Health Risk Assessment

Controlling health risks at work

July 2001

Policy and strategic objectives

Organisation, responsibilities, resources, standards, documents

Hazards and Effects Management

Planning and procedures

Implementation

Audit

Management review

Corrective action

Monitoring

Corrective action and improvement

Corrective action and improvement

Health, Safety and Environment HSE

Shell Health, Safety and Environment Panel
Health Risk Assessment

_Controlling health risks at work_

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HEALTH, SAFETY AND ENVIRONMENT ADVISERS PANEL

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_July 2001_
### Document History

<table>
<thead>
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<th>Issue</th>
<th>Reason for change</th>
<th>Author</th>
<th>Approval Signature</th>
</tr>
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<tbody>
<tr>
<td>1994</td>
<td>1.0</td>
<td>First Issue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 2001</td>
<td>2.0</td>
<td>Second Issue</td>
<td>OGNL</td>
<td></td>
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The printed version of this document is the controlled version. It is also available on the PXE Website.

Superseded issues of this document should be destroyed.
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Foreword

The Shell Group’s many and diverse activities include processes, operations and materials which can, in some cases, pose risks to health, safety and the environment.

*Health Risk Assessment – Controlling health risks at work* offers Line Managers and HSE Advisers clear, practical guidance on how to identify, evaluate and control health risks at work – the process known as Health Risk Assessment or HRA. It encompasses the best knowledge across the Group, particularly drawing on the experience of areas and people which have been carrying out HRA or similar assessments for many years. It is designed to be sufficiently flexible to apply across the Group’s activities, from a complex chemical plant to a simple retail filling station.

Today we know far more about the potentially harmful effects of the agents which can affect people’s health, including chemicals, dusts, noise, heat, radiation and microbiological agents. The challenge is to use HRA to apply this growing body of knowledge to ensure that hazards which could cause short term (acute) or long term (chronic) health effects are adequately controlled.

**HRA – for a healthier workplace**
Management Summary

Health Risk assessment is defined as: The identification of health hazards in the workplace and subsequent assessment of risk to health. This assessment takes into account existing or proposed control measures. Where appropriate, the need for further measures to control exposure is identified.

Health Risk Assessment (HRA) is one of the Minimum Health Management Standards endorsed by the Committee of Managing Directors (CMD) as required for all activity under Shell operational control.

HRA is the process by which health risks are addressed as part of the Hazards and Effects Management Process (HEMP) within the HSE Management System (HSE-MS) of an Operating Unit. It should take account of all employees, contractors and third parties at work within Shell premises.

It is the responsibility of Operating Unit line management to ensure that HRA, encompassing all activities within the scope of their HSE-MS, is carried out and followed up in conformance with the methodology described in this guide. One or more management representatives should be appointed to steer the implementation of HRA.

The main text of this document describes the mandatory elements to meet the Group Minimum Health Management Standards for HRA. The Appendices provide optional support to these mandatory elements with examples of good practice.

HRA must be carried out for:
- All new activities and developments
- All existing operations
- Where there are changes to existing activities
- For post-operating activities
- For acquisition (sufficient to identify potential health liabilities - a full HRA is not normally required)

HRA is required even if a HSE Case is not required. Where a HSE Case is required HRA can be incorporated into HSE Case documentation or documented separately.

The following steps must be incorporated in any HRA:

Organise
- Allocate adequate resources and form a competent team including specialist support resources as required (Section 6)

1 An Operating Unit can be a single operating company, a group of companies or an activity which straddles a number of companies and is managed on a global or regional basis.
• Break down activities into Assessment Units based on the scope of the HSE-MS (Section 7.1)

**Identify the hazards (Section 7.1)**
• For each Assessment Unit make an inventory of all Health Hazards and their potential harmful effects (acute and chronic)

**Assess the risks (Section 7.2)**
• For each Health Hazard use the HSE Risk Assessment Matrix (RAM) to assess the potential risk to the business by plotting them on the RAM to identify Low, Medium and High risks

**Control the risks (Section 7.3)**
• For risks assessed as Low: identify Occupational Exposure Limits (OELs) and other standards for the Hazards concerned and ensure that controls are established and maintained via standard procedures and staff competences specified in the HSE-MS. Manage for continuous improvement
• For risks assessed as Medium and High: identify OELs for each Hazard; identify the required controls to limit exposure to as low as reasonably practicable (ALARP) and to ensure that OELs are met; compare the required controls with current controls and identify any gaps; assess whether current controls are being effectively applied (it may be necessary to test existing controls or to carry out exposure measurements to determine their effectiveness); identify and agree any remedial actions and measures necessary to ensure that any identified gaps are addressed and that controls are consistently applied and effective (measures to ensure the continuing effectiveness of controls may include: routine exposure monitoring, health surveillance, maintenance of equipment and staff education)
• For risks assessed as High, give serious consideration to alternative ways of carrying out the operation to avoid the risk

**Establish Recovery Measures (Section 7.4)**
• Identify recovery (preparedness) measures which would be required to mitigate the potential effects should exposure control measures fail.
• Compare required measures with current measures; any gaps should be identified and remedial actions should be determined.
• Carry out regular exercises to test recovery measures and checks on necessary equipment.

**Formulate and Monitor Remedial Action Plans (Section 7.5)**
• Incorporate all required remedial actions into a Remedial Action Plan (RAP), allocate the necessary resources and put in place a tracking system to monitor implementation.

**Document (Section 7.6)**
• Keep written records of HRAs, RAPs and consequent actions to act as documented demonstration of control of risk.
A regular review of HRAs must be carried out as part of the formal review process of the suitability and effectiveness of an OUs HSE-MS (Section 7.7)

- Individual HRAs should be reviewed, as a minimum, every five years
- In addition, any significant change which may impact on health risk should trigger a review of the HRA

Processes must be included within an OUs HSE Assurance Plans to ensure the requirements of this guide are being met (Section 7.8)

To assist with the HRA process, inventories of generic health hazards and controls have been developed for a number of the principal business activities. Details are available from Business HSE Advisors.
2 The Purpose of this Guide

The Committee of Managing Directors has endorsed a set of Minimum Health Management Standards (MHMS). These are the minimum requirements for the management of health in companies where Shell has operational control. At the same time, compliance with the national statutory requirements for each country where the Group operates is mandatory for all aspects of health management. The full set of Group MHMSs are contained in (**PXE to add reference)**

The **Minimum Health Management Standards** for Health Risk Assessment states:

1. Management programmes are to be in place to assess, control and document those health risks associated with the work environment and which have been identified as potentially High or Medium on the Risk Assessment Matrix (RAM).
2. Health Risk Assessments are to be carried out by a competent person in line with the good practice described in this Guide.
3. Exposure monitoring and health surveillance programmes are to be implemented where the need is identified by Company or Governmental requirements.
4. Results of mandatory Company/Governmental exposure monitoring and health surveillance are to be recorded.

This guide defines what HRA is, what it should include, and how to incorporate the MHMS on HRA within the HSE-MS. The elements described within the main text are mandatory and it is expected that they be undertaken by all Operating Units. The appendices provide further guidance and good practice examples to assist in implementing these mandatory elements. HRA is an essential element of the HSE-MS of existing business activities. It also has an important role to play in assessing the health impact of major changes and new developments.

Relationship with other Guides

The Shell Group has a hierarchy of documents dealing with Health, Safety and Environmental issues starting with the ‘**Statement of General Business Principles**’ and the **Group HSE Commitment and Policy**. These were issued in March 1997, along with a **Group Procedure for an HSE Management System**. Within this Group Procedure, which has been adopted by all Group companies, the Hazard and Effects Management Process states:

‘**Health Risk Assessment shall address physical, chemical, biological, ergonomic and psychological hazards associated with work.**’

The **Group HSE Management System** (August 1999) describes how mandatory Group expectations are managed at Group level. Each Group Business Organisation has an HSE-MS, and there may be HSE-MSs at country, operating unit, installation and operation levels.
The Purpose of this Guide

Outputs from HRA should be managed via the HSE-MS to ensure the ongoing control of health risks and a continuing improvement in workplace health.

This document replaces the earlier Health Risk Assessment guide published in 1994.
What are Health Risks?

Any hazard has, by definition, the potential to cause harm in some way. With simple hazards, we can usually link the hazard (cause) to the harm (effect) quite clearly. For example, it is obvious that a person struck by a brick falling from an overhead scaffold because the toe boards were missing was injured by the falling brick.

In contrast, health hazards are not always obvious and the potential harmful health effect may not be as easy to link back to the cause. As a result, measures for controlling exposure to the hazard may be inadequate or overlooked. This is an important difference between the assessment of safety and health risks.

Health risks have a number of unique features which need to be taken into account when carrying out HRA. This section provides some further background on what should be considered when assessing health risks and why it requires a particular methodology.

**Key definitions**

**Health hazard:** The potential to cause harm to health. Health hazards may be biological, chemical, physical, ergonomic or psychological in nature.

**Exposure:** The amount of the hazard to which a person is subjected (dose). This is a combination of magnitude, frequency and duration.

**Occupational Exposure limit:** The average level of exposure intensity over a specified time period set by an authority as the recommended maximum.

**Health risk:** The likelihood that a health hazard will cause harm in the actual circumstance of exposure.

Health risk is directly proportional to the severity of a health hazard and the level of exposure to that hazard

Health Risk = Hazard x Exposure

In most cases the human body can cope with some exposure to a health hazard. Indeed, there are many examples where some exposure is essential for good health, for example, a certain level of psychological stress or chemicals that act as nutrients. A key element in carrying out Health Risk Assessment is to determine when exposure to a particular health hazard is too great and could lead to ill health.

There are a number of features particular to the health of individuals which complicate this simple relationship between hazard and risk.
3.1 **Acute and Chronic Health Effects**

Certain health hazards show their effects at the time of exposure, for example eye and throat irritants or corrosives. These are called acute effects and occur suddenly and in a short time (seconds to hours) following exposure. On the whole these are simpler to work with because they are self-indicating - it is obvious when exposure occurs and, in most cases, the individual can take remedial action before damage is done.

Chronic effects are more subtle. These occur gradually over a long period of time (often years) following repeated or prolonged exposure to a health hazard. Because over-exposure is not necessarily self-indicating, the individual is not usually aware of the exposure and its potential results at the time, so does not take remedial action.

3.2 **Cumulative Exposures**

When assessing health risks, it is important to look at all exposures to particular health hazards and not to focus on each hazard and exposure in isolation. With health hazards, multiple exposures can happen either simultaneously or consecutively, adding to an individual’s total dose and potentially increasing the risk. If, for example, a combination of chemicals with similar toxicity is encountered, the effect will be the sum of the effects of all the chemicals, or even more. Similarly, if several short tasks are carried out, exposures from each task may be carried forward to the next.

People may be exposed to health hazards in every aspect of their lives, including home, hobbies and leisure, as well as work. Where the same hazard is involved, this will add to the cumulative exposure of an individual. For example, people whose hobbies expose them to chemicals, noise or hand arm vibration are not starting with zero exposure when they begin work. This is particularly important for psychological hazards, where domestic and relationship pressures may affect an individual’s ability to handle their work situation. While non-occupational exposures are not routinely included in the HRA, such exposures may be relevant when investigating an incident or health effect.

3.3 **Individual Susceptibility**

Individual reaction to health risks varies from person to person, based on their heredity, age, sex, personal habits, life history to date, the state of their health at the time and other unclear factors. For example, a young, fit person may be perfectly capable of tolerating a certain level of exposure, but an older or weaker person may not. Previous health damage like a back injury, hearing loss or chemical sensitisation may also put certain individuals at particular risk. Pregnancy and subsequent nursing of babies have to be considered both for the health of the mother and the child.

Individual susceptibility is particularly important when considering psychological hazards - what may be regarded by one person as a stimulating challenge may present an intolerable burden to another.
Realistically, risk assessments have to be fairly generic - it would be impossible to assess how every individual will react to every health risk, so a standard reasonably fit, reasonably stable individual has to be generally assumed. Where a health risk has particular relevance to a group, for example smokers or pregnant women, and these are known to be in the exposed population, a further generic assessment for that group may be necessary.

Health and medical surveillance and medical fitness standards should aim to protect individuals with a particular susceptibility which may represent an increased risk to them.

**3.4 Threshold Levels**

Most health hazards have a threshold level - a level below which the human body and its metabolism can cope without causing adverse health effects, referred to as the No-Observed Adverse Effect Level (NOAEL). With health risks with such a threshold, the severity of the effect is proportional to the exposure, down to the threshold (which is above zero). Below that threshold there is no health effect - the body's defence and excretion mechanisms can cope with the exposure burden. A common example is exposure to solvent vapours causing acute effects to the central nervous system, but at low concentrations the effects cannot be seen.

For some health hazards, it is not known whether there is a threshold level for the potential health effect. However, even in these cases, the likelihood of that effect manifesting itself is in proportion to the exposure, so the risk can be controlled by minimising exposure.

**3.5 Knowledge Gaps**

Our knowledge and understanding of health hazards has grown over the years, and continues to develop through additional toxicology and epidemiology studies. Nevertheless, there can always be some incompleteness. For example, we may have test data for the acute toxicity of a material but not chronic toxicity. In addition, an exposure limit or guideline has not been set for every material. In fact, it is estimated that about one million chemicals and preparations are traded - of these, only about a thousand have assigned Occupational Exposure Limits.

Similarly, as knowledge changes, it becomes clear that some health hazards are more hazardous than was originally believed. This has led to a reduction in the Occupational Exposure Limit over time for many health hazards, for example, asbestos, benzene and ionising radiations. It is particularly important to have the latest Material Safety Data Sheet (MSDS) for all the products handled so that the most up to date information is available. Product blends change regularly, and the hazard ratings of the components may also change as knowledge grows. A file of MSDSs in the plant office can easily become outdated and could give inaccurate or completely wrong information.

The line manager and occupational health specialist should keep their knowledge of health hazards up-to-date. This requires keeping abreast with information relating to hazards relevant to the business.
Workstyle Changes

When there are changes in workstyle resulting from new ways of working, it is necessary to take these into account by reassessing the risks to health. For example, many office workers spend a large proportion of their day using a computer. This is a major workstyle change in the last 10 years and the number of people at risk from work related upper limb disorders is now much larger. Workstyle changes that may need to be included in the HRA depending on the health hazard are: increased working hours, more demanding targets, less direct management and the increased pace of work. These factors can influence exposure levels.

