Dominica Geothermal
Development Company Limited
Powering a New Generation...

Occupational Health & Safety Manual

DGDC-OHS-000: Index
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Volume 3: Site Specific Safety

Dominica Geothermal
Development Company Limited
Powering a New Generation...

Occupational Health & Safety Manual
Volume 1: Safety Management System

DGDC-OHS-001: Introduction
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1. Introduction

1.1 Purpose of System

It is the policy of Dominica Geothermal Development Company Ltd (DGDC) to provide and maintain safe and healthy working conditions and to develop and follow practices to safeguard all employees, visitors, contractors and the general public at its Dominica facility.

DGDC has developed this Safety Management System and its associated Safety Manuals to identify and describe the practices which the Company, and its management and staff shall follow to achieve the aims stated in DGDC's Health and Safety Policy, and to comply with relevant Dominica safety regulations as well as the Occupational Safety and Health Administration (OSHA) regulations.

The Safety Manual defines the procedures and actions required to ensure the Health and Safety Policy is implemented effectively and consists of three distinct volumes.

Volume 1: ***Safety Management Systems*** - Describes DGDC Health and Safety Policy and establishes the management systems that will be used to manage and review safety performance at each facility operated by DGDC.

Volume 2: ***Safe Work Practices*** - This volume establishes DGDC's minimum standards of safe work practices and emergency procedures for a range of activities and operations that may be undertaken at all facilities. The manual provides steps in identifying, assessing and controlling hazards; details the actions that must be followed in executing safe work practices; and contains information on the selection, care and maintenance of safety equipment. The level of detail allows this volume to be part of a fully integrated training programme for DGDC personnel.

Volume 3: ***Site Specific Safety*** - This manual specifies how the safe work practices, emergency procedures and safety rules will be implemented at a specific facility. The manual assumes that the person undertaking the work is conversant with the safe work practices specified in Volume 2, is trained to an appropriate level of competency, and is aware of the site-specific hazards and rules. It is DGDC's intention that this document is the one that persons readily refer to at the site in order to undertake their work safely.

1.2 Philosophy of Safety Management

The philosophies of the Dominica Geothermal Development Company's safety management system are that it embraces the following:

- Safety is inherent in all its activities.
- Health and Safety of employees are a key part of our business.
- All work must be carried out in a safe manner.
- Inherent hazards exist, but must be managed to as ALAP (as low as reasonably practical)
- Management of Change practices are adopted and encompassed in the management of safety at our work sites.
- Safety in Design principles are followed in the design and purchase of new plant and equipment.
- Continual improvement in safety performance is based on the setting and achievement of pro-active and yet realistic safety objectives and targets.
- All incidents that happen will have lessons learnt to ensure that the same incident does not occur again.

The safety management system which Dominica Geothermal Development Company has adopted is based on the approach used by the ISO14001 *Environmental Management System* and ISO 9000 *Quality Assurance System* and ISO 18001 *Occupational Health and Safety Management Systems* standards. This systematic approach will allow for a safe work environment for all.

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Occupational Health & Safety Manual
Volume 1: Safety Management System

DGDC-OHS-002: Policy and Commitment
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2. Policy and Commitment

2.1 Policy

DGDC's Health and Safety Policy is presented on the following page. Copies of the policy will be displayed in all DGDC's offices and Site reception areas.

It will also be displayed on staff health and safety notice boards throughout the sites operated by DGDC.

A copy of the Health and Safety Policy will be provided to all employees and contractors as part of their site induction training course prior to undertaking work at any site.

All staff, contractors and visitors to DGDC facilities should make themselves familiar with the aims stated in the policy as they are the basis for managing safety at the Company's sites.

Health and Safety Policy

The Dominica Geothermal Development Company is committed to providing a safe and healthy working environment for all employees, contractors, visitors and the public in general with respect to the facilities operated by DGDC. Health and Safety is inherent in all of our business activities. Accordingly, to achieve the aims of the policy DGDC will:

- Conduct business to conform with applicable health and safety laws, regulations, codes of practice and industry standards
- Take all practical steps to ensure the health and safety of employees is protected while at work.
- Seek to eliminate all situations which could lead to personal injury, occupational illness and damage to property and equipment.
- Provide safety training to enable personnel, contractors and visitors to work safely.
- Provide control measures to eliminate, isolate or minimise hazards in the workplace.
- Consider health and safety issues with respect to any changes in equipment, operation and design.
- Ensure the necessary procedures are in place in the event of an incident or an emergency.
- Monitor Health and Safety programs to ensure the effectiveness against pro-active measures.
- Establish a Health and Safety Committee responsible for effectively managing safety at the site and to foster employee involvement.
- Remind each employee safety is inherent in all their work, that they are responsible for their own safety, as well as other personnel and facilities and to report any unsafe act and any unsafe conditions without delay.

DGDC and all its employees share the vital responsibility of establishing and maintaining a safe work environment.

Insert Name
Executive Chairman *Date:*

2.2 Leadership and Commitment

DGDC's commitment to health and safety for all its operations is clear and unequivocal. DGDC will take all practical steps to:

- provide and maintain a safe and healthy working environment
- provide and maintain facilities for the safety and health of employees at work
- conform with all applicable safety laws, regulations and standards
- ensure machinery and equipment in the work place is designed, maintained, set up and operated in a safe manner
- ensure employees are not exposed to hazards in the course of their work
- manage its activities to prevent injuries to employees
- develop procedures for dealing with emergencies that may arise while employees are at work
- continually seek improvement in safety performance
- develop and implement safe work practices at all sites.

Top priority will be given to the provision of financial resources for the correction of unsafe conditions. Similarly, DGDC will take disciplinary action against any employee or contractor who wilfully or repeatedly violates safe work practices and site safety rules.

2.3 General Responsibilities

The Executive Chairman (or CEO when appointed) shall recommend policy on health and safety matters and provide leadership in the development of programs implementing DGDC Health and Safety Policy. Ultimately the responsibility for the safety performance of DGDC rests with the Executive Chairman.

The Site Superintendent of each site operated by DGDC shall have primary responsibility for the implementation of DGDC Health and Safety Policy, and the safety of employees, contractors and visitors at that Site.

Senior management will be actively involved with employees in establishing and maintaining an effective safety management system at all DGDC facilities.

Line management shall be responsible for achieving conformance with DGDC Health and Safety Policy, and for implementing and managing safe work practices within their areas of operation and control. They shall be responsible for ensuring employees under their supervision are adequately trained and have the appropriate safety equipment to carry out their work in a safe manner.

Compliance with DGDC safe work practices and rules shall be required of all employees as a condition of employment. Employees are required to take all practicable steps to ensure their own safety while at work, and to ensure that any of their activities will not cause harm to any other person.

It is the responsibility of all contractors and visitors at a DGDC Site to comply with site safe instructions and the safe work practices set out in the manual.

A Health and Safety Committee will be established according to local legislation at the DGDC site with the Chairperson being appointed as per the legislation. The committee is a way to engage the workforce in improving the site safety culture being led by Management, it will also identify corrective measures needed to eliminate or control hazards. It will act as a forum for evaluating the site's safety performance and for setting safety objectives and targets. Safety implementation at the site is a line management responsibility.

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Volume 1: Safety Management System

DGDC-OHS-003: Safety Management Plan
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3. Safety Management Plan

3.1 Introduction

In order to manage safety at a Site effectively, a management system needs to be introduced. One of DGDC aims is to seek continual improvement on safety performance at Site(s). For this reason, DGDC has adopted a health and safety management system based on the approach specified in ISO 14001: *Environmental Management System* - and ISO18001 *Occupational Health and Safety Management Systems* standards. The elements of this system are present in Figure 3.1.

A key area in continually improving safety performance is the ability to identify, assess and control hazards at a site effectively. Without effective control the hazards could result in a loss (accident, damage to equipment). Safety performance needs to be measured, including the effectiveness of controls and procedures, in terms of preventing loss.

To manage safety effectively, DGDC requires the management at site to develop a Safety Management Plan. The plan will be developed and implemented through the Site Health and Safety Committee.

The key steps in developing a plan are:

- hazard identification, and assessment
- establishing legal requirements that must be met
- setting performance objectives and targets
- corrective actions
- establishing operational controls
- establishing methods for monitoring and reviewing performance
- dealing with breaches of the safety system.

These steps are detailed in the following sections.

Figure 3.1: Safety Management Based on ISO 18001 Approach

3.2 Initial Status Review

A key aspect in developing a safety management system is to establish the current status of the facility in terms of safety performance.

DGDC's existing Site will undertake an initial status review to establish the current level of safety performance. This review shall cover the following:

- accident rates and types
- effectiveness of existing procedure/controls
- compliance with existing procedures/controls
- compliance with relevant legislation
- compliance with international best practices
- hazard management.

Hazard management is a key aspect in the review process. All hazards at the site should be identified, and their current controls assessed, following the procedures stated in Volume 2, Section 4: *Hazard Identification, Assessment and Control*.

For a new site, hazard identification and assessment shall be undertaken during the design review stage. The identified hazards will be assessed as to their significance by using the Risk Level Estimator specified in Volume 2, Section 4: *Hazard Identification, Assessment and Control*.

Significant hazards will be prioritised and a plan for implementing control established.

3.3 Legal and Other Requirements

In order to manage safety at its sites effectively, DGDC will implement procedures to keep itself fully appraised of current and proposed safety legislation.

DGDC will ensure that it holds copies of all Acts of Government, Regulations, Standards and Codes of Practice relating to safety, applicable to their operations.

The complete set of legislation will be held in DGDC's Corporate Office under the control of the Safety Officer. A list of the safety legislation held will be developed and disseminated to all DGDC sites.

The Safety Officer will be responsible for being fully appraised of any proposed regulations and the implications of the legislation. Information will then be disseminated to all DGDC sites. The Safety Officer will update the legislation inventories and arrange for the new legislation to be purchased.

The Management of Change process will be activated to assess the effects of any new legislation on DGDC current safety work practices and hazard control. As part of the safety management review process, procedures will be updated to cover changes in legislation.

It is not the intention of this section to detail all Acts, Regulations, Standards and Guides which may apply. However, the list presented below gives an overall picture of the legislation that applies to the company's activities.

- Accidents and Occupational Diseases (Notification) Act;
- Employment and Training Act;
- Employment Safety Act;
- Labour Standards Act and Labour Standards (Amendment) Act, 1991;
- Protection of Employment Act;
- Protection of Wages Act;
- Recruitment of Workers Act; and
- Trade Unions Act.

3.4 Setting Site Safety Performance Standards

3.4.1 Objectives and Targets

In order to meet the aims stated in the Health and Safety Policy and to seek continual improvement in safety performance at a site, specific objectives will be developed.

These objectives are overall goals for safety performance identified in the Health and Safety Policy. In establishing its site-specific objectives, management will take into account the relevant findings of the Initial Safety Status Review and the identified safety hazards and control measures at the site, or the results of the last safety performance review.

Steps in setting safety objectives are listed below.

- A list of objectives will be drawn up by the site's Health and Safety Committee based on outcomes of reviews, etc.
- The list of objectives will be prioritised.
- For each objective, targets will be set in order to achieve these objectives within a specified timeframe.
- Targets should be specific, measurable, achievable, relevant and timely. They will be clearly drafted so the persons tasked with implementing them know what is required.
- Performance indicators (measures) will be developed in order to measure the sites safety performance. These indicators will be used as a means for evaluating site safety performance and establishing if targets have been met.
- A Safety Plan (Programme) will be developed by the Health and Safety Committee or designated persons to achieve the key objectives and targets.
- Individuals will be assigned tasks to implement the plan.
- The Safety Plan will be implemented for a year, with ongoing monitoring as to progress in achieving the stated objectives and targets.

3.4.2 Performance Indication

Performance indicators selected to measure safety performance at the site will be proactive and reactive measures. It is of note that reactive indicators represent failures of the safety system.

3.4.2.1 Proactive Measures

Proactive measures are used to monitor compliance with the site's safety system and safe work practices (surveillance and inspection). Examples of proactive measures include:

- the extent to which objectives and targets have been achieved
- the numbers trained in safety and health and the level of competency achieved
- the extent of compliance with safe work practices identified in internal inspections
- Number of Audits carried out and actions closed
- the number of safety defects reported by staff (unsafe acts and unsafe conditions)
- the level of use of protective equipment
- results of workplace exposure monitoring
- extent of compliance with statutory requirements.

3.4.2.2 Reactive measures

Reactive performance measures monitor failures in the health and safety system and include:

- lost-time accidents
- near misses
- damage-only incidents
- regulatory agency enforcement actions.

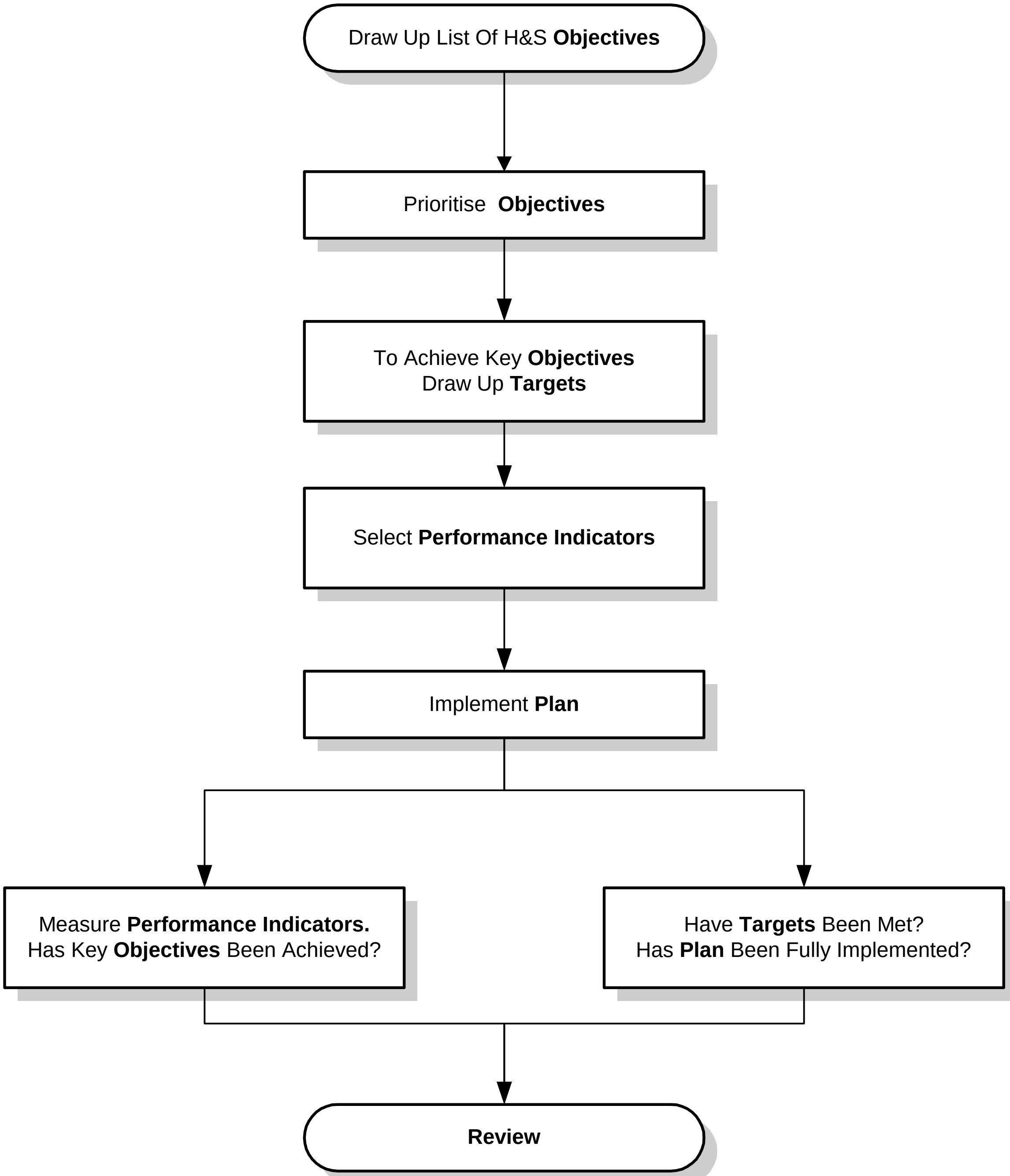
3.5 Reviewing Performance

3.5.1 Reviewing Safety Management

- Objectives will be reviewed annually to see if they have been achieved.
- Performance indicators will be measured during the year to see if the targets have been met. Failure to meet specific performance measures will result in corrective actions being taken.
- At the end of the year, the plan will be reviewed by the Health and Safety Committee to establish:
  - was the plan implemented as stated?
  - were the objectives/targets achieved?
  - was it the right plan?
  - are the objectives/targets relevant?
- For a continuing programme, new objectives and targets will be set for the forthcoming year.

Figure 3.2 presents a flow diagram of the steps in developing and monitoring a Safety Plan for the site.

Figure 3.2: Procedure for H&S Planning and Implementation



3.5.2 Corrective Actions

The Safety Management Plan may have to be adjusted through the course of the year to take into account changes from corrective actions.

These corrective actions could be from:

- auditing of site safe practices
- management of change reviews, due to a new piece of equipment or procedure being introduced at the site
- changes to legislative requirements
- new significant hazards identified by inspection of work site
- compliance requests from Government Safety Inspectors
- incident/accident investigations (system failures).

All corrective action requests are to be forwarded to the site Health and Safety Committee.

The Health and Safety Committee will review the corrective action and where necessary make the appropriate changes to the Health and Safety Management Plan. These may include:

- the setting of new objectives
- revised targets
- new safe work practices to be written
- revised/new performance indicators.

3.6 Breaches of the Safety System

DGDC takes breaches of the safety system very seriously.

DGDC will take disciplinary action against any employee, contractor or visitor who wilfully or repeatedly violates safe work practices and site safety rules.

The degree of punishment will reflect the seriousness of the breach. Minor infringements will be dealt with internally by that person's immediate line manager or supervisor.

The number of minor infringements will be recorded and reported to the Site Superintendent.

More serious breaches will be handled by the Site Superintendent, and DGDC Human Resources Department.

Contractors found in serious breach of DGDC safety practices may have their contract revoked and be required to leave the site immediately.

It is the duty of all personnel to report unsafe acts or unsafe conditions to their supervisor/foreperson.

Any supervisor or foreperson who sees or receives a report on an unsafe condition or unsafe act has the authority to immediately stop the work (contractors or DGDC employees). The stop-work instruction will remain in place until the site's supervisor/foreman can be satisfied the work can be undertaken in accordance with DGDC safety system.

All breaches/stop works at a site shall be recorded and reported as non-conformances of the system to the Site Superintendent and the site's Health and Safety Committee who will review the notice and implement recommendations to prevent future failures/breaches.

In all disciplinary issues, the final decision on the level of punishment rests with the Site Superintendent.

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DGDC-OHS-004: Implementation of Safety System
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4. Implementation of Safety System

4.1 Structure

4.1.1 Organisation

An organisation chart showing health and safety responsibilities within DGDC is presented as Figure 4.1. A list of individual responsibilities is included in the following section.

4.1.2 Responsibility

CEO (when appointed) or Executive Chairman

The CEO has ultimate responsibility for the health and safety of all personnel and operations carried out within Dominica Geothermal Development Company operations.

The CEO is responsible for:

- establishing the Corporate Health and Safety Policy and the philosophy of the safety system
- undertaking a periodic review to assess the effectiveness of the policy and to ensure that any necessary improvements are introduced
- ensuring that adequate staff, funds and materials are available to meet health and safety requirements
- ensuring DGDC has systems and procedures in place to comply with Health and Safety legislation
- approving regular updates to the Health and Safety Manual (Volumes 1 and 2).

Project Manager

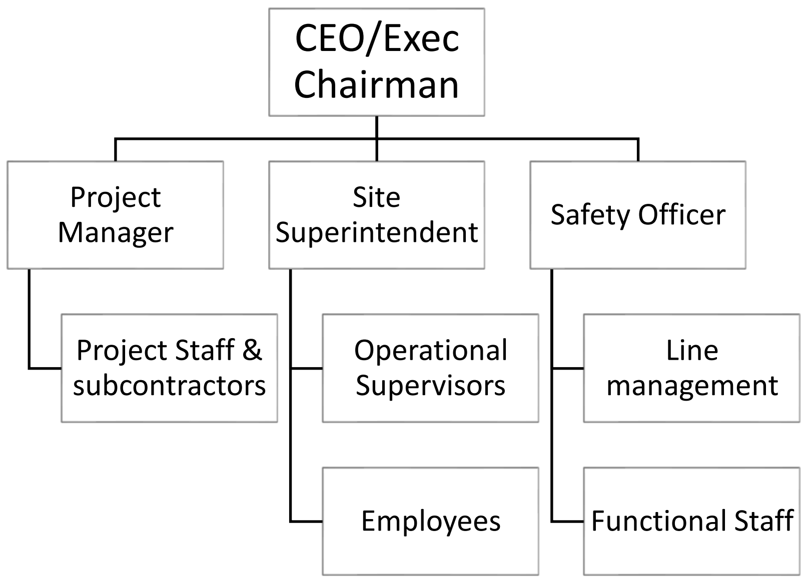
The Project Manager is responsible for ensuring that the Health and Safety Policy issued by the CEO is carried out within the operation.

They must assure themselves that the operations at the DGDC sites do not endanger the health and safety of:

- company employees
- contractors
- visitors
- the general public.

They must ensure that adequate staff, funds and equipment are available in order to implement the safety system to meet the stated aims of the Health and Safety Policy.

Figure 4.1: DGDC Health and Safety Organisation



Safety Officer

The Safety Officer is responsible for:

- maintaining the safety legislation inventory, keeping it up to date with proposed changes to safety legislation and disseminating this information to key personnel at DGDC facilities
- overseeing the control, document maintenance and distribution of the Corporate Health and Safety Manual (Volumes 1 and 2)
- giving advice on policy matters to the CEO, Managers and Site Superintendents
- maintaining an overview of corporate safety performance against facility and corporate safety objectives
- ensuring all divisions and departments are informed about changes to safety policies and safe work practices
- undertaking specific site reviews to ascertain performance and conducting independent incident investigations, as and when required.

Site Superintendents (Power Plant Manager)

Site Superintendents are responsible for:

- implementing the Health and Safety Policy and system at their site
- planning and executing ongoing communication on safety at the site
- managing the implementation of safe work practices and systems at the site
- Attending the HSE committee as the company representative
- ensuring recommendations, tasks and plans produced in the consultation with the Health and Safety Committee are implemented at the site
- planning and implementing actions to ensure effective and efficient management of hazard controls at the site
- maintaining the site accident register and notifying lost-time accidents at the site to the appropriate authorities
- receiving all accident notifications and reports, and after consultation with the Health and Safety Committee, implementing corrective actions
- ensuring all contractors and visitors to the site are adequately supervised and controlled
- ensuring the site safety manual is reviewed and kept up to date
- the site's emergency procedures
- ensuring that adequate safety training is provided to all staff to allow them to undertake their work in a safe manner
- issuing safety training certificates, showing level of competency achieved
- ensuring that arrangements are put in place with major contractors on the site to define safety responsibilities.

Operational Supervisors and Line Managers

It is the responsibility of the operational supervisors and line managers to:

- be familiar with the Company's Health and Safety Policy, its aims, to apply and monitor its effectiveness and to recommend any improvement
- organise the work so that it is carried out following established safety standards, with the minimum risk to employees, or anyone else who may be affected, and to ensure that any written working instructions provided are brought to the attention of employees carrying out the work
- comply with all applicable safety and health standards, rules, regulations and orders issued by competent authority pertaining to the activities immediately under their jurisdiction

- ensure that employees and contractors are instructed and/or trained in safe practices and methods of job performance as pertains to their assignment
- ensure that employees who report sick and/or are injured while performing official duties receive appropriate first aid and/or medical attention
- arrange transportation, delivery and handling of materials safely and efficiently; to install and maintain plant effectively and to ensure that services are installed and maintained without endangering employees or equipment
- plan and maintain adequate personnel transportation, emergency systems and equipment, and to organise adequate training and drills to ensure quick and orderly response to emergencies
- investigate and report each incident and/or injury in accordance with established procedures
- initiate, to the limit of their authority and capability, such actions as are necessary to correct working conditions determined to be unsafe or detrimental to health and to advise appropriate management promptly when such conditions require corrective actions beyond their authority
- conduct regular surveys of their operations to ensure compliance with such safety standards, codes, regulations, rules and orders applicable to the work area concerned
- ensure that employees under their supervision are aware of their responsibilities
- undertake inspections of safety equipment and safe work practices to ensure they are functioning correctly
- implement corrective actions developed to overcome weaknesses identified in the safety system and safe work practices.

Employees

All employees are required to comply with the Company's Health and Safety Policy, rules, safe work practices, that are applicable to an employee conducting their work. In particular, they are responsible for:

- using safety equipment and complying with the site work practices as stated in the DGDC Safety Manual
- promptly advising their supervisor regarding all work related incidents resulting in personal injury, illness and/or property damage
- promptly reporting to their supervisor or appropriate Health and Safety Officer any conditions in the work environment that are unsafe or detrimental to health

- taking all necessary and appropriate safety precautions to protect themselves, other personnel and the environment
- Wear the appropriate PPE provided by the company
- Report any hazards that has the potential to harm themselves or others
- keeping tools and equipment in a safe condition
- staying out of designated hazardous areas unless authorised to enter by the site's permit-to-work system
- complying with all requirements of the Company's permit-to-work system
- reading, and closely following, displayed instructions and safety warning notices
- knowing your nearest Site Briefing Area and tasks during an emergency event.
- smoking only in permitted approved smoking areas
- looking after visitors as necessary.

Contractors

It is the responsibility of all contractors working at DGDC Sites to comply with the Company's Health and Safety Policy and DGDC Safety Manual.

Contractors will be required to provide DGDC with a Health and Safety Management Plan, prior to going on site, showing how they intend to manage their work safety while at the Site.

All new contractors will be required to undertake a safety induction course before work can commence at a site. Contractors will attend refresher courses every three years.

For large construction/maintenance projects, contractors will be responsible for safety within the designated work area. No unauthorised person will be allowed to enter a work area, once control is assigned to the contractor from DGDC.

Contractors shall not commence work without first providing evidence of appropriate insurance cover.

Each contractor is responsible for his own staff, sub-contractors, sub-traders and specialists, in accordance with applicable safety laws.

Contractors shall report all incidents/accidents by end of shift and have first draft report submitted within 24 hours to DGDC Site Superintendent.

Visitors

All visitors to DGDC Sites will be assigned an escort. This will be a person who will be responsible for ensuring that the visitor remains safe, observes health and safety practices and is given all necessary assistance.

All visitors must sign the Site Visitors Register and be subject to a Site Safety Briefing, which covers the site work practices and emergency procedures they must follow while at the site.

Visitors must adhere to all safety instructions, and follow safe work practices while at the site.

4.2 Health and Safety Committees

4.2.1 Introduction

Health and Safety Committees will be established at each site operated by DGDC. The Health and Safety Committee will not have direct responsibility for implementing the safety system at the sites. This is the responsibility of line management.

The prime aim of the Health and Safety Committee is to act as a forum to monitor, co-ordinate and recommend measures to continually improve safety performance at the site.

4.2.2 Responsibilities

The Health and Safety Committee will be responsible for:

- approving and reviewing methods to identify, assess and control hazards at the site ensuring that the list of significant hazards is updated on a regular basis
- reviewing specific proposals for modifications, or additions, to any facilities or equipment to identify any aspects that may affect safety at the site
- approving new and revised Standard Operating Procedures (SOP) and facility changes that have safety implications
- ensuring SOPs and changes are safe and consistent with current safe work practices
- conducting or directing staff to undertake periodic reviews and inspections of activities and records, to determine if safety controls are being met

- maintaining technical surveillance of, and keeping informed of, current site activities to anticipate safety related problems
- receiving reports on incidents and non-compliances with procedures, approving corrective actions and making sure that recommendations and corrective actions are carried out within the specified time frames
- developing safety objectives and performance targets for the site on an annual basis
- throughout the year reviewing performances to establish current level of attainment with the safety objectives set
- initiating and overseeing safety training programmes such as induction, hazard identification and assessment, use and maintenance of personal protection equipment, permit-to-work, safety inspections and accident investigations
- reporting through the Committee chairperson to the CEO significant concerns or unresolved questions regarding the management of safety at the site
- being a forum for employees to submit recommendations for changes to equipment and work methods to improve safety
- maintaining an open channel of communication between employees and management over health and safety related matters.
- assisting management in communicating safety issues to employees and contractors.
- assisting management in updating safe work practices for the facility.

4.2.3 Membership

The Site Health and Safety Committee shall consist of the following standing members:

- Site Superintendent / Power Plant Manager
- Safety Officer who will also act as Secretary
- Senior Supervisor for each of the departments at the site
- Contractors Representative’s (when under contract).

On a 12-month basis the following additional members will be assigned to the Committee:

- contract employee representative (1 x each contractor)

4.2.4 Meetings

Health and Safety Committee meetings will be held for a new site on a two-weekly basis and, for established facilities, once a month or more often, if safety performance is found to be poor.

An agenda will be distributed to members at least one day before the next scheduled meeting. Standard agenda items which will be covered at each meeting include:

- review of progress on previous Action Plan
- review of modifications, changes to plant, equipment and procedures since last meeting
- review of audit reports since last meeting
- review of progress in meeting safety objectives and targets
- recommendations for corrective measures based on audits
- review of accidents, and incidents since previous meeting
- review of non-conformances since previous meeting
- recommendations from Incident Investigation Reports
- safety Training Recommendations
- suggestions from Employees
- review of whether safety objectives and targets are still appropriate.

The secretary shall record the outcome of the meetings in the minutes. The minutes are to include an ongoing action grid that shall identify responsibilities and action dates. All committee recommendations shall be forwarded to the Site Superintendent. Minutes will be distributed to members and attendees within 48 hours of the meeting.

4.3 Training, Awareness and Competency

Health and safety awareness will be promoted among managers, supervisors, employees, and others (contractors, visitors and community members) through induction and orientation programmes and regularly scheduled training sessions.

It is DGDC's policy that all staff will be adequately trained in safe work practices to enable them to undertake their assigned tasks safely. Personnel shall not undertake specific safe work practices (hazardous substance handling, permit-to-work systems) until it can be demonstrated that the individual is adequately trained and competent to perform the work safely.

It is the immediate supervisor's responsibility to ensure that the safety training needs of staff under their control are identified and adequately provided for. Advanced safety training will be provided to managers and supervisors to allow them to adequately train staff as required.

Induction safety training will be provided to every new employee and new contractor before they commence work at the site.

Specialised training courses will be provided by DGDC. These will include, but not be restricted to:

- first aid
- cardio-pulmonary resuscitation (CPR)
- hazard identification and assessment
- atmospheric monitoring
- respiratory protection (SCBA)
- permit-to-works, etc.
- safe work practices
- inspection and audit.

The results of all safety training shall be recorded on each staff member's training record. These will be filed in respective facility administration offices. It will be the Safety Officer's responsibility to ensure training records are updated.

The level of safety training provided, and the number of persons trained, at specialised training courses will be reviewed at the end of each year. Targets and objectives for the level of training and the competency to be attained at the site shall be set as part of the site's Safety Management Plan.

Good safety training and awareness is reflected in the lack of accidents and low level of non-conformance detected at a site.

4.4 Communications

Effective lines of communication are an essential element in a safety management system.

Line managers will be responsible for communicating to staff under their immediate control, changes to safe work practices and site safety issues that may affect their day to day operations.

The Site Health and Safety Committee will act as a forum, through which various departments/sections at the site can communicate to other sections changes to their work practices, equipment, etc. that may have safety implications on their department's work.

Safety awareness will be communicated to staff via DGDC Notice boards

Health and safety information will be disseminated to staff via the line management structure at the site.

Notice boards displaying health and safety information will be erected and located at key points throughout the facility. These notice boards will be used as an alternative means of disseminating information on site safety issues to staff. Emergency procedures and site layout drawings showing Safe Briefing Areas will be displayed on these notice boards, along with safety educational material.

Safety signs and notices will be erected at each facility to designate hazardous areas, where appropriate personal protective equipment shall be required to be worn, and to indicate other potential hazards. The signs will conform to current international standards for safety signs.

The Hazard Observation Card system will be introduced at sites. If a person identifies a hazard or potential hazard in their workplace, or believes a procedure is not effective they can fill in a Hazard Observation Card. The Hazard Observation Card is then forwarded to the site's Health and Safety Officer for action. The card will normally be presented to the site's Health and Safety Committee and the outcome will be communicated to the person who raised the observation.

Communication lines with contractors working on site will have to be established and formally documented to ensure there is a flow of information regarding safety issues and that work is properly scheduled.

Communication systems on safety matters at the site will be assessed in the site's annual review of safety management. Communication of safety information will be included in the annual safety review of the site.

4.5 Management System Documentation

The main document for managing safety at DGDC site is the Safety Manual. It consists of three separate volumes (parts):

Volume 1: Safety Management Systems
Volume 2: Safe Work Practices
Volume 3: Site Specific Safety

Corporate documents will also include:

- DGDC Health and Safety Policy
- Safety Legislation Inventory
- DGDC Safety in Design Manual.

Other documents which will be developed to manage safety at DGDC facilities and which will form part of the site-specific safety management system include:

- Site Safety Management Plan: lists out objectives, targets, performance measures and implementation measures for improving site safety performance
- Incident/Accident Register
- Hazard Identification Register
- Hazard Control Form
- Training materials and records
- Health and Safety Committee meeting minutes
- Approved list of contractors
- Hazardous Substances Inventory
- Visitors Register
- Complaints Register

4.6 Document Control

4.6.1 Controlled Document

A "controlled document" is a standard document produced by DGDC in which the format, content and distribution are controlled. The documents controlled in this system are:

- Health and Safety Policy
- Safety Manual Volume 1: Safety Management Systems
  Volume 2: Safe Work Practices
  Volume 3: Site Specific Safety

4.6.2 Controlled Format Document

A 'controlled-format document' in which the format is controlled but not the content once the document has been completed. All defined pre-printed forms including permit-to-work, accident reporting and investigation forms (proformas) and audit checklists are controlled format documents. Upon completion of a document copies are retained (filed) as safety records.

All other documents which make up the Safety Management System are subject to internal site-specific document controls.

4.6.3 Document Approval and Issue

The CEO reviews and approves all corporate safety system documents before issue. (This covers the Health and Safety Policy, and Volumes 1 and 2 of the Safety Manual.) The Site Superintendent will review and approve all site-specific safety documents that are included in Volume 3 of the Safety Manual, before issuing.

The issue of controlled documents is under cover note (memorandum) to all persons/companies identified in the distribution list. A master register which records the latest revision number of the issue is retained for all such distributions.

The cover note identifies the reason for the issue and which documents are superseded and to be subsequently removed. Each holder of a controlled document is responsible for updating issues upon receipt of the memorandum and removing obsolete copies.
The authorisation to issue the Safety Manual (Volumes 1 and 2) is denoted by a memorandum signed and dated by the CEO. A copy of the memorandum is located in the front of each volume. Subsequent revisions are denoted by the issuing of a new memorandum signed by the CEO. The Superintendent will authorise the issuing of

Volume 3 with a signed and dated memorandum. A copy of this memorandum will also appear in the front of Volume 3.

In addition, approvals are denoted by the signature of the CEO (Volume 1), Co-ordinator Environmental and Safety (Volume 2) and Site Superintendent (Volume 3) and date on the index page at the front of each section for controlled documents. For proformas the authorisation is on a cover page.

Each set of documents which make up the Safety Manual will have a unique identification and numbers (e.g. will be recorded as DGDC-OHS-Number) An issue log will be held by the Safety Officer as to the person who holds a particular numbered manual. The Site Superintendent will maintain an issue log for Site related activities.

4.6.4 Document Changes/Modifications

All document changes are reviewed and approved by the CEO and the Site Superintendent. Documents will be reissued only after a practical number of changes. The authorisation of these changes will be denoted by a memorandum issued by the CEO or Site Superintendent which will be added to the front of each controlled copy.

The cover note identifies the relevant change(s) in order to acquaint personnel with such change(s).

In each manual, before the content page, there is a revision log which shall be used to record the date and revision number of each section which is issued as a revision.

It is the responsibility of the manual holder to update the revision log on receipt of new revised sections.

The revision of legislation is controlled by other parties. However, the Safety Officer maintains a register of all safety legislation and updates.

An electronic version of the Safety Manual will be available via DGDC computer network. This document shall be retained in 'read-only' mode. The only person permitted to make changes is the Environmental and Safety Co-ordinator under the direction of the CEO and or Site superintendent.

A hard copy of the manual taken from the computer network is regarded as an 'uncontrolled' copy.

4.7 Operational Control

4.7.1 Introduction

If the management of safety is to be effective, it has to be fully integrated across DGDC organisation and into all its activities. Safe work practices have been developed for a range of work activities, with the aim of providing steps/actions to follow, that will allow the work to be undertaken in a safe manner. These safe work practices can be implemented at most of DGDC's facilities with only slight modifications.

Specific site-safety practices for the site is covered in this manual. This volume covers specific operational practices, rules, and identifies site-specific hazards, etc. for that site.

4.7.2 Safe Work Practices

Safe Work Practices have been developed for a range of activities commonly undertaken at DGDC' sites. They include but are not limited to:

- management of change
- training
- hazard identification, assessment and control
- natural hazards
- work control
- hydrogen sulphide
- drilling preparation, operations and production testing
- atmospheric monitoring
- plant, systems and equipment
- safety with hand tools and portable equipment
- electrical work
- hazardous substances
- heat stress
- noise and vibration
- lifting equipment and lifting
- working at height
- excavations and shoring
- construction and contractor activities

- hot work
- confined space activities
- traffic
- safety equipment
- laboratory
- office safety
- workshop practices
- food handling
- fire prevention and firefighting equipment
- first aid and medical
- emergency procedures
- incident/accident reporting
- painting
- housekeeping
- safety in design
- monitoring the safety system.

4.7.3 Implementation and Changes

All safe work practices specified in Volume 2 and 3 shall be implemented and followed at all times by DGDC employees, contractors and visitors. The safe work practices will be reviewed and modified in light of:

- results from the annual audit of the system
- site-specific hazards identified
- failure of practice resulting in an incident
- changes to legislation
- changes to plant and equipment or operating procedures, etc.
- changes to international best safety practice.

Every two years, all safe practices will be reviewed. Any which have not been changed or updated since the previous review will be formally reviewed by a specialist review team to assess whether the practice is still appropriate or in need of modification. Members of this review team will be chosen for their knowledge and experience relevant to their particular practice.

Review of Volume 2 practices will be on an DGDC-wide basis and of Volume 3 by the Site Health and Safety Committee.

4.7.4 Protecting the Public

Through the implementation of the safety management system DGDC aims to protect the general public from injury and damage due to its activities.

DGDC takes complaints from the public seriously and will investigate complaints from the public regarding poor safety practices in relation to work undertaken on DGDC behalf by employees, contracted employees or contractors.

A complaints register will be held at each site, to record the safety complaint and the outcome of the investigation.

Disciplinary action may be taken as an outcome of the investigations.

4.7.5 Supervision of Visitors

Visitors to DGDC sites will be directed by security to reception where they will be required to fill in the Visitors Register. The person they are visiting (guardian) will be responsible for their safety while at the site. The visitor shall be informed of potential hazards, and the evacuation procedures for the site. A site layout drawing (A4) showing emergency exits and Safe Briefing Areas will be provided.

Visitor control will be reviewed on a quarterly basis to gauge its effectiveness by the Safety Officer.

4.7.6 Supervision of Contractors

Contractors will be assessed for their capability to meet output requirements, including safety performance. As part of the contractor pre-qualification process evidence will be presented to DGDC testifying to the contractors past good safety performance. Information shall be provided in accordance with the requirement set out in Volume 2, *Contractor and Construction Safety*.

A Line Manager will be appointed as being responsible for supervising each contractor at the site. The line manager shall have the vested authority to exercise the contractual rights and responsibilities of DGDC. Regular inspection of the contractor’s activities shall be made, to ensure they are complying with the site safety requirements and the safety-related clauses in their contract with DGDC.

