire/explosion);
- That the possibility of loss of essential services (such as power, water, and communications) and other facilities has been taken into account and alternatives provided where necessary;
- That the emergency equipment provided is compatible where necessary with that of the emergency services and that provided by organisations which with a mutual aid agreement exists (by the provision of adapters where appropriate);
- That electrical equipment used in the emergency response is suitably protected for the foreseeable environmental conditions, so that its use does not introduce additional hazards.

5.4 Is it demonstrated that suitable and sufficient personal protective equipment will be available in the event of a major accident?

The Safety Report must demonstrate that sufficient protective equipment (PPE) is available with specifications appropriate to the range of mitigatory actions required of the response team. There must also be evidence that suitable and sufficient PPE is available for other individuals who may be required to wear it e.g. emergency escape respirators for site personnel in the event of a toxic gas release. The description of the PPE provisions should include (where relevant), but not necessarily be restricted to: respirators, breathing air sets, and protective clothing for radiant heat, water, or specific chemical hazards.

5.5 Is evidence provided that suitable and sufficient on-site fire fighting and fire protection provisions can be mobilised, taking account of resources available from local and other fire brigades?

The Safety Report must demonstrate that the quantity and specifications of the on-site fire fighting provisions that can be mobilised, with due consideration of off-site resources available from local and

other fire brigades, are adequate for the major accident scenarios that are identified elsewhere in the Safety Report. Where circumstances are foreseeable that make the use of fire fighting or other mitigatory measures impracticable or unsafe (for example, it may be unsafe to fight certain fires involving explosives), the arrangements should identify such circumstances and the additional arrangements necessary to limit the consequences of a major accident. The demonstration may include some or all of the following:

- That the fire fighting roles of the on-site personnel (e.g. full time on-site fire brigade, auxiliary fire fighters, other site personnel) during an emergency have been defined and are appropriate;
- That the fire fighting roles of the on-site personnel are complementary to the role of the off-site emergency services;
- That the quantity and specification of on-site fire fighting equipment is sufficient;
- That the water requirements for fire fighting and fire protection (e.g. cooling) have been pre-determined and that the capacity and reliability of the water supply are adequate taking into account the various sources which may be available, and the time required to establish back up supplies;
- That suitable and sufficient portable and mobile fire fighting equipment (such as mobile monitors, mobile pumps, hand/portable extinguishers, foam generation equipment, hoses), and hydrants have been located at appropriate points throughout the installation according to the hazard;
- That suitable and sufficient stocks of foam compound are available when and where necessary;
- That adequate consideration has been given in the design (e.g. the positioning of walls, fire screens), to assist the positioning and protection of fire fighting equipment and personnel, and that the reach of fire protection and extinguishing equipment is appropriate;
- That adequate consideration has been given to flammable substances being carried with fire water and spreading the fire to other areas.

5.6 Is it demonstrated that suitable and sufficient resources can be mobilised to minimise the release of, and mitigate the consequences of, airborne toxic and/or flammable substances?

In the event of a major accident involving a loss of containment of a hazardous substance(s) giving rise to an airborne release, the emergency response by the operator is likely to include actions to terminate or reduce the leak at source. Such actions might include the patching or plugging of leaks in lines and vessels, the closure of valves, and the isolation of sections of plant by blanking off etc. Such actions might be covered by normal operating procedures.

The Safety Report must provide sufficient evidence that consideration has been given to the practicability of carrying out such actions in the foreseeable accident conditions, and to the equipment, tools and PPE that would be required.

The Safety Report should also refer to any provisions to reduce the evolution of toxic or flammable fumes from hazardous material that has already been spilled, and to reduce the effects of fumes from spilled material. Measures to reduce fume production might include the erection of physical barriers (e.g. a foam cover), and surface cooling of the spilled material. Measures to reduce the effect of fumes might include the use of water sprays to absorb soluble fumes and/or to promote dilution by mixing with air.

5.7 Is it demonstrated that suitable and sufficient resources can be mobilised to minimise the consequences of loss of containment of a dangerous substance(s) to ground or water?

The Safety Report must demonstrate that adequate consideration has been given to the possible environmental impact of contaminated firewater on watercourses and groundwater and that necessary measures have been taken to minimise the consequences to people and the environment of leaks of dangerous substances to ground or water. In the context of mobilisable resources, such evidence might include provisions to stop or reduce spillage at source and measures to confine, recover and/or treat the spillage. The Safety Report must describe and justify the strategy to be adopted in the event of a loss of containment and show how this is a suitable approach in terms of protecting people and the environment.