Real Work Practices

It is a common feature that people may do things slightly differently from how they say they do, and even how they think they do. These small differences can have significant health impact. For example, a steward not changing overalls between housekeeping duties and food preparation, or a worker storing contaminated gloves in a ‘clean’ area leading to cross contamination and potential contact by unprotected workers, can result in unpredicted health risks.
Health Risk Assessment in the Overall HSE-MS Process

As with Safety and Environmental risks, Shell manages its health risks as part of its HSE-MS. The Hazard and Effects Management Process (HEMP) is the component of the HSE-MS which evaluates HSE risks to determine the measures necessary to control those risks to ‘as low as reasonably practicable’ (ALARP).

HEMP comprises four elements: Identify, Assess, Control and Recover. HRA is the practical application of the HEMP process to health risks and also encompasses the HSE-MS elements of Implementation, Monitoring and Corrective Action which are identified as separate parts of the HSE-MS but are logical extensions of the process. This is further explained in Section 7.

**HSE-MS flow chart**

The deliverables from the HRA will therefore satisfy certain health requirements of the HSE-MS.

All activities within the scope of the HSE-MS of an Operating Unit should be subject to HRA.

Line management is responsible for ensuring that HRA is carried out for all activities under their management responsibility and one or more management representatives should be appointed to steer the implementation of HRA within an Operating Unit. Their commitment and involvement in this process should be clearly visible and should include both the planning and implementation of any follow-up actions deemed necessary.
The approach to implementing HRA depends on the organisational structure and type of work in the Operating Unit. In some circumstances it may be appropriate for a single HRA to be carried out to cover all the activities in a country. In others, HRA may be carried out covering one operational facility or activity like a refinery or a head office. Operating Units should define within their HSE-MS a structure for implementing HRA taking account of the requirements of this guide and any guidance provided by their Business Organisation. HRA may be a stand-alone exercise or may be integrated within an HSE Case. Whatever the structure, the principles described in this guide must be applied to all health risks.

The boundaries for each HRA should be defined and should cover the work environment in the broadest sense, including all work activities whether they are carried out within the Company’s premises or the result of business travel requirements. Boundaries may also need to take account of country-specific requirements. In addition, the roles and responsibilities of line managers, specialist advisers, supervisors and the workforce should be clearly defined.

Adequate resources are essential to deliver effective HRA and the following must be considered:

- Clarifying the roles and skills required for HRA
- Ensuring those involved are competent (refer to Section 6)
- Identifying sources of specialist support, if needed
- Providing sufficient time, equipment, information, training and support for the Assessors
- Providing resource for the Remedial Action Plan

Health Risk Assessment in the Overall HSE-MS Process
5 When Health Risk Assessment Applies

HRA applies to all operations within the scope of the HSE-MS, whether an HSE Case is required or not. HRA addresses the life cycle of any Group operation, and takes account of all employees, contractors and third parties at work.

5.1 New Activities and Developments

Implementation of HRA at the conceptual and detailed design stages of new activities and developments allows selection of control and recovery measures when it is easiest and cheapest to integrate them in any plan. In this way, control is focused at the top of the control hierarchy (see Section 7.3).

Using the plans and process descriptions, together with discussions with design engineers, health specialists and operational staff, the first step is to identify the potential health hazards that may be encountered and identify Exposure Limits. It is also necessary to predict the tasks involving exposure to those hazards and the likely levels. This information should then be used to select the control design standards. In addition, it provides a key input into operating procedures.

Once the new activity/development is up and running, it is appropriate to test the effectiveness of the controls by implementing HRA for existing operations. Of course, the design HRA will provide a head start.

HRA principles should also be applied to any operations involved in constructing new plant. This would normally be carried out by the engineering contractor as part of the project HSE requirements.

5.2 Existing Operations

Using the HRA process, health risks from routine operational and maintenance activities will be assessed and continuously managed. For non-routine tasks, HRA is a key input to the task analysis for inclusion in safe systems of work. Details on the implementation of HRA for Existing Operations are given in Section 7.

5.3 Change to Existing Activities

Changes in operations, maintenance practices, or facilities should trigger review of the existing HRA. A management of change procedure should be in place to ensure that HRA is automatically triggered when the change introduces an additional hazard beyond the scope of the original HRA. Less significant changes should not trigger an HRA but should be integrated into the periodic update of the HRA.

This type of HRA should examine the impact of the existing plant on the proposed new design, and vice versa.
5.4 **Post-operational activities**

HRA should be applied when a facility is decommissioned and abandoned.

Abandonment brings a different set of health issues concerned with dismantling plant, buildings and equipment. They include residues, NORM (Naturally Occurring Radioactive Materials), asbestos, etc. There may be a need to clean up any contaminated land before divestment.

5.5 **Acquisitions**

The principles of HRA should be applied as part of the due diligence process when new businesses are acquired. The focus of the HRA should be on any potential health liabilities which may have an impact on the value of the proposed acquisition. A full HRA is not required at this stage, and will most likely take the form of an audit of the facility and existing health related documentation.
6 Putting Together a Competent Team

Supporting guidance is provided in Appendix 1.

Line management, operational staff and specialists all have a part to play in carrying out HRA. Those involved should have the collective knowledge, skill and experience to:
1. Know how to do HRA
2. Understand the workplace operations being assessed
3. Gather information systematically and make judgements on hazards, exposures and potential risks to health
4. Understand the methods for controlling exposures and reducing risks
5. Apply existing knowledge available within the Group
6. Know the limit of their competence and where to get further help

Access may be required to occupational health expertise to support the development and implementation of HRA. Specialists such as occupational health physicians, occupational hygienists, medical advisers, occupational health nurses, HSE advisers, toxicologists and ergonomists may need to be consulted.

The composition and expertise of the team will be dictated by the size and complexity of the Assessment Unit (see Section 7.1), by the nature and severity of the hazards and risks involved, and by the familiarity of the task. Specialists can be used in three ways:
- As part of the team
- As ongoing support to the team, being consulted as required
- To review the draft HRA before finalisation.
Carrying Out, Using and Maintaining an HRA

The most common HRA application is on an existing steady state operation, and this has been chosen as the main example.

**Flow chart of HRA within HEMP**

Where similar operations involving the same health hazards are carried out on more than one site, a ‘generic’ approach may be used. This involves carrying out HRAs at representative sites where the relevant activities take place and consolidating the results in a ‘Generic Record’. This Generic Record can then be ‘read across’ to other sites where the same activity takes place. If this approach is used, the Generic Record must be reviewed by each operational site and any necessary amendments made to give relevance to the individual site and to produce a site-specific Remedial Action Plan.

The generic approach does not relieve site management of responsibility for the implementation of their own HRAs. The Generic Record should be seen as a starting point for their HRAs and a template against which their HRAs can be compared.

### 7.1 HEMP Stage One: Identify

*Supporting guidance is provided in Appendix 2.*

As a first step, it is necessary to set the boundaries of the HRA (refer to Section 4) which may be described as an Assessment Unit (AU). AUs should be self-contained, either physically or as a process.
Examples of an Assessment Unit are:
• A complete operational site with a well-defined activity, such as a small gas production platform, distribution terminal, office block or lube oil blending plant
• An individual process unit within a large production platform, chemical manufacturing plant or refinery complex
• A group of functions which support a single Business Process, such as well operational activities on a production platform

All health hazards within the defined AU should be identified. These can be grouped into chemical, physical, biological, ergonomic and psychological hazards.

A walk-through survey of the work areas within the AU is a useful starting point. This builds a picture of the number and type of health hazards and identifies which members of the workforce face similar exposures and risks.

Health hazards in the AU should be identified and listed.

For each health hazard identify:
• Its harmful effect(s) and whether these are Acute and/or Chronic
• How it acts, e.g. via skin or eye contact, inhalation, ingestion, hearing, on whole or specific parts of the body
• Its Hazard Rating (RAM Consequence Category)

A useful reference for health hazards can be found in the Business-specific Health Hazard Inventories. These inventories include the information required above and offer supporting references on control. It should be recognised that these inventories are not an exhaustive list.

When selecting RAM Consequence Categories remember to consider ‘harm to people’, ‘assets’ and ‘reputation’. Health hazards may result in individual ill health, which in turn may lead to liability claims, fines, production losses, raised insurance premiums, and damage to reputation. Select the Category with the highest consequence rating.

### 7.2 HEMP Stage Two: Assess

*Supporting guidance is provided in Appendix 3.*

It is important that the main energy and resources for HRA are applied to those health risks which are having, or could have, a significant impact on the health of the workforce and the reputation of the company. The Risk Assessment Matrix (RAM) is the tool which allows assessment of the risk to the business from each identified health hazard and helps to:
• Prioritise potential health risks
• Determine which risks need a documented demonstration that controls are reducing the risk to As Low As Reasonably Practicable (ALARP)
The potential risk posed to the business for each health hazard should be plotted on the RAM. This is a combination of Consequence (vertical axis), see HEMP Identify above, and Likelihood (horizontal axis).

The RAM divides risks into Low, Medium and High. The MHMS requires that a detailed review of controls is carried out for those health risks that are assessed as Medium or High.

Low risks are managed for continuous improvement and exposure controls rely on standard procedures and competences as specified in the HSE-MS; a detailed review of controls is not required. However, it is important to remember that for Low risks it is still necessary to demonstrate compliance with occupational exposure limits. The relevant HSE-MS procedures and competences should be reviewed to ensure they are comprehensive and appropriate. It may be necessary to perform exposure measurements to confirm compliance with an exposure limit.

Experience has shown that health, and environmental, hazards are not always assigned a RAM risk rating which reflects the full extent of their potential consequences. This is particularly true of hazards with chronic effects because the evidence of actual ill health effects may not appear until many years after the excess exposure. To allow for this, the estimate of ‘Likelihood’ for chronic health risks should be based on the historical exposure evidence. It is also recommended that decisions on Likelihood should tend towards the higher category. This is because the RAM assessment is only a screening mechanism to identify priorities. Where there are uncertainties, it is prudent to move to the next stage to begin more detailed assessment.

7.3 **HEMP Stage Three: Control**

*Supporting guidance is provided in Appendices 4, 5, 6 and 7.*

RAM health risks identified as Medium or High should be prioritised for HRA so that existing arrangements for control can be reviewed to ensure they are adequate.

The HRA should determine whether controls meet relevant occupational exposure limits and other control standards, and whether they achieve ALARP. The basis for establishing ALARP should be documented for all risks assessed as Medium or High and may be contained within the HRA itself, or as part of an HSE Case. For risks rated High on the RAM, alternative ways of carrying out the operation to avoid the risk must be given serious consideration as part of the HRA.

If the existing controls do not meet these criteria it is necessary to:

- Consider improvement options
- Consider risk reduction versus efforts and costs to achieve it
- Document options and considerations
The selection of additional controls should be made taking account of the control hierarchy - elimination, substitution, engineering, procedural and lastly personal protective equipment. It may be necessary to carry out exposure measurements to support this review.

In order to decide whether control measures are adequate, it is necessary to obtain detailed information on the nature and degree of personal exposures for each relevant health hazard, including:

1. **Who is exposed** - by dividing the workforce into groups with similar exposure to particular health hazards. Staff with an increased individual risk should be specifically identified.

2. **The exposure level to each hazard** - by identifying and reviewing the various tasks involving potential exposure, including estimating the extent, frequency and duration of exposure and using available airborne and biological monitoring data. All normal operations, maintenance, shut down or start up operations, abnormal conditions and foreseeable emergencies should be considered.

3. **Effectiveness of existing controls** - by reviewing the tasks whilst they take place and comparing the control measures used against defined standards. The standards against which exposure controls are evaluated should include:
   - Health hazard exposure limits
   - Specifications for engineering controls
   - Specifications for procedural controls
   - Specifications for Personal Protective Equipment (PPE)

   These standards should be considered in the light of advances in technology and knowledge to encourage continuous improvement.

Exposure limits vary in nature depending on the type of health hazard. If no limit has been set by the national authority, or if the national limit is less stringent than that recommended by a Shell Service Company, the Shell Service Company advised limit should be applied. However, complying with a national limit should always be the first priority.

For chemical hazards with no assigned exposure limit, the supplier should be asked to provide a working limit with evidence to support the limit and a measurement protocol. Alternatively, Occupational Health Advisers in the Service Company can set an advised limit.

In certain instances, the assessors may not be in a position to decide whether a particular control is adequate because of lack of available information. In this case, the necessary additional information should be sought before any decision is made.
The continuing effectiveness of controls will also be required to be considered. Methods may include:

**Routine Exposure Monitoring:** Also referred to as Periodic Exposure Measurement. In some cases it may be necessary to carry out exposure measurements on a routine basis to a specified protocol determined as part of the HRA, for example, to meet legal requirements or to confirm that control measures remain effective.

**Health Surveillance:** Health surveillance should be carried out, provided that a suitable method is available, when:
- HRA reveals a (significant) risk to health
- National law and/or practice requirements need to be addressed

Health surveillance has the objectives of:
- Assessing the health of the individual in relation to the workplace hazards to which they are exposed
- Confirming the effectiveness of control measures
- Collecting data for the detection and evaluation of hazards to health

Health surveillance may require keeping records on individual exposures, the use of questionnaires, disease surveillance and medical surveillance.

The content and frequency of health surveillance should be determined by the HRA. Advice on health surveillance may be obtained from the Operating Unit or Service Company Occupational Health Advisers.

**Maintenance of Controls:** Control measures will only remain effective if they are properly and regularly maintained. Examples include:
- **Engineering controls:** implement a regime of preventive maintenance including routine inspections, examinations and tests to ensure plant and equipment continues to operate at design specification
- **Procedural controls:** implement procedures that will ensure adequate maintenance of controls, e.g. record systems, staff information, instruction and training, supervision, safe systems of work, emergency arrangements, etc
- **Personal protective equipment (PPE):** as with engineering controls, reusable PPE also requires routine inspection and maintenance

**Staff education:** educating the workforce by providing information, instruction and training on workplace health hazards and the control of those hazards.

Education should meet the needs of each staff group (Job Type) and give clear understandable messages. For example, on-the-job training, posters, summary cards and reminders on work sheets have far greater impact than detailed manuals.

To help achieve commitment to the HRA process, it should be emphasised throughout that the driving force behind HRA is to ensure staff are not exposed to health risks at work and that no
resulting health damage occurs. The HRA is a systematic review of how these health risks are controlled - it is the prime method of ensuring that the health of people at work is not harmed by their work. It is in everyone’s interest to do it properly.