The output of the inspections made shall be held as part of the contractor review records.

Contractors are required to notify all incidents to the DGDC's Site Superintendent by end of shift and draft copy of report within 24 hours.

Severe breaches of the safety system may result in the contractor being expelled from the site and their contract being revoked.

4.7.7 Hazard Management

A Hazard Identification Register will be maintained at each site. The identification, assessment and control of hazards is an integral part of an effective safety management system. Procedures for undertaking a hazard management programme are specified in Volume 2: *Safe Work Practices*, Section 4: *Hazard Identification, Assessment and Control*.

The Line Managers will be responsible for undertaking hazard identification in their work areas. The output shall be recorded in the Hazard Identification Register.

Based on the assessment of risk for each hazard, the adequacy of control measures at the site will be assessed.

The Site Health and Safety Committee shall be responsible for co-ordinating the site's hazard management programme and for prioritising the implementation of controls throughout the site based on significance of risk.

The output of the hazard management programme shall be maintained in the Hazard Identification Register.

Significant hazard control measures will be reviewed on an annual basis as to adequacy and performance.

All changes to equipment, plant and operators shall be subject to a hazard identification process to ensure all hazards created, upstream and downstream are adequately controlled. The output of this process shall be recorded in the Hazard Identification Register and forwarded to the site Health and Safety Committee for approval.

4.7.8 Work Control

The objective of the work control system which will be used at DGDC facilities is to avoid undue risks, injury to personnel, damage to property or disruption of operation by:

- instituting a systematic approach to identify and control potential hazards
- obtaining an independent, thorough and timely safety review of all technical designs, tests and operations
- permitting the operation of facilities systems/subsystems and contractor activity only within safe constraints
- controlling changes to permitted facilities system/subsystem
- instilling safety awareness in all employees.

The work control system shall be followed for the range of activities/operations that involve hazards which may pose a significant risk to workers. Specific documented work controls and safe practices are required to be implemented in order to minimise risk.

A range of work activities that are included in the work control system are identified in Volume 2: *Safe Work Practices*, Section 6: *Work Control*. However, additional activities may be identified at the site that are required to be included in the work control system, as dependent on the outcome of the site's hazard identification and assessment programme. The changes shall be included in Volume 3: *Site Specific Safety*.

Copies of all work permits issued will be retained in files at the designated site point of work control.

On a three-monthly basis, retained permits will be audited to assess whether the appropriate safe work practices prescribed by the permit and work control procedures were followed. The outcomes of the audits will be forwarded to the Site Health and Safety Committee for review.

The audits will be undertaken by the supervisor of the section and the Health and Safety Officer.

Changes to practices specified in the work control section and to all permit form layouts can be approved only by DGDC CEO as they are controlled documents.

4.8 Incident/Accident Investigation

All incidents/accidents shall be reported and investigated in accordance with the requirements stated in Volume 2 *Safe Work Practices*, Section 31: *Incident/Accident Reporting.*

Contractors are required to report all incidents/accidents by end of shift and draft report within 24 hours to the Site Superintendent.

The Site Health and Safety Committee shall review all incident/accident investigation reports and recommend corrective actions. The corrective actions and plan of implementation shall be recorded on the Accident Investigation Report and in the Health and Safety Committee Meeting Minutes.

All incident/accident reports shall be held by the Safety Officer. The Safety Officer shall analyse the reports for trends and failures of the safety system.

The Safety Officer will receive copies of the Incident/Accident Investigation Reports from Site. Trends analyses will be carried out and information on corporate trends/failures of systems will be disseminated to all facilities operated by DGDC, so that corrective actions can be undertaken.

The level of incident/accident reporting will be assessed to ensure that a true picture of the extent of failures in the safety system is maintained. For this reason, notification of near-miss incidents is important.

4.9 Emergency Management

DGDC will take all practicable steps to develop procedures for dealing with emergencies that may arise at, or near, the site.

Staff will be suitably trained in the company's emergency procedures.

Management will ensure that all visitors and contractors are advised of the site's emergency procedures and assembly areas.

Procedures will be developed for a range of emergency events that could affect the site. They will include but not be limited to:

- evacuation

- fire
- earthquakes
- volcanic eruptions
- flooding
- slope instability
- chemical/oil spillages
- well blowouts
- plant failures (major steam leaks)
- explosions
- vehicle accidents

Regular drills (once every six months) will be held to test the readiness of the staff and their familiarity with the fire and evacuation procedures.

Once a year, another of the emergency procedures will be tested. An emergency scenario will be developed by the Health and Safety Committee and this scenario will be the basis of the drill.

An inspection and planned maintenance system will be implemented to ensure all emergency equipment is maintained in the appropriate state of readiness.

Evacuation procedures and site layout plans that show Safe Briefing Areas will be strategically placed on noticeboards and walls throughout the site.

The emergency procedures will be reviewed by the Health and Safety Committee after each drill and the performance levels assessed. If procedures are found to be deficient the appropriate amendments will be approved by the Health and Safety Committee.

4.10 Safety Facilities

DGDC will provide safety equipment, personal protective equipment and medical facilities for their staff as necessary.

Inspections of appropriate safety equipment, as to its care, maintenance and correct use will be undertaken by line managers on a frequent basis (four times per year minimum). The results of these inspections shall be forwarded to the Health and Safety Committee.

First aid boxes, emergency shower, eye wash bottles, paramedic facilities, fire extinguishers, fire hose reels, etc. shall be made available to staff. This equipment will be inspected and maintained on a regular basis. Records will be held to show when the item was last inspected. Faults on this equipment or services shall be reported immediately.

The Safety Officer in conjunction with the Maintenance Supervisor will maintain records of inspections and corrective actions.

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Powering a New Generation...

Occupational Health & Safety Manual
Volume 1: Safety Management System

DGDC-OHS-005: Checking and Corrective Actions
Revision 0

Contents

5. Checking and Corrective Actions

5.1 Safety Monitoring

DGDC safety performance shall be monitored during the year, via a number of means. These include:

- occupational hygiene monitoring
- noise monitoring and hearing conservation
- incidents/accidents reported
- hazard identification and assessment
- medical surveillance of staff
- Safety Alert notifications
- regular inspections of safe work practices
- targets are being met within specified time frames.

A monitoring plan will be established at each facility in relation to the level and type of significant hazards present. The Health and Safety Committee shall approve the plan and the Site Superintendent will be responsible for implementing the plan.

5.2 Safety Auditing

An inspection and auditing programme will be established at Site. The audits will be at regular intervals to ensure the ongoing effectiveness of the site's Safety System. The audit programme shall be approved by the Site's Health and Safety Committee.

The audits are required to ensure that:

- the safe work practices are understood and being implemented
- the resources are adequate and personnel are suitably trained for delegated tasks
- hazards are being identified and control measures implemented
- the documented work control systems are being undertaken
- corrective actions arising from accident investigations, and changes to equipment, plant and operating procedures are being implemented in a timely manner.

Safety audits and checklists are provided in each of the sections detailing safe work practices, Volume 2: *Safe Work Practices*. These checklists should be used in the first instance to assess compliance with the requirements of the safe work practice.

A Safety Management Audit Questionnaire is provided in Section 35: *Safety System Monitoring* of Volume 2. This questionnaire includes elements relevant to managing safety at the Site. Safety management system audits should be performed on an annual basis until the Safety Management System is performing well and then that audit frequency can be extended to once every two years.

Objectives, targets and performance measures should be audited to establish whether targets are being achieved within appropriate timeframes and that tasks in the Safety Management Plan have been implemented.

The CEO has overall responsibility for ensuring that the safety system and performance is audited. At each facility the Safety Officer under the jurisdiction of the Site Superintendent has direct responsibility for planning and managing the safety audit plan. Such planning may vary, depending on the nature and significance of site hazards and the frequency of non-conformances detected within the system. The greater the level of non-conformance the more rigorous the auditing plan.

Generally, the audits will be carried out by personnel familiar with safety audit procedures and the safe work practices to be audited.

For each non-conformance detected during the audit, an Improvement Request will be raised and submitted to the Health and Safety Committee. The Health and Safety Committee will implement any required corrective actions.

A summary report will be produced for each audit undertaken. This report will list all improvement requests raised. The report will also be submitted to the Health and Safety Committee.

All audit reports will be held by the Safety Officer in their role as Secretary to the Health and Safety Committee.

An annual report on safety performance for each site will be prepared and submitted to DGDC CEO.

5.3 Corrective Actions

All Improvement Requests, Hazard Observation Cards and complaints will be forwarded to the Health and Safety Committee to review and outline corrective actions. For each instance the recommended corrective actions will be recorded in the Committee Meeting Minutes and tasks allocated to specific Line Managers, etc. for implementation of the corrective action.
The person with ultimate responsibility for implementing corrective action is the Site Superintendent.

Corrective actions could include one of the following:

- training of individuals or contractors
- disciplinary action for individuals or contractors
- adjustment of hazard control measures
- adjustment of safe work practices
- modifying the Safety System
- instigating new safe work practices.

Any resulting changes to the documented Safety Manual shall be authorised by the CEO (Volumes 1 and 2) and the Site Superintendent (Volume 3).

Additional auditing may be required to ensure that the corrective action implemented is effective.

5.4 Safety Records

Safety Records shall include:

- minutes of Health and Safety Committee meetings
- results of occupational health monitoring
- site Safety Management Plan
- records of medical surveillance of employees
- incident/accident register and investigation reports
- hazardous substances inventory
- completed permit-to-work forms
- visitors register
- records of safety training and competency levels

- hazard identification register
- safe work practice checklist and audits
- Improvement Requests
- Safety Audit reports
- contractor assessments and audits
- records of corrective actions
- incident/accident notification.

All records shall be stored under a unique reference number for each type of record. Records relating to safety will be held by the Safety Officer, except for medical surveillance and safety training records which will be held by the Personnel Department.

Records shall be stored in a manner to avoid damage and deterioration.

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DGDC-OHS-006: Management Review
Revision 0

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6. Management Review

A management review of DGDC safety performance will be undertaken on an annual basis. Site-specific management reviews will also be carried out.

The aim of the management review is to ascertain the DGDC's safety performance and site-specific performance against the following

- Health and Safety Policy
- site-specific objectives
- site-specific targets
- incident/accident rates
- non-conformances detected
- level of safety training/awareness achieved
- frequency of audit/checklists undertaken
- conformance with government requirements.

The Management Review will, in particular, look at whether the corporate and the site's safety objectives and targets for the year, as specified in the Safety Management Plan, have been achieved. The targets and objectives will be reviewed to see if they need to be adjusted, depending on the level of achievement. The aim is to achieve continual improvement in safety performance throughout the Company.

Occupational Health & Safety Manual
Volume 1: Safety Management System

DGDC-OHS-007: Definitions
Revision 0

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7. Definitions

Accident
Unplanned event giving rise to death, ill-health, injury, damage or other loss

Audit
A systematic and, wherever possible, independent examination to determine whether activities and related results conform to planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve the organisation's policy and objectives.

External Factors
Forces outside the control of the organisation that impinge on health and safety issues and need to be taken account of within an appropriate time frame, e.g. regulations, industry standards.

Hazard
A source or situation with a potential to cause harm in terms of human injury or ill-health, damage to property, damage to the environment, or a combination of these.

Hazard Identification
The process of recognising that a hazard exists and defining its characteristics.

Health and Safety Objectives
The goals, in terms of health and safety performance, that an organisation sets itself to achieve and which should be quantified wherever practicable.

Health Surveillance
The monitoring of the health of people to detect signs or symptoms of work related ill-health so that steps can be taken to eliminate, or reduce, the probability of further damage.

Incident
Unplanned event which has the potential to lead to an accident.

Internal Factors
Forces within the organisation that may affect its ability to deliver the health and safety policy, e.g. internal re-organisation, culture.

Management System

A composite, at any level of complexity, of personnel, resources, policies and procedures, the components of which interact in an organised way to ensure a given task is performed, or to achieve or maintain a specified outcome.

Organisation
A company, operation, firm, enterprise, institution, or association, or part thereof, whether incorporated or not, public or private, that has its own functions and administration. For organisations with more than one operating unit, a single operating unit may have been defined as an organisation.

Risk
The combination of the likelihood and consequence of a specific hazardous event occurring.

Risk Assessment
The overall process of estimating the magnitude of risk and deciding whether or not the risk is tolerable or acceptable.

Status Review
The formal evaluation of the Safety Management System.

Target
A detailed performance requirement, quantified wherever practicable, pertaining to the organisation, that arises from the health and safety objectives and that needs to be met in order to achieve these objectives.

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-008: Introduction
Revision 0

Contents

1. Introduction to Volume 2: Safe Work Practices

1.1 Introduction

The DGDC safety management system is set out and described in the company's Safety Manual. This manual is divided into three separately bound volumes:

- **Volume 1: *Safety Management System*.** This volume outlines the DGDC safety system management structures.
- **Volume 2: *Safe Work Practices*.** Contains the safe work practices that have been developed for a range of activities commonly undertaken at DGDC sites.
- **Volume 3: *Site Specific Safety*.** This volume covers specific operational practices, rules, and hazards for each separate site as well as a summary of the more frequently used safe work practices.

1.2 Application of DGDC Safe Work Practices

As stated above Volume 2 contains the Safe Work Practices that shall be applied at all DGDC sites. The only time they will not be required is when, under contractual agreement, a Contractor applies their own specified Safe Work Practices within a designated area and period (see Section 19: *Contractor and Construction Safety*).

Where there is conflict between the contents of this volume and the safety requirements of other documents or regulations then refer to Volume 1 for advice on which is to apply.

1.3 Use of Volume 2

Volume 2 is divided into sections, each of which describes a specific Safe Work Practice in detail. Safe Work Practices in this manual are non-site specific. A summary of these practices and, where applicable, supporting site specific information is contained in Volume 3 of the Safety Manual.

A succinct style has been adopted for most of the information contained in this volume to aid training and understanding. Where possible bullet style lists have been used and many of the sections contain checklists that can be copied for use on-the-job. Additionally, commonly used forms, permits and audit checklists are reproduced at the end of relevant sections; they may be photocopied as required.

1.4 Access to Volume 2

Copies of this volume are to be made readily available to all employees.

1.5 Training and Awareness of Contents

As this volume contains the practices to be adopted in full, it forms the foundation for all company safety training overall. Training requirements are covered in Section 3: *Training* (DGDC-OHS-010) as well as and, for each particular Safe Work Practice, in the relevant section of this volume. In general, however, the following awareness level is required of company employees:

- Supervisors and Site Superintendents are to be generally familiar with the contents of all sections, and are to be fully conversant with those sections that apply directly to their own departments.
- Foremen and Leading Hands are to be aware of existence of all sections and are to be fully trained in the practices that apply to themselves and those persons they oversee.
- Other employees are to be aware of the existence of Volume 2, and are to be trained to the level specified in the practices that are applicable to their work.

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Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-009: Management of Change
Revision 0

Contents

2. Management of Change

2.1 Introduction

DGDC has embraced the management of change philosophy in all its business undertakings. This section covers the management of change and how it affects an organisation specifically in terms of health and safety and the potential to introduce hazards to its personnel and to the public.

A change may have effects throughout the whole organisation, or affect only a section, small group or an individual.

The understanding of change in accidents and the use of change based analytical and prevention methods have emerged as critical management and safety skills.

2.2 Role of Change in Accidents

If a system has been operating in a stable manner but now has troubles, change is often the cause of the problem.

Change is pervasive, directional, and ongoing and has exponential effects over time. Consequently, managing change at a facility successfully has strong knock on effects for accident prevention and safety.

There are four common change management situations that can affect safety:

- The cause of the problem was obscure.
- A planned change, well-motivated and intended, has unwanted side effects as the effects of the change were not fully analysed.
- An unplanned change was not identified.
- An unplanned change is identified, but the significance is unrecognised in terms of its effects on safety.

All of the above can result in an incident at the workplace.

2.3 Classification of Change

A list of the types of changes which can result in a problem if not properly identified and managed are presented below.

1. Planned versus Unplanned
   - Planned: Requires scaled hazard assessment process (HAZID) and affirmative safety action.
   - Unplanned: Detected first by monitoring. When detected, immediate correction should be made when necessary, and a scaled HAZID carried out.

2. Actual vs Potential or Possible
   - Actual change is detected by reports and observations.
   - Potential or possible change requires analysis.

3. Time: Deterioration of a process over time, interaction with other changes.

4. Technological: New projects and processes, particularly near technological boundaries.

5. Personal: The many variables which affect performance capability.

6. Sociological: Closely related to personal changes, but of broader significance.

7. Cultural: persons not understanding the change or thinking it's too much.

8. Organisational: Shifts in department/section responsibilities may leave interface gaps, particularly when hazard analysis was not well-defined but done by custom by some people.

9. Operational: Changes in procedures without safety review.

10. Macro (Big Picture) vs Micro (Detail).

    - Macro: Overall organisation issues, e.g. new employees, transfers, and other operating data suggesting needs for preventive counter-measures.
    - Micro: Particular events. A useful subdivision of micro-events might be early detection and counteraction e.g. a plan to promote a supervisor and then to promote his/her assistant. What does this change imply?

2.4 The Basics of Management of Change

Management of Change provides the process to manage any change and the effects of that change on people in an organisation.

Steps taken in initiating change should include:

- Ensure that the organisation is ready to undertake the change successfully.

- Establish a communications programme to minimise resistance or confusion and to maximise acceptance of the change.
- Assess the impact that the change will have on the organisation.
- Develop the organisational and human resource infrastructure required to support the change.
- Support the implementation of the change.
- Monitor and evaluate the effects, both positive and negative, of the change itself.

These steps should be applied to all change within the organisation. For a small change one person may be sufficient to undertake all the steps, while larger changes will involve input from more of the organisation.

2.5 Change and Health and Safety

In order to reduce the risk of injury and occupational health within an organisation, hazards need to be controlled. The procedure for this is outlined in DGDC-OHS-011: *Hazard Identification, Assessment and Control*.

There are three hazard assessment procedures (HAZID's):

- ***Hazard Identification*** - ensures the recognition of specific hazards through regular monitoring of the workplace and reviewing any proposed changes to plant, equipment or procedures.
- ***Risk Assessment*** - involves the assessment of the level of consequence and likelihood of the identified hazards. Once the hazards in the workplace have been identified and the risks assessed, priorities can be set for action to control the risks.
- ***Risk Control*** - takes a variety of forms depending on the nature of the hazard, and should be based on a hierarchy of control options emphasising the elimination of the higher risk hazards at source.

This process needs to be applied to every aspect of the organisation and especially when a change is anticipated. It needs to be applied **before** the change, not after. Application of hazard identification and assessment procedures will help eliminate the introduction of chemicals, activities or equipment that will introduce additional hazards into the organisation.

The HAZID will not be confined just to the item being changed but should look upstream and downstream to see if the change will have any flow on effects which will affect safety performance and change the significance of an identified hazard.

To implement a Management of Change process to ensure hazards are identified, assessed and controlled for each change these actions should be adopted.

- Put in place a written purchasing policy that clearly incorporates health and safety and ergonomic considerations into specifications for design (both internal/external), tender and purchase of plant, equipment, materials, products, substances and services (contractors).
- Provide for health and safety considerations in all hire and lease procedures.
- Check newly purchased items for compliance with occupational safety and health specifications as a condition of acceptance.
- The hazard assessment process is formally undertaken by the Health and Safety Committee for any proposed changes to plant, equipment and operating procedures to ensure hazards are identified and the relevant controls are in place.
- Hazardous substances are always required to be accompanied by a MSDS when received. New substances are assessed as to their potential hazards before approval is granted for use at the site.
- Non-routine work can be seen as change. The work permit system is designed to manage this aspect.
- The Health and Safety Officer and Health and Safety Committee are advised of proposed changes to the plant, equipment and procedures to enable them to consider if there are any potential safety concerns that will need to be addressed by a formal HAZID.
- Encourage employees to regard changes as positive steps that can be made with appropriate management.
- Put procedures in place whereby employees can initiate changes that will help in the work they do personally or that will contribute positively to another aspect of the organisation.
- Value innovation from all levels of the organisation.

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-010: Training
Revision 0

Contents

3. Training

3.1 Introduction

Training is a key factor in accident prevention and is necessary in achieving a safe work environment. The aims of DGDC safety training schemes is for all employees and contractors to:

- develop safety awareness
- make staff knowledgeable and alert to the potential hazards within their work environments
- know how to use plant, equipment or substances safely
- be familiar with the use of protective clothing and equipment associated with the work they do
- be familiar with the safe work practices set out for specific tasks associated with their work
- achieve an appropriate level of competency to enable them to do their job safely
- be aware of their safety responsibilities when supervising staff or contractors.

DGDC will place employees in jobs consistent with their abilities and level of safety training achieved (competency).

This section establishes the basis of procedures and responsibilities for the provision of safety training of DGDC employees and staff. It also sets out minimum requirements for competency (certification) levels for personnel who will be involved in potentially hazardous operations.

Safety training programmes will be established at DGDC facilities to provide appropriate training to allow staff to undertake their work in a safe manner.

3.2 Responsibilities

3.2.1 Site Superintendent

- Has overall responsibility to ensure employees and contractors at the site are adequately trained to carry out their work in a safe manner.
- Will sign training certificates on the recommendation of supervisors that a person has achieved the appropriate level of competency with respect to a specific safe work practice.

3.2.2 Supervisors and Line Management

- Shall be trained in site work practices and hold appropriate certificates of competency with respect to work they supervise.
- Shall ensure staff under their control receive the appropriate level of safety training to allow them to undertake their work in a safe manner.
- Recommend that competency certificates are issued when satisfied that the person under their control has attained appropriate level of competency (passed the training course and demonstrated on-job competency).

3.2.3 Contractors

- Are to ensure staff are appropriately trained and competent to carry out tasks in a safe manner and are aware of DGDC safety requirements.

3.2.4 Health and Safety Officer

- To arrange safety training courses at the site, to provide safety induction training of new staff and contractors and approve specialist safety training where appropriate.
- Ensure training records, held by personnel are maintained and updated for each DGDC employee at the site.

3.2.5 Employees

- Attend training courses as required.
- Achieve appropriate level of competency between completing specified safety procedures.

3.3 Certificates of Safety Competency

3.3.1 Issuing a Certificate of Safety Competency

DGDC will place employees in jobs consistent with the individual's ability and level of competency achieved. Persons who do not hold an appropriate certificate of safety competency will not be permitted to perform that task.

In order to obtain a certificate of safety competency a person must have completed the following:

- attended an approved training course specific to the work task(s)

- passed an examination relating to that course
- demonstrated to their Supervisor after passing the training course an appropriate level on the job competency
- undertaken the work safely on a number of occasions under direct supervision.

When the supervisor is satisfied that an individual is competent in the safety procedures/tasks, the Supervisor will recommend that a competency certificate is issued by the Site Superintendent and ensure the individual's training record is amended accordingly.

The certificate of competency issued is for a finite period (three years) and will also lapse if the individual has not undertaken the practice for which they are certified during the last twelve months.

To keep their certificate of safety competency an individual must attend and pass a refresher training course every three years.

3.3.2 Levels of Safety Competency

Certificates of Safety Competency will be issued to staff when they attain the levels of competency listed below.

- Induction trained
- Basic: Knowledge in general safety practices and able to undertake general site work safely, but under supervision.
- Intermediate: Trained in specific safe work practices such as hazardous handling, hazard identification; self-contained breathing apparatus; working at height (safety harness etc). No Permit-to-Work requirements, but still requires supervision.
- Advanced: Trained in specific Permit-to-Work systems and is at a level to supervise other work tasks safely.
- Supervisor: Trained to be able to supervise Permit-to-Work systems and able to supervise staff in safe work procedures.

Courses for a range of specific items will be developed and the above levels of competency assigned.

3.3.3 Certificate of Safety Competency

For each activity carried out at a facility or with a contract by a contractor, at least one person must hold an appropriate certificate of safety competency for the particular class of work by carried out. This person shall be responsible for the safety of people and the work they undertake.

The particular class of work cannot be undertaken unless supervised by a person certified as competent to perform the tasks safely.

It is DGDC responsibility to ensure that the appointed line manager, supervisor or persons in charge of the work, have sufficient training, experience and are certified.

Certificates of competency may be granted on completion of formal training given by a recognised trainer who has experience in the class of work to which the certificate applies.

Recognised trainers can include:

- DGDC supervisors or line managers who are competent and appropriately trained
- Health and Safety Officers
- DGDC approved independent safety trainers.

3.3.4 Issuing of Certificates and Records

Certificates of Safety Competency will be signed by the Site Superintendent or by the approved trainer. Each certificate will specify the task in which the individual has achieved competency.

The certificate issued will specify the following information:

- discipline/activity for which certificate is issued e.g. first aid, confined spaces, scaffolding
- level of competency achieved
  - basic
  - competent
  - advanced
  - supervisory
- date of issue
- certificate number.

This information will be recorded on the individual's training record. The Site Health and Safety Officer will be advised of each new certificate issued so the Safety Training Records can be updated.

3.4 Safety Training Records

Safety Training Records will be held for each:

- DGDC employee
- Contracted employer
- Contractor.

The records will indicate the level of safety competency and safety training achieved by that individual or contractor.

The Safety Training Records will be held by the Site Personnel Department and will form part of the individual's personnel records. A copy of the individual's safety training record will also be held by the Site Health and Safety Officer. The Site Health and Safety Officer or person delegated by the Health and Safety Officer will be responsible for updating and maintaining Safety Training Records.

3.5 Safety Training Programme

3.5.1 Introduction

A Safety Training Programme will be developed for each site by the Site Health and Safety Officer. The programme will be approved by the Health and Safety Committee. The training programme will be designed to cover the hazards identified at the site, and the safe work practices that will be followed.

Training requirements specified for each of the safe work practices/activity detailed in this manual should be extracted to form the basis of the safety training programme specific to the site.

This programme will include, but will not be limited to:

- induction training of new employees and contractors
- the use and care of safety equipment
- specific safe work practices associated with the person's work discipline
- supervisor and line management safety responsible
- Permit-to-work system

- emergency procedures
- certification for specific practices, for example:
    - confined spaces
    - scaffolding
    - hot work
    - high voltage work
    - tag out / lock-out
    - working at height
    - use of cranes/heavy vehicles
    - hazardous substances handling
    - self-contained breathing apparatus
- hazard identification and safety inspection
- emergency rescue and firefighting.

3.5.2 Employee Induction Training

The supervisor or foreperson responsible for a new DGDC employee or contracted employee shall ensure that before they start work at the site, they complete the Safety Induction Training course. The course will cover the following:

- the location of hazardous areas of the site
- hazard types and practices necessary
- personal safety equipment required (boots, goggles, ear muffs)
- general site safety rules
- emergency procedures especially fire and evacuation
- location of the first aid boxes, first aid and paramedics
- site safety signs
- basic safety instruction regarding site work practices
- accident reporting
- who is responsible for day to day safety

3.5.3 Contractor Induction Training

All contractors and their employees will go through safety induction training before they commence work at the site. The aim of contractor induction training is to familiarise contractor personnel with the site's safe work practices and hazards, including:

- work permit procedures (as described in DGDC-OHS-013: Work Control)
- understanding of site safety signage

- standards of dress
- the location of hazardous areas at the site
- hazardous substances handling (see DGDC-OHS-020: Hazardous Substances)
- emergency procedures especially fire and evacuation
- accident reporting
- hazards relating to site's activities which may impinge on the contractor's operations
- specific safe work practices related to the contracted work.

The induction training will be given by DGDC personnel. It should be noted that contractors' supervisors will need a more intensive induction training course than that given to contractor personnel.

At the end of induction training, contractors will be required to sign a declaration, that they are:

- fully qualified to carry out the assignment and are aware of the necessary safety practices
- have the appropriate personal safety equipment
- are familiar with the on-site emergency procedures
- are familiar with the hazardous areas at the site
- are familiar with the DGDC Safety Manual.

3.5.4 Specialised Training

Specialised safety training will be provided to staff to enable them to undertake their work tasks. If they are handling hazardous substances, training in safe work practices for handling hazardous substances is required along with the correct use of personal protective equipment.

Maintenance personnel will need training in the Permit-to-Work system and specific work practices under this system. These aspects will be covered in the Site Training Programme.

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Powering a New Generation...

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DGDC-OHS-011: Hazard Identification Assessment and Control
Revision 0

Contents

4. Hazard Identification Assessment and Control

4.1 Introduction

In order to manage the health and safety of personnel at a Site effectively, an organisation has to be able to identify, assess and control hazards which have the potential to cause harm or damage.

This section sets out the actions necessary to ensure that all hazards with a potential to cause harm or damage are systematically identified at DGDC sites. The level of risk of each hazard is determined at each site. Controls are then implemented to eliminate, isolate, or minimise the hazard.

4.1.1 Responsibilities

The site's Health and Safety Committee will implement a systematic hazard identification and assessment programme. The aim being to identify all hazards at the site and to introduce controls for those hazards. Typically, these will be hazards inherent at the site and those caused by routine or normal activities. Non-routine work related hazards will usually be managed by the permit-to-work system.

Hazard identification and control is a shared responsibility between management and staff. Hazards will be systematically identified by examining specific areas of the work site and the activities carried out in them.

Designated staff and management are to review their work areas to consider the potential hazards present. The risk posed by the hazards identified will be evaluated and appropriate control measures developed.

The Health and safety Officer is responsible for updating and maintaining the Hazard Identification Register.

4.1.2 Definitions

Consequence
The outcome of an event or situations expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain.

Frequency

A measure of likelihood expressed as the number of occurrences of an event in a given time.

Hazard

A source of potential harms or damage or a situation with potential harm or damage.

Likelihood

A qualitative description of probability and frequency.

Probability

The likelihood of a specific outcome, measured by the ratio of specific outcomes to the total number of possible outcomes.

Risk

The measure both of the likelihood (frequency) and the consequences (severity) of a specified untoward event caused by an identified hazard.

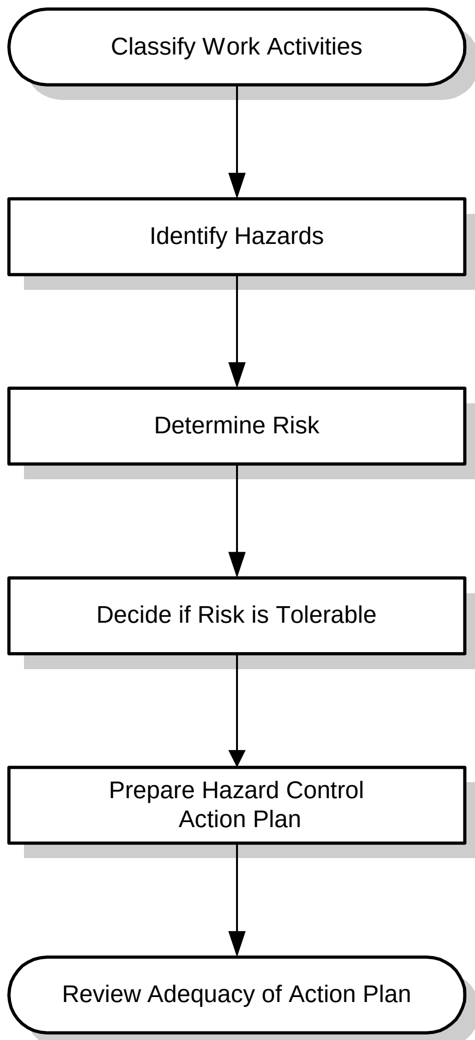
4.2 Steps in a Hazard Management Programme

The steps required in order to carry out an effective Hazard Management Programme are presented in Figure 4.1 and are listed below.

- Classify work activities: prepare a list of work activities covering premises, plant, people and procedures, and gather information about them;
- Identify hazards: identify all significant hazards relating to each work activity. Consider who might be harmed and how;
- Determine risk: make a subjective estimate of risk associated with each hazard assuming that planned or existing controls are in place. Assessors should also consider the effectiveness of the controls and the consequences of their failure;
- Decide if risk is tolerable: judge whether planned or existing precautions (if any) are sufficient to keep the hazard under control and meet legal requirements;
- Prepare risk control action plan (if necessary): prepare a plan to deal with any issues found by the assessment to require attention. Organisations should ensure that new and existing controls remain in place and are effective;
- Review adequacy of action plan: re-assess risks on the basis of the revised controls and check that risks will be tolerable.

Note: The word 'tolerable' here means that risk has been reduced to the lowest level that is reasonably practicable (the ALARP Principle).

Figure 4.1 Steps in a Hazard Management Programme



4.3 Hazard Identification

4.3.1 Hazard Categories

To help with the process of identifying hazards, it is useful to categorise hazards by types. Some examples are listed below.

- Chemical Hazards: Chemicals can affect the skin by contact or they affect the body either through the digestive system or, via the lungs if air is contaminated with chemicals, vapour, mist or dust.
- There can be an acute effect, (i.e. the person is affected immediately), or there can be a chronic effect, (i.e. the person health can be affected in the medium to long term).
- Noise Hazards: Excessive noise can disrupt concentration, interfere with communication and result in loss of hearing. High impact noises are particularly damaging. Noise can also mask out signals, adversely affecting communication.
- Radiation Hazards: Ionising radiation is in such equipment as radioactive gauging devices, radiographic sources, or the radioactive trace elements used in analytical chemistry. Non-ionising radiation covers infra-red radiation (heat producing processes), lasers, ultraviolet radiation (welding, sunlight), and microwaves (high frequency welders, freeze drying).
- Electrical Hazards: This covers the risk of injury from all forms of electrical energy.
- Lighting Hazards: Inadequate lighting levels are a potential safety hazard. A common problem area is the reaction time needed for the eyes to adjust from a brightly lit to a darker environment. Temporary lighting is often inadequate.
- Vibration Hazards: This includes whole-body vibration - e.g. truck drivers, people standing on vibrating platforms, and operators of mobile equipment - and also segmental vibration effects from such equipment as hand tools, chainsaws and pneumatic hammers.
- Temperature Hazards: Extremes of cold or heat can cause problems due to individual fatigue or reduced capacity to work.
- Biological Hazards: These include insects, bacteria, fungi, plants, worms, animals and viruses.
- Ergonomic Hazards: This covers risk of injury from manual handling procedures, incorrectly designed work stations, audio and visual alarms, and colour coding control mechanisms.

- Physical Hazards: This includes a wide range of risks of injury - as diverse as being caught in or by machinery, buried in trenches or hurt by collapsing machinery. This category also includes the hazards from working in confined spaces, being hit by flying objects, caught in a jet stream, falling from heights and tripping on obstacles.
- Miscellaneous Hazards: This includes stress, fatigue, the effect of shift work, and even assaults from other people.

4.3.2 Hazard Identification by Area

Fixed workplaces are ideally suited to hazard identification by area which involves grouping hazards into common types and identifying them by surveying in detail the different parts of the workplace.

An outline of steps in the process is given below.

(a) Obtain an up-to-date and accurate plan of the workplace.

(b) Draw up a diagram to show the movement of people or plant.

(c) Divide the workplace into discrete areas and number them. This division can be based on how work is carried out or on the physical layout of the site. Thus, for example, a power plant on it might contain a stores area, a plant area, workshops, offices, control room and switch rooms.

(d) Ask staff in each identified area to list what they consider are the hazards in the places they work and why they consider these to be hazards or potential hazards. Use a data collection form for information gathering.

Note: The process of hazard identification will need to be audited. Make sure therefore, that there is an audit trail established, with information clearly recorded.

(e) It is recommended that a meeting be held to fill in the data sheets rather than just handing them out. It is also important that judgements as to the likelihood that harm would result from the hazard are not made at this time.

(f) To further assist the hazard identification process make use of all available information. This can come from the following sources: codes of practice, pamphlets, booklets, regulations, manufacturers' information material, in-house and external reports, complaint details, environmental and health monitoring reports, etc. Use can also be made of records and reports on accidents and 'near misses', both at the particular workplace and more generally within the industry itself.

4.3.3 Hazard Identification by Task Analysis

Work that is not done at a fixed workplace is better analysed by first identifying the different type of work involved and the tasks that people are called on to perform, and then the hazards they face in doing these tasks can be identified. This method is well suited to those work activities where there is considerable scope for the workers themselves to decide how the task will be carried out, e.g. tradespeople.

This analysis method is applicable to such work as maintenance, construction and similar activities where people tend to work in small autonomous groups with minimal supervision.

A major problem with this type of approach is that hazards that are not part of a particular person's work tasks will not be identified by that person.

Steps included in the process are listed below.

(a) Identify all the tasks that people carry out. A task consists of a number of steps, actions or stages performed in order to complete a specific work assignment. The task identification process can initially be done by asking people what they specifically do. The work should be broken down into small enough components to be analysed, but not so small as to make the analysis impractical. A task breakdown of the work carried out may already exist, for example from the development of a quality assurance system.

(b) Discuss and then list the steps or stages involved in performing each task.

(c) Ask those involved what hazards they consider apply to each identified step, and record these.

(d) To further assist the hazard identification process make use of all available information.

4.3.4 Hazard Identification by Process

A more technical approach to hazard identification is to identify the processes involved at a work site and then go through each process step-by-step, identifying the hazards in each element of the process. The time taken to identify individual potential hazards in this way can be longer than the time taken to quantify the risks of these hazards.

Steps in this method are listed below.

(a) Make an inventory of all substances and/or chemicals used in the process.

(b) Outline the process from start to finish (source to sink). Identify the steps where process fluids are transformed by physical or chemical means.

(c) Draw up a flow chart detailing every step of the process (including waste streams) and setting out the various stages where chemicals and substances are used in the process.

(d) Identify all the hazards at each of the process.

(e) To further assist the hazard identification process, make use of all available information.

4.3.5 Hazard Identification Register

A detailed list of the hazards identified shall be prepared clearly linking delineated hazards to specific work areas, specific workplace activities or specific processes within the workplace. Information that needs to be recorded to allow the next stage of the process to be undertaken (risk assessment) includes:

- the exact location, activity or process of the hazard.
- determining who could come into contact with the hazard.
- when and how likely they are to come in contact with the hazard.
- how often (frequency).
- the consequence of coming into contact with the hazard, e.g. the worst case with no controls.

All the information obtained should be recorded on the Hazard Identification Register Form 4.1. These forms will form the basis of the Site Hazard Identification Register; these should be available on site to all employees/contractors.

In addition, hazards may be added to the register, via a Safety Alert Card Notification (see Subsection 4.13 for more details).

Form 4.1

Hazard Identification Register

Area/Activity/Process_____________________________ **Staff Member**_________________________________

Hazard Type_____________________________________ **Date**____

Hazard Descripton	**Location of Hazard**	**People Who Could be Exposed**	**When/How/Why/ How Often?**	**Consequences**	**Action Taken/Date**

4.4 Risk Assessment

4.4.1 Determine Risk

The risk from the hazard should be determined by estimating the potential severity of harm (consequence) and the likelihood that harm will occur.

4.4.2 Severity of Harm

Information obtained about work activities is a vital input to risk assessment. When seeking to establish potential **severity of harm**, the following should also be considered:

a) part(s) of the body likely to be affected

b) nature of the harm, ranging from slightly to extremely harmful:
   - i) slightly harmful, e.g.:
     - superficial injuries; minor cuts and bruises; eye irritation from dust;
     - nuisance and irritation (e.g. headaches); ill-health leading to temporary discomfort;
   - ii) harmful, e.g.:
     - lacerations; burns; concussion; serious sprains; minor fractures;
     - deafness; dermatitis; asthma; work related upper limb disorders; ill-health leading to permanent minor disability;
   - iii) extremely harmful, e.g.:
     - amputations; major fractures; poisoning; multiple injuries; fatal injuries;
     - occupational cancer; other severely life shortening diseases; acute fatal diseases.

4.4.3 Likelihood of Harm

When seeking to establish likelihood of harm, the adequacy of control measures already implemented and complied with, needs to be considered. Here legal requirements and codes of practice are good guides covering controls of specific hazards. The following issues should then typically be considered in addition to the work activity information:

a) number of personnel exposed

b) frequency and duration of exposure to the hazard

c) failure of services e.g. electricity and water

d) failure of plant and machinery components and safety devices

e) exposure to the elements (flooding, high winds, sun, etc.)

f) protection afforded by personal protective equipment and usage rate of personal protective equipment

g) unsafe acts (unintended errors or intentional violations of procedures) by persons, for example, who:
   i) may not know what the hazards are
   ii) may not have the knowledge, physical capacity, or skills to do the work
   iii) underestimate risks to which they are exposed
   iv) underestimate the practicality and utility of safe working methods.