Confinement of the spillage should preferably be achieved where practicable by permanently engineered secondary containment systems fitted with an isolation device. The Safety Report must, however, also identify any mobilisable resources, which may be required. Such resources may include earth moving equipment, sandbags, drain seals, pipe blockers and absorbents for spillages on the ground and in drainage systems, and floating booms for immiscible lighter-than-water products that have entered water. The Safety Report must also describe any provisions for recovering and/or treating spilled material. Such provisions might include mobile pumps, and special chemicals and other materials for neutralising or absorbing the spillage. Resources that can be provided by the operator to assist with the off-site emergency response should also be identified.

The Safety Report must demonstrate that suitable and sufficient provisions for monitoring and/or sampling can be mobilised, identifying the purpose of the sampling/monitoring provision and explain how the results might influence decisions concerning the on-site emergency response. The need for monitoring and/or sampling will depend on factors such as the type of hazardous substance involved, the rate at which it might disperse to safe levels, and the speed at which the results can be obtained. Provisions for sampling/monitoring might include:

- the monitoring of oxygen levels, combustible gases, and airborne toxic substances on-site
- off-site; the taking of samples from air, water and ground and their analysis using portable analytical equipment or laboratories (mobile or static).

The role assigned to carrying out such monitoring and/or sampled needs to be identified.

The Safety Report must also identify any special technical expertise or other provisions required to analyse or interpret the results, as well as those sampling/monitoring measures provided by the operator which could assist the off-site emergency response.

5.8 Is it demonstrated that suitable and sufficient provisions have been made for the restoration and clean up of the environment following a major accident?

Examples may include:

- equipment to contain toxic substances;
- agents to soak up and/or neutralise contaminants;
- earth moving equipment for the removal of contaminated soil and other material;
- booms and skimmers for spillages to water; any temporary storage arrangements e.g. portable storage tanks, for the contaminated material.

Other points to consider include the envisaged timescale over which temporary containment may be required, the arrangements made to ensure that such facilities would not pose an unacceptable threat to health and the environment, and suitable disposal arrangements. The Safety Report must demonstrate that sufficient financial resources are available for the restoration of the environment.

5.9 Is it demonstrated that suitable and sufficient provisions have been made to mobilise first aid/medical treatment during the emergency response?

The Safety Report must demonstrate that suitable consideration has been given to the first aid/medical provisions required in the event of a major accident and show how the on-site provisions dovetail with the provisions in the off-site emergency plan.

5.10 Is it demonstrated that suitable and sufficient provisions have been made to mobilise any ancillary equipment, which may be required during the emergency response?

Ancillary equipment in this context are those miscellaneous provisions that may be required to enable the emergency response to be carried out.

Such equipment could include vehicles to transport emergency equipment to and from the site of the accident, heavy lifting gear, earth moving equipment, emergency lighting, and special tools, parts etc. required to carry out emergency repairs and actions.

5.11 Is it demonstrated that suitable arrangements have been made for the maintenance, inspection, examination and testing of the mobilisable resources and other equipment to be used during the emergency response, for which the operator is responsible?

The Safety Report must demonstrate that suitable arrangements have been made for the maintenance (planned and breakdown), inspection, examination and testing, of emergency response equipment and provisions. The arrangements should cover equipment with a direct mitigatory function such as fire fighting equipment, as well as other equipment with a key function, such as alarms to warn personnel of the accident.

5.12 Is it demonstrated that suitable arrangements have been made in the safety management system for training of individuals on-site in the emergency response?

The Safety Report must demonstrate that individuals are trained in the emergency response and that the training is kept up to date (e.g. by refresher training). The training must cover those members of staff with a specific role in the event of a major accident, as well as the training/information needs of other employees, contractors and visitors to the site. The training should include where relevant:

- Information on the major accident scenarios which may trigger the on-site and off-site emergency plans;
- The nature of major accidents posing a threat to the environment and the particular steps to take in the event of such accidents;
- Knowledge of the alarm systems and the required response to each alarm;
- The procedures for reporting/ responding to incidents on site which have the potential to escalate into a major accident;
- The use of the resources which may be mobilised in the event of a major accident e.g. fire fighting equipment, special chemicals, etc.;
- The use of protective equipment (e.g. respirators, breathing air, clothing etc.), and any limitations

on their use;
- The evacuation and mustering procedures;
- The actions required by staff with key roles in the implementation of the on-site emergency plans e.g. the site main controller or site incident controller;
- The training of individuals from organisations with which a mutual aid agreement exists.