### 7.4 HEMP Stage Four: Recovery

Recovery (preparedness) measures are required to mitigate the potential effects should exposure control measures fail, and to prevent the potential escalation of health risks. Examples of mitigation measures include medical emergency response arrangements, eyewash and shower stations, escape equipment such as rebreathers, personal alarms, and post traumatic stress counselling. Some situations may require special measures such as the availability and use of calcium gluconate on hydrofluoric acid burns.

Measures to reduce the possible escalation of incidents when controls fail should be included in the medical emergency response plan.

Specifications for the recovery measures should be identified, as with control measures. Decisions on adequacy are also needed. All plant and equipment needed for recovery must be routinely inspected and maintained in good working order. In addition, regular emergency exercises should be carried out to test the effectiveness of emergency arrangements and to help train staff.

### 7.5 Remedial Action Plan

Where the need for action to reduce health risks is identified by HRA, a Remedial Action Plan should be drawn up. This should state which additional control or recovery measures are required. As with the Remedial Action Plans arising from other aspects of HSE-MS implementation, priorities, responsible persons and target dates for actions should all be clearly identified and the details entered into a tracking system to ensure that remedial action has been carried out efficiently, effectively and on time.

### 7.6 Documenting HRAs

*Supporting guidance is provided in Appendix 8.*

A written record of the HRA should be kept. This may be part of a self-contained HRA report or covered by an element of, for example, an HSE Case.

The record of the HRA should:
- Be readily retrievable when needed, for example, for internal/external audits, local or national authorities or periodic review
- Meet legal requirements
- Be kept for a period as required by national laws and/or practice. Where chronic health risks are encountered, records should be kept for a sufficiently long period to allow the evaluation of individual health effects. It is also possible that they may act as insurance against possible future
Carrying Out, Using and Maintaining an HRA

liabilities. To achieve this, arrangements should be made to place records which are no longer current in an archive
• Contain sufficient information to ensure an audit trail on how conclusions/decisions were reached
• Allow traceability from individual name via Job Type to tasks and thus to health hazards, controls, monitoring records, etc.
• Include exposure monitoring and health surveillance. The latter should meet the requirements of the Group protocol for handling of health files

Results of HRAs should be communicated to relevant staff as part of the site hazard communications programme.

7.7 Reviewing HRAs

OU senior management are required to confirm in their HSE Annual Letter that they carry out regular, formal reviews of the suitability and effectiveness of HSE-MSs. The recommended frequency is for at least an annual review. These HSE reviews should include consideration of the extent to which the HRA expectations described in this guide are being met, including whether systems and procedures operate as documented. Additionally, individual HRAs should be fully reviewed and revised if necessary every 5 years as a minimum. HSE Annual Letters also require confirmation that progress of HSE remedial action plans, which includes those arising from HRAs, is being monitored quarterly.

Any significant change which may have an impact on health risks - for instance, changes in the work processes and patterns or in appreciation of specific hazards and risks - should trigger a review of the HRA, in addition to reviewing effectiveness of designated actions following implementation.

7.8 Assurance

Within their HSE Assurance Plans, Operating Units should have processes to ensure that the requirements of this guide are being met. These Assurance Plans may include a risk-based range of self and independent appraisal processes.

Where health risks are particularly high, or if there are often health related concerns, it may be appropriate to have an HSE audit devoted exclusively to the adequacy of HRA. The scope of such an audit may include:
• Organisation of the system for implementing HRA
• The resources available to carry out HRA
• The quantity and quality of HRA records
• Areas of non-compliance with occupational exposure limits
• Remedial actions taken following an HRA
• The maintenance of controls
• The maintenance of employee work history
Carrying Out, Using and Maintaining an HRA

For activities where there are significant health risks, the evaluation of the quality of the HRAs by an experienced occupational hygienist is a useful insurance.

Independent HSE-MS Audits in accordance with procedures laid down by Business Organisations in accordance with the March 2001 Group HSE Auditing Guidelines shall include HRA within their scope.
Supporting guidance is provided in Appendix 9.

The Minimum Health Management Standards for HIA states:
- For all projects where there is the potential to impact on the health of the local community and/or staff and families, a Health Impact Assessment is to be made in conjunction with any Environmental and Social Impact Assessments required.

When carrying out an initial assessment of health related risks at a site associated with a new project, major modification or prior to abandonment of an existing project, it is important to consider the health, environmental and social impact on stakeholders and the local community. This is a separate assessment to an HRA but it clearly has a close relationship. HRA's function is to assess the health risks ‘within the fence’ of a project, whereas HIA examines health risks ‘outside the fence’ which could be associated with the project.

In exceptional circumstances, it may be necessary to carry out an HIA for existing operations where there are specific concerns about the impact on local people.
References

Shell HSE Advisers Panel Minimum Health Management Standards, May 2001

Shell HSE Advisers Panel Risk Assessment Matrix, April 1999

Other key references for HRA are contained within the Business-specific Health Hazard Inventories, as follows:

• HE98.003: Shell Chemicals Health Hazard Inventory
• HE99.004: Oil Products Business Health Hazard Inventory
• HE99.014: Shell E&P Business Health Hazard Inventory
Appendix 1  A Competent Team

An HRA is normally carried out by an Assessment Team. A Team Leader should be appointed who is responsible for co-ordinating HRA and reports to management.

The number of people involved and their level of competence depends on:
- The size and complexity of the activity being assessed
- The nature and severity of the hazards and risks involved
- Familiarity with the activity
- The stage reached in implementing HRA. This starts with information gathering where operational staff will have an important input. It then moves on to the stage where specialist skills may be needed for detailed tasks such as reviewing the effectiveness of engineering control measures like ventilation systems and measurements to quantify the workforce’s exposure to a particular agent or assessing ergonomic design

Each Assessment Team should include:
- The Line Manager or his representative from the activity or facility being assessed who will act as Team Leader
- A person who has competence in carrying out HRA
- Access to persons with greater competence as required

Where appropriate, the Team should also involve or refer to operational staff, occupational health specialists, technologists/engineers or other specialists, as required.

The importance of involving operational staff in the HRA cannot be stressed too strongly. They have the detailed knowledge of their tasks to help evaluate any potential health risks. Their involvement will increase their appreciation of the hazards and highlight any need for control measures for a specific task.

To gather the necessary information collectively, Team members must be able to:
- Observe so that they can clearly appreciate the activity being performed and the significance of what they are seeing, particularly if written procedures are not being followed
- Predict any potential departures from observed practice and realise the significance of the answers
- Ask supervisors, managers, staff, advisers etc the relevant questions and realise the significance of the answers
- Undertake simple diagnostic tests, for example using a smoke tube to test air movement, simple sound level metering or using colorimetric tubes for an indication of any air concentration of a particular substance
- Identify and review the relevant technical literature
- Gather the information together systematically so that potential consequences are known and likelihoods can be estimated
- Form valid, justifiable conclusions about any exposures and risks
- Follow up fundamental questions about whether there is a need for any exposures to occur
Appendix 1  A Competent Team

• **Appreciate** the range and limitations of possible control measures and their relative reliability
• **Look critically** at existing arrangements
• **Specify** the type of control measures needed
• **Ask** for specialist assistance if required

Specific training requirements are recommended as follows:

**a) Nominated team member:**
- Short course on the HRA process

**b) Local advisers supporting HRA:**
- Qualifications in occupational health depending on the complexity of the HRA and access to specialist advisers
- HRA course

Recommended courses:
- Shell Group workshop on HRA
- Specific modules on occupational hygiene topics relevant to their operations

**c) Occupational hygiene specialists:**
- Post graduate courses in occupational hygiene
- Occupational hygiene modules set by the profession, e.g. British Institute of Occupational Hygiene (BIOH), American Industrial Hygiene Association (AIHA)

An occupational hygiene specialist must at least meet the requirements for membership of a recognised occupational hygiene body such as BIOH or AIHA. Therefore, the above mentioned specialist courses should be selected based on their recognition by the professional bodies.

Further information may be obtained from SI-Health Services.
Appendix 2    Identifying Health Hazards
(HEMP Step 1 - Identify)

This Appendix provides guidance to help identify health hazards which may present a risk in the workplace and suggests some supporting information.

1. Look at the workplace and review design plans

a) Chemical Agents
   For example:
   • What feed stocks and catalysts are used?
   • What products, intermediates, by-products and wastes (gaseous, liquid or solid) are produced?
   • What proprietary chemical products are used, e.g. water treatment chemicals, glues, degreasants, cleaning materials, oils, greases?
   • Where are the emission points to atmosphere for chemical agents, e.g. ventilation exhaust points, production vessels, drainage points, tank vent points, sampling points, product loading of drums, road cars, rail cars, marine vessels?
   • Are ventilation fresh air inlets located close to ventilation exhaust points?
   • What potentially hazardous building construction materials have been used, e.g. insulation and fire retardant materials such as asbestos and man-made mineral fibres, lead pipes, leaded paint?
   • Is cutting and welding, brazing, soldering carried out? What gases and fumes are emitted?
   • Are there tasks that change the physical form of a chemical substance thereby increasing the potential for exposure, e.g. activities that create a dust from a solid such as grinding, sanding and sawing, or a liquid to an aerosol such as applying liquid chemicals using a spray lance?
   • Are any tasks carried out in confined/restricted workplaces which may prevent dispersal of gases/vapours/dusts/mists increasing the potential for build up of hazardous concentrations?
   • Smoking (active and passive)?

b) Physical Agents
   For example:
   • What noisy fixed equipment is present, e.g. compressors, boilers, machinery?
   • What noisy portable equipment is used, e.g. pneumatic tools, grinders?
   • Is there any impact noise from, for example, manual handling of containers such as empty barrel handling, LPG cylinder movement?
   • Are lighting levels adequate for the tasks required?
   • Are there distracting glare sources or reflections at workstations?
   • Is any equipment used which emits ionising radiation, e.g. level gauges, x-ray equipment?
   • Are cutting and welding activities carried out which emit infra-red or ultra-violet light radiation?
   • Are there any working areas where extremes of thermal environment (heat or cold) are present or may occur?
• Do staff have to carry out heavy manual tasks which may lead to heat stress in a hot environment, e.g. tank cleaning?
• Are there any tasks which require staff to be in a cold environment, e.g. working in a freezer room, outside during cold inclement weather?
• Are there any specialist tasks involving changes in atmospheric pressure, e.g. sub-aqua diving?

c) Biological Agents
For example:
• What water systems are present? What is the potential for the growth of disease/illness causing bacteria, e.g. legionella pneumophila? Is the drinking water quality controlled?
• Are there air conditioning systems? What is the potential for growth of disease/illness causing bacteria and other organisms e.g. dust mites?
• In catering establishments, what is the potential for the growth of food poisoning bacteria?
• Are there any disease carrying species, e.g. malaria carrying mosquitos?

d) Ergonomics
For example:
• Is the design and layout of the workplace such that no excessive stresses are placed on staff musculo-skeletal systems? For example, bending and stretching, lifting and carrying, pushing and pulling, repetitive movements using the same muscle groups?
• Do environmental factors of the work place affect worker comfort, e.g. noise, vibration, lighting, climate (see also physical agents)?

e) Psychological
For example:
• Is there rotating shift-work which might affect an employee's work performance and increase potential stress levels?
• Are individuals exposed to nervous system toxins that could affect the ability to recall information or have impaired coordination and reflexes (assess as part of chemical agents)?
• What is the probability of workplace violence, explosion or fire (include surrounding areas)?
• Is there a high probability that a significant loss of self esteem and pride will be created by an investigation, downsizing, or restructuring?
• Does the job require immediate need of reflexes and the ability to shift mental sets that the use of medications or jet lag could impair?
• Are any of the following issues apparent:
  - Isolation (degree of access to social support)?
  - Culture and language?
  - Job design (content and workload, too much or too little)?
  - Job organisation (shift patterns, rotations, jet lag, lack of resources)?
  - Lack of leisure and recreation opportunities?
  - A supervisor that is seen as uncaring?
  - Overt workplace harassment/discrimination?
2. Look at records to identify plant specifications, past incidents and actions

For example:
- Plans and drawings for plant specifications
- Incident/injury reports - identify, e.g. back injuries, chemical burns, dermatitis, chemical splashes in eyes, product spillages
- Occupational illness reports and incident investigations
- Plant and equipment fault reports
- Maintenance records for control measures, e.g. personal protective equipment, local exhaust ventilation
- Health surveillance records, e.g. audiometry results, biological monitoring results, dermatitis
- Sickness absence reports, is any absence the result of working conditions/incidents?
- Health and safety surveys/inspections;
- Minutes of health and safety committee meetings
- Previous occupational hygiene surveys e.g. noise dosimetry, plant noise contour plans, measurements of exposure to airborne agents

3. Review information sources on health hazards

For example:
- Manufacturer’s and supplier’s data sheets, labels or manuals on products and equipment
- Guidance material available from Shell Service Companies, e.g. Shell Business Health Hazard Inventories
- Occupational health advisers
- Organisations with knowledge and experience of the activity or operation, e.g. trade associations, government health and safety advisory bodies
- Guidance available from national competent bodies or institutes in the field of health and hygiene at work
- Journals and reference literature
Appendix 3 Examples of RAM Ratings for Health Risks Common to Shell Operations (HEMP Step 1&2 - Identify and Assess)

Risk Assessment Matrix ratings have been assigned to selected health hazards by way of illustration of potential levels of risk. The Consequence Category of ‘harm to people’ (RAM vertical axis) has been used as it is the category most likely to generate the highest RAM Rating, but it is important to recognise that both Assets, and/or Reputation may also be relevant. The rating assigned to the Likelihood category (RAM horizontal axis) is based on typical ‘worst Group cases’ and it is important to take account of any Business-specific guidance and local circumstances before finalising an assessment. The Likelihood has been assigned to the most significant harmful health effect, or consequence, for the health hazards listed.