It is important to take into account the consequences of unplanned events.

These subjective risk estimations should normally take into account all the people exposed to a hazard. Thus any given hazard is more serious if it affects a greater number of people. But some of the larger risks may be associated with an occasional task carried out just by one person, for example, maintenance of inaccessible parts of the plant.

4.4.4 Decide if Risk is Tolerable

Table 4.1 shows one simple method of estimating risk levels and for deciding whether risks are tolerable. Risks are classified according to their estimated likelihood and the potential severity of harm.

Table 4.1 A Simple Risk Level Estimator

	Slightly Harmful	Harmful	Extremely Harmful
Highly Unlikely	**Trivial Risk**	**Tolerable Risk**	**Moderate Risk**
Unlikely	**Tolerable Risk**	**Moderate Risk**	**Substantial Risk**
Likely	**Moderate Risk**	**Substantial Risk**	**Intolerable Risk**

Note: Tolerable here means that risk has been reduced to the lowest level that is reasonably practicable.

4.5 Hazard Control Action Plan

4.5.1 Prioritising Actions

Risk categories shown, for example in Table 4.1, form the basis for deciding whether controls or improved controls are required to reduce the risk from an identified hazard to acceptable levels.

To establish a prioritisation (timescale for action) list an approach is shown in Table 4.2, which shows that control effort and urgency should be proportional to risk.

Based on this approach, an inventory of actions, in priority order, to devise, maintain or improve controls, can be developed and implemented.

Table 4.2 A Simple Risk-Based Control Plan

Risk Level	Action And Timescale
Trivial	No action required and no documentary records need to be kept.
Tolerable	No Additional controls are required. Consideration may be given to a more cost-effective solution or improvement that imposes no additional cost burden. Monitoring is required to ensure that the controls are maintained.
Moderate	Efforts should be made to reduce the risk, but the costs of prevention should be carefully measured and limited. Risk reduction measures should be implemented within a defined time period. Where the moderate risk is associated with extremely harmful consequences, further assessment may be necessary to establish more precisely the likelihood of the harm as a basis for determining the need for improved control measures.
Substantial	Work shall not be started until the risk has been reduced. Considerable resources may have to be allocated to reduce the risk. Where the risk involves work in progress, urgent action should be taken.
Intolerable	Work shall not be *started* or *continued* until the risk has been reduced. If it is not possible to reduce risk even with unlimited resources, work has to remain prohibited.

Note: Tolerable here means that risk has been reduced to the lowest level that is reasonably practicable.

4.5.2 Hazard Control Options

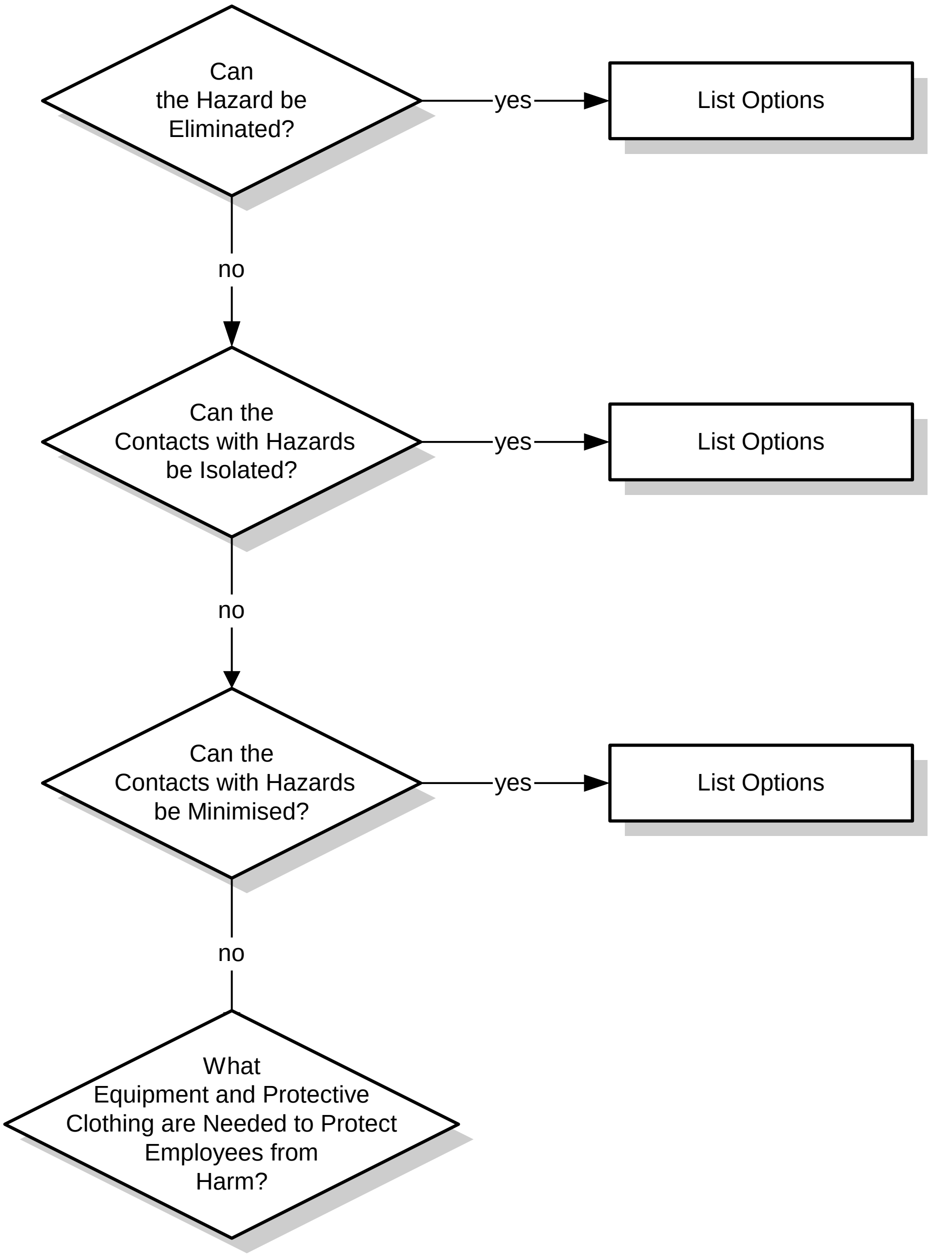
It is important when developing control options for identified significant hazards that all options are considered including reviewing the existing controls to ensure that the most effective controls are in place. Controls should be chosen taking into account the points listed below.

- If possible, eliminate the hazard altogether, e.g. substitute with a safer chemical for a more hazardous one
- If elimination is not possible, try to reduce the risk, e.g. by using a low voltage electrical appliance
- Enclose/isolate process or pieces of equipment
- Where possible, adapt work to the individual, e.g. to take account of individual mental and physical capabilities
- Take advantage of technical progress to improve controls
- Implement measures that protect everyone
- A blend of technical and procedural controls is usually necessary
- Consider the need to introduce planned maintenance of, for example, machinery safeguards
- Adopt personal protective equipment only as a last resort, after all other control options have been considered
- Review the need for emergency arrangements
- Pro-active measurement indicators are necessary to monitor compliance with the controls.

Consideration also needs to be given to the development of emergency and evacuation plans, and provision of emergency equipment relevant to the organisation's hazards.

A decision tree for deciding how a hazard can be controlled is presented in Figure 4.2.

Figure 4.2 Hazard Control Decision Tree



4.5.3 Review Adequacy of Action Plan

The action plan should be reviewed before implementation, typically by asking these questions.

a) Will the revised controls lead to tolerable risk levels?

b) Are any new hazards created by the implementation of the proposed control?

c) Has the most cost-effective solution been chosen?

d) What do people affected think about the need for, and practicality of, the revised preventive measures?

e) Will the revised controls be used in practice, and not ignored in the face of, for example, pressures to get the job done?

4.6 Implementation of Control Options

Once an appropriate control option has been decided on, it will be implemented and its implementation recorded in the Hazard Identification Register. The Hazard Control Plan (Form 4.2) will be filled in, assigning responsibilities and a timeframe for the implementation of the control. If the option is a set of safe procedures, these procedures will be added to the Volume 3 Site Specific Safety. The frequency of inspection for each control will be based on the degree of risk the hazard represents.

Form 4.2: Hazard Control Plan

To be developed in consultation with Management and Employees, with specialist advice as appropriate.

HAZARD TO BE CONTROLLED

Local Controls

Responsibilities

(i) For implementation
(ii) For monitoring

Timeframe for Implementation

MANAGEMENT CONTROLS

Responsibilities

(i) For implementation
(ii) For monitoring

Timeframe for Implementation

NOTE: Risk Assessments should be repeated for each control plan to ensure the most appropriate control measure is identified.

4.7 Plant Failures

4.7.1 General

Operations involving high energy systems require that the hazards presented by system and equipment failures are of particular concern. Plant hazard identification and control must start at the conceptual design stage and extend right through to decommissioning.

Most hazards not covered at the design stage will tend to be managed by operating procedures. Non-routine plant activities will usually be controlled by careful work planning and implementation.

4.7.2 Maintenance

The ongoing safety of plant and equipment is largely controlled by routine maintenance and prompt defect identification and rectification. To this end all safety-related maintenance is to be separately identified and monitored. It is of note that the term 'safety related maintenance (starred maintenance)' refers both to maintenance on safety equipment and safety systems, as well as systems and equipment if a failure occurred which could lead to hazards to personnel. See DGDC-OHS-017 Plant, Equipment and Other Machinery

4.8 Management of Change

The management of hazards at a facility is a continuous process. The adequacy of control measures should be subject to continual review and changes made as if required.

If conditions change, (activity change, process change or new equipment) then the extent that hazards and risks are affected by the change should be reviewed and the risk assessment revised to take into account these changes.

4.9 Hazardous Areas

As part of the hazard control process, certain areas, because of the nature of hazards identified in that area, will have specific control measures. Areas designated as Hazardous Areas will be marked on a site layout map and warning signs erected to inform persons that the area is hazardous, has restricted access and is subject to specific work controls. The Site Health and Safety Committee will establish appropriate rules for each designated Hazardous Area.

Hazardous Areas can include areas where there is the likelihood of flammable or toxic gases being present; high noise hazards, e.g. areas around a venting rock muffler or a venting safety valve; high voltage areas, such as switchyards.

4.10 Safety Alert Cards

If DGDC employees, contractors or visitors in their work come across a hazard that they believe has not been identified, or a control measure that is deficient, a Safety Alert Card should be filled in and forwarded to the Site Health and Safety Officer.

The Site Health and Safety Officer will process the Safety Alert Cards received and raise them at the next site Health and Safety Committee meeting for consideration. The actions decided on by the Health and Safety Committee will be conveyed to the person who raised the Alert.

Safety Alert Cards are red cards which are located in small boxes attached to Health and Safety Noticeboards throughout the site. A copy of the card is presented as Figure 4.3.

Figure 4.3 Safety Alert Card

SAFETY ALERT CARD

Date:
Time:
Work Area:

Hazard/Item:

Unsafe Condition:

Signed:

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5. Natural Hazards

5.1 Introduction

There are a number of hazards due to the natural environment in which a site is located. In some cases, work must be carried out in areas where natural hazards exist. This section briefly discusses those hazards and give guidelines on how exposure to those hazards can be controlled.

5.2 Responsibilities

- DGDC shall provide safety equipment as appropriate to the scale of the work and the hazards likely to be encountered.
- Employees shall avoid or minimise risk to themselves and others at all times.
- Employees shall wear or use safety equipment as required in this manual or by management for specific tasks.
- Supervisors must ensure that all members of a work party and all contractors and subcontractors are aware of the potential hazards and measures to avoid them.

5.3 Background

5.3.1 Possible Natural Hazards

Persons working outdoors must familiarise themselves with the areas in which they are working and the potential hazards that may be present in those areas. If significant hazards exist, such as unstable surfaces and acidic waters, a safety plan must be prepared by the work supervisor for the work required. As a minimum requirement, workers must work in pairs, carry appropriate first aid equipment and have training in first aid. The safety plan must include:

- identification of potential hazards
- likely locations and extent of potential hazards
- avoidance measures
- remedial measures, including first aid.

The following are examples of natural hazards which may exist at a site:

- Wildlife
  - snakes

- vermin

- Geothermal
  - fumaroles
  - blow holes
  - acidic lakes
  - sulphur rocks
- Topographical
  - cliff faces
  - areas prone to landslides
  - water
  - crevasses
- Forest fires
- Earthquakes
- Climatic conditions
  - heat stress
  - cold stress
  - flooding
  - tropical storms
  - lightning
  - ultra violet light
- Biological
  - virus
  - allergies
  - bacteria

5.3.2 Hazard Register

All natural hazards that are identified or found at a site in the course of work activities must be recorded and reported to Health and Safety Committee, following techniques specified in DGDC-OHS-011: *Hazard Identification, Assessment and Control*. All identified hazards shall be recorded in the Site Hazard Register and an assessment made of whether new controls are required.

5.4 Safety Precautions

5.4.1 Minimum Requirements

For work teams working outdoors and in isolated areas the minimum safety precautions, and equipment required include:

- Ankle protected footwear worn by all persons; protective footwear should be worn where there is a risk of falling objects, tree felling, etc.
- Safety Glasses/eye goggles and hard hat, depending on the work tasks (e.g. tree felling).
- clothing that fully covers the body
- as minimum, two persons in a work group
- first aid kit with each work group
- persons trained in basic first aid
- awareness of the potential hazards in the proposed work area (fumaroles, cracks etc.)
- clean water available with the teams.
- weather reports checked before undertaking work outside.
- work not undertaken outdoors when there is a possibility of extensive weather events.

5.4.2 Precautions with Snakes

- There are no venomous snakes in Dominica
- Know how to identify snakes common in the area.
- Be alert for snakes in unusual places. They may be found in or around homes, barns, outbuildings, driftwood, leaves, dikes, dams, stored automobiles, piles of debris, building materials, trash or any type of rubble or shelter.
- Before beginning any clean-up or rescue operations, search the premises thoroughly for snakes. They may be under or near any type of protective cover.
- In rescue or clean-up operations, wear heavy leather or rubber high-topped boots, and heavy gloves. Wear trouser legs outside boots. Be extremely careful around debris. Use rakes/bars, or other long-handled tools when removing debris. Never expose your hands, feet, or other parts of your body in a place where a snake might be.
- After dark, carry a strong light.
- A person realising, they are near a snake, should avoid sudden movement. Sudden movements may cause the snake to strike. If the person remains still, the snake may leave. If the snake doesn't move away after a few minutes, the person should slowly back away from it.

5.4.3 Precautions for Topographical and Geothermal Hazards

- Know where potentially hazardous areas are.
- Review maps prior to going into area to identify hazards.
- Wear safety harness and safety lines when ascending or descending steep surfaces.
- Avoid walking on areas of recent subsidence or slippage rubble.
- If proximity to geothermal area is unavoidable, wear protective equipment and always work up-wind.
- Carry H_2S monitors.

5.4.4 Precautions for Climate Extremes.

- Always check on weather prior to work.
- Do not undertaken outdoor work if there is a possibility of extreme weather events.
- Remain in vehicles during lightning storms.
- Follow guidelines on heat and cold stress as specified in the Heat Stress Section of this manual.
- During the very high rainfall episodes keep out of rivers that have a tendency to flash flood.
- Sunscreen, sunglasses to combat UV light
- Appropriate protective clothing

5.4.5 Precautions in Forests

- Always extinguish any cooking fires.
- Extinguish cigarettes carefully.
- Ensure adequate protection if staying overnight in tents etc.
- The group in the forest should be equipped with:
  - radio
  - radio telephone/cell phone
  - whistle
  - flashlight
  - first aid kit
- Maintain contact with Security on a regularly scheduled basis (minimum every two hours).

5.4.6 Earthquakes/Volcanic Eruption

Follow the emergency procedures as presented in Section 30 Emergency Procedures.

5.5 Training

Staff shall complete task-specific training in the hazards identified in the work that they will perform. In addition, all employees undertaking extensive work outdoors must complete first aid training.

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DGDC-OHS-013: Work Control & Permit-To-Work
Revision 0

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6. Work Control

6.1 Introduction

As discussed in the hazard identification section of this manual, activities or work carried out at a facility will invariably involve hazards that could lead in injury. It is therefore important that all work is controlled in a manner that will ensure safety. Clearly this control must be practical and enable the work to be completed effectively and efficiently.

6.2 Appropriate Control Measures

Work that is related directly to the purpose of the facility can be expected to be performed repeatedly under known conditions (e.g. synchronising supplies, changing over production wells). It is therefore possible to assess the associated hazards and set out any necessary precautions. However, some work such as defect repair may have to be carried under a range of differing conditions and therefore hazards. The precautions necessary to ensure safety cannot therefore be fully developed beforehand and so need to be considered at the work planning stage. Work control for this 'abnormal' or 'non-routine' type of work therefore needs to be quite different to that for 'normal' plant operation.

Typical activity-based work control measures can be summarised as:

- All activities
  - Hazardous Area Access Permits
  - Special Procedure Forms
  - Safe Work Practices
  - Technical Instructions
  - Work Permits
- Operation of high energy systems (e.g. steam systems, hydraulic services, power plant)
  - Standard Operating Procedures (SOPs)
  - Emergency Operating Procedures (EOPs)
  - Standing Orders
- Maintenance and repair
  - Work Permits
- Commissioning/Testing
  - Special Technical Procedures

- Test Procedures
- Major Works (construction, drilling, overhaul)
  - Contractual requirements
  - Work Permits.

6.3 Operating Procedures

6.3.1 Standard and Emergency Operating Procedures (SOPs and EOPs)

A power plant or other similar facility is designed to be safe during normal operations. This safe state can easily be negated by incorrect operation. SOPs and EOPs are designed to ensure plant is operated correctly and safely. However, even during normal operation a number of potential hazards may be present. It is important that these are understood so that they can be managed correctly.

SOPs are based upon a number of assumptions which are deemed to result from 'expected' conditions. Clearly, if the plant or equipment is not in a standard condition then use of the operating procedure may not result in a safe activity. It is therefore important that assumptions made are stated.

6.3.2 Format and Content of Operating Procedures

To ensure the operating procedures are used correctly and result in safe operations they are to:

- use a common format and style
- be clear and unambiguous
- include a list of prerequisites (the conditions and state of systems and plant that are necessary prior to the use of the procedure)
- include the specific precautions that should be taken or borne in mind when carrying out the procedure
- include the procedure (the actual procedure set out in logical stages and steps with each step including one distinct operation only)
- be authorised by the department manager and the safety committee before being issued
- include the revision status.

They may or may not include tick boxes to show completion of each step depending upon their complexity, frequency of use, and time scale over which they would be expected to be completed.

6.3.3 Control and Availability of Operating Procedures

Operating procedures to cover all standard and credible emergency plant and system conditions are to be written prior to initial commissioning of each facility. Further procedures are to be written whenever a need is identified. A central register of operating procedures together with their revision status, and location of all permanent copies, is to be controlled and maintained.

Copies of all SOPs and EOPs are to be available in bound form in each of the main operational control rooms in an installation. Additionally, copies of relevant operating procedures are to be held in bound form in all work control centres. Copies of individual operating procedures are to be posted next to local control points of machinery or equipment to which they refer. These copies are to be suitably protected from the surrounding environment.

6.3.4 Personal Copies of Operating Procedures

Strict control of revision and issue is important to ensure that personnel use only the latest revision of operating procedures. To this end operator are not to make personal 'quick reference' or 'come in handy' copies of procedures. If it is found necessary to copy a procedure to aid operation then photocopies, as opposed to handwritten notes are to be used. The copy should not be retained for use at a later date.

6.3.5 Control of Copies of Operating Procedures

Where copies of operating procedures or other instructions are posted near to equipment or control stations then these copies are also to be registered and controlled centrally to ensure they are maintained at the current status.

6.3.6 Changes to Operating Procedures

Well written, practical and easy to follow operating procedures can significantly aid plant and personnel safety. Their credibility, and therefore correct use depends largely upon their quality, technical correctness and practically. Operators are therefore to be encouraged to propose revisions to operating procedures whenever appropriate.

A simple administrative procedure that aids the proposal of revisions is to be set up at each facility. The revision process is to include a detailed check for technical accuracy, review by the Health and Safety Committee, registration in the central register, and re-issue of all registered copies. In addition, notification of changes, together with the philosophy behind and summary of the changes, is to be made to ensure all operators are aware that amendments have been made.

6.3.7 Review of Operating Procedures

Operating procedures are to be reviewed by the safety committee as follows:

- prior to initial issue
- whenever a revision is proposed
- whenever safety investigations identify that an operating procedure may be in need of improvement
- once every five years.

6.3.8 Special Technical Procedures and Test Procedures

Complex work on systems and equipment such as during commissioning and testing often involves personnel following non-standard procedures and sequences. In addition, during testing, systems and equipment may be subjected to conditions that are nearer to those which they were designed to withstand. As a result, the hazards faced by personnel during these times are higher than normal. These increased hazards therefore need to be managed with particular care.

Whenever unusually complex or unusual work is intended to be carried out on systems or equipment, a special procedure is to be written. This is to be written by an engineer of suitable experience and reviewed by a group of personnel drawn from all affected disciplines. Such a group shall consider hazard management and safety as a separate agenda item before authorising the use of a procedure. The site safety officer is to be an ex-officio member of all such special procedure groups.

Once proven in use, special procedures are to be registered and retained to form the bases of future special procedures. All such procedures are to be reviewed prior to re-issue to ensure all assumptions made regarding prior conditions are still relevant and correct.

6.4 Permit-to-Work System

6.4.1 Introduction

Formal Permit-to-Work systems, developed through many years' experience, are a major factor in the safety of oil, chemical and power industries.

The system used by DGDC is based on this prior experience and is designed to ensure safety within a practical and efficient level of control. It is based upon the permit systems used by the Company's shareholders but has been developed further to make it applicable to the technological systems and operational activities of DGDC. The system is to be reviewed by DGDC management from time to time and if necessary refined in the light of reports from site Health and Safety Committees.

6.4.2 Definitions

Work Permit
Signed statement by an authorised person that a particular job may be carried out with stated precautions. Permits are designed to aid safe job planning and co-ordination.

Master Work Permit
The main permit raised for each job. Other specific permits may be used to support it.

Specific Work Permits and Plans
Specialised permits that cover specific types of situations or areas. Plans aid work planning in the same way as permits, but do not need to be authorised by a technical or area supervisor.

Certificate
Signed statement that specifies checks or tests have been carried out by an authorised person and that conditions are acceptable, (e.g. Gas Test Certificate). Certificates do not replace permits; they are complementary.

High Voltage
High voltage is the term applied to electrical equipment that operates at more than 600 volts (terminal to terminal), or more than 300 volts (terminal to earth). High current AC or DC power supplies are to be considered as High Voltage. See Section 12: *Electrical* for further information.

Danger Tag
A notice conveying important information relating to work being carried out under a permit.

Isolation Tag
A specific type of tag used to identify isolation boundary points and the state they are to be in. They are usually used to indicate the items forming the isolation boundary.

Caution Tag
A specific type of tag used as a general warning. The hazard is stated on the tag.

Permit Applicant
The person who raises a permit. This is always the employee or contractor in direct charge of the work or immediate work site. They are to be of an appropriate engineering discipline. Where the job involves work on High Voltage equipment or systems, the permit applicant must be an electrical engineer.

Permit Holder
The person in charge of the job and who formally holds the authorised permit. The permit applicant becomes the permit holder when the permit is authorised.

Operational Supervisor
The manager of the section of the installation authorised by the Site Superintendent to grant Master Work Permits in the area concerned. The area should be a defined section of the installation (usually defined by the system or service covered). The Operational Supervisor will usually be the line or department supervisor directly responsible for the physical operation of that section of the installation.

Area Supervisor
The person authorised by the Site Superintendent to grant Hazardous Area Work Permits, (a type of specific work permit), for areas where they hold specific responsibility. This authority to grant area permits may be delegated to suitably qualified personnel.

Technical Supervisor
The person with particular training and knowledge authorised by the Site Superintendent to grant Specific Work Permits.

Shift Supervisor
The operations employee with current responsibility for the operation of the installation or section thereof. Out of normal working hours this person is likely to have operational responsibility for the whole site.

Authorised Gas Tester
This term is used to describe a person who is trained to perform gas tests and authorised to issue Gas Test Certificates (in support of specific work permits, etc).

Non-routine Activity
Non-routine refers to any activity that is outside regular operation of the plant or installation that is not covered by Standard Operating Procedures; or where persons may

be put at risk due to location, surrounding conditions, hazards or other activities. In this respect maintenance and construction activities are considered as non-routine. A permit is required prior to any non-routine activity, even if frequently carried out. If there is any doubt regarding the need to raise a permit, then one should be used.

6.4.3 Intent and Applicability

The Permit-to-Work system is intended to reduce the chance of misunderstandings when 'non-routine' activities are to be carried out on operational plant, systems or equipment, or where normal activities are carried out under 'non-standard' conditions. These are situations where unknown or unassessed hazards may occur. In doing so it attempts to safeguard people and property. The system is to be used within all DGDC operational facilities. The term 'non-routine' is defined under Definitions above.

An example of when a work permit may or may not be required is that of painting. A permit clearly is not appropriate to paint the ground floor windows of an administrative building. However, if the same otherwise safe activity was to be carried on an explosives store, a permit would enable suitable precautions to be put in place to safeguard the personnel and site.

The Permit-to-Work is a system that enables work to be planned and authorised in a way that allows all associated hazards to be considered and the risks mitigated. The Permit-to-Work system does not in itself make the job safe; that can only be achieved by the persons using the system and carrying out the activity.

The same permit system is to be used to control work being carried out by DGDC personnel and contractors alike. The only place and time it may not apply is when an area has been designated a contractor-controlled area. In these cases, alternative permit systems that meet DGDC contractual requirements will be used. (See DGDC-OHS-026*: Contractor and Construction Safety*). However, it is of note that a Master Work Permit (MWP) may be appropriate to manage the isolation boundary around a construction or drilling site. (See sub-section 6.7.8: *Blanket Clearance*.)

6.4.4 Aim of Permit System

The aim of the permit system is to;

- prevent harm to individuals or plant during 'non-routine' activities
- allow proper co-ordination of site activities

This is achieved by:

- ensuring proper authorisation of non-routine or hazardous work
- aiding complete job planning
- setting time, scope and area limits
- facilitating hazard identification, assessment and mitigation
- facilitating the obtaining of a second opinion to reduce the chance of errors
- ensuring information exchange and work co-ordination
- aiding job and team briefing.

6.4.5 Training

All personnel, whether employees or contractors, who may be required to carry out work within DGDC's installations are to be aware of the permit-to-work system. The minimum level of awareness shall include:

- basic outline of how the permit system functions and why
- there is a master work permit supported by additional specific permits
- tags are and that they must never be ignored
- a tag-out and lock-out system is used
- who to ask if in doubt.

All personnel who are expected to work regularly under the control of permits are to have additional training that shall include the items listed below:

- What permits are used, when they are used, what information they hold, and how they link to the Master Work Permit.
- How to check that the appropriate permit is in force, and what hazard controls have been put in place.
- Where original permits are held and where to expect to see copies posted.
- What tags are used on site, and what information they convey.
- How the tag-out/lock-out system is used and how to check that a system is safe to work on.

Any personnel who may be expected to be put in charge of work requiring permits to be raised may be required to become a Permit Holder. To this end all such persons are to be fully trained in the completion and use of permits, tags, and lockouts. The same requirement applies to Supervisors and the site safety staff.

6.5 Permit-to-Work System Fundamental Approach

The Permit-to-Work system is based upon a structured, systematic and disciplined approach to work planning that enables work to be correctly organised and co-ordinated. In particular, it requires all associated hazards and the necessary precautions to be identified. Permits are designed principally to aid safe work planning and hazard management.

The Permit-to-Work system is built around a Master Work Permit (MWP) Form that is supported by additional specific permits when required. The Master Work Permit allows the appropriate level of control and planning to be applied: minimal control on simple low-risk activities, and graduating to strict and sometimes involved control on potentially high-risk undertakings.

The work planning method outlined in this section follows a clearly defined and formalised process that aids the professional thought process that a worker should naturally apply prior to commencing a job. It consists of a series of fundamental steps, namely:

- work scoping and planning (what, when, who, how, etc)
- hazard/risk identification and management
- authorisation
- making systems and equipment safe
- execution of work
- recommissioning.

6.5.1 Permits and Associated Documentation

The permits are:

- Master Work Permit
- Hazardous Area Permit
- Specific Work Permit
  - ⇒ Hot Work Permit
  - ⇒ Confined Space Entry Permit
  - ⇒ Scaffolding Permit
  - ⇒ Change Permit.

The specific work plans are:

- Excavation Plan
- Mobil Crane Plan
- Purging Plan

Associated documentation required by the permit system includes:

- Master Permit Log
- Site/Field/Plant Status Boards
- Tag-out Tags
- Caution Tags
- Test Forms
- 'Awaiting Test' Log

Copies of the Tag-out and Caution Tag are presented later in this section. Copies of the Master Work Permit, Change Plan, and Hazardous Area Permit are at the end of this section. Other permits are presented in the appropriate sections of this manual.

Additional information required by to those raising permits includes:

- system diagrams
- site plans
- site/field/plant status (from boards/control screens, etc).

Additional hardware is required by the Lockout/Tag-out system that accompanies the permits. This includes:

- padlocks (individually keyed and numbered)
- locking chain
- purpose-designed locking devices
- built-in locking facilities
- lockable key boxes
- master key boards
- wall mounted system status boards.

6.5.2 Control of Permits

The correct administrative control of permits is fundamental to the safe working of the system. Permits are to be managed from a minimum number of points. Normally this will be the main plant control room. If more than one permit control point is used then a clear demarcation of responsibility is to be stated with the main plant control point remaining the lead point, where a master log of all permits raised is to maintained.

6.5.3 Master Work Permit (MWP)

The Master Work Permit consists of a single A4 sheet (see Form 6.1). It is divided into a number of sections that reflect the work planning process. As stated before the MWP is designed to form a planning frame work to ensure that all 'non-routine' work, or other work performed within a 'non standard' situation is carried out safely. In particular, it facilitates a systematic hazard identification and assessment process, as well as facilitating a second opinion and authorisation step.

The MWP will be initiated by the need to carry out work. This will normally be by a defect report, work request, or other administrative process. MWPs will normally be raised by the maintenance section of the appropriate department.

6.5.4 Master Work Permit Log

A log book is to be kept at the main control point (usually the plant control room) in which a record of all MWPs is kept (those in force and pending). The log is to record:

- the MWP identity number
- date raised
- the Permit Holder's name
- a brief description of the work
- the system/equipment being worked on
- location of work
- review period (where applicable)
- key box number (if applicable)
- date work started
- date work completed
- review complete boxes.

Example MWP Log headers are reproduced here:

Example of MWP Log (Left Page)

Permit Number	Permit Applicant/Holder	Work System/Equipment Location	Key Box Number

Example of MWP Log (Right Page)

Work Started (Sign/Date)	Review Period	1st Review (Sign/Date)	2nd Review	Work Completed Date

6.5.5 Completion of Master Work Permit (MWP)

The process of using the MWP is shown in outline in Figure 6.1 and detail in Figure 6.2:

- Each section is to be completed as required.
- Where there is no information for a section of the form then the reason for the omission is to be noted. For example, if no hazard is posed by any systems then "no isolations required" or other similar note is to be added under the Isolation Boundary section.
- Where it is necessary to use additional pages then 'see attached sheet' is to be noted in the relevant section of the MWP. All of the details relating to that section are then to be shown on the attached sheet. In this way accidental loss of the additional sheet would become obvious.

The following steps are to be carried out by the Permit Applicant when raising a MWP:

1. Obtain a sequential permit number from the MWP log (if not pre-printed).
2. Insert the current date.
3. Include a relevant reference to identify the reason that the work is required (e.g. maintenance instruction number, work request number, etc)

4. Identify and list the equipment and systems to be worked on.

5. Briefly describe the work to be done. Include enough detail to allow a general understanding of the nature and extent of the work.

6. Note the location of the work.

7. Record the Permit Applicant's name and department. This is always to be the person who will be in direct charge of the work or work site.

8. Note the expected duration of the work. This is the duration from preparing the work site to final completion and anticipated sign-off of the MWP.

9. Discuss the work with the appropriate operators to identify the implications to the plant and systems. State the effect on the plant, systems, services and the site. This is to include the implications on stand-by, back-up, and safety related systems or facilities.

10. Use the prompts given on the MWP to carry out a hazard identification process for the work. This is to relate to the workers directly involved in the work as well as all other employees, contractors, or members of the public. Where the work is complex or particularly hazardous a more comprehensive hazard management planning stage shall be undertaken. (See Section: 4: *Hazard Identification, Assessment and Control*).

11. Tick against the appropriate work type in response to the question *'Does the work require..'*. Each type of work listed requires a Specific Work Permit or Plan (see below). These additional permits are to be completed and authorised after preparation for the work has been authorised (signature box (i) but prior to the Permit Applicant stating that he/she is ready to start the work (signature box (ii)).

12. Inspect system drawings to identify the isolation boundary necessary to ensure the work site will be safe. Seek advice from operators, as necessary, to minimise the effect on the plant. List all tag-out tags required, and the isolation points that also require to be locked (see Tag-out and Lock-out procedures below).

13. Consider what other precautions are required such as barriers, signage etc. List them. Include a review period.

14. Consider whether there will be confined energy that will need to be released prior to work. Consider all energy types including pressure, electrical, mechanical, chemical, etc. State how energy will be released, removed or dissipated, and how a safe state will be confirmed.

15. List any tests that will be required before, during, or after the work is complete. Consider all associated safety implications and list all precautions necessary. If

testing is complex or hazardous then a separate test procedure shall be used and attached to the MWP. (See Subsection 6.4*: Special Technical Procedures and Test Procedures*.)

16. The Permit Applicant is to take the completed MWP to the Shift/Operational Supervisor for approval and authorisation. The supervisor signs to approve the work plan and precautions included therein, to acknowledge that he/she is aware that the work is to be carried out, is in agreement with the permit review period, and that preparations for the work may proceed. He/she thereby releases the equipment/systems for work and up-dates the system status board and control screen as appropriate. It is of note that the Supervisor may require that additional specialists review the plan when unusual or highly specialised hazards or work are involved (e.g. radiography, in situ grinding, etc).

17. Raise all appropriate Specific Work Permits and Plans to support the work.

18. Complete all preparations necessary to start the work and manage the hazards.

19. Request operators to carry out any system and equipment isolations required (see Tag-out and Lock-out below). Complete tag-out/lock-out.

20. Permit Holder briefs the work team. This is a particularly important step as workers cannot keep themselves safe if they do not understand the intended plan or the hazards they face.

21. Sign signature box (iii) to state that hazards have been, or are being, managed (including release of energy), workers have been briefed, and to certify the tag-out/lock-out is enforce.

22. Obtain shift or operational (as appropriate) supervisor's signature and permission to start work.

23. Carry out work while keeping all hazard management precautions under review, and all workers briefed.

24. Carry out any testing required in accordance with the precautions and safeguards previously stated (obtain authorisation where required). Record results.

25. Permit Holder to confirm by signing (box (iv)) that all work and testing is complete, and that the equipment/system is ready for commissioning.

26. Permit Holder briefs Shift/Operational Supervisor on the state of the work-site and systems/equipment and requests that systems/equipment be accepted for commissioning. Any further testing that needs to be carried out following commissioning, are to be reported. Once the Supervisor is content he/she signs acceptance of the equipment/systems for commissioning. There may be test

and/or commissioning requirements that have not, or cannot, be completed immediately due to the state of the plant. Then a note is to be made in an appropriate commissioning/test log to ensure that the requirements will be fulfilled within a specified time period.

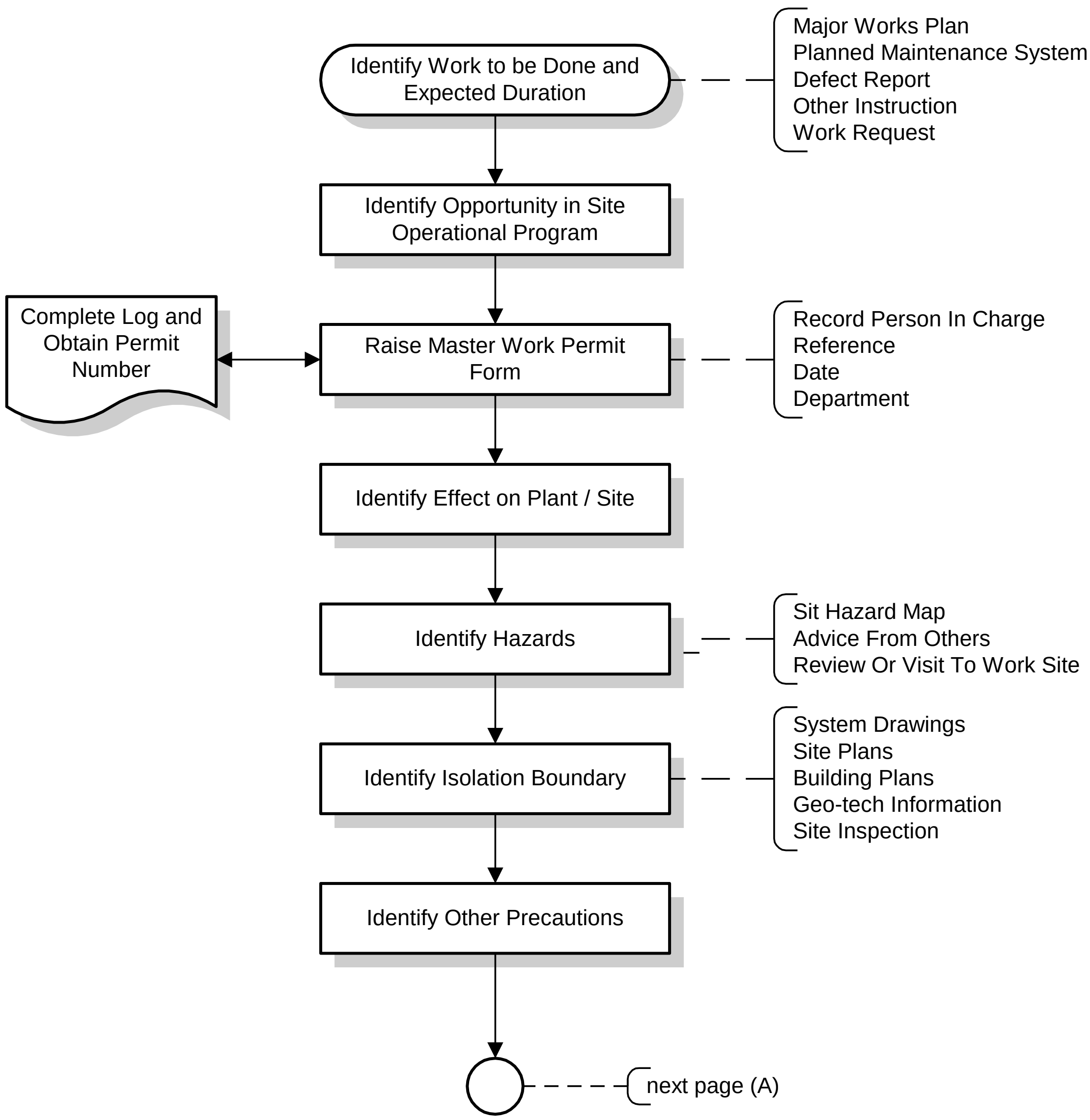
27. Permit Holder ensures that all other permits have been signed-off and that the work site is restored to a safe and correct state (see Section 33: *Housekeeping*). Sign off Permit Log.

28. Operational Supervisor signs (box (vi)) to acknowledge that the work is complete in all respects, that the test/commissioning log has been completed where appropriate, and to close the MWP.