5.13 Is it demonstrated that procedures have been made and adopted to test and review emergency plans, and to revise the emergency arrangements in the light of the lessons learned?

The Safety Report must demonstrate that a suitable programme of emergency exercises has been drawn up, and has been implemented, to test the emergency arrangements at all levels (i.e. the local plant response, the site-wide response, and the interface with the off-site response) and that a procedure exists to ensure that the lessons learned from these exercises are reviewed and the emergency arrangements revised where necessary.

The Safety Report must demonstrate that the on-site emergency plan is reviewed, and where necessary revised and updated, and that the plan is tested at least every 3 years. The review must take into account changes in the establishment or changes within the emergency services concerned, new technical knowledge including knowledge in relation to emergency planning.

5.14 Is sufficient information provided to enable the off-site emergency plan to be drawn up?

The minimum information to be included in the Safety Report is listed below:
- Details of the site including its location, nearby roads, and site access. *(*see also *'Descriptive Elements');*
- Site plan showing location of key facilities such as control centres, medical centres, location of main process plant and stores. Details of staffing levels.
- Details of the off-site area likely to be affected by a major accident e.g. maps with sectors and environmentally sensitive areas (e.g. Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs), Special Protected Areas (SPAs)) indicated, information on the types of building, the population density, roads, sensitive buildings (e.g. schools, hospitals), and a drainage map to help determine where spillages could leave the site.
- Details of the dangerous substances on-site covered by the Directive and similar information for other hazardous materials held on site, including:
    - quantities;
    - hazardous properties and the nature of their effects on people and the environment;
    - an outline of the use and storage of the materials on site;
    - an outline of the major accident hazards.
- Details of the technical advice that company can provide to assist the emergency response.
- Relevant technical details of the equipment (and other resources such as chemicals) which may be normally available on site and which may be available to assist the off-site emergency services during an emergency response, including resources supplied from other establishments with which a mutual aid agreement may exist.
- The functions of key posts with duties in the emergency response, their location and how they can be identified: e.g. the posts authorised to set the emergency procedures in motion and the conditions for doing so; the post responsible for the co-ordination of the on-site mitigatory action; the post responsible for liasing with the off-site emergency services.
- Outline of the initial actions, and procedures in the on-site emergency plans, to be taken by on-site staff once the emergency has been declared e.g. the warning of the public and adjacent sites, the

setting up of emergency facilities such as the emergency control room, and the response expected from on-site personnel (e.g. sheltering).

5.15 Is it demonstrated that the relevant information has been communicated to the public within the specified area.

The Safety Report must demonstrate that the following information is communicated to the public, within the specified area;

- Name of operator and address of the establishment;
- Confirmation that the establishment is subject to the Regulations;
- An explanation in simple terms of the activity or activities undertaken at the site;
- The common names or generic names or the general classification of the substances and preparations used on site which could give rise to a major accident, with an indication of their principal dangerous characteristics;
- General information relating to the nature of the major accident hazards, including their potential effects on the population and the environment;
- Adequate information on how the public concerned will be informed in the event of a major accident (e.g. siren, telephone, megaphone or some other system,which must be fit-for purpose);
- Adequate information on the actions that persons should take and the behaviour they should adopt (e.g. means of sheltering in the home or workplace, use of radio/telephone/television for further instructions from the emergency services, etc.);
- Confirmation that the operator is required to make arrangements on site, in particular with the emergency services, to deal with major accidents and to minimise their effects;
- A reference to the external emergency plan drawn down to cope with any off-site effects, including advise to cooperate with any instructions or requests from the emergency services;
- Details of where further information can be obtained.

The Safety Report must demonstrate that a system exists to ensure that;

- The above information is effectively communicated to the public;
- The means of communication by which this is achieved, e.g. leaflets, videos, meetings, media, etc;
- The public will be able to distinguish the warning from other potentially similar warning systems, so as to prevent confusion for the public. Where a mutually agreed warning system is employed with other operators, then the Safety Report should demonstrate how the system would function.
- The emergency services have examined and are in agreement on the content of the information to be communicated to the public by the operator.
- Ensures that the supply of the public information is repeated at least every 5 years and that the information is reviewed at least every 3 years, or sooner (if required as a result of a modification of the establishment).