Refer to the Business Specific Health Hazard Inventory for further examples of health hazards relevant to a particular business.
### Biological Hazards

<table>
<thead>
<tr>
<th>Health Hazard</th>
<th>Examples of situations or activities in which the health hazard may occur</th>
<th>Harmful health effects from over exposure (Consequences)</th>
<th>Consequence Category (harm to people)</th>
<th>Likelihood</th>
<th>RAM Risk Rating (C x L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food and drink contaminated with microorganisms causing food poisoning, e.g. salmonella, campylobacter, e coli</td>
<td>Contaminated food and/or drink provided by the Company. Examples of sources: sale of perishable foods at Retail outlets, vending machines, kitchens, small food preparation areas, drinking water supplies</td>
<td>Acute: food poisoning - nausea, diarrhoea, headache, fever Chronic: Carrier of disease without having symptoms</td>
<td>Acute: 2</td>
<td>D</td>
<td>2D - Medium</td>
</tr>
<tr>
<td>Insects carrying disease causing malaria</td>
<td>Bites from infected insects in endemic areas</td>
<td>Acute: malaria - could be fatal. Chronic: malaria</td>
<td>Acute: 4 Chronic: 2</td>
<td>C</td>
<td>4C - Medium</td>
</tr>
<tr>
<td>Water borne pathogen - Legionella bacteria</td>
<td>Primarily present in static water systems and emitted as an aerosol e.g. cooling towers, hot water supplies, cutting oil/water emulsions, domestic and safety showers, firefighting systems, high pressure cleaning of fouled systems, car wash machines</td>
<td>Acute: Pontiac fever (mildest form of infection), Legionnaires’ disease - pneumonia (severest form of infection - may be fatal), dependent on the strain of legionella bacteria Chronic: n/a</td>
<td>Legionnaires Disease: 4</td>
<td>B</td>
<td>4B - Medium</td>
</tr>
</tbody>
</table>

### Chemical Hazards

<table>
<thead>
<tr>
<th>Health Hazard</th>
<th>Examples of situations or activities in which the health hazard may occur</th>
<th>Harmful health effects from over exposure (Consequences)</th>
<th>Consequence Category (harm to people)</th>
<th>Likelihood</th>
<th>RAM Risk Rating (C x L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos</td>
<td>Materials containing asbestos, for example, gaskets, ceiling tiles, partitions, insulator</td>
<td>Acute: mildly irritating to eyes and respiratory tract Chronic: Category 1 carcinogen</td>
<td>Cat 1 Carcinogen: 4/5</td>
<td>C</td>
<td>5C - High</td>
</tr>
<tr>
<td>Benzene</td>
<td>Processing, handling and distribution of benzene containing process streams and products, e.g. naphthas, platformate, condensate, gasoline.</td>
<td>Acute: irritant to eyes and respiratory tract, narcotic to CNS Chronic: Category 1 carcinogen</td>
<td>Cat 1 Carcinogen: 4/5</td>
<td>B</td>
<td>5B - Medium</td>
</tr>
<tr>
<td>Health Hazard</td>
<td>Examples of situations or activities in which the health hazard may occur</td>
<td>Harmful health effects from over exposure (Consequences)</td>
<td>Consequence Category (harm to people) - C</td>
<td>Likelihood - L</td>
<td>RAM Risk Rating (C x L)</td>
</tr>
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<tr>
<td>Ethylene oxide</td>
<td>Shell Chemicals marketed product and process material</td>
<td>Acute: cold burns to skin and eyes, shortness of breath, dizziness and drowsiness on inhalation, may cause pulmonary oedema. Chronic: Category 2 carcinogen and mutagen</td>
<td>Cat 2 Carcinogen: 4/5</td>
<td>B</td>
<td>4B - Medium</td>
</tr>
<tr>
<td>Epoxy resins</td>
<td>Contained in some adhesives (maintenance)</td>
<td>Acute: irritant to skin and eyes Chronic: skin sensitizer</td>
<td>Sensitiser: 3</td>
<td>C</td>
<td>3C - Medium</td>
</tr>
<tr>
<td>Hydrogen sulphide</td>
<td>Waste gas stream, sour crude oil, condensates, bitumen and fuel oil tank head spaces</td>
<td>Acute: chemical asphyxiant causing respiratory paralysis. Chronic: n/a</td>
<td>Chemical asphyxiant: 5</td>
<td>C</td>
<td>5C - High</td>
</tr>
<tr>
<td>Kerosine</td>
<td>Fuel, degreasant, solvent e.g. used to cut back bitumen</td>
<td>Acute: irritant to eyes, skin and respiratory tract from mist and vapour, may cause lung damage if swallowed. Chronic: contact dermatitis</td>
<td>Irritant/contact dermatitis: 2</td>
<td>C</td>
<td>2C - Low</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>Blanket gas, to pressurise product transfers</td>
<td>Acute: causes asphyxiation by displacement of oxygen from the atmosphere. Chronic: n/a</td>
<td>Simple asphyxiant: 4</td>
<td>C</td>
<td>4C - Medium</td>
</tr>
<tr>
<td>Tetraethyl lead</td>
<td>Additive in leaded gasoline, tank sludge from leaded gasoline bulk storage tanks</td>
<td>Acute: irritant to skin, eyes and respiratory tract, CNS effects (narcotic, mania, convulsions). Chronic: Category 2 Toxic to reproduction</td>
<td>Acute: 4 Chronic: 4</td>
<td>C</td>
<td>4C - Medium</td>
</tr>
<tr>
<td>Health Hazard</td>
<td>Examples of situations or activities in which the health hazard may occur</td>
<td>Harmful health effects from over exposure (Consequences)</td>
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<tr>
<td><strong>Ergonomic Hazards</strong></td>
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<tr>
<td>Poor workplace/task design leading to e.g. awkward postures, repetitive movements</td>
<td>Heavy use of VDUs (operations and office workers) - screen viewing, use of keyboard and mouse (repetitive movements)</td>
<td>Acute: muscular discomfort; eyestrain; soreness to soft tissues (e.g. wrist) Chronic: musculoskeletal disorders, work-related upper limb disorders, repetitive strain injury</td>
<td>Chronic: 3</td>
<td>D</td>
<td>3D - Medium</td>
</tr>
<tr>
<td>Manual materials handling (excessive stretching, bending, pushing, pulling)</td>
<td></td>
<td>Acute: impaired or unsafe performance, musculoskeletal disorders. Chronic: musculoskeletal disorders; repetitive strain injury</td>
<td>Chronic: 3</td>
<td>D</td>
<td>3D - Medium</td>
</tr>
<tr>
<td><strong>Physical Hazards</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td>Noisy plant and equipment e.g. compressors, boilers, pumps, pneumatic tools, road driving, steam leaks, impact noise from handling drums, cartridge operated tools.</td>
<td>Acute: impact noise - rupture of eardrum; acoustic trauma. Loud steady noise - temporary threshold shift (indicates potential for chronic concern) Chronic: noise induced hearing loss (permanent threshold shift), tinnitus (ringing in the ears)</td>
<td>Chronic: 3</td>
<td>C/D</td>
<td>3C/D - Medium</td>
</tr>
<tr>
<td>Vibration (hand)</td>
<td>Holding a vibrating tool, e.g. pneumatic drills, nut runners, torque wrenches, needle guns</td>
<td>Acute: tingling sensation in the fingers (indicates potential for chronic concern) Chronic: hand/arm vibration syndrome (HAVS), includes vibration white finger</td>
<td>Chronic: 3</td>
<td>C</td>
<td>3C - Medium</td>
</tr>
<tr>
<td>Heat stress</td>
<td>Metabolic (body) heat e.g. tank/furnace cleaning, aggravated by full body ppe. Externally imposed heat e.g. working outside in hot climate, work close to furnaces or flares</td>
<td>Acute: heat stroke leading to death (lesser symptoms: exhaustion, cramps, rash, fatigue) Chronic: n/a</td>
<td>Acute: 4</td>
<td>C</td>
<td>4C - Medium</td>
</tr>
<tr>
<td>Health Hazard</td>
<td>Examples of situations or activities in which the health hazard may occur</td>
<td>Harmful health effects from over exposure (Consequences)</td>
<td>Consequence Category (harm to people) - C</td>
<td>Likelihood - L</td>
<td>RAM Risk Rating (C x L)</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------------------------------------------</td>
<td>---------------------------------------------------------</td>
<td>------------------------------------------</td>
<td>----------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Non ionising radiation: Ultra violet light (UV) - wavelength: 100 - 400 nm</td>
<td>Arc welding, sunlight</td>
<td>Acute: arc eye, erythema and skin burn. Chronic: skin cancer (caucasians)</td>
<td>Chronic: 4 or 5</td>
<td>B</td>
<td>4B - Medium</td>
</tr>
<tr>
<td>Psychological Hazards</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long working hours with few breaks</td>
<td>Potential in shutdown operations</td>
<td>Acute: impaired or unsafe performance (may lead to a safety incident or production loss). Chronic: psychological stress, depression, absenteeism</td>
<td>Chronic: 4</td>
<td>C</td>
<td>4C - Medium</td>
</tr>
<tr>
<td>Poor organisational design e.g. poor communication, inappropriate targets, time/pressure demands</td>
<td>Potential in all operations</td>
<td>Acute: impaired or unsafe performance (may lead to a safety incident or production loss). Chronic: psychological stress, depression, burn out, absenteeism</td>
<td>Chronic: 4</td>
<td>C</td>
<td>4C - Medium</td>
</tr>
<tr>
<td>Post traumatic stress disorder</td>
<td>Potential in violent situations, e.g. crime at Retail sites, and following major incidents e.g. explosions</td>
<td>Acute: nightmares, anxiety, depression Chronic: n/a but acute effects may be long term.</td>
<td>Acute: 3</td>
<td>C</td>
<td>3C - Medium</td>
</tr>
</tbody>
</table>
Appendix 4 Identifying Exposures and Reviewing Controls - Are Controls Adequate? (HEMP Steps 3&4 - Control and Recover)

This Appendix provides a suggested methodology to obtain detailed information on exposures to assist with decisions on adequacy of exposure control measures, including:

1. **Who is exposed**
2. Estimating the exposure level
3. Effectiveness of existing controls

### 1. **Who is exposed**

Members of the workforce who might be exposed to health hazards being assessed should be identified. The best approach is to divide the workforce into employee categories, known as Job Types, who carry out similar tasks involving potential exposure to particular hazards and, therefore, have broadly similar exposure profiles. It is also important to consider contractors whose activity involves exposure to the health hazards.

Typical examples of Job Types are:

- Plant operators, sub-divided by their operational group like production, finished production filling, warehousing
- Road tanker drivers, sub-divided by the product(s) they distribute
- Maintenance staff, sub-divided by the type of maintenance involved, for example mechanical, electrical, vehicle, construction
- Cleaning staff, plant and/or office
- Laboratory technicians, with appropriate sub-divisions
- Administrators, whose staff are mainly office-based
- Field staff, like geologists

You should identify the various tasks for each Job Type involving potential exposure to the health hazard being reviewed.

Make a point of drawing on the staff’s own experiences. Discuss the activities of a particular Job Type with the employees concerned and visit the areas where they work.

The HRA should also identify those employees with an increased chance of individual risk. These include:

- Pregnant women and nursing mothers
- Untrained or inexperienced staff such as new recruits or temporary workers
- Staff working in confined or poorly ventilated areas
- Smokers. Smoking can, in some cases, increase the risk to health from exposure to some hazardous agents at work
2. **Estimating the exposure level**

You can establish an employee’s exposure level to a particular agent by estimating:

- The extent of the exposure (for example the breathing zone concentration of the agent, chance of skin contact, noise level, strain on musculo-skeletal system). Examine each task in which the agent is involved and evaluate the measures taken to control exposure. The exposure route should also be identified - whether by inhalation, skin or eye contact, ingestion, hearing, effects on the musculo-skeletal system etc.
- The frequency of exposure measured in times per day, week, month, year
- The duration of exposure in minutes or hours per day
- The likelihood of exposure during normal work or from abnormal conditions or foreseeable emergencies

These estimates can be made from:

a. Existing data and experience
   or, where fuller data is needed by the HRA,
b. By direct measurement of the exposure level

**a) Existing data/experience**

In many cases there will be enough existing data/experience to decide whether exposure is acceptable or not without taking exposure measurements. The decision should be made by competent persons who understand the hazardous agents and who can evaluate the effectiveness of the existing exposure control measures.

*Exposure may be acceptable when*:

- **Quantities** or the amount of use of a chemical agent or the level of a physical agent are too small to constitute a risk in foreseeable circumstances, even if control breaks down

  For example, take the case of a small photocopier sited in a separate room which is generating ozone. General ventilation from the air conditioning system is relied on to disperse the gas and is sufficient. But note that while this may be the case for the occasional use of a small photocopier, it may not be so in a photocopying room where staff are exposed to day-long ozone generation from several working machines.

- **Operations** are being carried out strictly in accordance with well-documented information provided by the suppliers of the plant/equipment about the process and operating conditions with their valid assurances that the operation does not pose health risks.

  For example, the use of a purpose-designed local exhaust ventilation system with built-in filtration to remove welding fume/gases from the operator’s breathing zone and to prevent re-emission into the workplace. Maintenance and worker observation systems exist to ensure that the unit continues to operate to specification and that staff are trained in its correct operation.
• **Previous exposure measures** of the process, in-house or elsewhere, including ‘worst case’ situations, confirm that exposure is not a health risk at any time and conditions now are demonstrably still the same.

• **The process** is conducted to exactly the same standards, or better, as in up-to-date guidance on good practice with valid assurances that exposure is insignificant. For example, wet cooling towers should be treated to prevent the growth of the bacterium which causes Pontiac Fever and Legionnaires’ Disease, in accordance with the generally accepted standards. The standards should be incorporated into the HSE Management System to encourage continuing compliance.

**Exposure may be unacceptable when:**
- There is evidence of fine deposits on people and surfaces
- Fumes or particles are visible in the air (e.g. in light beams)
- There are broken, clearly defective or badly maintained control measures
- Recognised good practice is absent (e.g. eating and drinking in the workplace, incorrect or non-use of Personal Protective Equipment where procedures require its use, visibly poor hygiene conditions in kitchens or wash rooms)
- Complaints about discomfort or excessive odour arise
- If ill health linked to exposure has been reported or detected during health surveillance.

Health surveillance can vary from simple questions from trained supervisors to comprehensive medical supervision. Equal importance must be attached to adverse reports from all types of health surveillance

**b) Measuring the exposure level**

Direct measurement of the exposure to the health hazard to support any HRA decisions should be considered when:
- Doubts arise about compliance with recognised exposure limits
- Excessive exposure could involve particularly serious effects
- Justification is needed to implement control measures to meet the acceptance criteria
- The choice of control measures depends on the concentration of exposure
- Control measure efficiency needs to be evaluated
- Employee concerns need to be alleviated
- Legal requirements come into force
- Investigating or responding to reported health effects

All exposure measurements must follow the validated methodology and quality control procedures.