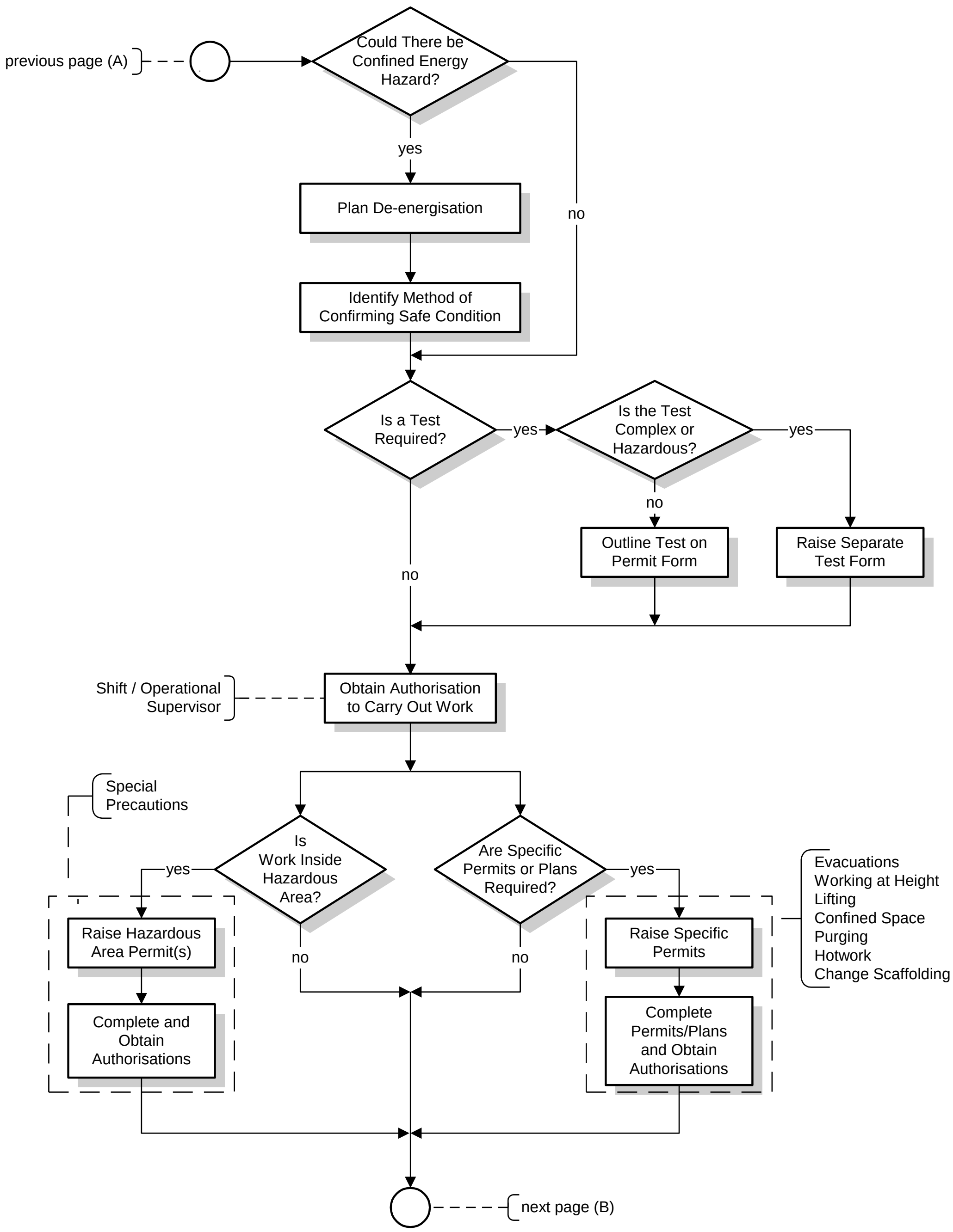
These steps are summarised below in an action flow diagram Figure 6.1

Figure 6.1: Work Permit Process

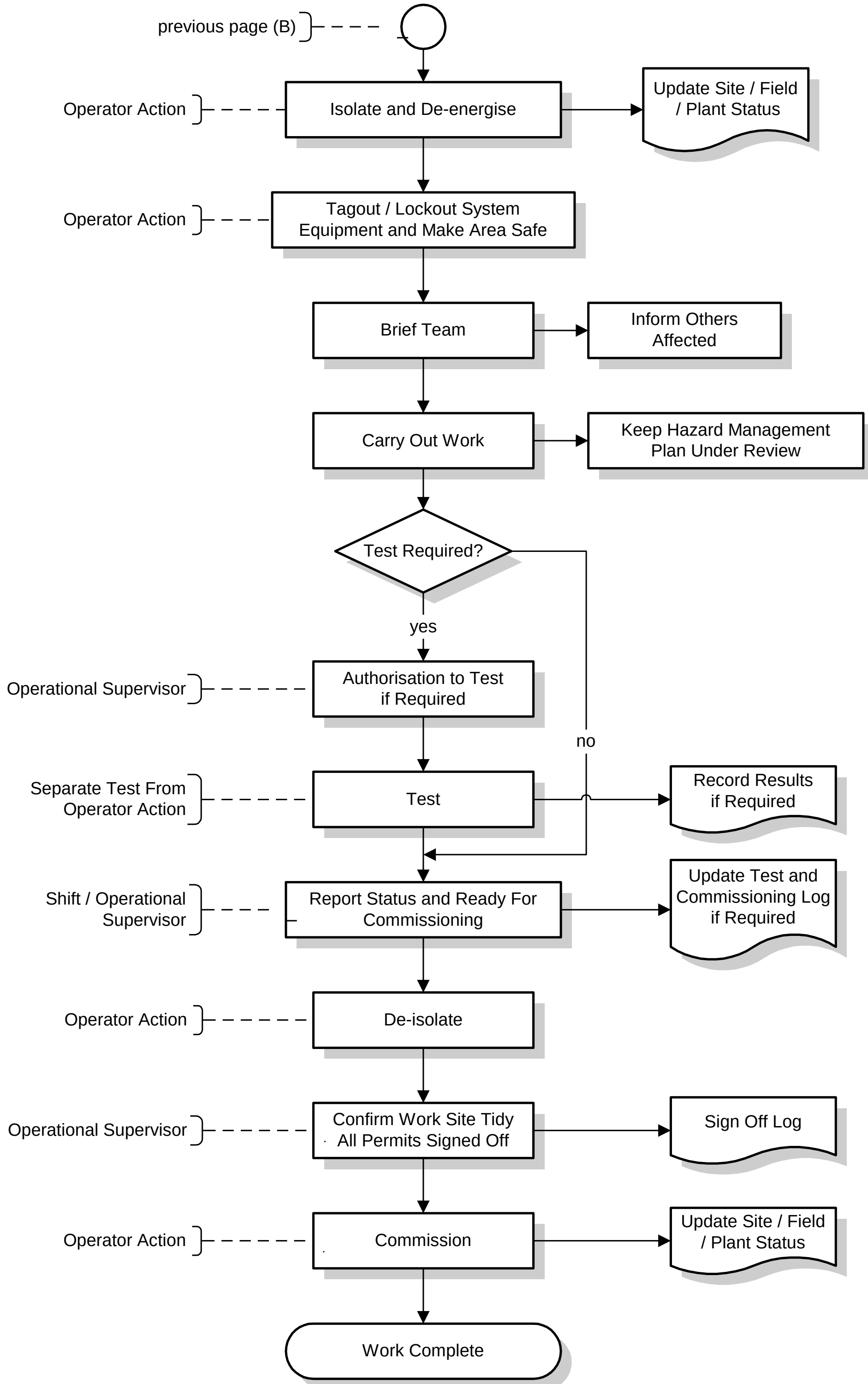
Outline Planning and Hazard Identification



Detailed Planning and Authorisation



Work Execution and Completion



6.5.6 *Review of Work under a MWP*

When work continues for an extended period (e.g. longer than a week) it is possible that the work situation, or surrounding conditions may change. As a result, the original precautions may become inadequate. Additionally, errors may be made that could threaten the safety of personnel, whether involved in the work or not. It is important therefore that reviews are undertaken at appropriate periods to confirm that a safe environment is being maintained.

Setting the Review Period

- The Permit Holder is to suggest a review period based upon the complexity and anticipated duration of the work.
- The Operational Supervisor is to discuss this and modify it as deemed necessary prior to authorising the work.
- The period is to be entered into the MWP log prior to work starting.

Undertaking the Reviews

- The reviews are to be carried out by the operations section of the relevant department.
- Operational Supervisors are to ensure that personnel instructed to carry out reviews have sufficient understanding of the permit system to identify discrepancies or when unsafe conditions exist.
- The reviews are normally to be undertaken during the quiet hours (out of normal work hours).
- On completion the reviewer is to sign off the appropriate column of the MWP Log noting if any discrepancy has been found.
- Any discrepancies are to be brought immediately to the attention of the Shift Supervisor who will instigate appropriate action to ensure continued personnel and plant safety. This may include the revoking of the MWP, and work being stopped until a new MWP and appropriate permits are raised.

6.5.7 *Change of Permit Holder*

Permit holder should normally be directly in charge of work from start to finish. The work programme should be arranged to achieve this whenever possible. However, at times it may be necessary to hand control of work over to another employee or contractor. Such handing over of responsibility can be the source of errors that can in turn lead to unsafe conditions. It is therefore important that handovers are undertaken with care and at suitably chosen stages as listed below:

- After verbal approval by the Operational Supervisor, who originally authorised the MWP, the worker taking over responsibility is to be fully briefed:
    - on the work,
    - the present status,
    - all hazards,
    - all precautions and controls (if possible by the present Permit holder).
- The replacement, once satisfied that he/she can safely take over control and that all is in order, is to rule through the original applicant's name (it is to remain readable) and append their name beside it on both the original MWP and in the MWP Log. He/she should then counter-sign box (ii).
- The Supervisor shall be satisfied that the replacement is fully aware of the work and all precautions and controls.
- Hand-over is finally authorised by the Supervisor initialling against the new applicant's signature on the MWP.

6.5.8 Hazardous Area Permit

Due to the nature of standing hazards in some areas, special precautions are necessary. There is therefore a requirement to impose certain controls on these areas. The Hazardous Area Permit system ensures that these controls are met during non-routine work. Examples of the hazards likely to be present in these areas include high voltage power lines, open water, hazardous chemicals, explosives, etc. Hazardous areas will have been previously identified for each site and are shown on a site layout map, presented in Volume 3: *Site Specific Safety*.

The Hazardous Area Permit is designed to ensure that a person with appropriate knowledge and responsibility (the Area Supervisor) is involved in the planning of work within the hazardous area, and authorises entry for work in the area. A copy of the Hazardous Area Permit (Form 6.3) is presented at the end of this section.

6.5.9 Specific Work Permits and Plans

Hot Work Permit
Work that generates heat or sparks is potentially very dangerous, particularly within the type of installation operated by DGDC. See DGDC-OHS-028: *Hot Work* for an explanation of the use of the Hot Work Permit and a copy of the permit form.

Confined Space Entry Permit
Work within a confined space, whether it be a tank, vessel, pipe or sump is potentially very hazardous. See DGDC-OHS-029: *Confined Space* for an explanation on the use of the Confined Space Entry Permit, together with a copy of the permit form.

Mobile Crane Plan
The use of mobile cranes can lead to major hazards that can be difficult to control. Examples of these hazards includes crane instability due to ground conditions, damage to underground services and contact with overhead lines. The plan for is designed to help control these hazards. A copy of the plan is presented in DGDC-OHS-023: *Lifting Equipment and Lifting*.

Scaffolding Permit
Work on or around scaffolding can be hazardous if the scaffolding is not erected correctly. Use of the Scaffolding Permit ensures that suitably qualified personnel are involved in the erection of scaffolding above 5m in height on sites owned and operated by DGDC. Details of safe scaffolding practices, controls, and the applicable permit are in DGDC-OHS-024: *Working at Height*.

Excavations Plan
An Excavation Plan is required for all work involving digging more than a specified depth into the ground or where work is to be carried near to an area prone to slippage. See DGDC-OHS-025: *Excavations and Shoring* for further details and a copy of the Excavation Plan.

Purge Plan
Purging operations need to be carefully thought through to control the major hazards that are often present. A copy of the Plan form is presented in DGDC-OHS-017: *Plant, Systems and Equipment*.

6.5.10 Changes to MWP Permit

Changes to an existing permit may be necessary for a number of reasons. However, the process of changing the precautions, limitations, or controls put in place by a permit is potentially very risky. To ensure that the change does not cause an unsafe condition a strict review process is necessary. The Change to Existing Permit (Form 6.2) aims to ensure the change is planned correctly, all implications have been considered and a review of the proposed changes are carried out by a suitably experienced supervisor. It is to be used to cover all changes to a Master Work Permit, a Hazardous Area Permit or a Specific Work Permit.

A copy of the form (Form 6.2) is presented at end of this section. As the potential for error during a change is significant, this permit is to be produced on yellow paper. It is designed to guide a Permit Applicant through the change process. It is important that whenever possible, the original Permit Applicant completes the change to Existing Permit Form as this person is best placed to understand the work plan, the precautions that were put in place and the implications of the change.

Once completed and authorised the change permit is to be stapled to the original permit and to all copies thereof. The use of yellow paper shall extend to all copies to ensure that the attention of all relevant personnel is drawn to the existence of a change permit.

6.6 Tag-out and Lock-out procedures

6.6.1 Introduction

The tag-out and lock-out procedure described here is based upon systems developed by high risk industries over many years and is in accordance with the requirements stated in OSHA Standard 1910.147: The Control of Hazardous Energy (Lock-out/ Tag-out).

The system aims to protect all people and equipment from injury or damage due to the inadvertent escape of harmful energy. As the placement of tag-outs and lock-outs can be complex, it is imperative that the correct processes are followed. (Refer to DGDC-OHS- 017: *Plant, Systems and Equipment*.)

6.6.2 Tags

Construction

- DGDC tags will be in English.
- The tag will be made of a suitable water-resistant paper-type material that resists damage and ripping.
- Printing of text and colour will be clear and be as shown in Figure 6.2.
- The attachment hole will be reinforced and where possible will be supplied with attachment wire already fitted.

Placing of Tags

Tags are normally to be fixed to equipment and fittings with wires, in such a way as to prevent unintended detachment. Alternate fixing methods using string or rubber bands can be used. However, heat, ageing, strength and UV limitations must be borne in mind when opting for these alternatives.

- The tags are to be completed in bold using black permanent ink.
- The tag shall be initialled by the person placing the tag.

Special Tags

Some locations and environments will demand the use of purpose made bi-colour tags (laminated plastic). These tags may be retained for repeated use as long as the writing can be removed cleanly.

Danger Tags

Tag-out tags are red in colour, with the word ‘Danger’ prominently displayed. Common instructions are written on the tag in list form and are designed to be crossed out or retained as applicable. A blank space is included for less common instructions.

Caution Tags

Caution Tags are designed to enable the reason for caution to be written on the tag as appropriate. Text should be as short and succinct as possible (ideally one word) and written in English.

6.6.3 Isolation Tagging/Locking Out

- Isolation and tagging out is carried out by an appropriate operator.
- Each tag/lock is to be placed immediately following operation of the item (valve, circuit breaker, etc) to the state required by the MWP.

- The Permit Holder or appropriate maintainer is to follow and check the isolation is correct and the tags applied. He/she also applies the required locks.
- The two personnel are not to work together to ensure that similar errors are not made.
- One key will be held under the MWP while the other will remain with the appropriate operators.
- Once the isolation is confirmed correct and all locks are in place, all the lock-out keys of the locks used are to be put in a key-tray as described below.

It is of note that locks placed under a MWP are in addition to those that may normally be in place for operational reasons. For example, if a particular valve that is to be locked-out is normally locked in position, following the tag-out/lock-out process it will have two locks and a tag-out tag attached.

6.6.4 Removing Tag/Unlocking

Unlike the tag-out stage, where isolation and tagging/locking are carried out together, the process of de-tagging/unlocking is quite separate to that of de-isolation.

- Once all work is complete and it is confirmed safe to do so, the Permit Holder is to oversee the removal of all tag-out tags and locks.
- This can only be done by the person who placed the Danger tag.
- Removed tags and locks are to be collated to confirm that all have indeed been removed.
- Once this is confirmed, all used tag-out tags are to be disposed of, and all lock-out locks and keys returned to their storage place.

The placement and removal processes are shown in the flow diagrams (Figures 6.3 and 6.4).

Figure 6.3: Placing Signage Tags and Locks

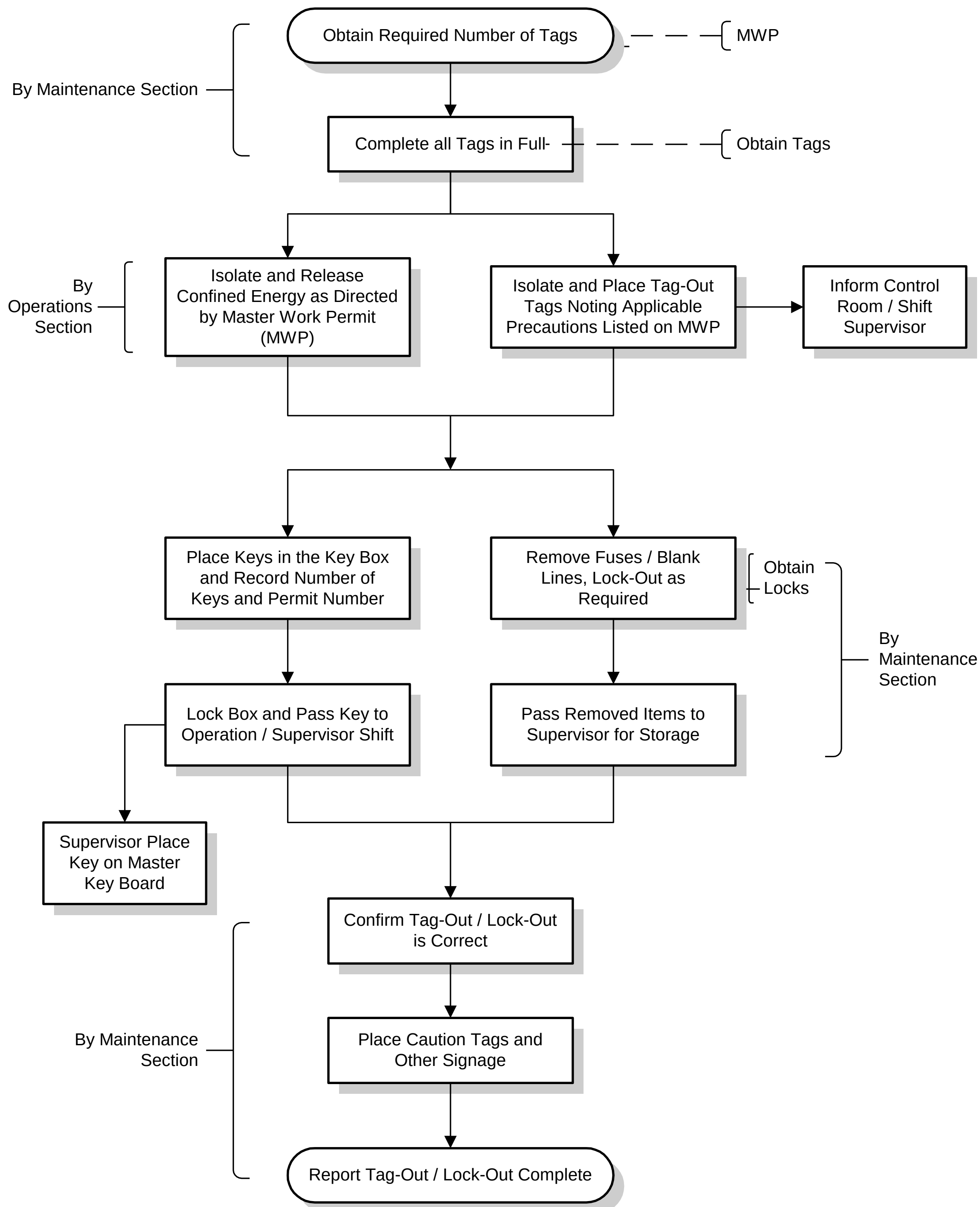
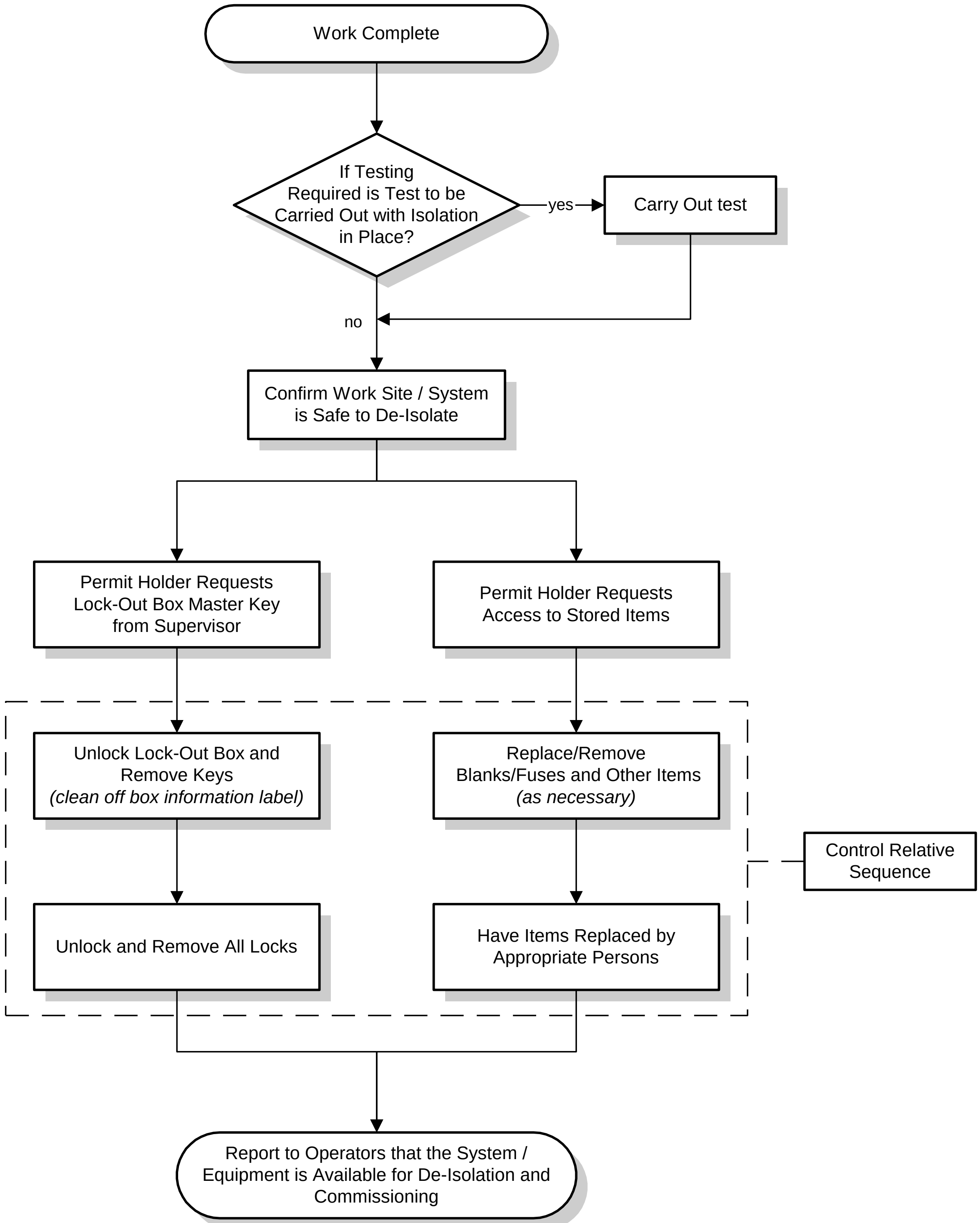


Figure 6.4: Removal of Signage Tag-Outs and Lock-Outs



6.6.5 Keys

Lock-out Keys

- Once the lock-out has been completed all keys are to be placed in a key box.
- The information label of the box is filled in with the MWP number and the number of keys held.
- The box is locked and the box key passed to the Operational/Shift Supervisor who puts it on the Master Key Board.
- On completion of the job, when de-tagging is required, the Permit Holder requests the appropriate key-box key from the Operational/Shift Supervisor.
- If there are no personal locks attached to the key-box it will then be possible to open the box and proceed with removal of tags and locks.

Personal Keys

Further protection of maintenance personnel is afforded by way of 'Personal Lock-out Locks'. Each maintenance employee is issued with a padlock and key. This they keep for use on each job they undertake. Contractor personnel are to be issued a similar lock on a temporary basis.

On being instructed to perform a task under a permit, and following job briefing by the Permit Holder, they are to inspect the key-box used under the relevant MWP to confirm that the correct number of keys are present as noted on the information label. If all appears in order they are to affix their personal lock to the boxes clasp before proceeding with their work. On completion of their own work session personnel remove their own personal lock from the key-box.

6.6.6 Key Boxes

Key boxes shall be designed to enable at least nine lock-out keys to be stored in a way that will allow them to be counted whilst remaining securely locked. In addition, an information label of suitable material is to be visible when the tray is locked. The label will allow the MWP number and number of keys to be recorded with non-permanent ink, and for this to be wiped clear after the tray has been unlocked for removal of the lock-out locks. The clasp shall be designed to allow at least six personal locks to be fitted as required. The trays are to be robustly constructed to prevent unauthorised interference.

6.6.7 Removed or Additional Items

As part of an isolation process it may be deemed appropriate to remove fuses or other items, or to fit blanks (see Section 10: *Plant, Systems, and Equipment* of this manual). If this is done then the item is to be identified by a label, securely attached. Removed items are to be passed to the Operational Supervisor for retaining in locked storage. Care should be taken to prevent damage. A tag will have been placed at the item's normal 'as fitted' location.

6.6.8 Blanket Isolation

During major plant overhaul and other periods when individual isolation boundaries may conflict, and when the maintenance activity becomes particularly intense or complex, it may be necessary or more practical to issue a 'blanket isolation'. This is similar to a normal isolation boundary and confined energy release set up under a MWP, except it will cover a larger area and include a number of systems.

The aim is to deaden all systems and associated equipment within a large work area, (e.g. a whole generating plant) to allow a large number individual jobs to be undertaken without separate isolation boundaries having to be set up. An example may be that of a power generating plant in which all steam systems, condensate systems, generator lubricating oil, gas extractions and generator governor systems are shut down to a safe state under one isolation.

Such blanket isolations must be carefully thought through and the area and systems covered clearly stated. On completion, of all work carried out, a full systems pre-operations line-up will need to be undertaken with each system being re-commissioned.

Blanket isolations are to be controlled under one overall MWP. Each individual maintenance or repair job in that area will be carried out under its own MWP but within the isolation boundary set up by the blanket isolations. All jobs will need to be cleared, and a list of tests outstanding completed, prior to the blanket isolations being removed.

Form 6.1: Master Work Permit

Permit # **Date Raised:** **Reference:** **Review Period:**

Description of Work:

Systems/Equipment: **Location:**

Person i/c: **Department:** **Expected duration:**

Effect on Power Plant, Services and Site:

Nature of Hazards to Persons (*use prompts below*)
Confined energy, Noise, H2S, Scald, Heat burn, Chemical, Crush, Fall, Shock, Suffocation, Traffic, Restricted access, Trip, Slip, Dust, Other (describe)

Does the work require:
(*tick and complete permit/plan*)

- Hazardous Area Permit? ...
- Hot work Permit? ...
- Confined Space Entry Permit? ...
- Scaffolding Permit? ...
- Mobil Crane Plan? ...
- Excavations Plan? ...
- Purging Plan? ...
- ...

Isolation Boundary (*list tags and locks*):

#	Device tagged	Device locked	Position	Applied by	Removed
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					

(use continuation sheet if required)

Other precautions required:	**Test requirements/precautions:**
Work accepted; equipment/system released:	(Shift/Dept Supervisor)
Hazards managed; briefing complete; Isolation in force:	(Person i/c)
Work may commence:	(Shift Supervisor)
Work complete; test complete; ready for commissioning:	(Permit Holder)
System/equipment accepted for commissioning:	(Shift/Dept Supervisor)
Work Completion noted:	(Dept Manager)

Form 6.1: Master Work Permit Continuation Sheet

MWP # _______________

Isolation Boundary (Continued List of Tags and Locks)

#	Device Tagged	Device Locked	Position	Applied by	Removed
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Other Precautions Required

Test Requirements/Precautions

Form 6.2: Change to Existing Work Permit

Master Work Permit# _______________ **Change # ____________________________**	**Dated: _____________________** **Dated: _____________________**
Reason for Change:	
Details of Change	
Additional Precautions	
Change Planned and Checked	Permit Holder
Change Authorised	Operational Supervisor

NOTE: *This change permit and all copies to be on yellow paper*

Form 6.3: Hazardous Area Work Permit

Master Work Permit# ______________ **Area in which work is required: ____** **Time period of permit - Start _________________ Finish ____________________**
Special Precautions to be taken before and during the planned work:
Work Authorised: Area Supervision
Work Completion Noted: Area Supervisor

Dominica Geothermal Development Company Limited
Powering a New Generation...

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-014: Hydrogen Sulphide (H_2S)
Revision 0

Contents

7. Hydrogen Sulphide (H_2S)

7.1 Introduction

Hydrogen sulphide (H_2S) is a colourless gas having an offensive odour and a sweetish taste, is highly toxic by inhalation, and is highly flammable.

H_2S is a naturally occurring gas that arises from the decomposition of organic material (animal or vegetable) by microorganisms (bacteria). It is found in regions of geothermal activity, occurring around sulphur springs and lakes. It is also found in areas of oil and gas exploitation, in foul sewers and in cesspools (stagnant water) as found in swamps. Along with carbon dioxide it is one of the main hazardous components of the non-condensable gas phase associated with geothermal steam. It poses a significant risk to personnel working in and around geothermal power generation facilities.

7.2 Health Effects/Toxicity

7.2.1 General Properties

- colourless gas having an offensive odour (rotten eggs) and sweetish taste
- slightly heavier than air with a specific gravity of 1.19 (air = 1.00@15^{o}C)
- highly flammable (auto ignition temperature of 500^{o}F)
- explosive limits in air 4.3% (lower explosive limit) to 46% (upper explosive limit). (43,000ppm to 460,000ppm volume/volume)
- moderately soluble in water and alcohol
- boiling point - 60.2^{o}C
- flash point - 83.8^{o}C
- corrosive to metals and to a lesser extent masonry and concrete materials
- toxic to humans.

7.2.2 Human Health Effects and Toxicity

Table 7.1 presents human health effects for exposures to a range of H_2S concentrations.

Table 7.1 : Human Health Effects for Exposures to a Range of H2S Concentrations

H_2S Concentrations mg/m^3	ppm	Health Effects
0.0002 - 0.002	0 001 - 0.002	Level of human detection (depending on H_2S purity).
0.016 - 0.02	0.011 - 0.014	Smells like rotten eggs.
15	11	Eye irritation.
70	50	Permanent eye damage.
225	161	Paralyses olfactory so odour is no longer a warning signal of the presence of H_2S.
400	286	Over stimulates the central nervous system, causing rapid breathing, followed by cessation of breathing, convulsions and unconsciousness.
1400	1,000	It is lethal.

H_2S causes nuisance from its unpleasant odour at concentrations well below those that cause physical health effects. However, continuous exposure to H_2S reduces a person's sensitivity to it.

Little information is available on the effect of chronic exposure to H_2S. Adverse effects have been observed in occupationally exposed populations at average concentrations of 15 to 30mg/m^3. Symptoms include restlessness, lack of vigour, and frequent illness. In occupationally exposed groups, at concentration of 30mg/m^3 or more, 70% complained of fatigue, somnolence, headache, irritability, poor memory, anxiety, dizziness, and eye irritation.

7.3 Occupational Health Exposure Standards

Occupational health exposure standards for individuals exposed in the workplace to various chemical compounds have been set by a range of governmental organisations. These standards are commonly referred to as Threshold Limit Values or Workplace Exposure Standards.

The American Conference of Governmental Industrial Hygienists (ACGIH) *Threshold Limit Values and Biological Exposure Indices* is regarded by most western international

occupational safety and health organisations as the benchmark document for the setting of occupational health standards for worker exposure to chemicals.
The 1993-94 Threshold Limit Values for hydrogen sulphide are as follows:

- TLV-TWA 10ppm (14mg/m^3)
- TLV-STEL 15ppm (21mg/m^3)

The TLV (Threshold Limit Value - Time Weighted Average) is defined as the time weighted average concentration for a normal eight-hour work day and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day, without adverse health effects.

The TLV-STEL (Threshold Limit Value - Short Term Exposure Limit) is defined as the 15-minute time average which should not be exceeded at any time during the work day even if the eight-hour time-weighted average is within the TLV-TWA. Exposures for the TLV-STEL should not be longer than 15-minutes and should not be repeated more than four times per day, with at least 60-minutes between successive exposures to the STEL.

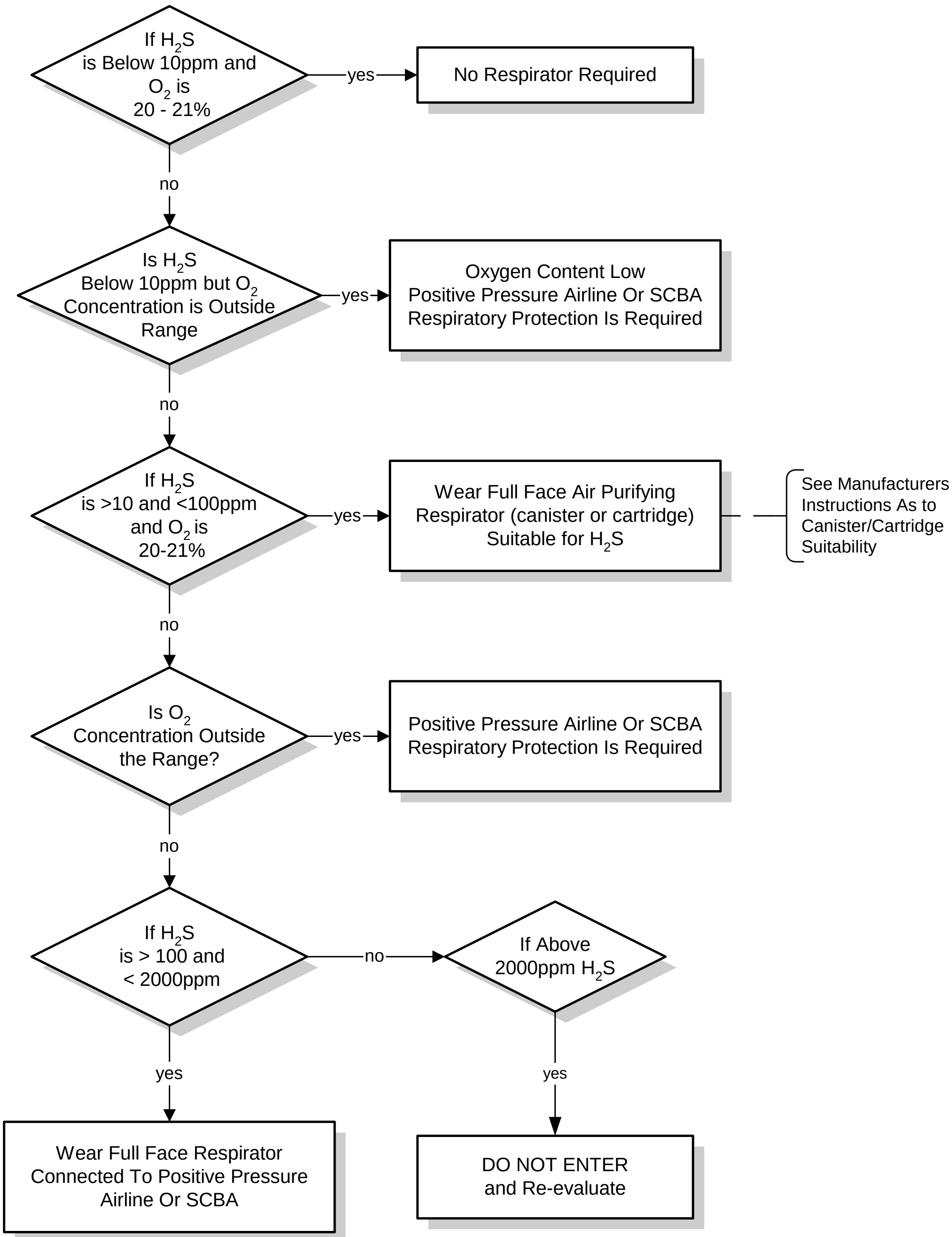
A worker will be required to wear respiratory protective equipment for exposures to hydrogen sulphide concentrations exceeding 50% of the published Threshold Limit Values.

A hierarchy of the type of respiratory protective equipment that must be worn is presented below:

- For concentrations 10 to 100ppm, a full face air purifying (canister or cartridge) respirator suitable for hydrogen sulphide can be used as long as oxygen concentration is between 20 and 21%.
- For concentrations 100 to 2,000ppm, or if oxygen concentration is below 20% a full respirator connected to a compressor-fed air line with an emergency escape set (ELSA) carried as back-up, or a SCBA (self-contained breathing apparatus) should be worn.
- At concentrations exceeding 2,000ppm no one should enter the area, as this is getting close to 5% of the lower explosive limit (LEL) for hydrogen sulphide.
- The selection, procurement, care and maintenance of respiratory protective equipment is covered in Section 23: *Personal Safety Equipment*.

Steps in determining what respiratory protection is required to protect against a known H_2S concentration are presented in Figure 7.1.

Figure 7.1 : Hierarchy Of Respiratory Protection For H_2S Exposure



7.4 H_2S Hazardous Activity

7.4.1 Hazardous Areas

There are areas/activities at each site where hydrogen sulphide could be encountered at a concentration that poses a significant hazard to workers, for which safe work practices and permit-to-work systems will need to be rigorously adhered to. These areas should be identified as part of the sites hazard identification and assessment process, and recorded on the Site's Hazard Identification Register (see DGDC-OHS-011: *Hazard Identification, Assessment and Control*).

- process vessels and related equipment, condensers, cooling towers and boilers
- spaces and areas located below ground such as basements, hot well pits, wellhead cellars, vaults, excavated ditches and holes
- enclosed spaces such as streamlines, sewers, sewer manholes, wet wells, and vessels
- areas near to lines, rock mufflers, silencers, etc which vent gases which may contain hydrogen sulphide
- any ditch or opened topped vault where air circulation is poor so hydrogen sulphide can accumulate at the bottom.

7.4.2 Designated Hazardous Areas

Areas where there is potential for hydrogen sulphide to accumulate and pose a risk to worker safety will be identified at the site.

Personnel trained in working in areas where hydrogen sulphide may be present and holding the appropriate permits-to-work, shall be authorised to undertake work in the hydrogen sulphide Designated Hazardous Areas. Specific actions with regard to work control and for entering a confined space are detailed in DGDC-OHS- 013: *Work Control* and DGDC-OHS-029: *Confined Space*.

7.4.3 Work in and around an Area with Hydrogen Sulphide Present

The following general safe work practices should be observed by all personnel working in an area where a hydrogen sulphide gas hazard may be present. Specific safe work practices shall be adhered to for work in Designated Hazardous areas.

- When approaching a job site, check for any obvious sources/signs/smells of hydrogen sulphide.
- Check the general condition flags, sign posted at the site:
  - ♦ red — Condition III - extreme danger to life. H_2S has reached injurious levels (above 50ppm). Do not enter area (drilling)
  - ♦ green — Safe to work/enter
  - ♦ yellow — Condition I - caution, possible H_2S hazard.

- Condition II - moderate danger to life is indicated by the display of yellow/black format signs with the words 'Danger' and 'Poison Gas'. This condition is when H_2S is 10 to 49ppm. Non-essential personnel shall proceed to Safe Briefing Areas.
- Identify the location of the nearest 'Safe Briefing Areas' which will be sign posted.
- Check the wind direction by observing the wind socks and streams which are located throughout the site. Wind socks should be checked on a regular basis throughout the working shift, to ensure changes in wind direction are not overlooked.
- Remember H_2S is heavier than air, so avoid low lying areas. If an area or trench is suspected of containing H_2S gas, do not enter without following permit-to-work procedures. Gas testing must be performed before entering.
- Observe all warning signs at the site (as specified above).
- Do not attempt to enter any restricted Designated Hazardous Area without the appropriate authorisation.
- Be aware of the location of emergency escape breathing apparatus (ELSA).
- In the event of an emergency, follow the site's excavation drills, which you must know.