In general, the type of measurement surveys fall into these categories:
- **Baseline:** to provide data to support the HRA decision-making process
- **Worst case:** Where potentially high exposure events are identified, for example when, during a high emission due to certain working activities, it is possible to select sampling periods. This is often carried out as part of a Baseline Survey as an indicator of compliance with an exposure limit
• **Detailed**: When the degree and pattern of exposure cannot be reliably determined by a Baseline Survey.

• **Routine (also referred to as Periodic Exposure Monitoring)**: Here exposure measurements are carried out regularly following a specified protocol decided by the HRA. This may be required by legislation for certain agents or carried out to check that control measures remain effective. Information on trends or changes in exposure patterns is obtained so that action can be taken before any excessive exposures occur.

An overview of exposure measurement strategies is given in the following flow chart:

**OVERVIEW OF EXPOSURE MEASUREMENT STRATEGIES**

**IF QUANTATIVE EXPOSURE DATA IS REQUIRED TO SUPPORT THE HRA IMPLEMENT THE FOLLOWING**

**CONDUCT ‘BASELINE SURVEY’**

Are personal exposures to the hazardous agent above or potentially above relevant limits?

- **YES**
- **NO**

Are personal exposures well below relevant limits and likely to remain so?

- **NO / NOT SURE**

**CONDUCT ‘DETAILED SURVEY’**

Are exposures above relevant limits?

- **YES**
- **NO**

Are exposures well below relevant limits and likely to remain so?

- **NO**

Are Periodic Exposure Measurements required?

- **YES**

**ESTABLISH ‘ROUTINE EXPOSURE MONITORING’**

Are exposures above relevant limits?

- **YES**
- **NO**

Are exposures well below relevant limits and likely to remain so?

- **YES**
- **NO**

**Is there a need for continuing ‘Routine Exposure Monitoring’?**

- **YES**
- **NO**

**RECORD HRA**

**TAKE REMEDIAL ACTION**

**REPEAT HRA**

**Continue**
Effectiveness of existing controls

The level of exposure experienced by workers is influenced by the work practices and the effectiveness of existing controls. Thus, as part of the review of tasks to determine exposure levels it is important to consider the effectiveness of existing controls and compare them with recommended control standards.

This section should be read in conjunction with Appendix 5: Assessing Controls - the Control Chart, Appendix 6: Setting Control Standards, and Appendix 7: Are Risks Controlled to ALARP?

The following will assist in the review of existing control measures and judging their adequacy:

- Draw up checklists identifying recommended measures for control of exposure to particular agents according to accepted standards against which to evaluate the activity
- Look at what actually happens in the workplace during the task as compared to what is specified by written procedures. Question any differences that occur
- Note aspects of the task which may increase exposure potential, e.g. overtime working or shift patterns increasing exposure time, spillage and leaks, manual decanting of materials, heated products, dusty materials, high ambient temperature in work area, lack of air movement in work area, spraying of liquids, manual movement of materials/equipment, repetitive tasks
- Speak to staff to seek their knowledge of the task, associated hazards and measure for controlling exposure
- Review non-routine and intermittent activities, e.g. maintenance operations, loading and unloading, changes in production cycles
- Take account of unplanned but foreseeable events such as interruptions in work activity, potential for accidental exposure
- Are the medical emergency response arrangements adequate, e.g. first aid measures, transfer of victims to specialist facilities?
- Consider workers not directly involved in a particular task but present in the vicinity and potentially exposed to the hazard, e.g. workers adjacent to someone using noisy equipment or arc welding, vents, drains, waste disposal
- Check the engineering controls provided. Do they meet recommended criteria to protect against the hazard in question? Have they been adequately maintained? Are they used? If not used, why not? What training has been given?
- Check the procedural controls in place, e.g. supervision, written procedures (such as standing instructions and emergency arrangements for controlling normal and abnormal situations), quality of information/instruction/training, housekeeping, quality of records
- Check the personal protective equipment provided. Is it required? Does it provide adequate protection? Is it used? Is it user friendly? Does it create a hazard in itself, e.g. poor visibility, thermal stress, reduced hand dexterity? Is it maintained? Are records kept of issue and maintenance? What training has been given?
- Check the amenities for washing, toilet facilities and storage of clothing. Are they adequate for the number of employees and nature of work?
- Are there any specific requirements for health surveillance?
- Are there any specific requirements for fitness to work requirements?
• Are VDU workstation and task patterns designed to minimise repetitive strain injury and eye strain?
• For psychological hazards refer to commentary under Appendix 6, Section e).

Examples of procedures covering the minimum standards of control that should be in place within the HSE-MS for all health risks no matter whether the risk is Low, Medium or High according to the RAM include:
• Training of staff in the hazards, risks and controls required by their job needs
• Information on hazards, risks and controls readily available, e.g. information cards/leaflets, posters, material safety data sheets, safe operating procedures
• Routine maintenance of engineering controls in place, e.g. examination and test of local exhaust ventilation or lifting equipment
• Where the use of personal protective equipment is required, systems in place to check that it is appropriate, cleaned, maintained and stored correctly
Appendix 5  Assessing Controls - the Control Chart

This Appendix describes a tool, The Control Chart, which has proven to be helpful in deciding on the need for action to strengthen controls and for assigning priorities in remedial action planning. As such it can assist decisions on whether risks are controlled to As Low As Reasonably Practicable. It uses the information on exposures and controls collected for each task (see Appendix 4) to assign a rating to the effectiveness of the controls. This is done by estimating the potential for over-exposure to the hazard taking account of the controls in place, and comparing this with appropriate standards. The resulting ‘Exposure Rating’ can then be plotted against the ‘Hazard Rating’ (RAM Consequence Category for harm to people) to give an indication of the adequacy of the controls, the need for any corrective action and also the priority for each action. This plot is termed the ‘Control Chart’. This process should not be confused with risk assessment using the RAM (see Section 7.2 and Appendix 4), though the definitions for the Consequence Categories are the same as those in the RAM.

The definitions for the Hazard Ratings and Exposure Ratings are given below, followed by the Control Chart itself.

**Hazard Rating**
The relevant Hazard Rating categories are:

<table>
<thead>
<tr>
<th>HAZARD RATING</th>
<th>DEFINITION (Consequence Category: Harm to People)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Slight health effects: Not affecting work performance or causing disability, e.g. non toxic dusts (as an acute hazard)</td>
</tr>
<tr>
<td>2</td>
<td>Minor health effects: Agents capable of minor health effects which are reversible, e.g. irritant agents, defatting agents, many food poisoning bacteria</td>
</tr>
<tr>
<td>3</td>
<td>Major health effects: Agents capable of irreversible health damage without loss of life, e.g. noise, poor manual handling tasks, hand/arm vibration, chemicals causing systemic effects, sensitisers</td>
</tr>
<tr>
<td>4</td>
<td>One to three fatalities or Permanent Total Disability: Agents capable of irreversible damage with serious disability or death, e.g. corrosives, known human carcinogens (small exposed population), sensitisers where the onset of sensitisation threatens continuing employment, heat, cold, psychological stress</td>
</tr>
<tr>
<td>5</td>
<td>Multiple fatalities: Agents with the potential to cause multiple fatalities, e.g. chemicals with acute toxic effects (hydrogen sulphide, carbon monoxide), known human carcinogens (large exposed population)</td>
</tr>
</tbody>
</table>
**Exposure Rating (as part of controls assessment)**

The Exposure Rating categories are:-

<table>
<thead>
<tr>
<th>EXPOSURE RATING</th>
<th>EXPOSURE BAND</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low</td>
<td>(a) (&lt;0.1 \times \text{OEL})</td>
<td>Exposures are negligible</td>
</tr>
<tr>
<td>Low</td>
<td>(b) (&lt;0.5 \times \text{OEL})</td>
<td>Exposures are controlled well below OEL and are likely to remain so in accordance with standards</td>
</tr>
<tr>
<td>Medium</td>
<td>(c) (&gt;0.5 - 1 \times \text{OEL})</td>
<td>Exposures are currently controlled below OEL to meet standards but control may be reliant on less robust measures such as personal protective equipment</td>
</tr>
<tr>
<td>High</td>
<td>(d) (&gt;\text{OEL})</td>
<td>Exposures are not adequately controlled to meet standards and continuously/regularly exceed OEL</td>
</tr>
<tr>
<td>Very High</td>
<td>(e) (&gt;&gt;\text{OEL})</td>
<td>Exposures are excessive and will almost certainly result in health damage to persons exposed</td>
</tr>
</tbody>
</table>

OEL = Occupational Exposure Limit

The Exposure Rating should take into account control measures used to reduce exposure via all relevant routes, e.g. inhalation, skin contact, hearing, effects on musculo-skeletal system, etc. dependent on the hazard. It is easiest to assign a particular Exposure Rating category if measurement data are available, since that data can be compared directly against the OEL. Care must be taken to ensure that the data are representative of the current situation, and, if possible, data from normal and extreme conditions should be obtained. However, exposure measurement data are only one indicator of adequacy of control and are not always readily available. The Exposure Rating category should also consider the reliability of the existing control measures, including engineering methods, procedures and personal protective equipment, to reduce exposures. This is done by comparing the controls with standards of good practice using experience and judgement. Appendix 4 provides guidance on how to do this. Appendix 6 gives guidance on selection of OELs and other control standards with which to compare.

It is emphasised that the use of personal protective equipment (PPE) as the main measure of exposure control is not robust. In such situations, the type of PPE must be checked to ensure it is appropriate for the type and level of the hazard, and maintenance and training programmes must be confirmed. Where PPE is the main form of control, then the Exposure Rating will always be C as a minimum.
Control Chart

When the Hazard and Exposure Ratings are combined in a Controls Chart they provide a visual representation of the urgency of action required to strengthen controls:

<table>
<thead>
<tr>
<th>Hazard Rating</th>
<th>Very Low (a)</th>
<th>Low (b)</th>
<th>Medium (c)</th>
<th>High (d)</th>
<th>Very High (e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Immediate</td>
<td>Third Priority</td>
<td>Second Priority</td>
<td>First Priority for Action</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The position on the chart represents a qualitative interpretation of the need for improved controls to ensure health risks are minimised. Risks can be reduced by moving the Exposure Rating from right to left by improving controls, and the Hazard Rating from bottom to top by substituting with less hazardous alternatives, where it is practicable to do so. The shading splits the need for action to improve controls in to three priorities - First, Second and Third, with a Fourth level not requiring immediate action. Please note that for those agents with the potential to cause irreversible health effects, permanent total disability or death, i.e. Hazard Ratings of 3, 4 or 5, the need for improved controls has been weighted to ensure they receive attention with appropriate priority, even where the Occupational Exposure Limit is not exceeded with the existing controls.

Recommended actions under the various priority headings are as follows:

**Action - First Priority**
- Stop the exposure
- Notify management immediately
- Identify all sources
- Implement immediate control improvements, e.g. introduce use of Personal Protective Equipment as a short term measure until other more robust controls are in place
- Consider need for exposure measurement
- Identify and implement work practice and control improvements - consider hierarchy of controls
- Review HRA, including measurements, after improvements are made

**Action - Second Priority**
- Reduce exposure to below OEL (Hazard Ratings 1 - 2) and consider reducing to below 0.5 x OEL (Hazard Ratings 3 - 5), e.g. introduce use of Personal Protective Equipment as a short term measure until other more robust controls are in place
- Identify and implement work practice and control improvements - consider hierarchy of controls
- Consider need for exposure measurement
- Review HRA, including measurements, after improvements are made
Appendix 5  Assessing Controls - the Control Chart

Action - Third Priority
- Identify and implement work practice and control improvements - consider hierarchy of controls
- Consider need for exposure measurement
- Review HRA, including measurements, after improvements are made

Action - No Immediate Action Required
- There should normally be no need for immediate action on improved controls. As with other aspects of HSE management, opportunities to achieve continuous improvement should be sought.
Appendix 6 Setting Control Standards

The Business-specific Health Hazard Inventories provide recommended references on health hazard controls which are key inputs to determining appropriate control standards. This Appendix provides an overview of types of control standards.

1. Occupational Exposure Limits

a) Chemical Agents

Personal Exposure: Air Measurement

Many countries have established Occupational Exposure Limits (OELs) for various chemical agents. Units are in:
- Parts per million for gases and vapours
- Milligrams per cubic metre (for all gases, vapours and dusts, except fibrous dusts)
- Fibres per millilitre of air for fibrous dusts

In general, these limits comprise:
- Time-Weighted Average (TWA) exposure: The TWA concentration for a normal 8-hour working day and 40-hour working week to which nearly all workers may be repeatedly exposed, day after day, without adverse effect. And/or,
- Short Term Exposure Limit (STEL): This is applied to chemicals with acute effects and, in general, is a maximum allowable exposure for a 15-minute period. And, in some cases,
- Ceiling Limit: A concentration that should never be exceeded during any part of exposure at work

If a country has no OEL or Shell advisory limit for a particular substance, then the supplier should be asked to provide a working limit with evidence to support the limit. Alternatively, Occupational Health Advisers in the Service Company can be asked for an advised limit through SI-Health Services.

Shell Companies may refer to the documentation and Threshold Limit Values (TLV) list published annually by the American Conference of Governmental Industrial Hygienists (ACGIH).

Other valid reference sources are the European Union’s Indicative Occupational Exposure Limit Values and individual national limits, for example the United Kingdom’s Occupational Exposure Standards (OESs) and Maximum Exposure Limits (MELs), the Netherlands’ MAC warden and the German Maximale Arbeitsplatzkonzentrationen (MAKs) and Technical Exposure Limits (TRKs).

Personal Exposure: Biological Monitoring and Biological Effect Monitoring

Biological monitoring and biological effect monitoring are methods for assessing the absorption of certain substances to which individuals may be exposed in the workplace. These techniques
are particularly useful because they reflect absorption by all routes, i.e. by skin absorption and ingestion as well as by the more usual airborne route. They have the important advantage of giving additional information about individual risk.

Biological monitoring involves the measurement of a hazardous substance or its metabolites\(^2\) in body fluids, usually blood, urine or exhaled breath. Biological effect monitoring is the measurement of a reversible biochemical change caused by the absorption of the substance; the degree of change being below that associated with toxic injury and not associated with a known, irreversible pathological effect.

Biological Limit Values (BLVs) have been set for a number of chemical agents. A BLV is the maximum allowable concentration in body fluids of workers of a chemical or its metabolite which does not cause adverse effects. Shell Service Company recommended BLVs are given in Report HSE 94.014 Laboratory Tests for Biological Monitoring and Biological Effect Monitoring.

**b) Physical Agents**

Occupational Exposure Limits for physical agents identified in the following references are advised unless national limits are more stringent:

- Cold stress: OGP Guide No. 6.65/270
- Ionising radiation: HSE Panel Guide 1993
- Heat stress: OGP Guide No. 6.70/279
- Lasers: ACGIH TLV
- Light (visible): DEP 1992
- Illumination levels (lux): 33.64.10.10 92/12
- Near infra-red radiation: ACGIH TLV
- Radio frequency/microwave radiation: ACGIH TLV
- Static magnetic fields: ACGIH TLV
- Sub-radiofrequency (30 kHz and below) and magnetic fields: ACGIH TLV
- Sub-radio frequency (30 kHz and below) and static electric fields: ACGIH TLV
- Ultra-violet radiation: ACGIH TLV
- Vibration - hand/arm (segmental): ACGIH TLV

**c) Biological Agents**

The presence of pathogenic biological agents should be controlled to a level as low as is reasonably practicable to prevent infection/disease occurring. A regime of routine treatment of potential breeding grounds for these organisms to prevent their reproduction may be required in risk areas, e.g. work locations in areas where malaria-bearing mosquitoes are present, cooling towers which may harbour the Legionella species of bacteria, food preparation areas.

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\(^2\) A metabolite of a substance is either a breakdown product or modified (more soluble) form suitable for excretion by the kidney in the urine or by the liver into the intestine.
d) Ergonomics
Ergonomic principles in the design of tasks and workplaces should be applied to all work activities to reduce the likelihood of staff suffering from, for example, discomfort, musculoskeletal problems, psychological stress (see next paragraph).

e) Psychological
Psychological illness such as depression or mania (abnormally elevated mood, speech, and behaviour), anxiety, post-traumatic stress disorders and sometimes psychoses can be seen in the occupational setting. In general these will be referred to a specialist for evaluation and treatment. Interventions to prevent exacerbation of illness are not well developed except in the prevention of mania. For that illness, rotating shifts can be a precipitating factor. Treatment intervention is especially important for post-traumatic stress disorders. Following the event, structured intervention is highly correlated with a successful outcome particularly in those at high risk.

‘Stress’ is a broad term, and unless associated with one of the above diagnosable disorders, generally best thought of as an organisational design or effectiveness issue. Common threads seen in organisational design include excessive travel/work-hours, inappropriate time/product delivery, lack of management caring, little attention to work-home balance, and lack of management vision.

Interventions are aimed at three levels:
- Primary prevention (e.g. addressing work design/organisational effectiveness)
- Secondary prevention (e.g. symptom relief such as stress groups or ‘heart mapping’)
- Tertiary prevention (e.g. treating the affected with Employee Assistance Programmes).

The research effectiveness of all three levels of interventions is most promising for primary prevention models. Secondary prevention research has yielded the most controversial and uncertain findings. Tertiary interventions and in particular Employee Assistance Programmes have achieved a 50% improvement in the return to work in those individuals that present for evaluation and treatment.

Improved individual people management skills will probably be key to minimising stress in the company.

2. Specifications for Engineering (plant and equipment) Controls

For example: methods of containment such as double-mechanical seals, sealed sampling systems, acoustic enclosures, general and local exhaust ventilation, mechanical aids, etc.

Any local legislative requirements must be met. References to design specification for engineering controls are extensive. Sources include company, industry, national, European and international bodies and professional institutions.
3. **Specifications for Procedural Controls**

For example: supervision, work methods, housekeeping, personal hygiene, information, instruction and training.

The standards for procedural controls should be identified to ensure the continuing integrity and effectiveness of the implementation of controls that might arise from HRA. As far as possible, these should be incorporated into existing HSE management systems and operating procedures and they should be compatible with national requirements and the accepted industry standards.

4. **Specifications for Personal Protective Equipment (PPE)**

For example: respiratory protective equipment, eye/face protection, hearing protection, skin protection (body and hand).

All local legal requirements must be met. The HSE Panel Guide on Personal Protective Equipment (1989) gives a general review of standards for different types of PPE, although standards will require checking to ensure they are current. The use of PPE should only be considered when control measures in the categories above are not practicable, or as a secondary line of defence.
Appendix 7  Are Risks Controlled to As Low As Reasonably Practicable (ALARP)?

For RAM Medium and High risks it is necessary not only to confirm the adequacy of control and recovery measures in place but to demonstrate that the risks are controlled to As Low As Reasonably Practicable (ALARP). This involves balancing the reduction in risk against the time, difficulty and cost of achieving it and requires judgements, balances and trade-offs. It aims to achieve a performance that is better than required by regulation to a level that can be realistically afforded. It is a management judgement for which there are no hard and fast rules.

Underpinning the judgement on adequacy of control are two key concepts - exposure limits and reasonable practicability. This Appendix considers these two concepts and how they should be applied to arrive at the best decision for selection of control and recovery methods.

Occupational Exposure Limits
An overview of exposure limits is given in Appendix 6.

The concept underpinning these limits is one of 'no harm levels', i.e. that there is an exposure level where the risk disappears, or is so small that it is tolerable. These limits are set at a level where, in the opinion of the authorities, any results of exposure are low enough to be tolerated, and may be referred to as the 'tolerability level'. The limits are usually set on the basis of epidemiology, laboratory testing and knowledge of the chemistry, physics and health impact of the agent in question.

Since Occupational Exposure Limits are usually mandatory, there is no decision as to whether they should be met.

Reasonable Practicability
Reasonable practicability relates to the lowest level below the ‘tolerability level’, at which it is considered reasonable to control exposure to a health hazard, hence the term as low as reasonably practicable, ‘ALARP’. At its highest level it should meet legislative requirements such as the Occupational Exposure Limit, but selection of its lowest level is subject to discussion and decisions balancing reduction in risk against the time, trouble, difficulty and cost of achieving it. It is the point at which the effort to introduce further reduction measures become unreasonably disproportionate to the additional risk reduction that will be obtained. To put it another way, where additional controls are reasonably practicable, then these should be implemented.

This can be illustrated taking an example where the exposure limit for a chemical agent is 5 ppm 8hr Time Weighted Average (TWA), and the present controlled exposure is 4ppm TWA. If, with a small outlay on a better control measure, it would be possible to get that to 0.5 ppm TWA, then ALARP would indicate that the better control is justified - the large gain in risk reduction is worth the small extra cost.
Reasonable practicability is essentially about the comparison and selection of control options. Where several control options are possible, these should be compared, and the one’s which take the risk to ALARP should be implemented. So in the example below, controls meeting the first two options are unacceptable because they do not meet the tolerability level (in a health situation, the Occupational Exposure Limit). Controls meeting the third and fourth options do meet that criterion, but for a small additional cost, a large risk reduction is possible at option 5. At the sixth option, to achieve further control would involve costs considerably out of proportion to the reduction in risk. The fifth option is therefore ALARP.

In addition to the tolerability level, ALARP also considers the robustness or reliability of the control measure. If limits are just being met by using a control measure which is prone to failure, such as personal protective equipment, then the risk is less likely to be ALARP, and a more robust control measure, such as local exhaust ventilation, should be considered. This is particularly the case if a weak control measure is being used for a hazard with a serious potential health impact.

As a rule of thumb, you should list the measures that have been taken to reduce the risk. Then you should go on to identify an additional option(s) which might be introduced to reduce the risk further and give reasons as to why this additional control has not been adopted.

Hierarchy of Controls
To allow reasoned decision-making on health risk control selection, the Hierarchy of Control is applied. The Control options for health risks fall into a well recognised general hierarchy. The strongest options are highest in the hierarchy.

Removal/Reduction of the Hazard
Elimination - get rid of the hazard, the practice that introduces it, or the situation that generates it
Substitution - use something different, or use it in a less hazardous form
Selection/Replacement - provide better equipment
Appendix 7 Are Risks Controlled to As Low As Reasonably Practicable (ALARP)?

**Engineering Controls**
- Total Enclosure - keep the hazard within the plant
- Partial Enclosure with local exhaust ventilation
- Local Exhaust Ventilation
- General Ventilation
- Noise Insulation
- Mechanical lifting equipment

**Procedural**
- Reduce numbers of employees exposed
- Reduce periods of exposure
- Good working procedures to minimise cross-contamination
- Good housekeeping, storage, maintenance procedures and facilities
- Good washing, laundry and personal hygiene procedures and facilities

**Protective Equipment**
- Respiratory protective equipment
- Hearing protection
- Thermal extreme protection

While the above list can only be partial, it illustrates a range of control options and where they fit in the hierarchy.

As discussed, selection of the most appropriate control measures should result in the risk being ALARP. In general, the higher in the hierarchy a control measure is, the more effective and the more robust it is. However, as a general rule, the higher in the hierarchy a control measure is, the more expensive it is. This may be in terms of process change, capital investment, maintenance cost, training etc. Although it should not be overlooked that there can be significant running costs associated with controls lower in the hierarchy, such as a personal protective equipment programme both in terms of equipment and supervision. This balance of effectiveness versus cost is at the heart of ALARP.

**How to identify the ALARP option?**

There are several good ways of testing and recording the ALARP decision. Demonstration of ALARP is often very important, as regulators may challenge the final decision, and a well recorded thought process leaves an important audit trail.

The process consists of generating a set of control options and then submitting them to the judgement process shown in the chart above to identify the one which is ALARP. However there are certain techniques available which allow the ALARP option to be identified more reliably. These are discussed below.
Tiered Challenge
A team of operations and specialist staff works together down the hierarchy, identifying all the possible control options in each category. The team then starts with the highest one and challenges why it cannot be applied. If the case is made and agreed not to apply a control, the team moves on to the next one down. It carries on down the options list, and eventually identifies the option which is most acceptable to all. This is a simplistic description for illustrative purposes. In reality a combination of control operations will normally be required to achieve ALARP.

While this sounds quite formal, the discussion throws up relevant information such as remaining life of the facility, profitability, shutdown opportunities, possible process changes and other key inputs to the ALARP decision. The range of the team ensures a widely thought out solution. An example of a format to assist this tiered challenge is given at the end of this Appendix.

Good Practice
Good practice is a general term for good engineering and procedural practices for common situations. It may include solutions which have not been incorporated into design standards but have been found to be successful in the field. Good practice is found in Shell internal guidance such as the Shell HSE Advisers Panel publications, EP 95000, Governmental publications and Industry Association publications. It is also found by communicating with colleagues in similar operations within Shell, and in other operators through trade associations. Formal and informal benchmarking is another source of good practice.

While good practice may not be appropriate where a unique situation exists or where a state of the art improvement is required, it gives a good feel for what is acceptable, and can certainly be used as a minimum from which to work.

Codes and Standards
Codes and standards embody the lessons learnt over past years, and for well understood hazards and situations often provide an appropriate solution. Design codes for particular types of plant and particular services will specify appropriate health risk control and recovery measures. They do however lack a continuous improvement element.

Engineering Judgement
Engineering judgement involves sound application of engineering and scientific principles and methods to a control situation. It includes within it a subjective experience based feel for what is acceptable. It is particularly useful for filtering out extremes - situations which are clearly inappropriate to allow more rigorous analysis of the less clear situations.

It is of course less easy to defend than the more formal analyses, but usually comes to a sound solution much more quickly. It does however require an experienced practitioner.

Stakeholder Consultation
Consultation with stakeholders - workforce, particularly those exposed, safety representatives, supervisors, managers, regulators - is an important part of the ALARP judgement, particularly if the
views, concerns and perceptions of any of these groups is not aligned. While control and recovery measures should be based on engineering and analysis as described to show ALARP, it is important that stakeholders buy in to the final decision.

**HAZID and HAZOP**
Hazard Identification (HAZID) and Hazard and Operability (HAZOP) studies are structured brainstorming techniques usually used within projects to ensure all potential hazards and threats are identified, understood and controlled. While not specifically used for health hazards, they can incorporate them, and verify appropriate control, within their scope.

**Risk Quantification Tools**
The application of the following tools in evaluating health risks is not yet well developed but may well be in the future. They are used extensively in safety engineering, particularly for selecting plant design and equipment options. They are in fact true ALARP tools as they do attempt to quantify the risk and the cost of each option and use this in a mathematical way to make the ALARP selection.

**Quantitative Risk Assessment**
Quantitative Risk Assessment (QRA) is a mathematical tool used extensively for major accident hazards, but is not normally applied to health risks. QRA is particularly used to show that plant and installation designs have reduced the overall risk to ALARP. However it can be laborious, difficult to interpret, and suffers from ‘garbage in, garbage out’.

**Cost Benefit Analysis**
Cost Benefit Analysis (CBA) is a mathematical tool which balances costs and safety improvements to derive ‘implied costs of averting a statistical fatality’. It should be possible to use it in a health sense, but it is not used in this way at present.
### Suggested record format for tiered challenge of Hierarchy of Controls

<table>
<thead>
<tr>
<th>Location</th>
<th>Task</th>
<th>Hazard</th>
<th>HRA date</th>
</tr>
</thead>
<tbody>
<tr>
<td>General recommendations:</td>
<td></td>
<td></td>
<td>Resp. person</td>
</tr>
<tr>
<td>Further information required? Y/N</td>
<td>Details:</td>
<td></td>
<td>Resp. Person</td>
</tr>
<tr>
<td>Can the hazard be eliminated?</td>
<td>Yes</td>
<td>No</td>
<td>If yes remedial action is elimination. Transfer action to remedial action table, with name of responsible person</td>
</tr>
<tr>
<td>Can the hazard be substituted with a less hazardous agent?</td>
<td>Yes</td>
<td>No</td>
<td>If yes remedial action is substitution. Transfer action to remedial action table, with name of responsible person</td>
</tr>
<tr>
<td>Can the agent be isolated to reduce the risk?</td>
<td>Yes</td>
<td>No</td>
<td>If yes remedial action is isolation. Transfer action to remedial action table, with name of responsible person</td>
</tr>
<tr>
<td>Can engineering controls be used to reduce the risk?</td>
<td>Yes</td>
<td>No</td>
<td>If yes remedial action is engineering controls. Transfer action to remedial action table, with name of responsible person</td>
</tr>
<tr>
<td>Can procedural controls be used to reduce the risk?</td>
<td>Yes</td>
<td>No</td>
<td>If yes remedial action is procedural controls. Transfer action to remedial action table, with name of responsible person</td>
</tr>
<tr>
<td>Can personal protective equipment be used to reduce the risk?</td>
<td>Yes</td>
<td>No</td>
<td>If yes remedial action is Personal protective equipment. Transfer action to remedial action table with name of responsible person</td>
</tr>
</tbody>
</table>

Assessment of control options carried out by: | Date: |
Approved by: | Date: |

---

1. The assessment of the practicability of the control measures to achieve control of risk to ALARP using a tiered challenge of the hierarchy of controls.