Emergency Action:

- Should you encounter someone overcome by H_2S, **DO NOT ATTEMPT TO RESCUE THE PERSON.** Only persons wearing Self Contained Breathing Apparatus should enter the area.
- As quickly and as safely as you can, raise the alarm.
- Advise emergency personnel of the location of the incident and number of personnel involved.
- Let the personnel trained in emergency rescue etc carry out the rescue.

7.4.4 Specific Site Work Practices

For all personnel entering Designated Hazardous Areas or equipment where hydrogen sulphide is a known potential hazard, the permit-to-work system shall be followed at all times.

For entry into confined spaces, the requirements of the confined space permit-to-work and entry permits shall be followed. These permits and the steps required in actioning them are detailed in DGDC-OHS-013: *Work Control* and DGDC-OHS-029: *Confined Space.* Please refer to these sections.

7.5 Hydrogen Sulphide Detection/Monitoring

There are three types of monitoring systems currently used to detect/monitor hydrogen sulphide concentrations.

7.5.1 Fixed Monitoring System

This system is commonly used in a process or drilling environment and is used to detect leaks/failures from process equipment, eg. condenser. The main features of the system are listed below.

i) A number of electronic sensors are placed at strategic locations in the workplace.

ii) The sensors send an electronic signal to a master control system which, via a computer terminal or screen, displays the H_2S concentration recorded for each sensor.

iii) The H_2S concentration is usually measured as parts per million (ppm) and alarm points can be set, so when H_2S concentration exceeds the Workplace Exposure Standard (10ppm), a Hi alarm is activated with a general evacuation alarm (Hi Hi) set when the H_2S concentration exceeds 20ppm.

A single Hi indication will initiate a control room alarm and two HI's or a single Hi Hi will initiate appropriate automatic shutdown of wells or production train, as appropriate.

Audio visual alarms will be installed in areas where fixed monitors are installed (wellheads, condenser area). The audio-visual alarms will coincide with alarm signals generated by the fixed H_2S monitoring system. They will be distinct in sound and colour from all other alarms at the site.

The drawback of such a system is that it is primarily designed to detect process leaks and covers only a small percentage of the workplace. The positioning of sensors is critical if one is to use such a system for personnel protection.

Note: In all instances, one should manually test the atmosphere using a personal H_2S monitor or personal gas detector prior to entry, to verify that the Fixed Monitor System reading is correct.

7.5.2 Personal Portable H_2S Monitor

- These units are electronic, using electrochemical cells and are usually hand-held or belt mounted.
- They measure H_2S concentrations continuously, providing a digital read out of the concentration in ppm.
- They are fitted with audible alarms which are activated when concentration exceed a predetermined action level, (usually TLV-TWA).
- Monitors should be held or worn as low as possible, definitely no higher than the waist.

7.5.3 Personal Detectors

There are a number of personal detectors that can be used. These units are usually supplied with a hose extension which allows the base of wells, sumps, cellars, etc to be tested without the testing personnel having to enter the potentially contaminated work area.

Two common type of devices are listed below.

i) Colorimetric Tape Detector Units.
This unit takes a sample of gas, passes the gas onto a reaction chamber and, via a reaction mechanism, produce a stain on a tape. The colour and depth of the stain indicates the concentrations of H_2S. These units are not suitable for high concentrations, as they are primarily used to measure low concentrations of H_2S in ambient air.

ii) Colorimetric Gas Tube Detectors.
This type of unit incorporates a pump, colorimetric detector fuse and a scale for reading of three concentrations of H_2S detector. There are a number of commercial types available, with the most common being Dragger and Gastec.

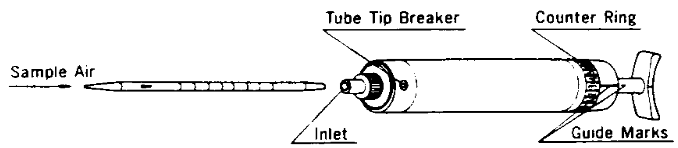


Figure 7.2 Typical Colorimetric Tube Gas Detector

7.5.4 Procedure for Using Colorimetric Tube Gas Detector

Set Up
The sampling and measurement procedure for the Gastec system is detailed below.

1. Break tips off a fresh detector tube by bending each tube end in the tube tip breaker of the pump.

2. Insert tube securely into pump inlet with arrow on tube pointing toward pump.

To Sample Air

3. Make certain pump handle is all the way in. Align guide marks on pump body and handle.

4. Pull handle out to desired stroke volume. Handle can be locked on either ½ pump stroke (50ml) or one pump stroke (100ml).

5. Read concentration at the interface of stained-to-unstained reagent when staining stops. Unlock handle by making ¼ turn and return it to starting position.

6. Where more pump strokes are indicated in the instruction sheet included in each box of tubes, take additional sample by repeating pump strokes without removing tube.

An extension hose can be used to detect gas concentration in vessels and sumps etc.

Measurements shall be carried out by only persons trained in the correct use of the gas detector.

7.6 Maintenance and Calibration of H_2S Monitors

Due to the hazard poised by equipment failure, all H_2S monitoring equipment will be inspected on a regular basis for defects and corrosion. This work will be undertaken by DGDC equipment technicians.

Portable monitors will be tested at least weekly against a proprietary calibration test facility to confirm the function and accuracy of the monitor.

Fixed and portable monitors will be routinely calibrated and maintained in accordance with manufacturer's requirements. Fixed monitors will be calibrated and checked at least every six months. Calibration records will be kept to show when the unit was calibrated, by whom and the results of the tests.

7.7 Ventilation

Hydrogen sulphide is one to two times heavier than air and does not readily dissipate. It tends to accumulate in low lying areas and confined spaces. As stated earlier, these areas must be tested for H_2S concentrations before entering.

If areas are found to contain H_2S, forced ventilation can be applied to remove the accumulated gas and make the areas safe for entering. See DGDC-OHS-029: *Confined Space* for further details.

Occupational Health & Safety Manual
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DGDC-OHS-015: Drilling, Preparation, Operations and Production Testing
Revision 0

Contents

8. Drilling Preparation, Operations and Production Testing

8.1 Introduction

8.1.1 Purpose

The safe work practices contained in this section are non-rig specific and therefore some details may not apply. To be used as a guide for issue to contractors and as background information for DGDC personnel.

The purpose of this section is to recommend practices and procedures for the promotion and maintenance of safe working conditions for employees engaged in rotary drilling operations and well servicing operations, including special services.

8.1.2 Reference

API RP 54, American Petroleum Institute, Recommended Practices for Occupational Safety for Oil and Gas Well Drilling and Servicing Operations is to be read in conjunction with this section of the DGDC Health and Safety Manual. All drilling contractors working at DGDC sites must hold a copy of this document.

8.1.3 Scope

This section deals with DGDC safety requirements related to:

- pad or drill site preparation
- drill rig movement, setting up and tearing down within the DGDC lease area
- drilling operations involving a rig and third party services
- post drilling activities like production testing and wire line activities.

The requirements pertain to operations dealing with core, production and injection wells drilled into geothermal reservoirs. The operations at DGDC sites will normally be performed under contractual arrangements. Refer also to DGDC-OHS-026: Contractor and Construction Safety.

8.1.4 General

The contractor is responsible for safety at the designated drilling site in accordance with the detailed requirements set out in this section and in the project specific health and safety plan.

High safety standards in drilling and work-over operations will be achieved:

- using well designed and properly laid out equipment
- using appropriately trained and qualified personnel
- where the details of the operations are effectively communicated to all levels of personnel
- using appropriate drilling industry practices.

8.1.5 Standards and Definitions

Unless otherwise stated, the definitions given in API RP 54: Recommended Practices for Occupational Safety for Oil and Gas Well Drilling and Servicing Operations shall be applicable. Supervisor is further defined to include the contractor tool pusher and the DGDC drilling supervisor or 'Company Man'.

Drilling contractors are to conform with all appropriate API RP 54 recommended practices, and MIGAS regulations: Recommended Practices for Safe Conduct of Onshore and Offshore Drilling Operations in Dominica (reference DGDC-REF-001) in addition to the requirements of this manual. Where there is conflict between these documents requirements, the stated higher requirements take precedence.

These standards apply to all activities and all parties associated with drilling operations.

All personnel must be fully trained and qualified for the position and work that they carry out.

It is the responsibility of the contractor's supervisor for drilling and service contracts to ensure that all safety standards and manuals are readily available to site personnel and to conduct regular site safety meetings.

8.1.6 Control of Place of Work

When DGDC is in charge of the drilling operation, they are responsible for all safety at the drilling site. The DGDC health and safety requirements outlined in this section must be complied with.

When the contractor is in charge of the drilling operation and in control of the place of work, a safety plan that incorporates the requirements of this section as a minimum must be prepared and submitted to DGDC for approval. In this case, the contractor is responsible for safety at the designated drilling site and DGDC is no longer directly responsible for the drilling operation.

8.2 Drilling Site Preparation

For siting of wells, the effects on existing facilities and operations in terms of safety will be considered by DGDC.

Excavations will be carried out in accordance with the requirements set out in this manual (see DGDC-OHS-025: Excavations and Shoring). In addition, any operations must be adequately illuminated at night.

Sumps or reservoirs which are likely to retain water or sludge to a depth of more than one metre shall be fenced to prevent the general public and animals from entering. As an aid for someone climbing out of a sump, plastic lined sumps shall be installed with access ladders at 3m centres along the lined slopes. One end of each ladder must be suitably anchored to the ground outside the sump and the other end shall be no greater than 1m off the bottom of the sump. All sumps shall be signed with warning notices relating to the changing height of the liquid contents in the sump and the possible hydrogen sulphide gas hazard.

Conductor pipe shall be installed using safe construction techniques. When installed, all conductor pipes shall be completely covered with a steel plate or grate tack welded or padlocked to the pipe.

An adequate water supply shall be available to the site during all drilling and work-over operations. The supply shall be adequate for all quenching, drilling (including drilling without returns of circulation) and cementing operations. It shall have adequate redundancy (storage or standby pumps) to ensure water is available at all times and in sufficient quantities to maintain well control and a safe drilling operation.

The cellar depth shall be minimised and the cellar shall be well ventilated. Cellars shall be designed and constructed to incorporate a fast and easy means of egress from the cellar floor, both when the rig is operating and following rig removal. Ladders are not acceptable as the sole means of egress. Cellars shall be adequately drained.

8.3 Well Drilling and Services Operations

8.3.1 General

The contractor will be required to develop, implement and monitor safety programmes that must meet or surpass all applicable industry, government and DGDC (outlined in this manual) standards and should include:

- instruction of the driller or crew chief of his/her responsibility for the safety of drilling crews under normal operating and emergency conditions
- sufficient training of new employees, regardless of prior experience, to the stage that the employee can fill the assigned position in a safe manner
- instruction of crew members in safe work procedures and practices
- weekly safety meetings attended by all personnel where crew safety education, hazard identification, problems of the job relating to safety, and related safe practices are discussed
- good housekeeping practices
- availability and use of personal protective clothing and equipment
- contingency and emergency plans suitable for the operation.

Records of safety meeting attendance and topics discussed are to be kept.

A detailed safety inspection of the operation shall be carried out on a monthly basis and a copy of the inspection record (refer to the safety audit checklist for on-shore rigs - at the back of this section) sent to the local relevant authority within 48 hours of completion. This inspection will be carried out on the first work day of each month. A copy is to be kept on the site file and a copy sent to DGDC.

8.3.2 Injuries and First Aid

The drilling contractor shall follow first aid procedures the same as, or similar to, DGDC procedures as described in DGDC-OHS-037: First Aid and Medical.

The DGDC incident and accident reporting procedures outlined in DGDC-OHS-039: Accident and Incident Reporting are to be followed at all times.

Bonus incentives (for minimal lost time accidents) are not to be used as a reason for not reporting injury or damage accidents. Reporting of all accidents is necessary to prevent repeating accidents with possibly more serious consequences.

8.3.3 Emergency Preparedness

Emergency drills, procedures for evacuation and abandonment, H2S evacuation, firefighting, site stability, well control, kick detection and control and spill response are to be carried out weekly by all personnel.

8.4 Personnel Safety

8.4.1 General

Employees must wear personal protective clothing and use personal protective equipment (PPE) when working in hazardous environments where injury, illness, or death can be prevented by the use of such equipment. DGDC's requirements in the use and wearing of safety clothing and equipment discussed in DGDC-OHS-031: Personal Safety Equipment and the requirements of API RP 54 must be complied with.

8.4.2 Safety Clothing

- Head protection (safety helmets) must be worn in all designated hard hat areas.
- Eye protection must be worn at all times when onsite
- Safety boots with toe protection must be worn. Hot fluids may be inadvertently discharged onto the rig floor or in the vicinity of the rig floor. Footwear with open tops can collect hot fluids during such discharges. Personnel shall ensure that open tops are laced closed or that PVC over trousers lap over the top of the open footwear.
- Protective gloves, aprons, and face visors must be worn by personnel handling chemicals. Additional PPE (such as respirators) may be required. Refer to the Material Safety Data Sheet (MSDS).
- Loose or poorly fitting clothing, jewellery and other adornments that may catch or snag must not be worn.
- Long hair must be contained to prevent entanglement.
- Hearing protection must be worn in high noise areas above 85db.
- Respiratory protective equipment must be worn in any situation where the presence of harmful gases etc, are suspected or known to be present.

8.4.3 Safety Equipment and Procedures

All personnel must obtain permission from the tool pusher before going onto the drill floor.

Safety belts with an attached lanyard must be worn by derrickmen when handling pipe or casing above derrick floor. A safety harness must be worn by all personnel when working or climbing aloft.

All equipment must be maintained in proper working order. Any failure or break-down of equipment must be reported immediately to the driller on shift, or to the tool pusher.

8.4.4 Visitor Control

All visitors must report to the site office upon arrival at site.

8.4.5 Housekeeping (refer also to Section 5.5 of API RP 54)

DGDC safety regulations with respect to housekeeping as outlined in DGDC-OHS-041: Housekeeping are to be followed.

Adequate means should be provided to convey any hazardous substances away from the rig floor while pulling wet strings of pipe.

If personnel are required to work in a cellar, it should be kept reasonably clear of water, oil, or drilling fluid accumulation. No loose equipment or materials should be in the cellar except equipment or materials in use or about to be used. Personnel are to take appropriate precautions for the presence of hydrogen sulphide gas as outlined in Section 7: Hydrogen Sulphide, when working in, or entering, cellars.

8.4.6 Flammable and Hazardous Liquids Handling and Storage

For details on the DGDC safety procedures in the handling, signage and storage of hazardous substances such as fuel and chemicals etc, refer to DGDC-OHS-20: Hazardous Substances. (Refer to Section 7 of API RP 54)

8.4.7 Fire Prevention

For details on the DGDC safety procedures in fire prevention and protection, refer to DGDC-OHS-036: Fire Prevention and Fire Fighting Equipment. Fire prevention and protection is also discussed in Section 6 of API RP 54.

8.4.8 Personnel Qualification

All drilling personnel must be fully trained and qualified for the position and work that they carry out.

All training must include, but not be limited to, the following:

- well control and blow-out preventions
- firefighting requirements and procedures
- first aid procedures
- plant and equipment operations
- personnel protective equipment
- emergency and evacuation procedures
- understanding the health effects of carbon dioxide (CO_2) and hydrogen sulphide (H_2S).

8.4.9 Permits-to-Work

The Contractor is to use a permit-to-work system that is the same or similar to the DGDC Work Permit system. For details refer to DGDC-OHS-013: Work Control.

8.4.10 Warning and Other Notices

- Warning notices shall be prominently displayed indicating restriction, safety equipment and first aid station.
- Safe briefing areas (muster stations) are to be established at suitable locations, signed accordingly, and indicated with a green flag.

8.4.11 Machinery and Tools (Refer also to Section 5. of API RP 54)

DGDC safety regulations for machinery and tools outlined in DGDC-OHS-017: Plant, Systems and Equipment and DGDC-OHS-018: Safety with Hand Tools and Portable Equipment are to be followed. Machinery shall be operated only when authorised to do so by the supervisor.

8.4.12 Vehicles

Vehicles not involved in the immediate rig operations should be located a minimum distance of 30m from the well bore.

8.4.13 Explosives

DGDC safety regulations on the storage, handling and use of explosives as laid down in DGDC-OHS-20: Hazardous Substances.

8.4.14 Welding and Flame Cutting

Procedures the same as, or similar to, DGDC procedures for welding and flame cutting outlined in DGDC-OHS-028: Hot Work; are to be followed whenever any such work is to be undertaken.

Field welding shall not be carried out unless a permit has been signed off and a risk assessment carried out.

8.4.15 MSDS (Material Safety Data Sheets)

Material safety data sheets shall be applied with all potentially hazardous materials supplied on-site.

8.5 Drilling Equipment and Operations

8.5.1 Equipment Safety

Inspection and testing of equipment is an important factor for the safety of personnel, especially equipment that must be operated when emergencies occur. All equipment shall be regularly inspected and maintained to a high standard. All inspections and tests shall be duly recorded.

8.5.2 Operational Safety

The erection and lay down of derricks and masts shall be performed only during daylight hours.

All equipment and materials used on site shall be manufactured, designed, marked to a recognised standard, and certified 'safe for use' by an appropriately qualified person.

Prior to any structure being constructed, a foundation analysis shall be performed by an appropriately qualified person and certified 'safe for construction'. In addition, the foundation shall be inspected after heavy rains or occurrences that could adversely affect the safety of the structure.

Temporary structures shall be thoroughly inspected during and after erection, and weekly thereafter.

Non-destructive test (NDT) inspections are required on selected equipment. The contractor must list out the equipment that requires NDT testing and supply the appropriate certificates showing test compliance.

8.5.3 Preliminary Rig Up Operations (Refer also to Section 5.3 of API RP 54)

Before commencing operations involving the rig, the rig must be rigged in a safe manner.

The rig substructure or derrick mast should be grounded to prevent build-up of static electricity.

Amenity buildings must not be located immediately in front, or to the rear, of boilers, nor in the vicinity of rig fuel tanks.

Prior to initiating well servicing operations, the well must be checked for pressure. Appropriate steps should be taken to remove pressure, or to operate safely under pressure, before commencing operations.

8.5.4 Derricks and Masts (Refer to Section 8.2 of API RP 54)

The regulations outlined in the Section of 8.2 shall be followed in addition to the requirements set out below.

8.5.5 Erection

All nuts and bolts should initially be tightened to a low torque until the entire structure is completely erected, at which time the bolts and nuts should all be tightened to the correct torque specified by the manufacturer.

All leg sections must be straight as bent sections have reduced strength and place undue stress on other sections by pulling them out of line.

All erection equipment such as winches, gin poles etc. must be regularly inspected with records kept of the inspections and must be used only within their safe working loads.

No other work shall be carried out under the derrick while it is being erected or dismantled or under the mast while it is being raised or lowered. In addition, it is a MIGAS requirement that the cellar must be completely covered during these operations.

8.5.6 Derrick Alignment

Eccentric loading of a derrick should be avoided. Due to unequal settling of the derrick corners the centre of the water table may not line up with the centre of the well. This situation should be rectified by shimming the corners, never by moving the crown block.

8.5.7 Ladders, Stairways, and Platforms (Refer to Section 8.3 of API RP 54)

The regulations outlined in the Section8.3 of API RP 54 shall be followed.

8.5.8 Drawworks (Refer to Section 8.4 of API RP 54)

The regulations outlined in Section 8.5 of API RP 54 shall be followed.

8.5.9 Catheads and Lines Powered by the Cathead (Refer to Section 8.5 of API RP 54)

The regulations outlined in Section 8.5 of API RP 54 shall be followed.

8.5.10 Hoisting Lines and Other Wire Rope (Refer to Section 8.6 of API RP 54)

The regulations outlined in Section 8.6 of API RP 54 shall be followed.

8.5.11 Hoisting Tools, Such as Hook, Bails, Elevators, and Other Related Equipment (Refer to Section 8.7 of API RP 54)

The regulations outlined Section 8.7 of API RP 54 shall be followed.

8.5.12 Rotary Table (Refer to Section 8.8 of API RP 54)

The regulations outlined in Section 8.8 of API RP 54 shall be followed.

8.5.13 Drill Pipe Slips and Tongs (Refer to Section 8.9 of API RP 54)

The regulations outlined in Section 8.9 of API RP 54 shall be followed.

8.5.14 Weight Indicators (Refer to Section 8.10 of API RP 54)

The regulations outlined in Section 8.10 of API RP 54 shall be followed.

8.5.15 Drilling Fluid Tanks (Refer to Section 8.11 of API RP 54)

The regulations outlined in Section 8.11 of API RP 54 shall be followed.

8.5.16 Pipe Racks (Refer to Section 8.12 of API RP 54)

The regulations outlined in Section 8.12 of API RP 54 shall be followed.

8.5.17 Pressure Equipment (Refer to Section 8.13 of API RP 54)

The regulations outlined in Section 8.13 of API RP 54 shall be followed.

8.5.18 Generators, Motors, and Lighting (Refer to Section 8.14 of API RP 54)

The regulations outlined in Section 8.14 of API RP 54 shall be followed.

8.5.19 Internal Combustion Engines (Refer to Section 8.15 of API RP 54)

The regulations outlined in Section 8.15 of API RP 54 shall be followed.

8.5.20 Work in Proximity to exposed Energised Power Sources (Refer to Section 9.1 of API RP 54)

The regulations outlined in Section 9.1 of API RP 54 shall be followed.

8.5.21 Electrical Systems Equipment (Refer to Section 9.2 of API RP 54)

The regulations outlined in Section 9.2 of API RP 54 shall be followed.

8.5.22 Land Rig Move

A detailed rig move plan shall be prepared and submitted to DGDC for approval 5 days prior to rig move or mobilisation. The plan should include full details on route control, equipment weight, location, hazardous loads and police escort. In addition, a contingency plan on the above must be prepared.

8.5.23 Wellhead Operations

In all instances, the design working pressure of the wellhead assembly shall not be less than the maximum reservoir pressure at operating conditions.

Removal and/or installation of the wellhead assembly shall be carried out with the required safety equipment in operation or ready for immediate use. When wellhead assemblies are removed, where practically, they shall be broken down, inspected, re-assembled and tested before being re-installed. Following installation, all working components of the assembly shall be operated and pressure tested before removing tubing plugs and opening of surface and subsurface safety equipment.

Before making any minor adjustments to the wellhead assembly, such as gauge changes, the operator will first close all necessary wellheads, flow lines or any other valves which could be a potential pressure source and shall ensure that all pressure is bled off.

8.5.24 Riding Hoisting Equipment (Refer to Section 5.8 of API RP 54)

The requirements of Section 5.8 of API RP 54 must be followed.

Personnel may not ride the elevators or catline except in emergency situations or in extreme climatic conditions where, with the appropriate fall protection equipment, it may be safer than ascending or descending the derrick ladders. The elevators must be empty of pipe and other equipment while personnel are riding the elevators.

8.5.25 Racking Pipe and Drill Collars (Refer to Section 5.9 of API RP 54)

The requirements of Section 5.9 of API RP 54 must be followed.

Pipe and drill collars racked in the derrick must be secured to prevent them from falling across the derrick or mast and precautions taken to prevent them from accidentally rolling across the storage rack. Safety clamps used on drill collars, flush-joint pipe, or similar equipment (to prevent them falling into the well when not held by the elevators) must be removed before hoisting continues.

8.5.26 Blow Out Protection (BOP) - (Refer to Section 5.4 of API RP 54)

i) All necessary precautions must be taken to keep all wells under control at all times. The following general procedures must be followed, unless waived or amended by DGDC.

- Blow-out preventers and related well control equipment must be installed and tested immediately after installation and then at weekly intervals, and be maintained ready for use until drilling operations are completed.
- Temperature-sensitive components such as packing elements and ram rubbers must be made of material(s) that will resist as high a temperature as necessary.
- All kill lines, blowdown lines, manifolds and fittings must be constructed of steel or iron and must under all circumstances have a minimum working pressure and temperature rating exceeding the maximum anticipated surface pressure and temperature.
- Subject to (ii) and (iii) of this section, blow-out prevention equipment must have manually-operated position selectors and hydraulic actuating systems with accumulators of sufficient capacity to close all of the hydraulically-operated equipment.

- Dual control stations must be installed with a high-pressure backup system. One control panel must be located at the driller's station and one control panel must be located on the ground, at least 15m away from the wellhead or rotary table.
- Air or other gaseous fluid drilling systems must have blow-out prevention assemblies. Assemblies may include, but are not limited to, a rotating head, a double ram blow-out preventer or equivalent, or a blind ram blow-out preventer or gate valve.

ii) A proposed blow-out prevention program and blow-out contingency plan must be submitted to DGDC by the rig contractor and meet the minimum requirements listed below.

- Before drilling below the conductor casing string, at least one remotely controlled annular preventer and flow diverter system must be installed. The annular preventer must permit the diversion of geothermal and other fluids.
- Before drilling below the surface, intermediate or production casings, the blow-out prevention equipment installed must include a minimum of:
  - one expansion-type preventer and accumulator or a rotating head
  - both a manual and a remote-controlled hydraulically-operated double ram blow-out preventer, or acceptable alternative having a minimum working pressure and temperature rating exceeding the maximum anticipated surface pressure and temperature
  - a drilling spool with side outlets, or equivalent
  - a fill-up line
  - a kill line equipped with at least one valve rated for high temperature conditions
  - a blow down or choke line equipped with at least two valves rated for high temperature conditions and securely anchored at all bends and at the end.

iii) Blow-out equipment must be tested or inspected in accordance with the following provisions and the results recorded in the drilling log:

- Ram-type blow-out preventers and auxiliary equipment must be tested to a minimum of 1000psig (70barg) or to the working pressure of the casing or assembly, whichever is less. Expansion-type blow-out preventers must be tested to 70 percent of the above pressure testing requirements.
- The blow-out prevention equipment must be pressure tested:
  - when installed
  - before drilling out plugs and casing shoes
  - not less than once each week, alternating the control stations
  - following repairs that require disconnecting a pressure seal in the assembly.

- During drilling operations, blow-out prevention equipment must be actuated to test proper functioning as follows:
  - once each trip for blind and pipe rams but not less than once each day for pipe rams
- at least once each week on the drill pipe for expansion-type preventers.
- All flange bolts must be inspected at least weekly and tightened as necessary during drilling operations.
- The auxiliary control systems must be inspected daily to check their mechanical condition and effectiveness.
- Blow-out prevention and auxiliary control equipment must be cleaned, inspected and, if necessary, repaired before installation.

iv) Blow-out prevention controls must be plainly labelled. All crew members must be instructed on the function and operation of this equipment.

v) A blow-out prevention drill must be conducted weekly for each drilling crew.

vi) A drill string safety valve in the open position must be maintained on the rig floor at all times while drilling operations are being conducted. A kelly cock must be installed between the kelly and the swivel.

vii) The properties, use and testing of drilling fluids and related drilling procedures must be adequate to prevent the blow-out of any well. Sufficient drilling fluid materials to ensure well control must be maintained in the field area and be readily accessible for use at all times. Control and testing procedures are listed below.

- Before pulling the drill pipe, the drilling fluid must be properly conditioned or displaced. The hole must be kept reasonably full at all times. The annular mud level should not be deeper than 30 meters from the rotary table when coming out of the hole with drill pipe. Mud cooling techniques must be utilised when necessary to maintain mud characteristics for proper well control and hole conditioning.
- Mud testing and treatment consistent with good operating practice must be performed daily or more frequently as conditions warrant. Mud testing equipment must be maintained on the drilling rig at all times.
- The following drilling fluid system equipment must be installed and operated continuously during drilling operations:
  - high-low level mud pit indicator including a visual and audio-warning device
  - degassers, desilters, and desanders, or acceptable alternatives

- a mechanical, electrical, or manual surface drilling fluid temperature monitoring device. The temperature of the drilling fluid going into, and coming out of, the hole must be monitored, read and recorded on the drilling log for a minimum of every 3m of hole drilled below the conductor casing
- a hydrogen sulphide indicator and alarm must be installed in areas suspected or known to contain hydrogen sulphide gas which may reach levels considered to be dangerous to the health and safety of personnel in the area
- a reliable and adequate water supply and rig site water storage must be maintained at all times when drilling below the surface casing. The suction of each mud pump shall allow for the immediate switching to the rig site water storage when required.

viii. Unless the well is secured with blow-out preventers or cement plugs, a member of the drilling crew or the toolpusher must monitor the rig floor from the time drilling operations are initiated through until the well is completed or abandoned.

iv. No exceptions to the requirements of this section are allowed without the specific prior approval of DGDC.

Note that Items i to iii above are not normally necessary for work overs.

8.5.27 Acidising, Fracturing, and Hot Oil Operations (Refer to Section 15 of API RP 54)

The regulations outlined in Section 15 of API RP 54 shall be followed.

8.5.28 Cementing Operations (Refer to Section 16 of API RP 54)

The regulations outlined in Section 16 of API RP 54 shall be followed.

8.5.29 Gas, Air, or Mist Drilling Operations (Refer to Section 17 of API RP 54)

The regulations outlined in Section 17 of API RP 54 shall be followed.

8.5.30 Wire Line Work (Refer to Section 12 of API RP 54)

8.5.30.1 General

All wire line equipment to be manufactured or fabricated must be designed and built to appropriate standards and to withstand the anticipated temperatures, pressures and loads with adequate safety margins.

8.5.30.2 Placement and Handling of Wire line Service Units

The regulations outlined in the relevant section of API RP 54 shall be followed.

8.5.30.3 Gin Poles (telescoping and single poles)

The regulations outlined in relevant section of API RP 54 shall be followed.

8.5.30.4 Rope Falls (block and tackle)

The regulations outlined in the relevant section of API RP 54 shall be followed.

8.5.30.5 Wellheads, Wellhead Connections, and Adaptors

The regulations outlined in the relevant section of API RP 54 shall be followed.

8.5.30.6 Lubricators and Wire Line Blow-out Preventer Equipment

The regulations outlined in the relevant section of API RP 54 shall be followed.

8.5.30.7 Wire Line Operations

The regulations outlined in the relevant section of API RP 54 shall be followed.

8.5.30.8 Perforating

The regulations outlined in the relevant section of API RP 54 shall be followed in addition to the following requirement.

During wellbore operations, any work requiring the use of explosives (perforating guns, line cutters, etc.) shall be carried out according to DGDC safety standards outlined in Section 13: Hazardous Substances.

8.5.31 Auxiliary Escape (Refer to Section 5.7 of API RP 54)

On all rigs, prior to personnel working on the derrick, the derrick or mast shall have an auxiliary means of escape from the derrickman's platform installed. Except in an emergency, personnel shall not ride the safety buggy, escape equipment or slide down stands of drill pipe, stands of drill collars, or the deadline to get down the derrick or mast substructure.

Auxiliary escape devices shall be tested after installation to confirm that they are operating correctly.

8.5.32 Hydrogen Sulphide (H2S) and Drilling

DGDC safety regulations outlined in Section 7: Hydrogen Sulphide are to be complied with.

a) A contingency plan shall be developed when hydrogen sulphide (H2S) is expected during well operations. The contingency plan should include:

- H2S monitoring plan
- pre-alarm conditions
- designation at briefing areas
- evacuation plan and notification of authorities
- a list of medical facilities and contact details
- personnel to be fully trained
- procedures for the evacuation of surrounding public areas.

b) Drilling and associated equipment selected for wells where H2S may be encountered, shall be designed and constructed to comply with recognised standards and specifications.

c) All personnel whose presence is required on a drilling operation where H2S is anticipated, shall be properly trained and shall have available the necessary equipment to prevent exposure to the hazard that can cause serious injury.

8.5.33 Dangerous Area

The area around the drilling rig is a 'Hazardous Area'. Hazardous Area Classification is required to ensure that the area has special precautions developed for control. No unauthorised personnel shall enter the area.

While the installation is under drilling or workover conditions, the following special precautions apply:

i) The standard wellhead pressure test, applicable to the work in hand, must be repeated every seven days.

ii) Warning signs must be placed around the site and no unauthorised personnel should be permitted in it. Specific site areas may be designated as 'NO SMOKING' areas and 'NO SMOKING' signs shall be displayed in these areas.

iii) Welding and cutting will be permitted only on issue of a Hot Work Permit (refer to DGDC-OHS-013: Work Control).

8.5.34 Abandonment of Wells

Abandonment of a well operation shall not commence without prior approval from DGDC and shall be carried out in accordance with standard industry procedures. A report of abandonment shall be submitted by the drilling contractor within 30 days from completion of the work and shall include the following:

- notice of intent to abandon well
- subsequent report of abandonment
- procedures for permanent abandonment
- procedures for temporary abandonment.

Installation of the plug shall, where possible, result in the isolation of any potential source of fluid migration from one zone to another within the well bore due to formation pressure differentials. Installation of plugs shall ensure isolation of the well casings from formation pressure.

8.6 Post Drilling Operations

8.6.1 Production Testing

Production testing should commence only if the following conditions are met:

- all test facilities have been fully pressure tested and checked
- H2S and abandon location drills have been held
- a check to ensure that all chicksan type hammer unions are properly matched and of standard type has been carried out
- lock-out procedure for well/pipeline has been completed as required.

8.6.2 Well Testing and Monitoring

This section deals with the well, after the rig operations have ended, and when it is either left unattended, monitored or tested.

- All valves on a well head shall have their valve wheels or handles removed or locked when the well is unattended. Removed wheels or keys to padlocks shall be left in the care and responsibility of the DGDC site manager.
- Only experienced personnel shall be allowed near the wells and to operate the valves.
- Warning signs indicating the appropriate hazard shall be erected at each well and adjacent to any pipework leading from the well or equipment attached to the

well. If the equipment or pipe is uninsulated the warning shall indicate a hot pipe hazard.

- When discharging any well, including bleeding, the primary or master valve shall not be used to control the flow. A second valve shall be installed adjacent to the primary or master valve and used to control the flow rate.
- All valves, flanges, spools, tees, elbows and pipework shall be rated for the anticipated temperature and pressure conditions.
- Bleed lines shall be terminated at some distance from the well head to avoid the concentration of hazardous gases in the cellar or in other low lying areas.
- Installation of output test equipment shall be done in a safe manner.
- Where suction can be developed at the open annulus between two concentric pipes (e.g. when a discharge is through a smaller pipe into the larger entry pipe of an atmospheric separator or silencer), then the opening should be covered to prevent material or personnel being pulled into or against the open annulus.
- During well discharges, personnel shall wear safety helmets, safety boots and ear protection when working within 30m of any equipment. Wire line work shall be carried in accordance with the relevant clauses in Section 8.4.29 of this manual.
- Where possible, prior to discharge testing, the well's casing should be allowed to heat-up by bleeding the well through a dedicated bleed line.
- Prior to injection testing, wells are to be quenched as per standard industry practice.
- Good industry practice is to be used during all testing operations to ensure the well casing is not damaged. Such damage could lead to safety implications.

8.7 Safety Audit Checklist

The 'Safety Audit Checklist' shall be completed at the beginning of drilling work or as deemed appropriate by DGDC

For convenience, the 'Safety Audit Checklist' is reproduced at the end of this section. The reader should refer back to the original checklist contained in the Recommended Practices, to ensure the checklist is up to date.

SAFETY INSPECTION
ONSHORE DRILLING RIG

COMPANY	**: ....**	**LOCATION**	**: ....**
WORK AREA	**: ....**	**WELL**	**: ....**
DRILLING RIG	**: ....**	**DATE**	**: ....**

A	**GENERAL**		**B**	**STRUCTURE**	
1	Location Condition	:............................	1	Rig Foundation	:............................
2	Signboard/well number	:............................	2	Rig Floor	:............................
3	Sign board		3	Rig Substructure	:............................
	a. No Smoking	:............................	4	Fences	:............................
	b. No Entrance	:............................	5	Ladders	:............................
4	Signboard to use		6	Mast Ladder	:............................
	a. Safety Helmet	:............................	7	Locking Pin	:............................
	b. Safety Shoes	:............................	8	Deck	:............................
	c. Mask	:............................	9	Gin Pole	:............................
	d. Safety Belt	:............................	10	Monkey Board	:............................
5	Cleanliness		11	Crown Block	:............................
	a. Doghouse	:............................	12	Traveling Board	:............................
	b. Engine Area	:............................	13	Stubbing (st) Board	:............................
	c. Tool house	:............................	14	Stopping (st) Board	:............................
	d. Pump area	:............................	15	Guy Wire	:............................
	e. Mud tank area	:............................	16	Moon Line	:............................
	f. Work shop	:............................	17	Drilling Rope	:............................
	g. Rig Floor	:............................	18	Rotary Hook	:............................
6	Communication System		19	Swivel	:............................
	a. Radio	:............................	20	Kelly Stop Cock	:............................
	b. Telephone	:............................	21	Rotary Hose	:............................
	c. Intercom	:............................	22	Rotary Table	:............................
	d. Public Address	:............................	23	Elevator & Spider	:............................
7	Wind Sock	:............................	24	Kelly Bushing	:............................
8	Welding Equipment	:............................	25	Elevator Links	:............................
	a. Positive Wire	:............................	26	Pipe Slips	:............................
	b. Negative Wire	:............................	27	Spinning Wrench	:............................
	c. Welding Torch	:............................	28	Safety Clamps	:............................
	d. Tong	:............................	29	Rotary tong & Power Tong	:............................
	e. Terminal Box	:............................	30	Lift Nipples	:............................
	f. Acetylene Bottle	:............................	31	Rat Hole System	:............................
	g. Oxygen Bottle	:............................	32	Steel Hammer	:............................
	h. Hose Condition	:............................	33	Copper/Fibber Glass	:............................
	I. Gas Bottle Rack	:............................	34	hammer	
9	Explosive Storage	:............................	35	Pipe Bridge	:............................
10	Radioactive Source system	:............................	36	Pipe Wrenches	:............................
11	Survey Meter	:............................	37	Toe Board	:............................

38	Wrenches	:............................	D	**FIRE EXTINGUISHER**		
	a. Pipe Wrenches	:............................				
	b. Chain Wrenches	:............................	1	Light Duty Fire	Qty	Last Check
	c. Open Ended	:............................		Extinguisher Type	.....	....
	d. Rig Wrenches	:............................		a. Dry Powder	.....	....
39	Chain on Stand pipe & Swivel	:............................		b. CO2	.....	....
40	Blow Out Preventer			c. Foamite	:.........................	
	a. Hydrill	:............................		e. Halon	:.........................	
	b. Pipe Rams	:............................				
	c. Blind Rams	:............................	2	Fire Pump	:.........................	
	d. Wellhead Connector	:............................	3	Monitor	:.........................	
	e. Flow Line	:............................	4	Hoses	:.........................	
	f. Killing line Valve	:............................	5	Nozzle	:.........................	
	g. Choke Line Valve	:............................	6	Water/Hydrant	:.........................	
	h. Accumulator Unit	:............................				
	i. Last Test	:............................				
			E	**LIFTING EQUIPMENT**		
			1	Brake	:.........................	
C	**SAFETY EQUIPMENT**		2	Clutch	:.........................	
			3	Control Buttons	:.........................	
1	Escape Line	:............................	4	Cat Head	:.........................	
2	Escape Line Anchor	:............................	5	Speed Transmission	:.........................	
3	Escape Chair	:............................	6	Hydromatic Brake	:.........................	
4	Climbing Belt	:............................	7	Weight Indicator	:.........................	
5	Safety Line on Counter Weight	:............................				
6	Safety Helmet	:............................				
7	Safety Shoes	:............................	F	**MOTORS**		
8	Safety Belt	:............................				
9	Gloves		1	Combustion Engine	:.........................	
	a. Leather	:............................		a. Exhaust Pipe System	:.........................	
	b. Rubber	:............................		b. Chain/Sprocket Cover	:.........................	
	c. Cotton	:............................		c. Fuel Leaks	:.........................	
	d. Heat Resistant	:............................		d. Exhaust Pipe Insulator	:.........................	
10	Gas Mask on Monkey Board	:............................		e. Wire Terminal/	:.........................	
11	Supply of Gas Mask	:............................		Insulation		
12	Extra Canister Gas Mask	:............................				
13	Dust Mask	:............................	2	Electric Motor/Generator		
14	Breathing Apparatus	:............................		a. Switch Box/(on/off)	:.........................	
15	Gas Detector for H2S and other Toxic Gases	:............................		b. Terminal Box	:.........................	
16	Dust Goggles	:............................		c. Circuit Breaker/Fuse	:.........................	
17	Welding Goggles	:............................		d. Ground Wire	:.........................	
18	Stretcher	:............................		e. Conductor Cable	:.........................	
19	Apron	:............................		f. Rotating Parts Cover	:.........................	
20	Ear Protector	:............................				
21	Coverall	:............................				
22	Fire Axes	:............................	G	**MUD PUMPS**		
23	Fire Blanket	:............................				
24	Fire Suits	:............................	1	V-belt Cover	:.........................	
			2	Safety Valves	:.........................	
			3	Mud Pressure Pipes	:.........................	

			4	Shale Shaker	:..........................
			5	Mud Tank	;..........................
6	Mud Mixer	:.............................	**I**	**LIGHTING**	
7	Manometer	:.............................			
8	Viscosity Meter	:.............................	1	lamps	:..........................
9	Density Meter	:.............................	2	Flood Light	:..........................
10	Safety Chain on Discharge Hoses	:.............................	3	Fog Lamps	:..........................
11	Safety Valve Set	:.............................	4	Emergency Lamp	:..........................
12	Mud Gun	:.............................	5	Cable Installation	:..........................
13	Sattling Valve Set	:.............................	6	Fuse Box	:..........................
14	Waste Disposal Pit	:.............................			
15	Degasser	:.............................			
			J	**ALARM SYSTEM**	
			1	General Alarm	:..........................
H	**AIR COMPRESSOR**		2	General Alarm Switch	:..........................
			3	Signalling Bell	:..........................
1	Air Tank		4	Manual Motor Siren	:..........................
	a. Working Pressure	:.............................	5	Sensor Near Shaker	:..........................
	b. Date of Last Inspec-	:.............................	6	Sensor Near Bell	:..........................
	tion		7	Sensor Driller Nipple	:..........................
2	Accessories				
	a. Pressure Gauges	:.............................			
	b. Safety Valve	:.............................	**K**	**CLINIC**	
	c. Valves	:.............................			
3	Air Hoses/Pipes	:.............................	1	Doctor/Paramedic	:..........................
4	Thermometer	:.............................	2	Medical Supplies	:..........................
			3	Resuscitator	:..........................
			4	Stretcher	:..........................
			5	Minor Surgery Set	:..........................

COMMENTS/SUGGESTIONS:

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Inspector

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Witness

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Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-016: Atmospheric Monitoring
Revision 0

Contents

9. Atmospheric Monitoring

9.1 Introduction

The purpose of this procedure is to establish methods and standards for monitoring of atmospheric contaminants.

This procedure shall apply to all atmospheric monitoring performed by DGDC staff as required in this manual.

9.2 Definitions

Calibration
Process of adjusting instrument readout to correspond to a known reference standard (eg adjusting amplification of detector signals)

Ceiling Exposure Standard
An exposure standard not to be exceeded for any length of time.

Explosive Atmosphere
Air that is flammable because of the presence of a flammable substance at a concentration between the LEL and UEL.

Lower Explosive Limit (LEL)
Lowest concentration of a substance in air at which it is explosive. Normally expressed as a percentage.

Oxygen Deficiency
Insufficient oxygen in air.

Relative Response
Instrument response to a specific compound relative to the calibration standard (response factor = 1 or 100% response).

Short Term Exposure Standard (STEL)
Exposure standard applicable for short term exposures - averaged over 15 minutes.

Threshold Limit Value (TLV)

Exposure standard listed in the current TLV publication of the American Conference of Occupational Hygienists (ACGIH). TLV's are defined for both short-term effects (ceiling and STEL standards) and long term effects (8-hour TWA standards)

Upper Explosive Limit (UEL)
Highest concentration of a substance in air at which it is explosive. Normally expressed as a percentage.

9.3 Responsibilities

- DGDC shall provide monitoring equipment as appropriate for the task and the gases to be monitored.
- DGDC shall maintain the equipment, as required by manufacturer's instructions.
- DGDC shall ensure the equipment is calibrated and records shall be kept.
- Employees shall wear and use personal monitoring equipment as required in this manual.
- DGDC shall ensure that employees are trained in the use of monitoring equipment as appropriate.
- Management shall keep a record of details of training and persons approved for use of monitoring equipment.

9.4 Actions

9.4.1 Use of Combination Electrochemical Cell Meters

Combination meters are normally equipped with 2 or 3 electrochemical cells. Typically, they can be used to monitor oxygen, explosive atmosphere and hydrogen sulphide simultaneously. Combination meters give nearly instant measurements of these variables and are portable. They should be used for confined space entry or where two or more gases, which the cells can detect are present. It is possible to use combination meters to record details and consider changes over time.

Calibration of these meters must be done regularly and they shall be sent to an approved laboratory at least annually.

For normal use, combination meters shall be worn, attached to the worker by a belt. Combination meters should not be allowed to get wet. If this has occurred, they shall be sent to the laboratory for re-calibration and a check over.

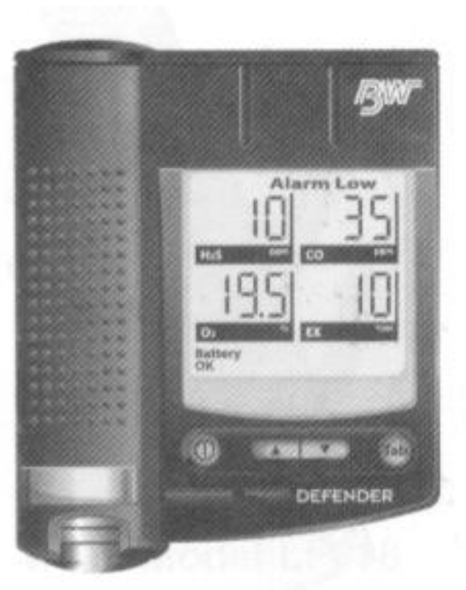

Figure 9.1 Two and Four Gas Electrochemical Cell Personal Detector

In some cases, combination meters may be used for source monitoring, for this purpose, the meters should be placed as close to the source as practicable and will normally be set up to data log measurements at appropriate intervals.

Combination meters are very simple to use - the most important requirement being that they are switched on at **all times** while in a hazardous environment.

Prior to use, batteries shall be checked as to their life. It is not desirable to have a meter fail during a work task.

The meters shall be held by a designated person (Stores Officer) who will be responsible for checking out and in the unit and ensuring it is appropriately maintained and calibrated.

9.4.2 Monitoring Explosivity

Explosivity is measured using an electrical 'Wheatstone Bridge' to combust the sample gases and heat a platinum filament. The increase in filament temperature results is proportional to the concentration of combustible gas or vapour. Thus the **flammability** of the atmosphere is measured directly. The read out is given as a percentage (0 to 100%) of the lower explosive limit (LEL), expressed as 'calibration gas equivalents'.

This is NOT a concentration, and the reading will be dependent on the LEL of the calibration gas used and the response factor for the flammable chemical present.

Instruments shall be calibrated by an approved laboratory for:

- the gas most likely to be present at levels approaching the LEL; or
- a gas with a lower response than any gas likely to be encountered in flammable concentrations.

The instruments must always be labelled with the date last calibrated and the gas that was used to calibrate the instrument. Records shall be kept showing meter's last date of calibration. The calibration records shall be held by the Health and Safety Officer.

The explosivity meter shall be set up to alarm at 5% of the LEL. Actions levels for explosivity measured in confined spaces are included the Confined Space Section of this manual.

In a well ventilated or outdoor environment, the following action levels shall apply:

Level	**Action**
Investigative level 5 - 20% of LEL	Continuous personal monitoring must be done. An emergency plan must be prepared. If possible, time in affected area should be minimised. Remove ignition sources from close to the source.
Personal monitoring level 5 - 10% of LEL	Continue work with caution and above requirements.
Personal monitoring level 10 -20% of LEL	Remove all ignition sources. Work only with intrinsically safe appliances.
Personal monitoring level >20% of LEL	Evacuate area.

9.4.3 Monitoring Oxygen

Oxygen monitors use an electrochemical cell to measure the partial pressure and thus the concentration of oxygen in air. The measurement is given as a percentage. The following action levels apply for both confined space and outdoor activities:

For oxygen concentration action levels refer to DGDC-OHS-029: Confined Space.

9.4.4 Monitoring Hydrogen Sulphide

Hydrogen sulphide concentrations can also measure using an electrochemical cell. The measurement is given in ppm (parts per million).

For action levels refer to DGDC-OHS-014: Hydrogen Sulphide.

The meter should be checked against a H_2S span gas of known concentration to ensure its readings are accurate. This test should be performed monthly and if the unit is heavily used at least weekly. Records of the tests shall be kept and forwarded to the Health and Safety Officer.

9.5 Use of Colorimetric Detector Tubes

These tubes are filled with a reagent that changes colour when exposed to certain airborne contaminants. Air is pumped through the tubes using a vacuum pump (eg Gastec).

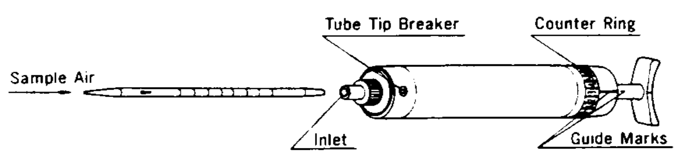

Figure 9.2 Typical Colorimetric Tube Gas Detector

Colorimetric tubes should not be used to assess personal exposure (consult an occupational hygienist). Colorimetric tubes can be used where a quick check on airborne contaminant levels is required. In some cases, they can be used to identify airborne contaminants. They do not give a continuous measure, however, the method is simple, with nearly instantaneous results.

Colorimetric tubes are chemical specific measuring devices - each tube is designed to detect only limited number of substances. For example, a 'gasoline' tube cannot be used to measure mercaptan concentrations. There are a range of tubes available for the measurement of a large number of different airborne contaminants. These are given in manufacturer's instructions.

Colorimetric tubes (e.g. Gastec tubes) are used in conjunction with a constant flow pump (e.g. Gastec precision pump). The tube is attached to the end of the pump. The pump is pulled out to create a vacuum. The air is then pulled through the tube at a constant flow rate (the time this takes is dependent on the resistance of the tube). The pump can be pulled again for a second 'stroke', enabling twice the sample volume to be taken. If necessary, up to ten strokes can be used for ten times the sample volume. This may be necessary for the detection of lower concentrations of contaminants.

The tube will change colour as the particular chemical is passed through at a constant flow rate. The colour change goes part way down the tube, depending on the amount of contaminant that is passed through.

The tubes are marked with a printed scale to indicate concentrations of the contaminant for the prescribed number of pump strokes. The number of strokes necessary will be given in the instructions with the tubes. Thus for a tube with a prescribed pump stroke number of one, the concentration can be read directly off the tube by reading the mark at the place in the tube where the colour changes after a single pump stroke.

If the concentration is below the range detected using one stroke, it may be necessary to use more than 1 pump stroke to be able to read the scale. The concentration would need to be adjusted to give the true concentration (e.g. if two pump strokes are necessary for tube with a prescribed pump stroke of one, the value read off the tube would need to be halved to give a true concentration). These instructions are given in detail with every tube and must be read before the tubes are used.

The instructions with the tubes also give information regarding the 'specificity' of the tubes. The tube may detect a number of similar substances and therefore may be misleading. For example, the toluene tube will also detect xylene and so if both xylene and toluene are present, it may appear to be a very high concentration of toluene, but in reality there may be a high concentration of xylene and very little toluene. Thus when measuring mixtures of chemicals, one must be careful to look at other chemicals that may interfere with the results.

Temperature and humidity can have a significant effect on the accuracy of the tubes. For some of the tubes, adjustment factors are given for their use in nonstandard conditions. If unusual temperature or humidity is likely, temperature and humidity should be measured and the colorimetric tube results adjusted appropriately.

The vacuum pump must be calibrated annually. Records of calibration will be held by the Health and Safety Officer.

9.6 Training

All staff that may need to be equipped with a combination meter must be trained in its use and interpretation of the results. This will normally be done as a half day in the confined spaces training. Persons not involved in confined space work that need to use this monitoring equipment must do the monitoring section of the confined spaces training course.

The training shall cover:

- Conditions under which a monitor should be worn
- Types of Monitors
- Alarms and action levels
- Interpretation

Staff expected to use colorimetric tubes will have previous training and experience in chemistry or engineering. They must also complete a two-day course on the identification and assessment of airborne chemical hazards.

These courses must be repeated every two years.

Management shall keep a record of details of training and persons approved for use of monitoring equipment.

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DGDC-OHS-017: Plant, Systems, and Equipment
Revision 0

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10. Plant, Systems, and Equipment

10.1 Introduction

This section deals with the hazards that plant, equipment and machinery present. These hazards relate to the release and confinement of energy, and include moving parts, rotating shafts and hot points such as exhausts etc. These hazards are not always obvious and may change without warning. Personnel must therefore take all care and be fully aware of the hazards in order to avoid being injured when working on or around such equipment.

10.2 Training

10.2.1 General

No equipment or systems are to be operated by anyone who does not have the necessary knowledge and experience to operate them safely. Operators are to have been instructed in the hazards associated with all equipment and systems, and the precautions to be taken in relation to those hazards. All locally operated machine operators are to be trained in the safe use of all plant objects and substances as well as the protective clothing and equipment required to work with such objects and substances.

Untrained workers or those in the process of training must be directly supervised by a person who has the necessary knowledge and experience and has been adequately trained in the work or operations to be done.

10.2.2 Machinery and Equipment

When training people to operate machinery and equipment, the following aspects must be explained and understood:

- what the machine does
- how the machine works
- hazards and appropriate controls
- emergency procedures
- how to stop and start the machine
- what are, where are the machine's warning systems (alarms)

- post start-up checks
- correct use and adjustment of guards
- correct work methods to be used
- how to check and adjust the machine prior to starting it
- how to recognise faults which have the potential to cause harm
- limitations and capabilities of the machine
- location and operation of other controls
- purpose of guards and other safety devices
- How it affects systems and other machines.

10.2.3 Systems

When training personnel to operate systems the following aspects must be appreciated:

- what the system is designed to do
- how the Task is carried out
- how it relates to other systems
- normal and abnormal hazards and how these are controlled
- Standard Operating Procedures (SOPs)
- Emergency Operating Procedures (EOPs)
- routine readings and checks
- Operating limits
- fault conditions, alarms and alarm settings
- protection devices and limits
- ‘remote’ and ‘local control’ stations

10.3 General Hazards

10.3.1 Basic Precautions

Where there is a risk of entanglement with machinery, people with long hair shall have it tied up out of harm’s way (use a hair net if appropriate). Loose clothing must not be worn by persons who may pass near to machinery or who may enter plant rooms and areas. Where there is a danger of heat, exposed skin such as arms and legs must be covered.

10.3.2 Noise

All practical steps should be taken to ensure that the noise produced by machinery is minimised. Where it is not possible to reduce noise below acceptable exposure limits then all practical steps should be taken to isolate the excessive noise from people. Where both are not practical, systems should be put in place to ensure that people exposed to the remaining excessive noise are unlikely to suffer harm. For further information, refer to DGDC-OHS-022: Noise and Vibration.

10.3.3 Lighting

In general, there must be adequate lighting in all areas to prevent accidents. As a minimum, appropriate legislation must be followed.

Artificial lights should be shaded so as to control glare and reflect available light to where it is required. Care should be taken to avoid stroboscopic effects from flickering fluorescent tubes shining on revolving shafting, wheels and reciprocating parts.

10.3.4 Starting-Up and Shutting Down Machinery, Equipment and Associated Systems

When starting or shutting down equipment and systems, the appropriate SOP (Standard Operating Procedure) must be followed. If procedures are not covered in the SOP then the manufacturer's routines shall be followed.

10.3.5 Starting Up Machinery

When machines are being returned to service, especially after maintenance or repair, they should be checked to ensure that no foreign objects such as tools, rags, etc. are in a position to foul any moving part, and that no person is in a position of danger.

10.3.6 Trips and Emergency Shut-Down

Emergency shut downs are to be in accordance with the EOP (Emergency Operating Procedures). The EOP aims firstly to protect life and prevent injury, and secondly to prevent damage to machinery and plant.

Machines fitted with trips and limit switch devices and should not be operated unless these are in full working order. Do not render trips and governors inoperable unless direct authorisation has been given by the Site Superintendent.

Governors, Limit switch devices and emergency shut-down devices, whether locally or remotely operated, shall be tested strictly in accordance with the maintenance schedule to be designated as “starred” maintenance (refer to sub-section 10.13 of this section).

10.4 Equipment/Machinery

10.4.1 Guarding Machinery

Machinery guards and barriers should be designed in accordance with OSHA Standard Machinery and Machine Guarding 1910.212-1910.213 so that people cannot reach over, around or through them and come into contact with the prime movers, transmissions, nip points, hot points and other dangerous parts of machinery. Guards should prevent the trapping of fingers, hands, limbs, hair and loose clothing.

Consider how far a person can reasonably be expected to reach when designing guards that are necessary to keep a person’s fingers, hands, arms, legs, etc from reaching the danger area.

- Guards must be made of a substantial material as per the OSHA standard
- Guards must be securely fixed in position.
- Ensure that the guards themselves do not become a hazard by having sharp edges, corners or projections.
- Guards must be kept in good order.

Where oil and grease points exist, the guards should be designed to allow lubrication to take place yet prevent the worker contacting hazardous parts. Alternatively, it may be possible to fit extension pipes to oil and grease points so that remote lubrication can be performed from outside the guard. If the above are not possible, lubrication must only occur when the machine is at rest and locked-out.

Refer to the DGDC Safety in Design Manual which covers guarding, selection, and layout of machinery.

10.4.2 Servicing of Machinery

Before any maintenance or repair work is carried out on machinery it should be isolated from its power source. DGDC work control procedures are to be followed (see DGDC-OHS-013: Work Control).

Where it is not practical for the machine to be stopped and yet it is essential that the work be carried out, then the following steps should be taken:

- authorisation is to be obtained from the Site Superintendent to carry out the live work.
- only the part of the machine which is to be worked on is to be made accessible (use temporary guards if necessary).
- workers are to be made fully aware of the hazards and are to be experienced and fully trained in the intended work.

Where inching of machinery is necessary for the purposes of cleaning, loading, and setting up the inching control must be a hold-to-run type. Hand barring of machinery is an alternative method that can sometimes be used as it usually gives finer control.

Machinery and equipment must be maintained and kept in sound operating condition at all times. A centralised preventative maintenance system that calls up regular inspections, as well as defect reports is to be used to manage the maintenance of machinery.

10.5 Systems and Pipelines

10.5.1 Isolation of Systems

The double block and bleed (double valve isolation) principle is to be applied whenever high energy systems are being isolated for work. In addition, locks are to be applied as appropriate to provide further protection to personnel carrying out work on high energy, or hazardous systems. Where it is not practical or possible to provide double valve isolation, then isolation points are to be physically and solidly locked in position (i.e. with a purpose-designed device as opposed to a lock and chain). Blanks, drop-out spools, or other similar devices are to be considered noting however that their fitment involves opening up of the system.

Damage to pipelines and vessels containing liquid can occur when the line is 'boxed in' or 'solid' (e.g. sections of the line have been valved shut at each end of the section). Unless fitted with a pressure relief system, one end of the line must be allowed to breathe (e.g. into a partly full tank). High pressure can develop quickly through expansion of the liquid due to a rise in temperature. It should be remembered that a non-return valve acts as a shut-off valve if the liquid down stream of it expands. Pressures are to be regularly monitored if the line is boxed in/solid.

10.5.2 Line Opening and Purging Procedures

Definitions
Line Opening: all work that requires the opening of pipelines or vessels (e.g. removal of pipe fittings, tank or hopper fittings or equipment) where any person may be exposed to process materials and is not covered by routine operating procedures.

Preparation:
After being taken off line, all residual pressure must be released from steam, hydraulic, pneumatic and gas systems. Gas systems must be purged with inert gas or air, if possible. Work is to be carried out under the DGDC permit-to-work system (See DGDC-OHS-013: Work Control and in accordance with the Purge Permit (Form 10.1) presented at the end of this section).

10.5.3 Draining Lines Containing Corrosive/Dangerous Chemicals

Pipelines containing corrosive or dangerous chemicals must be drained either into a purpose built drainage system or into suitable containers. Neutralisation or water dilution may be necessary. Suitable protective clothing and, where necessary, breathing apparatus shall be worn.

Note:- Consideration must be given to the safety and environmental implications associated with the disposal of the flushings.

- Isolation valves upstream of the location being worked on should be shut and tagged, noting the double isolation principle (see above). Where applicable, single or double isolation should be used downstream.
- All supply pumps are to be switched off and isolated, tagged, and locked or de-fused.
- All electrical and pneumatic controls are to be switched off and isolated/de-pressurised/earthed and tagged.
- 'Tag-out' tags must be attached onto each isolation valve, electric or pneumatic control and/or switch as required by the Master Work Permit.
- Blank flanges are to be fitted to the open ends of any pipelines that are to be left open and unattended for longer than 8 hours.
- Use the Confined Space Entry Procedures laid out in DGDC-OHS-029 document where entry to a vessel is to take place.

If a bleed line is used to bleed to a safe area, the line must be securely anchored to prevent movement. Swings, ells and short nipples downstream of bleed valve shall be removed. If turns are necessary, all points where a change of direction occurs shall be anchored securely.

- Valves controlling bleeding operations shall be opened or closed slowly.
- No line or fitting under pressure shall be hammered.
- All pressure should be bled off before attempting to tighten any threaded or flanged connections.

When re-pressuring lines and equipment, open valves slowly. Everyone along a line, or in front of equipment, should stand clear and remain so, until normal operating pressures are reached.

- Where a pipeline flange is to be unbolted it shall, if possible, be unbolted and 'cracked' on the side of the line opposite to, and away from, the service person. In the case of screwed fittings, these should be undone slowly and with care.
- When undoing or removing parts of a pipework system, care shall be taken in identifying the weights of any components that may be supported or come loose during the removal. Take steps to be able to handle and support such loads.

10.6 Steam Systems

Steam has the potential to kill or maim. Leaks are often invisible and difficult to detect before they become hazardous. Great care should therefore be taken when operating or maintaining steam systems and equipment.

- All personnel who will be required to work on steam systems must be suitably trained and carry out work to a high standard.
- Steam systems are to be maintained to a high standard. Maintenance items that are identified as having a safety implication are to be designated as 'starred maintenance' (Section 10.13: Safety Related Maintenance).
- Steam leaks, however small, are to be repaired without delay and not allowed to become worse.
- New gaskets must be used whenever a joint is re-made and the correct pulling-up sequences (torque pattern) used.
- Welders working on steam systems are to be qualified to the appropriate standard.
- Personnel working or passing near steam systems are to wear clothing that covers arms and legs. Those who work near steam systems are to wear clothes made of heat resisting natural materials such as cotton, wool, or nomex. 100% man made materials such as nylon or rayon are never to be worn by people working near hot systems or equipment.
- Hot-tapping is a particularly hazardous operation that is to be undertaken only when no alternatives are available. Personnel involved in such work must be fully qualified in the procedures involved, and be supervised by experienced personnel (see the 'Hot Tapping' section below).

10.7 Blowdown

The blowing down of pressurised steam systems and boilers is a potentially dangerous operation. Aside from the obvious physical hazards such as heat, the associated noise and gas can also present dangers. Normally, blowdown is covered by standard operating procedures (SOPs). Where there is no written procedure, the operation is to be carefully controlled by suitably trained and experienced personnel. An alternative isolation plan must always be available should the blowdown valve fail in the open position. The safety of all persons including the general public must be considered.

10.8 Cathodic Protected Pipelines

Cathodic protection is an electrical means of protection to prevent corrosion.

The insulating flanges may be distinguished by distinctive electrical tape and by being painted black. They will also be recognised by the presence of two washers, one an insulating washer beneath the nuts and bolt heads.

When doing any work on the insulating flanges of any pipeline which may involve cutting the pipelines, the system must be made safe against any possible arcing or sparking, by isolating the associated rectifier(s) and by providing suitable temporary bonds. In the case of systems protected by sacrificial anodes, temporary bonding will be required so that the anodes need not be disconnected. These switching and bonding operations are the responsibility of the electrical section of the relevant department, and a Master Work Permit shall be obtained to indicate that electrical isolation has been carried out.

Plans indicating what systems are protected by impressed currents are to be maintained up-to-date, and are to be readily available to workers.

10.9 Warming Through and Water Hammer

The consequences of rapidly introducing steam into a cold line or one that may contain water (condensate or flush water) can be very serious and hazardous. Lines and systems must be fully drained prior to admitting steam. Warming through must be carried out slowly to prevent damage to systems and seals.

10.10 Power Plant Systems

Personnel assigned to work within the power plant are to be inducted in general plant safety rules as well as the precautions relating to the system being worked on. The interdependence of systems within a power plant leads to particular hazards and must be understood by work supervisors.

10.11 Hydraulic Systems

Hydraulic systems present the following hazards listed below.

- burst hydraulic lines presenting a fire hazard (especially if hydraulic fluid soaks lagging etc.)
- leaking or burst hydraulic lines creating a slip hazard
- vaporised hydraulic fluid causing a breathing and eye hazard
- high pressure fluid penetrating skin
- movement of hydraulic machinery causing entrapment.

If major hydraulic system failure occurs, then the procedures outlined in the EOP (Emergency Operating Procedures) are to be followed.

10.12 High Pressure Air

All equipment used in connection with compressed air or high pressure equipment must be soundly constructed and properly maintained. All gauges and control devices must be regularly checked against a master pressure gauge following the procedures set out in the PMS (Planned Maintenance Schedule). Damaged or faulty equipment must not be used.

All compressed air hoses shall be of the correct type and size to fit the equipment being used.

Air systems are to be protected by pressure safety devices at all times.

Compressor air supply hoses must be properly connected and in good condition.

No compressed air or high-pressure nozzle, gun or equipment should ever be pointed at any person or fooled with. A small increase in pressure to any body orifice will cause serious injury or death. Eye protection should always be worn when using compressed air to blow clean.

Extreme noise levels are possible when compressed air is vented. Vents and drains are often automatically controlled and there may be no warning of sudden noise.

10.13 Hot Tapping - Precautions and Procedures

Note:

- No hot tapping is allowed on installations without the authorisation of the Site Superintendent.
- In brief terms, hot tapping is a means whereby under controlled conditions, a hole can be trepanned (bored) into a live line in a safe manner.
- The hot tapping machine consists mainly of a motor (normally air-driven) operating a trepanning tool which is so encased as to withstand a designated working pressure.
- The trepanning tool has fitted at its centre a twist drill of a suitable diameter protruding below the cutting edge. The twist drill is fitted with a spring-loaded bush collar or some other similar device, so that once the drill has pierced the pipe, the bush or collar holds the metal coupon that the trepanning tool has cut out. Thus the coupon is prevented from falling into the pipe and can be withdrawn by the hot tapping machine on completion of the operation.

Before any hot tapping operation commences and before a Work Permit is issued, the conditions listed below shall be met.

- The contents of the system will allow welding by their own nature because they provide an adequate heat-sink and are not affected by elevated temperature.
- If any air is likely to be in the line, the oxygen content shall remain insufficient to create a flammable atmosphere.
- The material of the pipeline is suitable for welding and the right techniques, skills and materials are available.
- The material of the connection and the valve to be used are correct.
- The hot tapping machine to be used is suitable for the pressures and temperatures to be met and for the contents of the line.
- The condition of the pipeline is such that it is of sufficient strength and thickness to receive the connection. Ultrasonic or X-ray testing of the pipe should be carried out to ensure that no corrosion has taken place.
- Proper fire-fighting precautions are taken.

The procedure set out below shall be strictly adhered to.

a) Prior to welding the connection, establish a flow through the line.

b) After the connection has been welded to the pipe and a valve fitted to the flanged end, the whole shall be hydro-tested to prove the weld, the connection and the valve.

c) Once b) above is completed satisfactorily, the hot tapping machine can be installed on the valved connection.

d) With the valve of the hot tapping machine and the connection valve open, the whole assembly shall be pressure tested again before hot tapping commences.

10.14 Safety Related('Starred') Maintenance

All maintenance on plant, equipment and systems is to be reviewed to identify those items that have a safety implication. This requirement relates to both safety equipment and systems as well as other plant where a failure could cause injury or death. Examples include examination of steam pipe welds, overspeed trip testing or visual checks on a fire extinguisher.

All safety related maintenance items, once identified as such, are to be identified by a '*' and be known as 'Starred Maintenance Items'. Starred maintenance is to be given priority over all other items. Starred maintenance is always to be completed within the required interval. Any items not completed are to be reported to the Site Superintendent by the appropriate supervisor with the reason for non-completion and the intended action.

The state of completeness of all safety related maintenance items is to be reviewed at regular intervals by the site safety committee. A summary of these records is to be forwarded to the DGDC' Head Office.

Form 10.1 Purge Permit

Master Work Permit # **System to be Purged:** ____________________ **Person in Charge of Purging Operation:** ________________________ **Due to Start:** ______________
Details of Purging Operation Sketch Purging Line-up **Purging with**: ___________________ **Source**: _________________________ **Vent**: ___________________________ **System Proved Clear/Safe/Purged By**: _____________________
Special Hazards/Precautions

Purge Authorised:	Operational Supervisor

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-018: Safety with Hand Tools and Portable Equipment
Revision 0

Contents

11. Safety with Hand Tools and Portable Equipment

11.1 Introduction

This section outlines DGDC safety standards for the safe care and use of hand tools and portable electric and pneumatic equipment. It is intended as a basic guide for non-skilled or semi-skilled personnel who may be occasional users of hand tools. Workers who will be expected to use tools regularly must be fully trained in the use of their tools. Injuries will occur when defective or inappropriate equipment is used or when the operator is unfamiliar with the safe operation of tools, and when training is inadequate.

11.2 Training

Appropriate training shall be given to employees and new users in the use and care of hand tools and portable pneumatic/electrical equipment prior to those personnel using the tool(s).

11.3 General

Any faulty equipment must be immediately withdrawn from use. Such equipment is being tagged with a 'Caution' equipment tag. Faulty equipment is to be repaired as soon as practical.

Visible and durable labels must be attached for equipment identification and proof of inspection and test. The labels must display the name of the person or company who performed the test and the retest date.

All pneumatic/electric saws and cutting tools are to be fitted with appropriate guards to prevent injuries, these are not to be removed at any time.

Ensure that the heads of axes, sledge-hammers, etc are firmly attached prior to use.

Do not carry tools in breast pockets. Tools must be carried in a tool kit or in hand in such a manner as to prevent injury by stabbing, dropping, pinching and the like.

11.4 Storage

All hand tools, portable electrical and pneumatic equipment, extension leads and fixtures shall be located and stored in positions where they are protected from mechanical damage and moisture.

11.5 Maintenance

All hand tools and pneumatic/electrical equipment shall be maintained in good order and condition and shall be regularly visually examined to ensure that there are no defects or developing defects which could endanger personnel.

All electrical equipment should be regularly (as required by the Planned Maintenance Schedule - PMS) inspected and tested for electrical safety. Initial visual inspection shall include:

- check that the supply lead is firmly attached to the appliance
- check that the lead is not damaged
- check that the plug is dry
- check that the plug pins are straight
- check that the housing is not broken
- listen to the switch sound and check that it feels mechanically good
- check that the equipment is dry.

All portable electrical equipment is to be on an equipment register which will record the date last tested.

All tools are to be included in the site Maintenance Schedule.

11.6 Hand Tools

11.6.1 General

As a general rule, a hand tool is safe and effective only if it is used as intended and if kept in a good serviceable condition. Notes on some common tools follow as a guide on the use of hand tools. These notes are not intended to substitute for suitable training of personnel.

Only hand tools that are in good condition shall be used in operations. They shall be properly cleaned after use, and cutting tools shall be kept sharp.

11.6.2 Screw Drivers

- It is essential that a screwdriver should be of the correct size to fit the screw. If the screw driver fits the screw correctly, the tool will be drawn into the correct position without unnecessary force being applied.
- Screwdrivers shall be in good condition
- Do not use a screwdriver as a lever, a chisel, a drift pin, or a hammer.
- Bent shanks, broken tips, or damaged handles are all hazards to screwdriver user's hands.

11.6.3 Hammers

It is essential that the right kind of hammer be selected for the job. Hammer handles should be made from smooth timber or of an integral head and shaft of steel. Before use, check the hammer head for tightness. Always use eye protection when the work material is hard, brittle or may chip.

The hazards that hammers present are:

- the head if loose flying off and causing injury
- chipping of the head, the flying particle being a hazard to the eyes
- the hammer slipping out of the hand
- breaking or splitting of the handle, thus causing possible injury to the hand.

11.6.4 Cold Chisels

Cutting edges should be kept sharp at all times and the original shapes and angle maintained. A cutting edge that becomes dull or 'gapped' will not cut successfully and has a tendency to slip when the chisel is struck. A cold chisel should always be kept correctly ground and sharp. Re-Sharpened cold chisels should be suitably hardened and tempered to maintain them in a safe working condition.

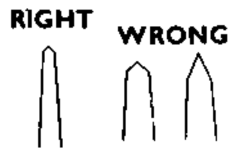

Figure 11.4 : Correct Cold Chisel Sharpening Angles

Repeated blows cause the softer head to spread and crack at the edges (mushroom head). If this is allowed to continue, small particles are liable to break off and fly. Regular dressing on a grinding wheel will reduce this hazard.

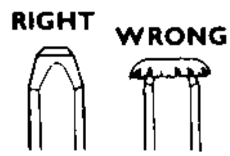

Figure 11.5 : 'Mushroom Head'

11.6.5 Picks and Shovels

Picks and shovels shall at all times be maintained in a serviceable condition. Shovel blades should not be allowed to become blunt, turned, split or jagged. Pick head points shall be kept sharp and heat-treated so that the metal wears down in use and does not splinter or chip off.

11.6.6 Spanners and Wrenches

- Only spanners and adjustable wrenches of the right size shall be used. The jaws shall be inspected for any sign of opening out or splitting.
- Spanner and wrench lengths are graded to provide sufficient leverage on the nuts for which they are designed. Do not place extensions on wrench handles for more leverage.
- Do not use a hammer on the handle to assist the turning unless the spanner is especially designed for that treatment. For heavy work, a properly designed slugging wrench should be used.
- Do not use a spanner or wrench as a hammer

- Grip the spanner handle firmly near the end and turn the part by pulling towards you. Never push a spanner - pushing increases slippage.

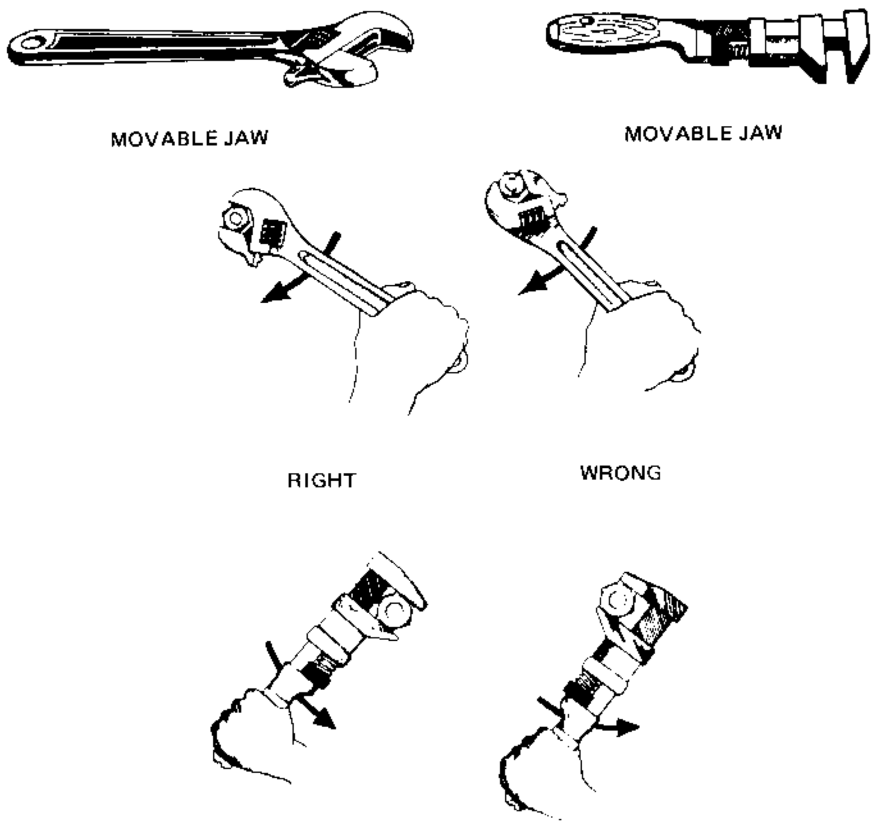

Figure 11.6 : Correct Use of Spanners and Wrenches

11.6.7 Pipe Wrenches

Pipe wrenches shall be large enough for the job. The jaw teeth shall be kept clean and sharp, and the knurl, pin and spring shall be kept free from damage. Pipe wrenches shall never be struck with a hammer, nor should they be used as a hammer.

11.6.8 Pliers

Pliers are meant for gripping objects and should not be used as a wrench. All pliers shall be kept free from dirt and grit and the movable parts lightly lubricated. When clipping wire ends, eye protection must be worn and the pliers should be held so that the ends, when snipped, are directed towards the ground.

There are many special purpose pliers available. Where a job requires the use of such purpose made pliers (e.g.. circlip, bent-long-nose, glass breaking) then only these should be used.

11.6.9 Jacks

Jacks shall be heavy and strong enough to raise and maintain the load (always check the SWL (Safe Work Load)). They shall be placed on a firm and solid support and the load shall be positioned on the centre line of the jack. Once a load had been raised, it shall be shored or blocked. The jack shall never be relied upon to hold the raised load in position by itself. Never crawl or put any part of your body, under a load that is supported only by a jack.

11.6.10 Hacksaws

- The correct type of blade shall be selected to suit the material to be cut.
- The blade shall be set in a hacksaw frame so that the teeth are pointing in the forward direction.
- Sufficient tension shall be applied to ensure the blade remains rigid.

11.6.11 Handsaws

Many kinds of woodworking handsaws are available and all care shall be taken to select the correct saw. All handsaws shall be regularly examined to ensure that the saw teeth are properly set so as to avoid binding in the timber which can cause the blade to buckle.

11.6.12 Knives

- Retractable knife blades are only to be used
- Hands and the knife handles shall be kept clean, dry and free of grease.
- Knives should not be placed where they might fall.
- Blades should be kept in a sheath when the knife is not in use.
- Never use a knife with a dull edge.
- Have blades sharpened only by a skilled tradesman.

11.7 Pneumatic Equipment

All equipment used in connection with compressed air or high pressure equipment should be soundly constructed and properly maintained. All gauges and control devices must be regularly checked against a master pressure gauge following the procedures set out in the PMS (Plant Maintenance System). Damaged or faulty equipment must not be used.

All compressed air hoses shall be of the correct size to fit the tool being used.

Air lines should be suitable for the pressure or connected to a pressure control device.

Pneumatic tools require clean air to operate efficiently.

Compressor air supply hoses must be properly connected and in good condition.

No compressed air or high-pressure nozzle, gun or equipment should ever be pointed at any person. It cannot be emphasised enough that compressed air equipment should never be fooled with. A small increase in pressure to any body orifice can easily seriously injure or kill. Eye protection should always be worn when using compressed air to blow clean.

11.8 Electric Tools

11.8.1 General

Only portable electric tools manufactured from sound materials and free from defects shall be used.

All portable electrical tools including welding machines and portable generators shall be either effectively earthed or double insulated.