N.B. A combination of control options may be appropriate to achieve ALARP
Appendix 8   Example Record Format

The following provides an example record format covering information identified in the main text which should be captured in the HRA record to ensure that there is an audit trail on how conclusions/decisions were reached.

The information can be captured on paper format, or entered into a database package. The format suggested below includes a coding system for hazards, job types and tasks, which allows sorting of the data against anyone of these parameters when a database is used.

Separately, there is a need for recording associated documentation, for example, exposure measurement data (including airborne and biological), health surveillance, ventilation maintenance and testing, personal protective equipment issue and maintenance, recommendations, follow up etc. It is recommended that these are recorded separately making use of available standard location system(s), where appropriate.

The record format shown follows the following general structure:

**HEMP stage one/two: Identify/Assess**

<table>
<thead>
<tr>
<th>Assessment Identification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>Exploration and Production</td>
</tr>
<tr>
<td>Country</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>Company/Operator</td>
<td>Shell Expro</td>
</tr>
<tr>
<td>Location/Asset</td>
<td>Brent Alpha</td>
</tr>
<tr>
<td>Assessment Unit</td>
<td>This AU comprises all staff associated with the drilling, maintenance and workover of wells. This covers the Shell supervision, the KCA drill crew and any associated permanent or transient contractors.</td>
</tr>
</tbody>
</table>

**Is this a new HRA or an adaptation of a generic HRA?**

- New   X
- Generic
### HRA Team (responsible for carrying out HRA)

<table>
<thead>
<tr>
<th>Name</th>
<th>Job Title</th>
<th>Dept/Company</th>
<th>Role on Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. Smith</td>
<td>Drilling Supervisor</td>
<td>Shell UEDN/311</td>
<td>Leader</td>
</tr>
<tr>
<td>A. Jones</td>
<td>Driller</td>
<td>KCA</td>
<td>Member</td>
</tr>
<tr>
<td>R. Evans</td>
<td>Roustabout</td>
<td>KCA</td>
<td>Member</td>
</tr>
<tr>
<td>A. Black</td>
<td>Logging Engineer</td>
<td>Schlumberger</td>
<td>Trainee</td>
</tr>
<tr>
<td>D. Clark</td>
<td>Occupational Hygienist</td>
<td>Shell UESE</td>
<td>Facilitator</td>
</tr>
</tbody>
</table>

### Location/Asset Team (HRA owner responsible for approving and progressing actions)

<table>
<thead>
<tr>
<th>Name</th>
<th>Job Title</th>
<th>Dept/Company</th>
<th>Accountability</th>
</tr>
</thead>
<tbody>
<tr>
<td>K. Brown</td>
<td>BU Manager</td>
<td>Shell UEDN</td>
<td>Asset Owner</td>
</tr>
<tr>
<td>B. Whyte</td>
<td>Platform Manager</td>
<td>Shell UEDN/3</td>
<td>Asset Manager</td>
</tr>
<tr>
<td>R. Green</td>
<td>OIM</td>
<td>Shell UEDN/31</td>
<td>Asset Operator</td>
</tr>
</tbody>
</table>

**Assessment Reviewed by:**  
Sign: R. Green  Date: 06/04/01

**Assessment Accepted by:**  
Sign: R. Brown  Date: 15/04/01

**Next Review:**  
Date: 15/04/02
## Assessment Unit Health Hazard Inventory

<table>
<thead>
<tr>
<th>Code</th>
<th>Type</th>
<th>Hazard</th>
<th>Acute Effects</th>
<th>Chronic Effects</th>
<th>Occupational Exposure Limit (OEL) reference</th>
<th>RAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0111</td>
<td>Chm</td>
<td>Oil based mud</td>
<td>Skin and lung irritant, Slightly narcotic</td>
<td>Skin damage, skin sensitiser</td>
<td>Vapour: 100 ppm 8 hr TWA (based on Stoddart solvent MW140); Mist: 5mg/m3 8hr TWA - Operating Unit Internal Working Limit</td>
<td>3C-M</td>
</tr>
<tr>
<td>H0112</td>
<td>Chm</td>
<td>Mud additives (powders)</td>
<td>Eye, skin and lung irritant,</td>
<td>Skin damage - dermatitis</td>
<td>Dust: 8 hr TWA 2 mg/m3 Operating Unit Internal Working Limit</td>
<td>2D-M</td>
</tr>
<tr>
<td>H0352</td>
<td>Phy</td>
<td>Noise</td>
<td>Rupture of eardrum, acoustic trauma</td>
<td>Noise induced hearing loss, tinnitus</td>
<td>85db(A) 8 hr daily noise dose; 135 dB Impulse - Shell Noise Guide 1991</td>
<td>3D-M</td>
</tr>
<tr>
<td>H0232</td>
<td>Psy</td>
<td>Long and irregular hours or working cycles</td>
<td>Impaired or unsafe performance</td>
<td>Psychological stress, depression</td>
<td>Best practice and national regulation</td>
<td>4C-M</td>
</tr>
</tbody>
</table>

etc
### HEMP stage three/four: Control/Recover

#### Job Type/Exposure Groups

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Overview description of job and tasks</th>
<th>Number per shift</th>
<th>Basic hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>J006</td>
<td>Drillfloor crew - Driller, assistant driller, derrickman, floorman, roughneck</td>
<td>Make and break drillpipe, prepare and run assemblies, control well</td>
<td>7</td>
<td>07.00 – 19.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.00 - 07.00</td>
</tr>
<tr>
<td>J008</td>
<td>Drilling fluids team - Derrickman, roustabout, mud engineer</td>
<td>Mix and treat mud and brine, carry out oilwell cementing</td>
<td>5</td>
<td>07.00 – 19.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.00 - 07.00</td>
</tr>
<tr>
<td>J015</td>
<td>Well logging team - Logging engineer, MWD engineer</td>
<td>Prepare and run logging tools, load radioactive sources</td>
<td>3</td>
<td>07.00 – 19.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.00 - 07.00</td>
</tr>
</tbody>
</table>

etc

#### Exposure Tasks (to RAM M/H Hazards)

<table>
<thead>
<tr>
<th>Code</th>
<th>Task</th>
<th>Work Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>T001</td>
<td>Makes and breaks drillpipe and tools on drillfloor</td>
<td>Drill floor</td>
</tr>
<tr>
<td>T002</td>
<td>Prepares, handles, treats and tests drilling fluids</td>
<td>Shaker house, Pit room</td>
</tr>
<tr>
<td>T003</td>
<td>Loads radioactive sources into tools</td>
<td>Drill floor</td>
</tr>
</tbody>
</table>

etc
### Task Appraisal (Complete for each Exposure Task)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H0111</td>
<td>Oil based mud</td>
<td>J006, J008</td>
<td>H011</td>
<td>Oil based mud</td>
<td>Base oil piped from bulk storage to mud pits via venturi liquid addition system. Potential for oil mist generation during mixing of oil with additives. Potential for inhalation of mist and vapour while working in shaker house and pit room.</td>
<td>1 / week</td>
<td>8 hours</td>
<td>Shakers have intrinsic local exhaust ventilation hoods. Mud pits plated, extract ventilation below plates limiting oil mist emission to shaker house. Ventilation tested and efficient. Goggles and PVC gloves worn.</td>
<td>+ following testing</td>
<td>Low (B)</td>
<td>3b oil-based mud</td>
<td>Yes</td>
<td>?</td>
<td>No</td>
<td>Not required</td>
<td>Yes - test ALARP</td>
</tr>
<tr>
<td>H0112</td>
<td>Mud Additives</td>
<td>J006, J008</td>
<td>H012</td>
<td>Mud Additives</td>
<td>Powder mud additives added to mud system via cutting booth. Potential for eye/skin contact and inhalation.</td>
<td>1 / week</td>
<td>8 hours</td>
<td>Cutting booth has Local Exhaust Ventilation. Empty sacks placed in open</td>
<td>+ following testing</td>
<td>Medium (c)</td>
<td>2c additives</td>
<td>May exceed STEL during bag handling</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H0352</td>
<td>Noise</td>
<td>J006, J008</td>
<td>H035</td>
<td>Noise</td>
<td>Shaker house and pit room are hearing protection zones (levels &gt;85dB(A)).</td>
<td>3 / week</td>
<td>12 hours</td>
<td>Peltor H7 earmuffs provided - but muff seals worn and need replacing.</td>
<td>-</td>
<td>Medium (High)</td>
<td>3c/d</td>
<td>No</td>
<td>No</td>
<td>Yes - audiometry</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>H0189</td>
<td>Manual materials handling</td>
<td>J006, J008</td>
<td>H019</td>
<td>Manual materials handling</td>
<td>25 kg sacks transferred from pallet to chemical addition point. Bending and twisting necessary to lift sacks.</td>
<td>1 / week</td>
<td>3 hours</td>
<td>Only 25 kg sacks purchased Sacks stored on pallets and transferred from storage via forklift. Manual lifting of sacks from pallet to addition point</td>
<td>+</td>
<td>Medium (c)</td>
<td>3c</td>
<td>No</td>
<td>n/a</td>
<td>Not required</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

1. The exposure level may be represented by the Exposure Rating (See Appendix 5 - Control Chart) - optional tool
2. Combined Hazard and Exposure Rating (See Appendix 5 - Control Chart) - optional tool to indicate priorities for action

---

**Task Recovery Measures:**

- Safety shower, eyewash, medic on location - phone contact
- Tested Y/N? Best practice Y/N? Action required Y/N?

- Yes
- Yes
- No

And so on for each task.
### Recommendations - Remedial Action Plan

<table>
<thead>
<tr>
<th>Rec. No</th>
<th>Hazard Code</th>
<th>Recommendation (using hierarchy of controls, principle of ALARP) (Also note need for further information)</th>
<th>Action accepted? If no, give reason</th>
<th>Responsible person</th>
<th>Due Date Target</th>
<th>Date Completed</th>
<th>Revised Control Chart Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>T002-01</td>
<td>H0111</td>
<td>Consider automated mud treatment system - assess reasonable practicability</td>
<td>No, space restraints make this impractical</td>
<td>OIM</td>
<td>01/05/01</td>
<td>01/05/01</td>
<td>2b</td>
</tr>
<tr>
<td>T002-02</td>
<td>H0112</td>
<td>Investigate inclusion of sealed empty bag disposal facility integrated into the cutting booth. Meanwhile review empty bag handling to limit dust emission and wear dust mask.</td>
<td>Yes</td>
<td>OIM</td>
<td>01/05/01</td>
<td>16/04/01</td>
<td>2b</td>
</tr>
<tr>
<td>T002-03</td>
<td>H0352</td>
<td>Renew seals on ear muffs</td>
<td>Yes</td>
<td>OIM</td>
<td>01/05/01</td>
<td>01/05/01</td>
<td>3c (PPE)</td>
</tr>
<tr>
<td>T002-04</td>
<td>H0352</td>
<td>Review procedure for inspecting hearing protection and staff training to ensure ear muffs repaired/replaced as required</td>
<td>Yes</td>
<td>OIM</td>
<td>01/06/01</td>
<td>20/05/01</td>
<td>3c</td>
</tr>
<tr>
<td>T002-05</td>
<td>H0352</td>
<td>Ensure all staff within Job Types J006 and J008 undergo audiometry checks</td>
<td>Yes</td>
<td>Platform Manager</td>
<td>01/06/01</td>
<td>28/05/01</td>
<td>3c</td>
</tr>
<tr>
<td>T002-06</td>
<td>H0352</td>
<td>Instigate biannual check of area noise levels and personal noise dosimetry</td>
<td>Yes</td>
<td>OIM</td>
<td>01/06/01</td>
<td>20/06/01</td>
<td>3c</td>
</tr>
<tr>
<td>T002-07</td>
<td>H0352</td>
<td>Consider methods to reduce noise at source</td>
<td>Yes</td>
<td>Platform Manager</td>
<td>01/01/02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T002-08</td>
<td>H0189</td>
<td>Purchase sack lifter for raising sacks to hopper level and minimise need for manual handling</td>
<td>Yes</td>
<td>OIM</td>
<td>01/10/01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3 Refer to suggested record format for tiered challenge of Hierarchy of Controls (See Appendix 7 - Are Risks Controlled to ALARP?)

4 Review Control Chart Rating following introduction of controls as an indicator of revised health risk (See Appendix 5 - Control Chart) - Optional tool

**Note:** For ease of reference, list recommendations for all tasks carried out by each Job Type in one table
Appendix 9  Health Impact Assessment

1. Introduction

The Group position on Health Impact Assessment is evolving. This Appendix is a general introduction.

The Minimum Health Management Standards require a Health Impact Assessment (HIA) for all projects where there is the potential to impact on the health of the local community and/or staff and families. The HIA is to be made in conjunction with any Environmental and Social Impact Assessment required and should cover all new projects, major modifications and prior to abandonment of existing projects.

The potential impacts on human health of industrial development are numerous and cut across many specialist concerns. Most industrial development projects are expected to have an indirect beneficial effect on health by increasing the resources available for food, education, employment, water supplies, sanitation, and health services. Sometimes the indirect impacts include unexpected negative effects on health. Many of these can be avoided by careful planning. Adverse health impacts are most likely to affect the most vulnerable social groups. This may serve to amplify the overall adverse effects. Such impacts reduce the social and economic benefits expected from industrial development.

Experience shows that the Environmental or Social Impact Assessment in assessing the biogeographical environment does not pay due attention to the health component. Health Impact Assessment offers an opportunity to identify health hazards in advance. Analysis of health risk provides an opportunity both to implement risk controls and to incorporate health-promoting measures.

2. Main steps and operational procedures of the Health Impact Assessment

The main steps in a Health Impact Assessment are (i) identification of health hazards, (ii) interpretation of health risks, and (iii) management of health risks. The operational procedures required to achieve these steps are:

- **Initial screening of the project for health hazards**: The initial screening process identifies the health hazards associated with the project. This may be carried out as part of the scouting phase or early feasibility phase of a project.

- **Initial health examination, or rapid appraisal**: The initial health examination, or rapid appraisal, uses existing information to assess whether the health hazards will actually cause health risks. The rapid appraisal will result in a project health risk classification, which may indicate the need for a full Health Impact Assessment. This is carried out as part of the feasibility phase of a project.