All portable electric tools shall be clearly marked with their voltage and maximum current rating and a label indicating compliance with an approved standard.

Personnel operating electrically-driven power tools and other portable appliances shall be protected by one or more of the following approved safety systems:

- earth leakage circuit breaker (ELCB)
- isolating transformer or a residual current device (RCD).

All earth leakage circuit breakers are to be tested using the integral test facility prior to use. Faulty units are to be discarded.

The secondary voltage of isolating transformers shall not exceed 250V. The transformer shall be positioned as near as possible to the switchboard or point of supply. Only one tool or appliance shall be connected to each transformer.

11.8.2 Extension Leads

All extension leads shall comply with the requirements listed below.

- The outer sheath and all plugs and connectors shall be in good condition.
- They shall be in one continuous length.
- They shall contain an earth continuity conductor.
- They shall be of the shortest practical length to suit the application.
- They shall be fitted with high impact industrial type plugs and connections.
- They should be used in such a manner that they do not pose a trip hazard. Otherwise warning signs that indicate the hazard are to be erected.
- They shall not pass through doorways without suitable mechanical protection and for a short period of time only (e.g. use a door stop).

Portable electrical or battery operated equipment shall not be used where the user is partially immersed or in direct contact with water. Consider the use of hand powered or pneumatic power tools if water will be present.

11.9 Operation of Pneumatic/Electric Tools

11.9.1 General

During operation, all electric and pneumatic tools should be held firmly to prevent them spinning and jumping. Keep a firm grip, steady stance, and keep hands dry and free of grease.

The tool bit retaining spring of jack hammers and concrete breakers shall always be securely fitted in position to prevent the bit from dropping out. The bit shall be kept sharp.

11.9.2 Rock Drill

It is extremely important for the operator to maintain a firm grip with both hands and stand in a balanced position.

11.9.3 Hand Grinding Machines

- No 9 Inch grinders are to be used on site
- Hand held grinders must always be treated with care as they can be very dangerous if faulty or misused.
- Ensure that the wheel is not visibly faulty or excessively worn.
- Ensure the guards are in place and secure.
- Check that the wheel is of the correct type for the intended job (read notes on the centre or on the wrapper and/or check with a skilled tradesman)
- Keep clothing and hair clear.
- Wear gloves and eye protection

11.10 Powder Actuated Tools

A powder actuated tool (e.g. Ramset Gun) is a tool that uses the explosive force from an explosive cartridge to drive any pin, stud, bolt or other device into or through building materials.

The tool shall be operated by an accredited operator, or under the direct supervision of an accredited operator.

Hearing and eye protection must be worn when operating the tool and adequate ‘firing’ warning must be given to nearby fellow workers who may be surprised by the explosion.

A barricade must be placed between the operator’s body and the tool.

11.11 Safety Equipment

Figure 11.7 : Safety Equipment

Safety goggles/Shield shall be worn when grinding, drilling, riveting, turning, milling or when performing any operation in which airborne objects are being discharged. Ear protection must be worn when performing noisy operations such as grinding. Refer also to DGDC-OHS-031: Safety Equipment for further information on Personal Protective Equipment (PPE).

Industrial overalls (made from flame resistant fabrics such as cotton) and appropriate eye protection shall be worn when engaged in welding and cutting operations. Gloves or gauntlets for arc welding shall be worn as protection against shock, burns and radiation burns. Refer to DGDC-OHS-028: Hot Work.

Dominica Geothermal Development Company Limited
Powering a New Generation...

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-019: Electrical
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Contents

12. Electrical

12.1 Policy

12.1.1 General

It is DGDC policy to comply with the relevant safety standards documented in the sections below to reduce or eliminate the dangers associated with the use of electrical energy. Every person on DGDC property is exposed to electricity to some extent. The electrical safety program is intended to give those persons who may come in proximity with energised electrical parts in their work activities the minimum knowledge of safety and recommended practices necessary to protect against electrical shock or burns. It also provides hazard awareness information to those who use electrical equipment.

Reading this section does not qualify the reader to perform electrical work. Guidelines and standard operating procedures that are beyond the scope of this document must be established at each work area. They should include, as a minimum, the safety concerns outlined herein.

All electrical wiring and equipment must comply with the local regulations, and numerous other established safety and engineering standards. This section shall not be construed as a synopsis of all electrical requirements, nor as a substitute for formal study, training, and experience in electrical design, construction, and maintenance.

12.1.2 Principles (General Implementation Policy)

It is DGDC policy to follow the fundamental principles of general safety described below which are equally relevant to electrical safety. A clear understanding of these principles increases the safety of those who work with or around electrical equipment.

- Practice proper housekeeping and cleanliness. Poor housekeeping is a major factor in many accidents. A cluttered area is likely to be both unsafe and inefficient. Every employee is responsible for keeping a clean area, and every supervisor is responsible for ensuring that his or her areas of responsibility remain clean.
- Identify hazards and anticipate problems. Think through what might go wrong and the consequences of that action. Do not hesitate to discuss any situation or question with supervisors and co-workers.

- Resist "hurry-up" pressure. Program pressures should not cause the bypassing of thoughtful consideration and planned procedures.
- Design for safety. Consider safety to be an integral part of the design process. Protective devices, warning signs, and administrative procedures are supplements to good design, not a substitute for it. Engineering controls are always preferable to administrative controls. Completed designs should include provisions for safe maintenance.
- Maintain for safety. Good maintenance is essential to safe operations. Maintenance procedures and schedules for servicing and maintaining equipment and facilities, including documentation of repairs, removals, replacements, and disposals, should be established.
- Document all work. An up-to-date set of documentation adequate for operation, maintenance, testing, and safety should be available to anyone working on potentially hazardous equipment. Keep drawings and prints up to date. Dispose of obsolete drawings and be certain that active file drawings have the latest corrections. All facilities drawings are to be archived.
- Have designs reviewed. All systems and modifications to systems performing a safety function or controlling a potentially hazardous operation must be reviewed and approved by a project engineer.
- Have designs and operation verified. All systems performing safety functions or controlling a potentially hazardous operation must be validated by actual test procedures before being placed in service, at least once a year, and anytime the system is suspected of malfunction. Both the procedures and actual tests must be documented.
- Test equipment safety. Conduct tests with the electrical equipment de-energised, or, if the equipment cannot be de-energised, with reduced hazard.
- Pushbuttons, selector switches, and other control circuit devices do not isolate energy. Energy-isolating devices should be lockable by means of a hasp or other type of attachment. It should not be necessary to dismantle or reassemble a device to lock it.
- Know emergency procedures. All persons working in areas of high hazard (with high-voltage power supplies, capacitor banks, etc.) must be trained in emergency response procedures, which should include cardiopulmonary resuscitation (CPR) certification.

12.2 Definitions

The following definitions help clarify general electrical safety:

Amps
The standard unit for measuring electrical current.

Watt
A unit of electrical power, equal to the power developed in a circuit by a current of one amp flowing through a potential difference of one volt.

Voltage
Electromotive force expressed in volts.

Circuit Breaker
A device that automatically interrupts the flow of an electrical current.

Breaker Box
An insulated box on which interconnected circuits are mounted.

H-Z Point
High impedance earth used to discharge capacitors.

Electrical Panel
An insulated panel on which electrical wires are mounted.

Current Flow
The rate of flow of an electrical charge, generally expressed in amps.

Electrical Load
The amount of power delivered by a generator or carried by a circuit. A device to which the power is delivered.

Earth-Leakage Circuit Breaker (ELCB)
An ELCB detects earthing problems and shuts electricity off to prevent a possible accident.

High Voltage
The term high voltage applies to electrical equipment that operates at more than 600 Volts (for terminal-to-terminal operation) or more than 300 Volts (for terminal-to-earth operation). Low voltage, high current AC or DC power supplies are also considered to be high voltage.

Hazardous Energy Sources
This term applies to stored or residual energy such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure.

Lockout
The placement of a lock on an energy-isolating device. This act prevents workers from operating a piece of equipment until the lock is removed.

Tag-out
The placement of a tag on an energy-isolating device. A tag-out device is a prominent warning device of a lockout.

Energy-Isolating Device
A mechanical device that prevents the transmission or release of energy. Examples include the following:

- manually operated circuit breakers
- disconnect switches
- line or block valves

Electrical Arc
Electrical arcs produce temperatures up to 2,000°C. At these temperatures, fatalities can occur at distances greater than 3 meters from the arc and light first degree-burns at distances up to 15 meters from the arc. The temperature effect on human skin is determined by the power of the arc (system voltage x short circuit current) and the distance from the arc.

Electrical Blast
Electrical blast is produced by the rapid expansion of the air in an arcing situation. When an arc occurs metals are melted and in most cases vaporised. This vaporisation of metals, mainly copper, produces an expansion of the air around the arc. When copper vaporises at atmospheric pressure it expands 67,000 times compared to water turning to steam expanding 1670 times. If 25mm3 of copper is vaporised it produces 1.44 meters3 of vapour. This is the same expansion that is produced with dynamite when it explodes.

12.3 Types of Hazards

12.3.1 Electric Shock

Electric shock happens when the body becomes part of an energised electrical path and energy is transferred between parts of the body, or through the body to an earth or the earth.

In order for shock to occur, a potential difference or stored electrical charge must be present to cause the current to flow. Current flowing through the highly sensitive central nervous system can, under certain conditions, cause serious injury or death. Some of the conditions which govern the severity of a shock are mentioned below.

12.3.1.1 Hazard

Persons who handle electrical equipment mistakenly believe their tolerance to electrical shock is related to their ability to withstand the pain of the shock. Actually, the lethal incidence is a function of current passage (duration and level) through the heart region. In addition, the onset of possibly lethal currents is only marginally higher than those ranked just painful and well within the range of industrial low-voltage power systems. While asphyxiation is the physiological result of the first zone of over-painful shock, the second shock zone results in heart ventricular fibrillation, or heart dysfunction. Not only is the latter non-self-curing on cessation of the current, but it is generally lethal within about 3 minutes.

Electricity is one of the most commonly encountered hazards in any facility. Under normal conditions, protection from shock is afforded by the inherent safety features of the electrical utilisation equipment. Nonetheless, accidental contact with electricity can cause serious injury or death. Most electrical systems establish a voltage reference point by connecting a portion of the system to an earth. Because these systems use conductors that have voltages with respect to earth, a shock hazard exists for workers who are in contact with the earth and exposed to the conductors. If people come in contact with a 'live' (unearthed) conductor while they are in contact with the earth, they become part of the circuit and current passes through their bodies.

The effects of electric current on the human body depend on the following:

- circuit characteristics (current, resistance, frequency, and voltage 60 Hz is the most dangerous frequency)

- contact and internal resistance of the body
- the current's pathway through the body, determined by contact location and internal body chemistry
- duration of contact
- Environmental conditions affecting the body's contact resistance.

The most damaging route of electricity is through the chest cavity or brain. Fatal ventricular fibrillation of the heart (stopping of rhythmic pumping action) can be initiated by a current flow of as little as several milliamperes. Nearly instantaneous fatalities can result from either direct paralysis of the respiratory system, failure of rhythmic pumping action, or immediate heart stoppage. Severe injuries, such as deep internal burns, can occur even if the current does not pass through the vital organs or nerve centre.

Tables 12.1 to 12.3 are based on limited experiments performed on human subjects in 1961. These figures are not completely reliable due to the unavailability of additional data and the inherent physiological differences between people. However, they do give an indication of the effects of electrical current on the human body. Electricity should be considered potentially lethal at lower levels than those cited.

12.3.1.2 Type of Current

The type of current involved i.e. alternating current (AC) or direct current (DC) is important. Low voltage up to 40 volts of direct current (DC) circuits do not normally present a hazard to human life. Under some circumstances, however, severe burns can result. (Refer to Table 12.1, which summarises some possible effects on the body when the current path is from hand to hand.) Even at low voltage, alternating current (AC) circuits can be dangerous and present a lethal threat.

At commercial frequencies (50-60 cycles or hertz) and intermediate voltages (50 to 600 volts), lethal current may be conducted through the body. (See Tables 12.1 and 12.2).

12.3.1.3 Resistance

The resistance of the body and the degree to which the skin is insulated from the earth govern the amount of current flowing through the body. The skin offers the principal resistance which the human body presents to the flow of current. Table 12.2 shows how skin resistance decreases with increased voltage. Current flow through the body is also given with resultant body sensations noted. The current path is from hand to hand, with the palms of the hands moist. If the skin is wet or moist, the resistance is lowered, (see Table 12.3) and therefore the greater flow of current and the severity of shock.

12.3.1.4 Time

The length of time the body is in the circuit is also important, particularly with respect to the severity of burns. Burns break down the skin, thereby lowering the resistance. The more extensive the burn, the less resistance provided.

Table 12.1: Effects of Electrical Current on the Human Body

Current in Milliamperes						
Effect	**DIRECT**		**ALTERNATING**			
			60 Hertz		**10,000 Hertz**	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
Slight sensation on hand	1	0.6	0.4	0.3	7	5
Perception threshold	5.2	3.5	1.1	0.7	12	8
Shock-painful, muscular control not lost	62	41	9	6	55	37
Shock-painful, let-go threshold	76	5l	20	l0.5	75	50
Shock-painful and severe, muscular contractions, breathing difficult	90	60	23	15	94	63

Table 12.2: Human Resistance as Affected by Voltage

Applied 60 Cycles Voltage	Resistance Ohms	Current Milliamperes	Sensation
10	10,000	1	Tingling
20	10,000	2-2.4	Strong tingling
30	2,500	12-15	Painful muscular contraction
40	2,000	19-22	Extremely painful muscular contraction

Table 12.3: Human Resistance to Electrical Current

Body Area	Resistance in Ohms
Dry skin	100,000 to 600,000
Wet skin	1,000

Internal Body	
Hand to foot	400 to 600
Ear to ear	About 100

Time becomes critical when current flowing though the body causes loss of muscular control, contraction of the chest (which affects breathing), and ventricular fibrillation of the heart. When the last occurs, the heart's pumping rhythm becomes irregular and it ceases to function properly. Table 12.1 shows the effect of current on fibrillation thresholds at 60 hertz or cycles.

Both the magnitude and path of the current flowing through the body are of primary importance. When the path of the current is hand-to-hand or hand-to-foot, vital organs (brain, heart, lungs, spinal cord) are affected, possibly with serious consequences.

The age and physical and emotional condition of the person involved can also affect the severity of an electrical shock.

12.3.1.5 Burns

Burns suffered in electrical accidents are of three basic types: electrical burns, arc burns, and thermal contact burns.

In electrical burns, tissue damage (whether skin deep or deeper) occurs because the body is unable to dissipate the heat from the current flow. Typically, electrical burns are slow to heal.

Arc burns are caused by electric arcs and are similar to heat burns from high-temperature sources. Temperatures generated by electric arcs can melt nearby material, vaporise metal in close vicinity, and burn flesh and ignite clothing at distances up to 10 feet.

Thermal contact burns are those normally experienced from skin contact with the hot surfaces of overheated electric conductors.

Damage to the internal tissues may not be apparent immediately after contact with the current. Delayed internal tissue swelling and irritation are possible. Prompt medical attention can help minimise these effects and avoid death or long-term injury.

12.3.1.6 Other Hazards

Voltage sources that do not have dangerous current capabilities may not pose serious shock or burn hazards in themselves and therefore are often treated in a casual manner.

However, they are frequently used adjacent to lethal circuits, and even a minor shock could cause a worker to rebound into a lethal circuit. Such an involuntary reaction may also result in bruises, bone fractures, and even death from collisions or falls.

Electricity poses other hazards. An arc is often created when a short circuit occurs or current flow is interrupted. If the current involved is strong enough, these arcs can cause injury or start a fire.

Fires can also be started by overheated equipment or by conductors that carry too much current. Extremely high-energy arcs can cause an explosion that sends fragmented metal flying in all directions. Even low-energy arcs can cause violent explosions in explosive or combustible atmospheres.

Emergency Measures for Shock
Everyone engaged in any electrical or electronic work should be capable of carrying out the measures listed below.

- Free the person involved from the live circuit. If a person is "frozen" to a live electrical contact, shut off the current if possible. If this cannot be done, use wood boards, poles, or sticks, a belt, piece of dry rope, an article of clothing, or any non-conducting material of sufficient length to pull the body away from the contact. Act quickly, and remember to remain protected during this operation.
- Cut off the power. Because of the dangers involved in being caught in a live circuit, know how to cut off the power anywhere in the work area, and how to summon help in case of an emergency.
- Immediately report any shock received, no matter how slight, to a supervisor, instructor, foreman, or other appropriate authority. Promptly report any ‘popping’ or sparking as well as any noticeable defects or hazardous conditions that could cause injury, property damage, or interference with service.

12.3.2 Electrical Fires

Fires can have electrical causes. Some possible sources of electrical fires and ways to prevent them from becoming hazards are listed below.

- Soldering irons should be disconnected when unattended and not in use. Keep them in metal holders when in use. Bench tops should be made of fire-resistant material.

- Motors should have thermal protection devices to protect them against excessive heating due to motor overloads or failure to start.
- Ignitable materials should not be stored in electrical closets.
- Overloaded circuits can, by overheating, be a cause of fires. Do not overload them by using extension cords or cube taps.
- Static electricity is generated when a fluid flows through a pipe into a tank. When the fluid is a flammable liquid, the vapours can be ignited by a spark discharge caused by static electricity. Earthing and bonding of flammable liquid containers is necessary to prevent static electricity from causing an explosion or fire.

12.3.3 Stored Energy Discharge

Provisions should always be made to discharge capacitors capable of storing more than 0.1 joule when shutting down equipment.

It has been found that a discharge of energy exceeding 10 joules into the human body can be hazardous to life, while 0.25 joule gives a severe shock.

Keep each spare or disconnected capacitor individually short-circuited, by a robust connection or shorting resistor, when not in use. Similarly, capacitors built into equipment which is not in use must also have provision to be individually short-circuited, as they present a shock hazard from discharge, whether wired in series or parallel. 'Earthing' capacitors in series, for example, may transfer rather than discharge stored energy.

New capacitors have already been energised for test purposes, and should also be kept short-circuited when stored. All high-grade capacitors, if left on an open circuit after discharge, will recover a considerable proportion of the original charging energy. This is particularly true of large-energy storage capacitors, such as those used in power factor correction or electrical filtering. As much as l0% of the original voltage maybe recovered, and 30-kilovolt capacitor may build up a charge potential of 2 or 3 kilovolts in 10 minutes. Dangerous voltages can build up in open-circuited high-grade capacitors over a period of many months after they have been discharged. This is particularly true where inexpensive paper dielectrics have been used. It is recommended that all discharged capacitors carry a label adjacent to their terminals, for example, 'WARNING: Keep short-circuited when not in use'.

Another hazard exists when a capacitor is subjected to high currents that may cause heating and explosion.

Capacitors may be used to store large amounts of energy. An internal failure of one capacitor in a bank frequently results in an explosion when all other capacitors in the bank discharge into the fault. The threshold energy for explosive failure of metal cans is approximately 104kJ.

High-voltage cables should be treated as capacitors because they have capacitance and thus can store energy.

The liquid dielectric in many capacitors, or its combustion products, may be toxic.

12.3.4 Inductor and Magnet Hazards

This section describes inductors and magnets that can store more than 5 J of energy or that operate at 50 V or more. Some hazards peculiar to inductors and magnets are listed below:

- The ability of an inductor to release stored energy at a much higher voltage than that used to charge it.
- Stray magnetic fields that attract magnetic materials.
- Time-varying stray fields that induce eddy currents in conductive material thereby causing heating and mechanical stress.
- Time-varying magnetic fields that may induce unwanted voltages at inductor or magnet terminals.

12.3.4.1 Automatic Discharge

Use freewheeling diodes, varistors, thyrites, or other automatic shorting devices to provide a current path when excitation is interrupted.

12.3.4.2 Connections

Pay particular attention to connections in the current path of inductive circuits. Poor connections may cause destructive arcing.

12.3.4.3 Cooling

Many inductors and magnets are liquid-cooled. The unit should be protected by thermal interlocks on the outlet of each parallel coolant path, and a flow interlock should be included for each device.

12.3.4.4 Eddy Currents

Units with pulsed or varying fields must have a minimum of eddy-current circuits. If large eddy-current circuits are unavoidable, they should be mechanically secure and able to safely dissipate any heat produced.

12.3.4.5 Earthing

Earth the frames and cores of magnets, transformers, and inductors.

Rotating Electrical Machinery
Beware of the hazards of residual voltages that exist until rotating electrical equipment comes to a full stop.

12.3.5 Safety Practices for Capacitors

Use permanently connected bleeder resistors when practical. Capacitors in series should have separate bleeders. Automatic-shorting devices that operate when the equipment is de-energised or the enclosure is opened must be used. The time required for a capacitor to discharge to safe voltage (50 V or less) must not be greater than the time needed for personnel to gain access to the voltage terminals. In no case must it be longer than 5 minutes

In the case of equipment with stored energy in excess of 5 J, an automatic, mechanical-discharging device must be provided that functions when normal access ports are opened.

This device must be contained locally within a protective barrier to ensure wiring integrity and should be in plain view of the person entering the protective barrier so that the individual can verify its proper functioning. Protection also must be provided against the hazard of the discharge itself.

12.3.6 Safety Earthing

Provide fully visible, manual-earthing devices to render the capacitors safe while they are being worked on. Clearly mark earthing points and use caution to prevent transferring charges to other capacitors.

12.3.7 *Earth Hooks*

Earthing hooks are used to discharge high voltage or large distribution style capacitors which are installed in specialised electrical distribution equipment. Earth hooks shall only be installed as part of a switching or equipment isolation procedure. All earth hooks must:

- have crimped and soldered conductors
- be connected such that impedance is less than 0.l to earth.
- have the cable conductor clearly visible through its insulation
- have a cable conductor size of at least 6mm2 extra flexible, or in special conditions a conductor capable of carrying any potential current
- be in sufficient number to earth all designated points conveniently and adequately
- be earthed and stored in the immediate area of the equipment in a manner that ensures they are used.

In equipment with stored energy in excess of 5 J, a discharge point with an impedance capable of limiting the current to 500 A or less should be provided. This discharge point must be identified with a yellow circular marker with a red slash and must be labelled ‘HI Z PT’ in large, readable letters. A properly installed earthing hook must first be connected to the current-limiting discharge point and then to a low-impedance discharge point (less than 0.1 ()) that is identified by a yellow circular marker. The earthing hooks must be left on all of these low-impedance points during the time of safe access. The low-impedance points must be provided, whether or not the HI-Z current-limiting points are needed. Voltage indicators that are visible from all normal entry points should also be provided.

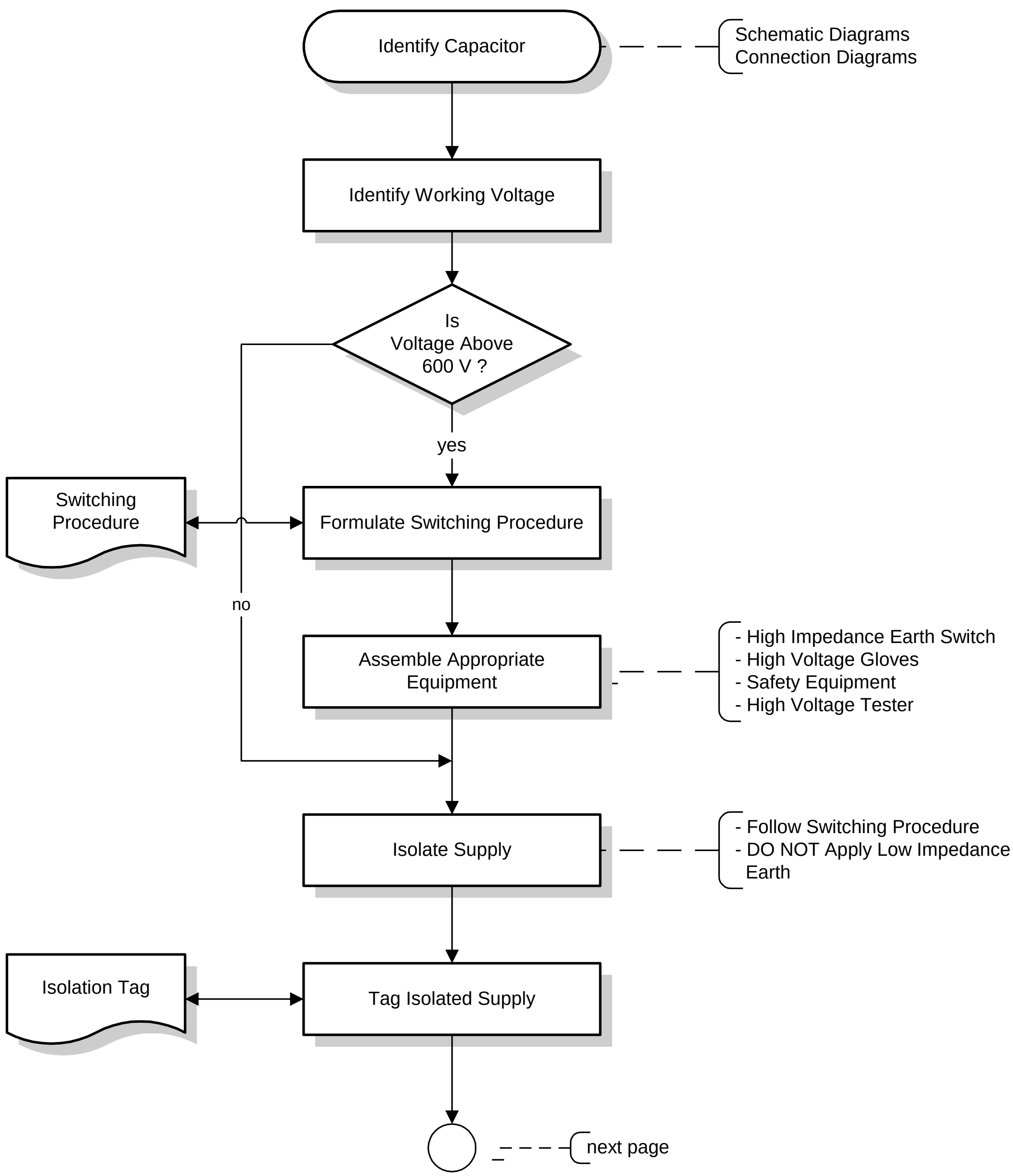
12.3.8 *Fusing*

Capacitors used in parallel should be individually fused when possible to prevent the stored energy from dumping into a faulted capacitor. Care must be taken in placement of automatic-discharge safety devices with respect to fuses. If the discharge will flow through the fuses, a prominent warning sign must be placed at each entry indicating that each capacitor must be manually earthed before work can begin. Special knowledge is required for high-voltage and high-energy fusing.

12.3.9 Unused Terminal Shorting

Terminals of all unused capacitors representing a hazard or capable of storing 5 J or more must be visibly shorted. Refer Figure 12.1.

Safe Method to Discharge Stored Energy



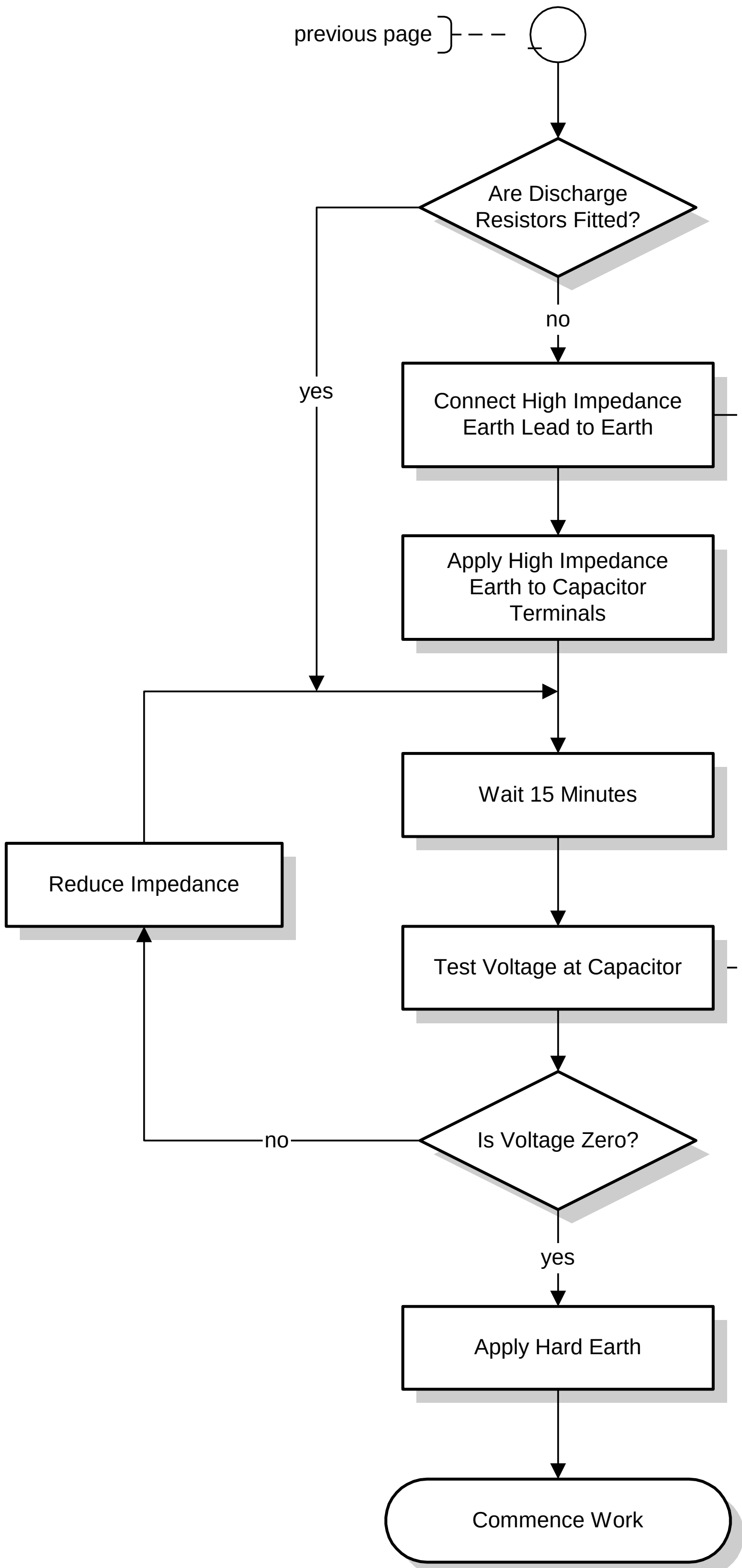

previous page
Are Discharge Resistors Fitted?
yes
no
Connect High Impedance Earth Lead to Earth
Impedance Proportional to Voltage
Apply High Impedance Earth to Capacitor Terminals
Wait 15 Minutes
Reduce Impedance
Test Voltage at Capacitor
Use Test & Safety Equipment Appropriate for Voltage
Is Voltage Zero?
no
yes
Apply Hard Earth
Commence Work

Figure 12.1 : Discharging Capacitors

12.4 Authorisation and Responsibilities

12.4.1 General

All energised electrical work above 50 volts in Mode 3 requires advance written supervisory authorisation. In the case of recurrent activities, such as maintenance, an open authorisation may be used. In this case, a written record must be made of the open authorisation, and the worker must understand the specific circumstances under which the energised work is permitted. Such circumstances may include verbal confirmation of each task.

12.4.2 Authority Having Jurisdiction

The authority having jurisdiction (AHJ) is responsible for making interpretations and granting special permission as contemplated in the relevant electrical wiring regulations. The AHJ is responsible for determining the acceptability of electrical installations.

Responsibility is delegated as listed below.

Facilities Manager
The Facilities Manager is delegated by the AHJ with the responsibility for ensuring compliance with all electrical safety and code requirements in the design, erection, construction, enlargement, alteration, moving, demolition, conversion, maintenance, and repair of all buildings, structures, and utilities. Electrical code and safety decisions are vested in the Facilities Manager during the course of these activities.

Environment Health and Safety Manager
The Environment Health and Safety Manager is delegated major responsibility for ensuring compliance with all electrical safety requirements that pertain to maintaining a safe working environment and protecting employees and contract and subcontract personnel from injury or death as a result of electrical hazards.

Electrical Engineer
As the authorised representative of the EH&S Manager, the electrical engineer has the responsibility to ensure the acceptability of electrical wiring and apparatus. In this capacity the electrical engineer will, as needed:

- review drawings, tests and other documentation provided by the project engineers, or other responsible parties for compliance with accepted safety criteria and code intent.
- consult with the appropriate specialists to verify that engineering, design, and construction parameters have been correctly applied
- inspect power systems and incidental wiring related to testing
- conduct other inspections and analyses as necessary to verify the acceptability of the apparatus involved
- ensure compliance with all electrical safety requirements for design, installation, maintenance, and repair of equipment
- provide testing and evaluation, as needed, for unique equipment
- evaluate existing workplace safety by inspecting or assisting in the inspections of the workplace for Electrical Wiring Regulation Compliance, as needed.

For the purposes of this policy, a facility becomes a workplace once construction is completed and the facility is occupied by employees. Prior to completion of construction, all compliance is vested in the supervisor of the construction site for safety-related work practices and construction safety orders.

12.4.3 Qualified and Authorised Personnel

A qualified person is an individual recognised by DGDC as having sufficient understanding of the equipment, device, system, or facility to control positively any hazards it presents. Written proof of qualifications and authorisation qualification to operate complex devices, systems, equipment and facilities, should be available.

Qualification and authorisation to perform electrical or electronics work is based on a combination of formal training, experience, and on-the-job training.

On-the-job training should be documented to ensure that training is consistent for all employees with similar tasks. This document should be reviewed and approved by a person knowledgeable in safe work practices and familiar with the hazards of the apparatus.

If work on energised components is anticipated, this training should cover:

- specific operations in which live work is anticipated
- features of the equipment including any specialised configuration

- location of energy-isolating devices
- techniques, tools, and personal protective equipment used for this specific equipment
- relevant documents such as wiring diagrams, schematics, service manuals, design packages and operating, testing, and calibrating procedures
- systems energy control procedures, including energy-isolating devices, earthing and shorting procedures, and other energy control procedures
- record-keeping and logging requirements.

12.4.4 Specific Qualifications

Only authorised personnel are considered by DGDC management to be qualified to perform electrical wiring or other work directly connected to any facility electrical distribution system. This does not include the connection of cord and plug-connected equipment into an appropriate facility receptacle, but does include permanent connections of (hard-wired) equipment to a facility system.

Only appropriately qualified persons may build, modify, or repair electronic or electrical equipment. Supervisors are responsible for ensuring that employees or others under their supervision are qualified.

12.4.5 Overlapping Responsibilities

Many activities and projects progress through different areas of responsibilities. Some or all of the delegated bodies may be involved in a given project at various times. Cooperation between groups is essential to ensure safety and efficiency of execution. The authority having jurisdiction at each level should notify others who may be involved in subsequent decision making. If agreement cannot be reached, the appropriate channels should be used to obtain an early resolution.

12.5 General Safe Work Practices

12.5.1 Introduction

This section sets out requirements and procedures for maintaining safety working conditions for personnel who operate, maintain or install electrical and related mechanical apparatus and equipment. It is applicable to all DGDC and contractor employees, who do electrical work.

12.5.2 Requirements

Keep hands off connected electrical apparatus unless directly involved or familiar with it.

- Do not permit unauthorised people to work in hazardous areas. Do not hesitate to question unfamiliar faces. DGDC employees entering areas in which they do not usually work should check with whoever is in charge, state their reasons for being there, and receive clearance to perform their duties or to visit.
- Question the methods or procedures of fellow workers if they violate any safety practices or otherwise work in an unsafe manner.

- Provide signs and barriers to warn people of high voltage hazards. Use danger signs and flashing lights wherever conditions require them. They should not be used promiscuously, or left where danger no longer exists, as this detracts from their effectiveness. Maintain safe working distances around energised equipment at all times. A minimum of one metre widths should be maintained on all working sides of equipment operating at 600 volts or less.
- A neat, clean work space is essential where work on electrical equipment is to take place. Spaces behind and under consoles or power supplies should never be used for storage, and should always be kept clear of rubbish or unnecessary equipment.
- Portable equipment which is found to be defective should be labelled as such before storing. List defects on a tag. The tag must remain on this equipment until it is repaired, junked or dismantled. Cut the plug off all seriously defective equipment if it is not going to be repaired immediately.
- Always connect from the load to the source. Disconnect first at the source and work toward the load.
- Check the supply circuit voltage to see that it is what is expected, either AC or DC- before closing circuits.
- Avoid using electrical equipment or tools where there is moisture present. If it is unavoidable to do so, use earth leakage circuit breakers.
- Rigidly observe the 'one hand' habit when throwing open switches, removing leads, pulling plug leads from apparatus such as terminal or distribution boards, operating line power rheostats, measuring voltages, or when testing circuits where any voltage may be present.
- Do not wear rings, metal wrist bands, watches, key chains or other metal objects around exposed conducting material.

- Do not use metal rulers, metal flashlights, or metallic pencils when working with or around electricity.
- Use a wooden or fibreglass ladder instead of a metal one, if work requires the use of a ladder around electrical equipment. ALL metal ladders should be marked,

Caution: Do Not Use Around
Electrical Equipment.

12.5.3 *Lock-out/Tag-out Procedures*

Lock-out/Tag-out procedures are used to isolate hazardous energy sources from electrical, hydraulic, or pneumatic machinery. Furthermore, when service or maintenance work is required, lock-out and tag-out devices help ensure personal safety from possible energy releases. All employees whose work involves hazardous energy sources must be trained in lock-out/tag-out procedures. The information in this section is additional to the requirements of the lock-out and tag-out parts specified in DGDC-OHS-013: Work Control and is related to electrical isolation and safety only.

Before anyone starts work on any system or circuit, it is their responsibility to make a personal inspection to assure themselves that it is de-energised. Opening a switch is not enough. To insure that all appropriate systems are isolated it is necessary that all possible sources of power be investigated and de-energised.

To isolate a system and guarantee that it remains de-energised, all appropriate disconnecting switches shall be locked open and tagged with the appropriate tag. These locks and tags must be removed only by the person who placed them on the switches. Additional or alternative protection can be afforded by removal of fuses or the racking-out of breakers. The appropriate measure will depend both on the hazards and work time frame.

Before anyone begins work on a de-energised circuit or system it should be checked out by the use of a reliable voltage tester or other appropriate device to verify that it is ‘dead’.

Before putting equipment to use, test for adequate insulation resistance and earth continuity. Never work alone around energised electrical equipment. Keep personnel away from dangerous situations or places unless their work requires them to be there.

12.5.4 Tags

Tags are used where work requiring equipment lock-out is being done on electrical, electro-mechanical, mechanical, or pressure equipment or systems. No person, regardless of position or authority, may attempt to operate any switch, valve, or other piece of equipment which has been locked-out and tagged-out. Different tag types are identified in the lock-out and tag-out section of this document.