- **Full health impact assessment**: A full health impact assessment involves detailed field studies and is more rigorous, extensive and specific. This is carried out as part of the feasibility phase of a
project in parallel with the preparation of the basis-of-design for the facilities. It usually involves the preparation of a Health Baseline Study.

- **Proposals for health risk management:** Where significant health risks are attributable to the project health safeguards and mitigation measures should be incorporated in the project life cycle, from construction, through operation and maintenance, until decommissioning.

3. **Benefits of the Health Impact Assessment**

- The project owner/operator will need the Health Impact Assessment as a calibration point, in order to demonstrate both to themselves and to third parties, including courts of justice, that they manage health properly and that they adequately protect the relevant communities from untoward health effects brought on by the project and its (associated) operations.
- The Health Impact Assessment will help to demonstrate to the various stakeholders that the project owner/operator are serious about protecting the health of the relevant communities.
- The knowledge acquired on the health status/susceptibility of the relevant population will assist the project owner/operator with protecting the health of the relevant communities from the hazards associated with the project and its (associated) operations.
- The Health Impact Assessment will help the project owner/operator in determining how they can best assist both at a short and a longer term with improving community health in the project area, which could well be one of the benefits the local communities expect to get out of the project.

4. **Planning and scope of the Health Impact Assessment**

- The Health Impact Assessment should be implemented before field activities start, at about the same time as the Social and Environmental Impact Assessment.
- The Health Impact Assessment should address the health of all communities which may be impacted upon by the project and its (associated) operations e.g. local communities, imported & local workers and their families, camp followers.
ACUTE HEALTH EFFECTS
Acute health effects are those which occur suddenly and in a short time (seconds to hours) following exposure, generally to higher levels or concentrations of a health hazard. An acute exposure runs a comparatively short course.

AGENTS HAZARDOUS TO HEALTH
See ‘Health Hazard’.

AS LOW AS REASONABLY PRACTICABLE
To reduce a risk to a level which is ‘as low as reasonably practicable’ involves balancing reduction in risk against the time, difficulty and cost of achieving it. This level represents the point, objectively assessed, at which the time, difficulty and cost of further reduction measures become unreasonably disproportional to the additional risk reduction obtained. It represents a performance that is at least equal to that required by regulation and exceeds it to a level that can be realistically afforded.

ASSESSMENT TEAM
A group of people selected to carry out Health Risk Assessments within an Assessment Unit.

ASSESSMENT TEAM LEADER
The line manager, or his representative, responsible for co-ordinating the activities of the Assessment Team.

ASSESSMENT UNIT
A unit comprising a complete operational site, a self-contained segment of a large or complex site, or a group supporting a single business process, so defined as to assist in the management of HRA within an organisation.

BASELINE (MEASUREMENT) SURVEY
Quantified personal exposure data is obtained to compare against the relevant Occupational Exposure Limit(s).

BIOLOGICAL AGENTS
For example, insects and mites, moulds, yeasts, fungi, bacteria and viruses, as far as they are related to the working environment.

BIOLOGICAL EFFECT MONITORING
Biological effect monitoring is the measurement of a reversible biochemical change caused by the absorption of the substance; the degree of change being below that associated with toxic injury and not associated with a known, irreversible pathological effect.
BIOLOGICAL MONITORING
Biological monitoring involves the measurement of a hazardous substance or its metabolites in body fluids, usually blood, urine or exhaled breath. A metabolite of a substance is either a breakdown product or modified (more soluble) form suitable for excretion by the kidney in the urine or by the liver into the intestine.

CHEMICAL AGENTS
For example, irritants, carcinogens, systemic poisons, sensitisers. They may be present in the working environment as gases, vapours, mists/aerosols, fumes, dusts, liquids or solids.

CHRONIC HEALTH EFFECTS
Chronic health effects are those which occur gradually over a long period of time following repeated and prolonged exposure to relatively low levels or concentrations of a hazardous agent. In certain cases a short term exposure may result in a chronic health effect.

COMPETENCE
Competence is a function of Knowledge, Skill, and Experience. A competent person should recognise the limits of their competence including when and where to seek further advice.

CONSEQUENCE
The severity of the potential ill-health effect that may occur following exposure to a particular health hazard. See also Hazard Rating.

CONSEQUENCE CATEGORY
Consequences are divided into the following categories: harm to people, environmental effect, loss or damage to assets, impact on reputation.

CONTINUOUS IMPROVEMENT
Year-on-year enhancement of overall health performance, not necessarily in all areas of activity, resulting from continuous efforts to improve.

CONTRACTOR
Contractors are parties working for the reporting OU either as a direct contractor or as a sub-contractor where the OU exercises HSE management control. The need for management control can be established by applying a risk analysis based evaluation (Reference: Group HSE Performance Monitoring and Reporting Guide, 2000).

CONTROL
See ‘Hierarchy of controls’.

DETAILED (MEASUREMENT) SURVEY
Carried out if the degree and pattern of personal exposure cannot be reliably determined by a Baseline (Measurement) Survey.
ENGINEERING CONTROLS
The control of exposure to a hazardous agent by the design of plant and equipment, e.g. containment, exhaust ventilation, mechanical aids.

EPIDEMIOLOGY
Epidemiology is the study of the occurrence of disease in human populations. Epidemiological studies in industry enable us to establish the relationship between work environment and the health, type of illnesses and ultimate causes of death of working people.

To be effective, epidemiology must be based on accurate data on the occurrence of disease, types of jobs and exposures. The quality of the statistical analysis, and therefore the information produced, improves with (i) larger number of people and (ii) longer follow-up periods. Some diseases, particularly cancers, may take several decades to appear.

ERGONOMICS
A multidisciplinary activity dealing with interactions between man and his total working environment. The factors that affect the smooth interface between man and his working environment are:

• body posture and movement (sitting, standing, lifting, pulling and pushing)
• environmental factors (noise, vibration, lighting, climate)
• information and operation (information gained visually or through other senses, controls, relation between displays and control)
• tasks and jobs (appropriate tasks, interesting jobs)

Where ergonomics has not been taken into account in the design of workstations and tasks, staff may suffer, for example, discomfort, musculo-skeletal problems, psychological stress.

EXPOSURE
The amount of the hazard to which a person is subjected (dose). This is a combination of magnitude, frequency and duration.

EXPOSURE PROFILE
Nature and degree of exposure to health hazards.

EXPOSURE RATING
The chance of over-exposure to a health hazard when compared against agreed control standards and is evaluated as Very Low, Low, Medium, High or Very High.

GENERIC APPROACH & GENERIC RECORD
Where several operational sites carry out similar activities involving potential exposure to similar health hazards, it may not be necessary to repeat Health Risk Assessments at each site independently. In this situation a ‘Generic Approach’ to HRAs may be used in which detailed HRAs are only carried out at representative operational site(s) selected to ensure all common activities are covered. The resultant ‘Generic Record’ is then read across to the other comparable sites.
HAZARD
See ‘Health hazard’.

HAZARDS AND EFFECTS MANAGEMENT PROCESS (HEMP)
The structured hazards and effects analysis methodology involving hazard and effect Identification, Assessment, Control and Recovery. To completely manage a hazard or effect requires all four steps to be in place.

HAZARD RATING
A rating allocated to a Health Hazard dependent on the severity of its potential ill-health effect. It is the equivalent of Consequence Category ‘Harm to people’.

HEALTH HAZARD
The potential to cause harm to health. Health hazards may be biological, chemical, physical, ergonomic or psychological in nature.

‘Health hazards’ are also known as ‘agents hazardous to health’ and ‘hazardous agents’. These terms are interchangeable.

HEALTH RISK
The likelihood that a health hazard will cause harm in the actual circumstance of exposure. Health Risk = Hazard x Exposure.

HEALTH RISK ASSESSMENT
The identification of health hazards in the workplace and subsequent evaluation of risk to health. This assessment takes into account existing or proposed control measures. Where appropriate, the need for further measures to control exposure is identified.

HEALTH SURVEILLANCE
Measures for monitoring the health of the workforce if risk to health cannot reasonably be excluded.

HIERARCHY OF CONTROL MEASURES
The means of controlling exposure to health hazards, listed in preferential order as follows:
• Elimination
• Substitution (alternatives)
• Engineering (plant and equipment)
• Procedural
• Personal protective equipment

HSE MANAGEMENT SYSTEM
The company structure, responsibilities, practices, procedures, processes and resources for implementing health, safety and environmental management.
JOB TYPE
Jobs with a similar exposure profile.

JOB TYPE CODE
A code allocated to individual Job Types to assist in the compilation of a work history of employee exposure.

LIKELYHOOD
How likely it is that a particular ill-health effect will occur, based on past experience.

MEDICAL SURVEILLANCE
Medical surveillance is defined as an assessment of an employee’s health using medical or biological procedures (biological effect monitoring) to identify any significant abnormalities attributed to exposure to hazardous agents, at as early stage as possible.

The procedures used should be of acceptably high sensitivity, specificity and predictive value in detecting abnormalities related to the nature and degree of exposure. The criteria for interpreting the data should be known and the procedures should be safe, easy to perform, preferably non-invasive and acceptable to employees. Surveillance should only be undertaken if the possible detected changes are reversible or measures are available to prevent their further development.

OCCUPATIONAL EXPOSURE LIMIT (OEL)
The airborne concentration of chemical agents and levels of physical agents to which workers may be repeatedly exposed day after day without adverse effect. OELs are based on the best available information from industrial experience, from experimental human and animal studies, and when possible, from a combination of the three. The basis on which the values are established may vary from agent to agent; protection against impairment of health may be a guiding factor for some, whereas reasonable freedom from irritation, narcosis, nuisance or other forms of stress may form the basis for others.

OELs are guidelines or recommendations in the control of potential health hazards. THEY ARE NOT FINE LINES BETWEEN SAFE AND DANGEROUS CONCENTRATION nor are they a relative index of toxicity.

OCCUPATIONAL HEALTH ADVISER
A person who, on the basis of his expertise, assists line management with the development and implementation of the occupational health programme. Occupational health advisers may include occupational health physicians, medical advisers and occupational health nurses, occupational hygienists, safety advisers, toxicologists, health inspectors and ergonomists.

OCCUPATIONAL HYGIENIST
A person trained to protect the health and well being of workers and the public from chemical, microbiological and physical health hazards present at, or emanating from, the workplace. An occupational hygienist has particular expertise in implementing HRA.
PERIODIC EXPOSURE MEASUREMENT
See Routine Exposure Monitoring.

PERMANENT TOTAL DISABILITY
Any work related illness or injury which permanently incapacitates an employee and results in termination of employment.

PERSONAL PROTECTIVE EQUIPMENT (PPE)
The collective term describing clothing and equipment used to protect the individual against agents hazardous to health.

PHYSICAL AGENTS
For example, noise and vibration, ionising and non-ionising radiation, extreme temperatures, humidity.

PROCEDURAL CONTROLS
These include: supervision, work methods, housekeeping, personal hygiene, information, instruction, training.

RISK
The product of the chance that a specified undesired event will occur and the severity of the consequence of the event. See also ‘health risk’.

RISK ASSESSMENT MATRIX
The Risk Assessment Matrix is a tool that standardises qualitative risk assessment and facilitates the categorisation of risk from threats to health, safety, environment and reputation. The axes of the matrix are Consequences and Likelihood.

ROUTINE EXPOSURE MONITORING
Exposure measurements carried out on a regular basis to a specified protocol to check if exposure conditions have changed.

SEVERITY
The degree to which an agent hazardous to health can cause harm. See also Hazard Rating.

STANDARD
A prescribed set of rules, conditions or requirements. Standard is an all-inclusive term denoting specifications, recommended practices, procedures, guidelines, philosophies and handbooks.

THRESHOLD LEVEL
No-observed adverse effect level; the highest dose at which no adverse effects are seen.
WALK-THROUGH SURVEY
A walk-through survey is designed to provide an overview of health hazards and associated potential exposures involving a particular working population to assist in the preparation for Health Risk Assessment.

WORK HISTORY OF EMPLOYEE EXPOSURE
A record of an employee’s exposure profile during his/her working career with the company. At its simplest, it consists of name, employee identification number and a list of Job Type Codes and dates.

WORST CASE MEASUREMENT
Quantified personal exposure measurement of events involving potentially high exposure.
Group HSE Management System (1999)
Group Health, Safety and Environmental (HSE) Auditing Guidelines (2001)
Group HSE Performance Monitoring and Reporting (2000)

Further Documents on Occupational Health matters
Asbestos (1986)
Guide for Health Performance Reporting (1993)
Health Guidelines for Catering (1995)
Health Risk Assessment (2001)
Management Guidelines for Hearing Conservation (1991)
Man-made Mineral Fibres with Addendum (1988)
Medical Emergency Guidelines for Management (1994)
Risk Assessment Matrix (1999)
The Use of Contact Lenses in Industry (1984) leaflet
Working with Visual Display Units (1989)

Enhanced Safety Management (1985)
Further Documents on Safety matters
Company-Organised or Supported Social Events - Safety Considerations (1990)
Contractor Safety (1987)
Electrical Safety (1986)
Guidelines for Entry into Confined Spaces (1992)
Guidelines for Laboratory Safety (1989)
Hand Tools and Sparking Hazards (1982) leaflet
Hotel Fires, Plan for Survival (1988) leaflet
Hydrogen Sulphide (1986)
Incident Classification and Reporting (1997)
Incident Investigation and Analysis Guide (1993)
Office Safety (1987)
Safety Features of Light Vehicles and Mini Buses (1997)
Safety Signs and Colour Coding (1981)
Scaffolding Safety (1987)
Seat Belts (1989)
Static Electricity, Technical and Safety Aspects (1988)
The Secondary Use of Containers (1978) leaflet
Tripod-BETA (Incident Analysis EP 95-0321, to be ordered through EP)
Unsafe Act Auditing (1987)
The Use of Small Marine Craft by Group Companies (1992)
Welding and Cutting (1976)
Work Permits (1981)

Environmental Management Guidelines (revised 1992)
Further Documents on Environmental Conservation matters
Guide for Operating Companies on External Environmental Reporting (1992)
Recommendations for Alternatives to Fire Fighting Halons (1994)
Safe Handling and Disposal of PCBs (1985)
Volatile Organic Compounds (1996)

These publications can be ordered from SI The Hague; PXE Division via E-mail: GUIDES, Internet address: Guides-Yellow@shell.com

July 2001

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