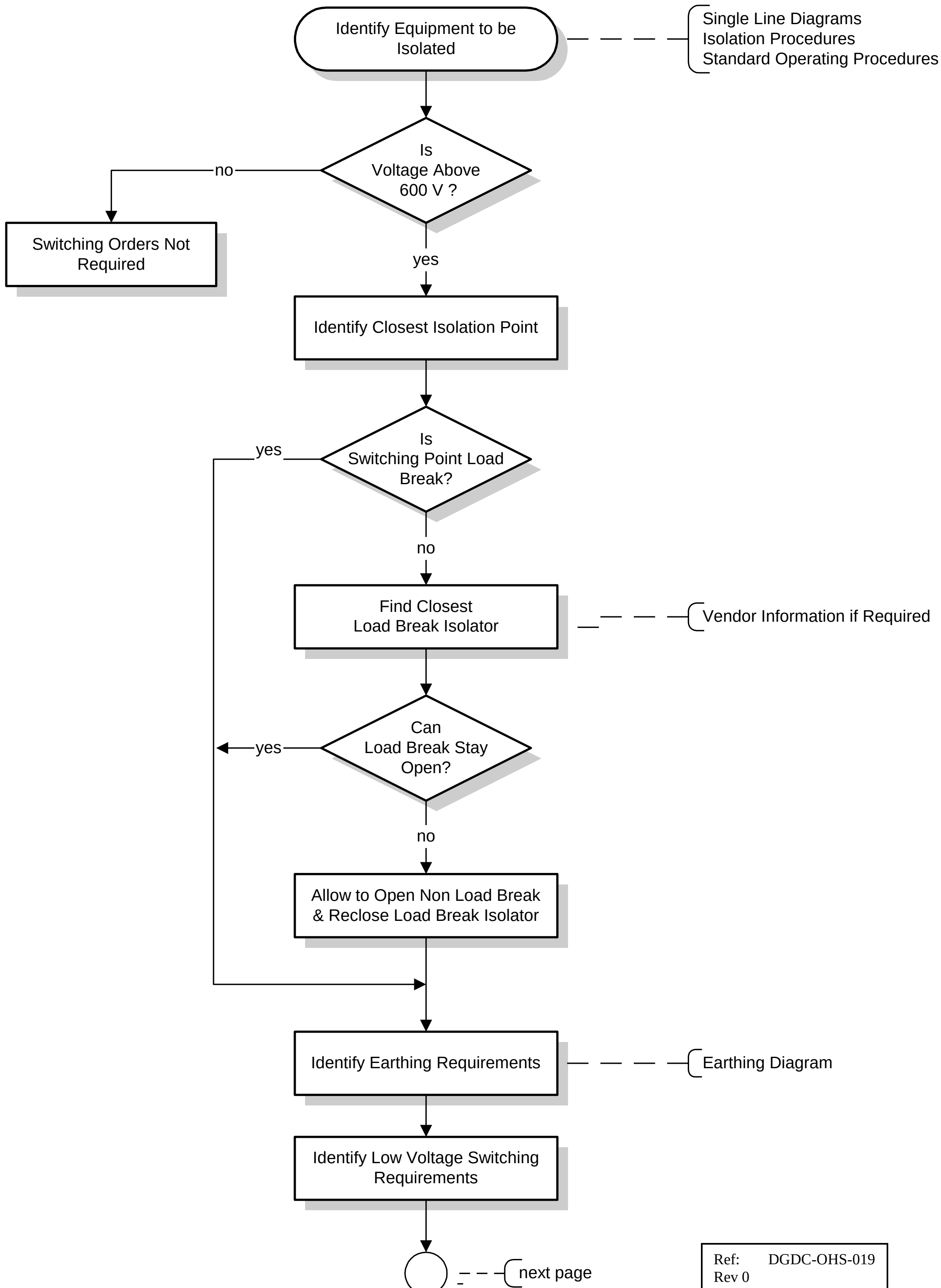
12.5.5 Authority for Lock-Out And Tag-out

An Electrical Engineer is to be the Permit Applicant for all work involving lock-out and tag-out high voltage electrical switching devices associated with the power distribution system, facility generation systems, and air-conditioning systems (except electrical devices operated as part of normal facility operations).

Where a contractor has been hired to operate a facility, he/she must have responsibility for lock-out and tag-out of all equipment in the facility as necessary. The contractor's employees responsible for conducting such lock-out and tag-out must be cleared by the Engineer and must following the Engineers Switching Orders (see Figure 12.2 and the Contractor Safety section of this manual).

Note: No One Is Authorised to Perform Switching Operations On Circuits with Which He Is Not Completely Familiar.

Outlines the Details Required to Create Switching Orders



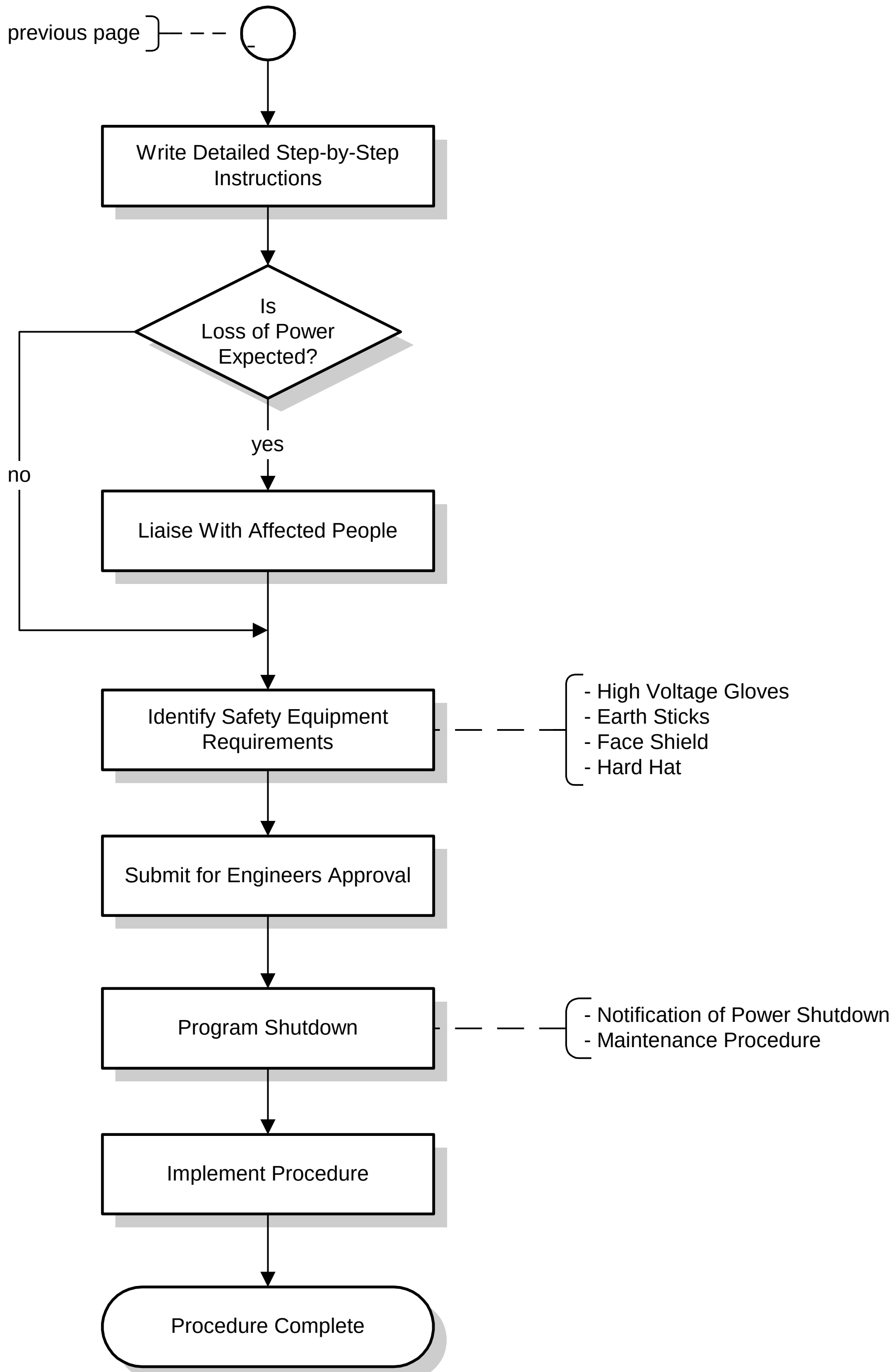

previous page
Write Detailed Step-by-Step Instructions
Is Loss of Power Expected?
yes
no
Liaise With Affected People
Identify Safety Equipment Requirements
- High Voltage Gloves
- Earth Sticks
- Face Shield
- Hard Hat
Submit for Engineers Approval
Program Shutdown
- Notification of Power Shutdown
- Maintenance Procedure
Implement Procedure
Procedure Complete

Figure 12.2: Switching Orders

12.5.6 Energised Systems

It is DGDC policy to de-energise live parts, when possible, before an employee works on or near them. (See DGDC-OHS-013 : Work Control for further information on lock-out/tag-out.) This is the preferred method for protecting employees from electrical hazards.

Personnel are permitted to work on or near exposed live parts only if an overriding reason necessitates the practice. Overriding reasons might include situations in which de-energising would introduce additional or increased hazards or those in which de-energising is not feasible due to equipment design or operational limitations.

Recognising the hazards associated with various types of electrical procedures and equipment is of paramount importance in developing and applying safety guidelines for working on energised equipment.

It is not feasible to develop a single set of safety requirements for energised work that covers every electrical task. It is the collective responsibility of worker, supervisor, and management to ensure that the safeguards for a specific operation effectively protect the worker against electrical hazards.

In general, electrical work at DGDC can be organised into seven classifications, according to the degree of energy present, and three modes, according to the operational status of the equipment or system.

12.5.7 Modes of Operation

Mode 1 ('COLD')
All operations are conducted in a positively de-energised state. All external sources of electrical energy are disconnected by some positive action for example, with a locked and tagged out circuit breaker--and all internal energy sources are rendered safe. See DGDC-OHS-013: Work Control for further information on lock-out/tag-out.

Mode 2 ('COLD to HOT')
All manipulative operations of uninsulated parts are conducted with the equipment in the positively de-energised state. When all manipulative operations are suspended, measurements and observation of equipment functions are conducted with the

equipment energised and with some or all normal protective barriers removed and interlocks bypassed.

Some Mode 2 examples are:

- making connections or alterations to normally energised components.
- working in close proximity to normally energised, exposed components.

Mode 3 ('HOT')
Manipulative operations are conducted with the equipment fully energised and with some or all normal protective barriers removed.

Mode 3 work in excess of 50 volts is a high-risk situation that is permitted only when justified. Tasks performed in this mode must be conducted under close supervision and control. Written approval of the documented justification and plan of work is required.

12.5.8 Battery Handling Procedures

When handling vented cells, batteries, caustic electrolyte or acid electrolyte, always wear safety goggles, rubber gloves, and a protective rubber apron and keep a weak neutralising agent nearby in the event of an accidental spills or cell rupture. A weak boric acid or acetic acid solution will neutralise potassium hydroxide (used in nickel-cadmium cells) and a solution of sodium bicarbonate will neutralise sulphuric acid used in ordinary lead acid cells such as automobile batteries. If electrolyte gets into the eyes, flush with water and get immediate medical attention. **Do not use a neutralising solution on the eyes. Use water.**

The rules listed below should be followed.

- Always charge vented cells in a well-ventilated area. Refer to manufacturer's recommendations.
- Adjust the electrolyte in each cell in accordance with the manufacturer's procedures.
- Select cells for each battery for charge, voltage and capacity match, and charge retention.

- Charge the battery in a well-ventilated area with the battery box cover completely removed. Note: Make sure individual cells are able to dissipate heat to prevent thermal runaway.
- To reduce gassing and subsequent electrolyte spewing, a voltage limited current taper charging method is recommended.
- Do not replace the battery box cover until the battery has been cleaned and at least 4 hours have elapsed since termination of charge.
- Assemble the battery in a container separate from that of the rest of the electrical system.
- Do not use porous-type materials for packing as they entrap gases or liquids.
- Reduce the void volume in the battery package to an absolute minimum.
- Coat the battery cell terminals, cell interconnects, and wiring with a suitable epoxy, or preferably, pot the entire battery in a suitable material so as to encapsulate all wiring and terminals.

Note: Make sure that vented cells are not sealed by potting material.

- Provide an easily removable cover for the battery container.
- Relieve the battery container with a splash-proof pressure vent. Ensure that all individual cells are vented.

Note: Do not seal vented cells in a container that will trap gases.

12.5.9 Underground Utilities

Manhole cover hooks, cover lifters or recessed handles must be used for removing or replacing electrical manhole covers.

When manholes, hand holes, or vault gratings are open, they must be protected by suitable barriers or guards, with adequate lighting provided during hours of darkness. In addition, safety cones and warning flags must be used to direct vehicular and pedestrian traffic around such openings.

Manholes must be entered or exited by means of a ladder when practicable. Entry into a manhole, or vault is only permitted if a Confined Space Entry Permit has been completed. See DGDC-OHS-029: Confined Space for further details.

When employees are working in manholes, hand holes, or vaults, one employee must be stationed on the surface so as to be readily available to those working below the surface.

Tools and materials must be raised or lowered in manholes by means of a suitable bucket, toolbox, or rope.

Manhole covers and gratings must be properly seated when replaced.

Employees must use only approved lighting units for illumination when working underground.

12.5.10 Gas and Fumes

Before entering a manhole or vault, approved gas detection tests must be made. If gas or fumes are detected, no employee may enter the manhole or vault until thorough ventilation has been accomplished and tests made to ascertain that the gases and fumes have been eliminated. (Refer to DGDC-OHS-029: Confined Space for further information and requirements for working in confined spaces such as manholes and vaults.)

When ventilating a manhole or vault to eliminate gases or fumes, the manholes on either side must be opened when practicable.

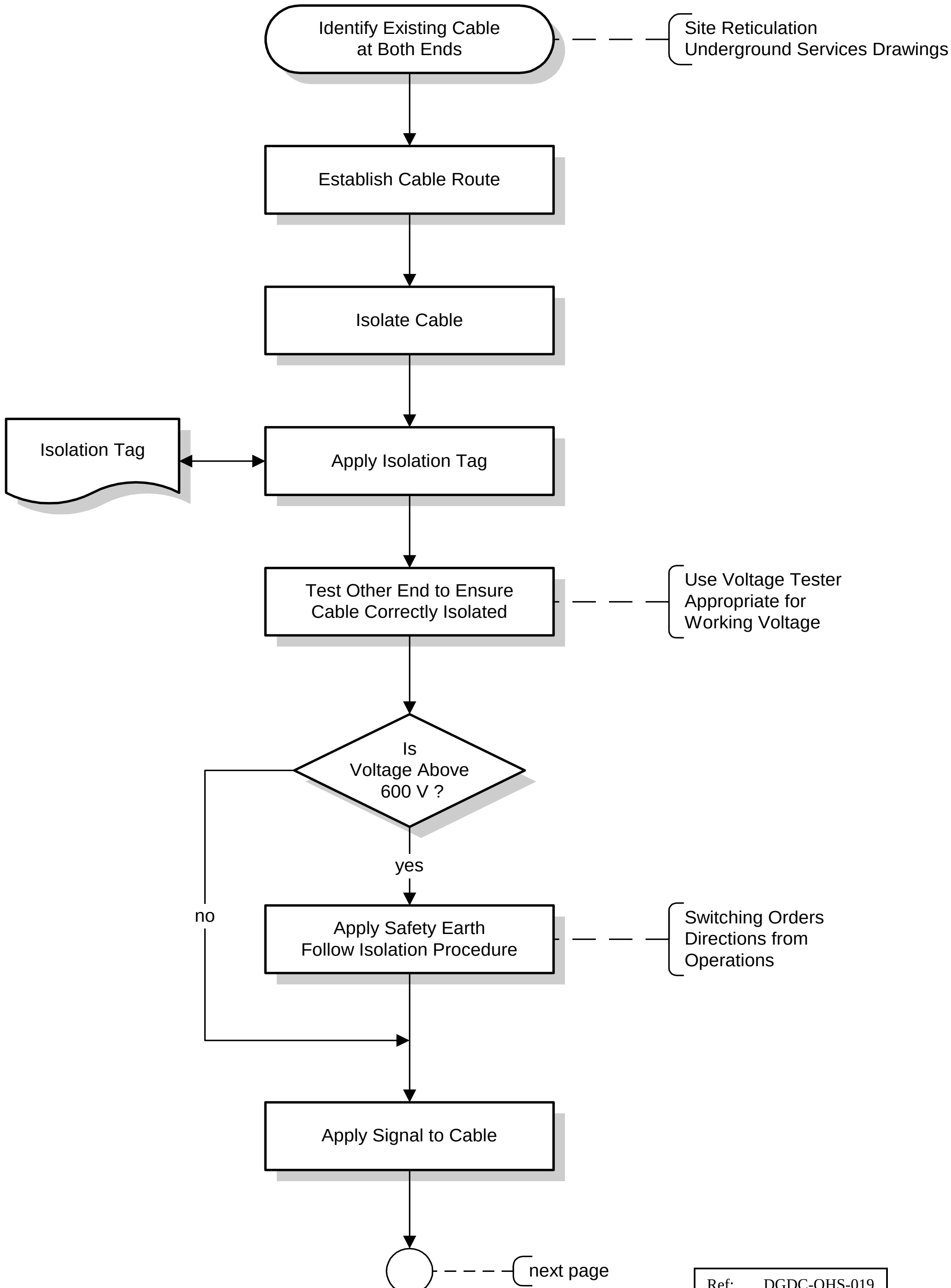
12.5.11 Underground Cables

Cables must not be spliced while energised.

When cables are to be de-energised to permit work on them, in addition to instructions elsewhere in this manual covering clearing, tagging, testing, earthing, and short-circuiting, employees must comply with the following general requirements while cutting into cables:

- Identify cables by tags, ducts, and/or duct records.
- Tags and ducts occupied by the cables must be checked against records and if practicable, physically in manholes on either side of the location where the work is to be performed.
- When the cable has been identified and the circuit de-energised, tagged, and earthed, the cable must be pierced with an earthed remote-operated piercing tool by a qualified high-voltage personnel working under the direction of the engineer.
- High Voltage rubber gloves and safety glasses must be worn by the operator performing the piercing operation. Refer Figure 12.3.

Outlines the Procedure to Join or Repair a Fault in an Existing Underground Cable



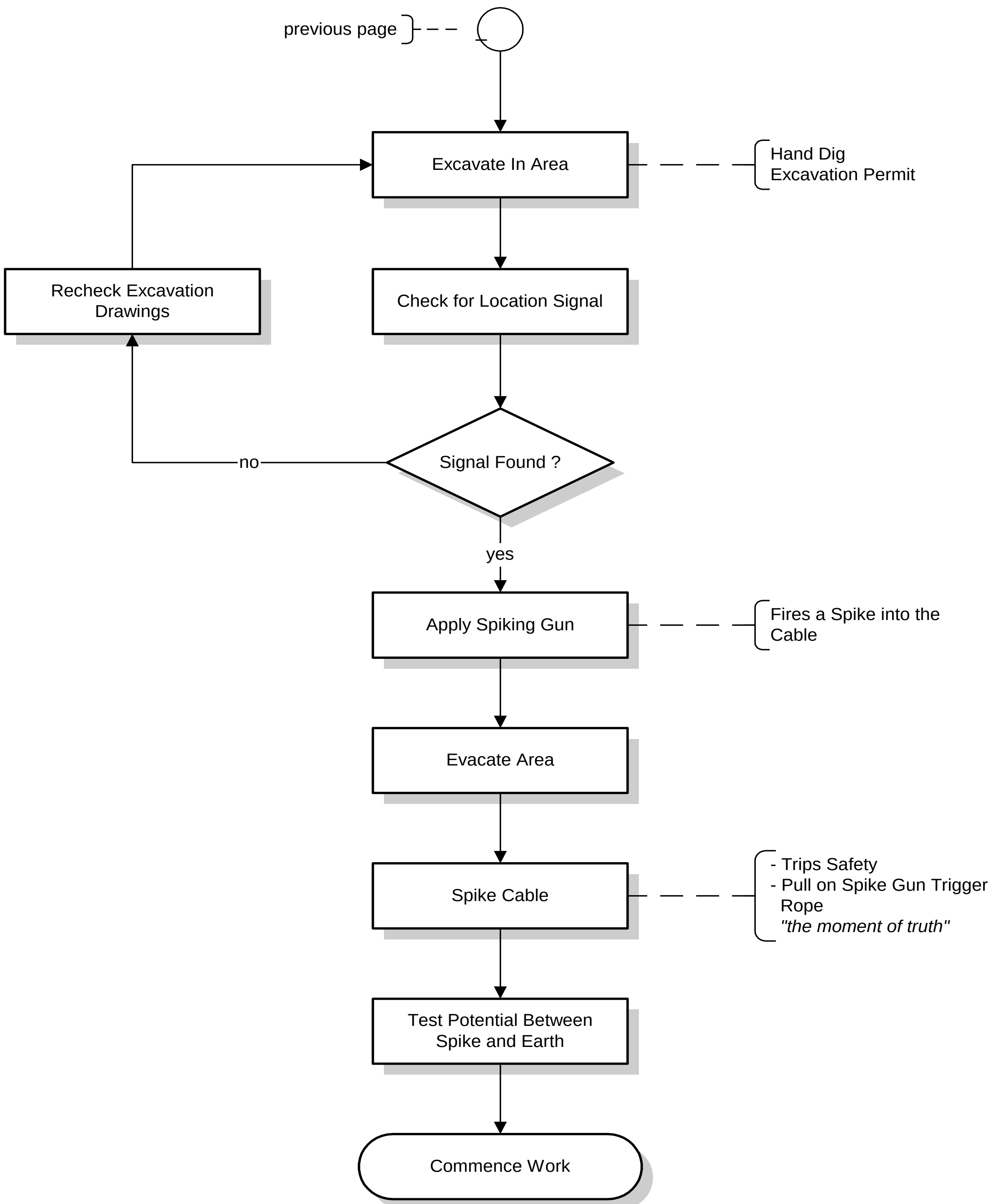


Figure 12.3: Underground Cable Isolation

12.5.12 *Energised Cables in Manholes*

All cables in manholes must be considered a potential source of shock. Tests must be made to make sure there is no voltage between their outer sheaths and earths.

Cables must not be moved while they are energised. Even though cables are shown to have no potential between their outer sheaths and earth, contact should be avoided unless necessary to complete some specific item of work; and then high-voltage gloves must be worn unless cables have been cleared as required above.

When cables are being pulled into manholes, a physical barrier must be provided to prevent contact between existing energised cables and the new cables, cable pulling equipment, and personnel.

Integrity Control of Underground Systems
The responsible engineer is responsible for providing clearance on all subsurface work planned or performed. The clearance provided must assure that the proposed work or design will be free from any obstruction or interference with any existing underground system or any other systems scheduled to use the same area.

The engineer must maintain complete, as-installed, up-to-date, underground system drawings including underground electrical wiring, duct systems, piping, and sanitary sewer systems and any other underground installations. These drawings must be sufficiently scaled and must include the necessary ‘tie points’ to permit exact location and elevations of underground lines, etc at any location.

No excavation may be made for any subsurface work without first obtaining permit (Refer to DGDC-OHS-025: Excavations and Shoring).

12.5.13 *Extension Cord*

One of the most frequently occurring violations cited during safety inspections is the misuse of extension cords. This problem is common to all areas of activity. Because of its universal nature, the use of extension cords is an issue that needs clarification and guidelines in determining the permissibility of its usage.

The use of extension cords may be summed up in a general way by saying

'THE USE OF AN EXTENSION CORD REPRESENTS A CONFLICT WITH DGDC POLICY BECAUSE IT SERVES AS A SUBSTITUTE FOR A RECEPTACLE THAT SHOULD BE LOCATED NEAR THE APPLIANCE OR EQUIPMENT'.

The primary consideration in determining the application of extension cords is that they are intended for temporary use with portable appliances, tools and similar equipment which are not normally used at one specific location.

Guidelines for the Safe Use of Extension Cords:

- Use only approved and properly maintained extension cords that have no exposed live parts, exposed unearthed metal parts, damage, or splices.
- Use only heavy-duty or extra-heavy-duty rated cable.
- Use extension cords that are protected by an earth leakage circuit breaker (ELCB) around construction sites, in damp areas, or in an area where a person may be in direct contact with a solidly earthed conduct surface. The ELCB can consist of a special circuit breaker, a ELCB outlet, or an extension cord with a built-in ELCB. Refer to the ELCB section at the end of this chapter.
- Always use three-conductor (earthed) extension cords - even if the device has a two-conductor cord. Never use two-conductor extension cords.

Observe the following restrictions to avoid misuse of extension cords:

- Do not use extension cords in place of permanent facility wiring.
- Avoid running extension cords through doors, ceilings, windows, or holes in the walls. If it is necessary to run a cord through a doorway for short term use, ensure that the cord is:
  - protected from damage
  - removed immediately when no longer in use
  - not a tripping hazard.
- Do not daisy chain extension cords (i.e. plug one extension cord into another extension cord).
- Do not overload extension cords. Make sure that the wire size is sufficient for the current required.

- Do not cut off the earth pin of an extension cord or compromise the earth protection in any way.
- Do not use extension cords with an earth conductor that has less current-carrying capacity than the other conductors.
- Do not use frayed or damaged extension cords.

12.5.14 Multi-Plug Outlet Box

A multi-plug outlet box is a variation of an extension cord, where the cord terminates in a row or grouping of receptacles. Multi-plug outlet boxes are commonly used in offices to provide multiple receptacles to office equipment. In general, all rules pertaining to extension cords also apply to multi-plug outlet boxes.

Additional considerations are:

- Only use approved multi-plug outlet box.
- Do not permanently mount multi-plug outlet boxes to any facility surface. Multi-plug outlet boxes are classified as temporary devices. It is acceptable to hang them from screws or hooks if they are manufactured with slots or keyholes.
- In equipment racks, the preferred method of supplying utility power to rack-mounted instruments are via a special multi-plug outlet box specifically designed to be rack-installed.

12.5.15 Working Conditions

Equipment shall be designed and constructed to protect personnel. First-line and backup safeguards should be provided to prevent personnel from accessing energised circuits. Establish periodic tests to verify that these protective systems are operative.

12.5.16 Equipment Acceptability

Electrical equipment is considered safe only when it is used as specifically intended by its listing and design. Equipment must not be altered beyond the original design intent and must not be used for any purpose other than that for which it was constructed.

Any equipment that is being re-commissioned must be examined and/or tested, as appropriate, to verify the status of all safety features and the integrity of construction.

Electrical equipment must be listed or labelled by a nationally recognised testing authority

The division within DGDC responsible for the equipment must maintain all documentation pertaining to the design safety features of the equipment, including any test data. This documentation must be available to any safety inspector.

An inspector may require that equipment undergo inspection and/or testing for conformance to standards. Such testing should be documented and submitted for approval. The inspection record must specify, as a minimum:

- equipment identification.
- evaluator's name, date, mailstop, and extension
- standard to which equipment is being evaluated
- specific tests, results, and areas of examination
- any conditions of product acceptability or limitations of use.

12.5.17 Electrical Hazard Prevention

When working with or around electrical equipment all personnel should assume responsibility for their own safety and that of those working with them. The following information, principles, and good working practices will help in the avoidance of electrical shock and injury.

A person can protect against electrical hazards by the correct use of the measures listed below:

- Electric arcs can generate enough energy to cause shock, sufficient heat to cause severe burns, and ample ultraviolet light at certain wavelengths to cause serious and painful injury to the eyes even after a very brief exposure. To avoid such injuries, never close a switch or circuit breaker slowly or hesitatingly, (as arcing may occur) and keep the face turned away to avoid exposing your eyes and skin.
- Beware of wet areas. While working with liquids (e.g. washing, mopping, and spraying), exercise extra care to avoid contact with electrical outlets or devices. Cover electrical openings if liquids can penetrate them. If the openings cannot be covered, the power must be disconnected and locked. (See DGDC-OHS-013: Work Control)

- Use electrical devices only as intended. Electrical devices may not be modified beyond the intent of their design. Electrical equipment is only safe when it is used according to its intended purpose. Some examples of misuse of electrical equipment are:
- pulling out a plug by the cord rather than by the plug
- inserting wires or objects other than a standard plug into a receptacle outlet
- constructing home-made extension cords from standard junction boxes and receptacles (a 'radar box').
- deforming a contact to enable it to fit a receptacle for which it was not intended.

- Always consider electrical equipment energised unless positively proven otherwise. When working on electrical equipment, treat the equipment as live until it is tested, locked, tagged, shorted and/or earthed, as appropriate.
- Re-set circuit breakers only after the problem has been corrected. When a circuit breaker or other overcurrent device trips, it is usually due to an overload or fault condition on the line. Repeated attempts to re-energise the breaker under these conditions may cause the breaker to explode. Do not attempt to re-set a circuit breaker unless the problem has first been identified and corrected or isolated.

12.6 Safe Work Procedures

12.6.1 Cable Clamping

A suitable mechanical-strain-relief device such as a cord grip, cable clamp, or plug must be used for any wire or cable penetrating an enclosure where external movement or force can exert stress on the internal connection. Grommets, aglets, or similar devices must not be used as strain relief.

12.6.2 Emergency Lighting

Make emergency lighting available in case normal lighting fails when work is being conducted on energised components.

12.6.3 Flammable and Toxic Material Control

Keep the use of flammable or toxic material to a minimum. A catch basin or other approved method must be provided to prevent the spread of these materials should the normal component case fail. Refer also to DGDC-OHS-020: Hazardous Substances.

12.6.4 Isolation

Isolate all sources of dangerous voltage and current with covers and enclosures. Access to circuits must be either via screw-on panels (each containing no fewer than four screws or bolts) or via interlocked doors, panels, covers, etc. The frame or chassis of the conductive enclosure must be connected to a good electrical earth with a conductor capable of handling any potential fault current.

12.6.5 Lighting

Provide adequate lighting for easy visual inspection.

12.6.6 Disconnecting Means and Overload Protection

Provide overload protection and well-marked disconnects. Local 'off' controls must be provided on remote-controlled equipment. All disconnects and breakers must be clearly labelled to identify the loads they control.

12.6.7 Rating

Operate all conductors, switches, resistors, etc within their design capabilities. Pulsed equipment must not exceed either the average, the root mean square, or the peak rating of components. The equipment must be de-rated as necessary for the environment and the application of the components.

12.6.8 Electrical Equipment Rooms

Place an identifying label or sign on the door when equipment that may require servicing, manipulation, or inspection is concealed in an equipment closet or otherwise is obscured behind doors or panels.

12.6.9 Enclosures

The following specifications apply to circuits operating at 50 V or more or storing more than 5 J. An enclosure may be a room, a barricaded area, or an equipment cabinet.

Interlock easily opened doors, hinged panels, etc. that allow ready access to exposed energised components so that the act of opening de-energises the circuit. Automatic discharge of stored-energy devices must be provided. See the Subsection 12.3.5: Safety Practices for Capacitors.

Doors should be key-locked, and the same key should also be used for the locks in the control-circuit interlock chain, if applicable. This key must not be able to be removed from the door unless the door is closed and locked.

Mount heat-generating components, such as resistors, so that heat is safely dissipated and does not affect adjacent components.

Ensure that the enclosure physically prevents contact with live circuits. The enclosure can be constructed of conductive or non-conductive material. If conductive, the material must be electrically bonded and connected to a good electrical earth. These connections must be adequate to carry all potential fault currents.

Secure all racks, cabinets, chassis, and auxiliary equipment against movement during earthquakes.

Ensure that enclosures are strong enough to contain flying debris caused by component failure.

Temporary enclosures (of less than six-month duration) not conforming to the normal requirements may be used but must be considered as temporary hazards.

Ensure that ventilation is adequate to prevent overheating equipment and to purge toxic fumes produced by an equipment fault. Ventilation openings must not be obstructed.

Ensure that enclosures large enough to be occupied by personnel allow exterior observation of equipment and personnel working inside the enclosure.

12.6.10 Clearance Around Electrical Equipment

Maintain clearance space around power and lighting circuit breaker panels, motor controllers, and other electrical equipment. This clearance space ensures safe access for personnel who inspect, adjust, maintain, or modify energised equipment.

Clearance space must not be used for storage or occupied by bookcases, desks, workbenches, or similar items.

Clearance space is not required for wall switches, disconnect switches, combination multiple circuit-breaker/outlet-receptacle assemblies, and similar electrical equipment if:

- equipment can be positively de-energised for inspection, adjustment, or maintenance using approved lock-out/tag-out procedures
- readily accessible space is maintained around such equipment at all times.

Readily accessible space enables an employee to operate any circuit breaker handle or switch toggle, insert or remove any connector, or perform any similar act associated with the equipment quickly and effectively without moving apparatus, climbing, or resorting to a ladder.

12.6.11 Primary Disconnect

Provide a lockable means of positively disconnecting the input on large power. This disconnect must be clearly marked and accessible.

If provided with a built-in lock that is part of an interlock chain, the key must not be removable unless the switch or breaker is in the 'off' position.

12.6.12 Floating Power Supplies

Some test equipment requires unearthed (floating) power supplies. This equipment may operate in voltages ranging from 50 V to kilovolts with output capacities in excess of 50mA and must be considered a lethal electrical hazard. Users of such equipment must take special precautions to minimise electrical hazards. All manufacturer's instructions for equipment use, testing, and training shall be followed. The following general guidelines also apply:

- locate equipment away from water and large metal areas.
- do not use connectors and fittings that allow accidental skin contact with energised parts
- interlock readily accessible enclosures
- use non-metallic secondary containment if liquids or gels are involved.

12.6.13 High Voltage Capacitor Banks

Where capacitor banks with voltages above 600 volts are employed, ensure that test personnel have a total knowledge of the equipment, the circuit and component layout, and are fully trained in the operating and safety procedures to be used, including procedures to be used in the event of equipment failure.

The high-voltage area should be enclosed and protected through the use of gates and interlocks on the controls. Capacitors and related high-voltage component faults are a potential source of hazardous shrapnel, requiring isolation of these components in a manner that precludes personnel injury or facility related hazards such as fire.

High-voltage warning signs should be conspicuous, and flashing warning lights should be used to indicate that tests are in progress.

A shorting switch or earthing device that normally discharges the capacitor bank should be clearly visible to the test operator. This device should be fail safe and function to a safe configuration with no electrical power.

A voltmeter connected across the capacitor bank should be clearly visible to the test operator at all times. A redundant voltmeter should be installed at the capacitor banks.

Prior to touching a high-voltage component within the test area, a hot stick of special design should be used to assure that the capacitor bank is fully discharged to an earth.

Use extreme caution when dealing with capacitor banks that are operated by DC voltages. A DC capacitor bank will maintain a residual voltage for extended periods. Therefore, shorting must be reconnected wherever more work is to be done or changes are to be made.

Capacitors that are connected in series to form a bank should be treated with great care, and each and every capacitor terminal in a series should be shorted to earth prior to making any changes to a test bank or circuit.

12.6.14 Substations (Contractor Work)

The contractor must conform to all applicable DGDC safety rules and regulations.

The contractor must submit a work plan three days prior to initiating work in the substation outlining the work to be done and identifying the circuits required to be de-energised to safely conduct his operation. All changes to this work plan must be reviewed with the engineer prior to initiation.

The contractor must appoint an individual responsible for the electrical safety of each work team and must restrict entry to the substation to those whom the contractor authorises jointly with the engineer.

12.6.15 Temporary Earthing and Bonding

The circuit or equipment must be de-energised and tagged before the protective earths are attached. All conductors, including static wire and neutral of the circuit or equipment, must be effectively earthed so as to earth and short-circuit the conductors before the work is started. Protective earths must not be removed until all workers are clear of the circuit or equipment.

It is the responsibility of the person directly in charge of the work to see that adequate earths are placed for the protection of the workers, even though the tags may be placed in the name of another person. Protective earths must be placed on all sides of the work where there is a possible source of power (including wire crossings and parallel lines) and as close to the point of work as possible. Additional earths must be placed where necessary to reduce static charges or induced voltages from adjacent lines. The best protection is afforded when the short-circuiting and earthing is closest to the work.

Only earthing devices approved by the electrical supervisor may be used, but in no case may the earthing cable be smaller than 6mm2 copper or equivalent.

All protective earthing cables must first be attached to a common point on the metal structures or connected together with a jumper not smaller than 6mm2 copper or equivalent. In all cases the earth cables must be applied so as to both earth and short-circuit all the conductors of the circuit. After this is done, attach one of the earthed cables to each circuit, keeping as far below the conductors as possible, and keeping clear of the earthed cables or clamps.

To remove protective earths on metal structures or lines, first detach the earthed cables from the conductors. Start at the top and work down, keeping as far below conductors as possible and keeping clear of the earthed cables and clamps until all conductor clamps are removed. Then remove clamp or clamps from metal structure.

Earthing eliminates a difference in electrical potential between a conductive object and earth by connecting them together. Earthing will protect a person from electrical shock by providing a path which offers less resistance to the current than the human body. Bonding eliminates a difference of potential between conductive objects.

All exposed, non-current-carrying metal parts of fixed and portable equipment which are liable to become energised must be earthed.

Earth paths from circuits, equipment, and conductor enclosures must be permanent and continuous, having ample current-carrying capacity, and their impedance must be low enough to facilitate the operation of over-current devices in the circuit.

Bonding keeps separate pieces of conducting material at the same earthed electrical potential. All conducting material, such as metal floor plates, equipment chassis, bench tops, tables, piping, and conduits, should be bonded to each other.

Use suitable lugs, pressure connectors, clamps, or other approved connecting means. Connections that depend upon solder must not be used in earthing or bonding.

Unearthed electrical fixtures or equipment should be not being used, or where unavoidable, they should be located so that a person cannot touch them and another earthed object at the same time.

12.6.16 Protective Earthing in Substations

In performing work on substation equipment, extreme caution must be exercised to eliminate the danger of feedback from other sources by testing, disconnecting, earthing, or short-circuiting transformers, potential devices, coupling capacitors, etc.

First, attach protective earthing cable or cables to the station earthing system. Then attach an earthed cable to each conductor of the circuit or bus, or to the conductor to be worked on in special cases. Be sure that all workers keep clear of the earthed cables and clamps until earthing is completed.

To remove the protective earth, detach the earthed cable from each conductor, keeping as far away as possible and being sure that all workers keep clear of the earthed cables and clamps until all conductor clamps have been removed. Then remove earth clamp or clamps from the station earthing system.

Protective Earthing of Underground Cables
Protective earthing of conductors making up underground cables cannot always be done at the point of work. In such cases, the earths must be attached at the nearest location where the conductors can be reached, in accordance with protective earthing instructions for stations or overhead lines.

12.6.17 *Transformers*

When transformers are installed or replaced, the secondaries must be checked for correct voltage and phase rotation.

When transformers are installed and before they are energised, the earth connection must be made to the case and to the neutral where applicable.

All transformers must be considered energised at full voltage unless they are disconnected from the primary and secondary wires or unless they are disconnected from the primary wires and the secondary wires are tested for voltage, short-circuited, and earthed. The openings of a fused primary cut-out or switch must not be considered a primary disconnection unless the de-energised side of the cut-out or switch is earthed.

Internal work on transformers may be performed without wearing gloves if the transformers have been de-energised, short-circuited, and earthed. On distribution transformers, the secondary neutral may be considered a sufficient earth for this purpose provided there is an earthing conductor that is interconnected with the secondary neutral, the transformer case, and an earth electrode. When performing internal work on transformers, be alert for possible contacts with energised leads, including lightning arrester leads.

When removing transformers, the case and neutral earths must be disconnected last.

When working on or in the vicinity of any three phase WYE-connected transformer bank where the transformer star point is not earthed but floated, the transformer star point conductor must always be treated as a phase conductor because it is possible to have up to full phase voltage present.

Transformer covers or hand hole plates must not be removed from energised transformers.

12.6.18 *Current and Potential Transformers (Instrument)*

Current transformer case and secondary must be earthed.

Where more than one set of current transformer secondaries are connected electrically, an earth point must be selected that provides earthing for the network.

Secondaries of current transformers must never be opened while a transformer is energised.

The case and one wire on the low-voltage side of a potential transformer must always be earthed before energising the transformer.

12.6.19 Power Capacitors

All individual power capacitor banks must be earthed except the capacitors installed in banks on specially insulated mounting racks. In the case of a capacitor bank mounted on a specially insulated rack, the rack also must be earthed before working on the bank.

In order to work on any capacitor unit or bank, the capacitor or capacitors must be removed from service and earthed in an approved manner.

12.6.20 Coupling Capacitors

The pedestal base of all coupling capacitors must be permanently earthed.

Before any work is performed on the external part of a coupling capacitor, it must be de-energised, each section discharged to earth, and then earthed at the line side of the top section. In discharging the sections, first attach the earth clamp to the station earth and then use an earthing stick to touch the earth conductor to the bottom of each section.

12.6.21 Equipment

The cases of all portable electrical motor-driven hand tools must be earthed by use of standard three-prong plugs and receptacles, and the cases or frames of all other electrical equipment supplied with 50 volts or above must be connected to earth, except as follows:

- Devices operated solely from self-contained batteries.
- Devices that have cases and all exposed parts protected by insulating material.

12.7 Safety Equipment

12.7.1 Earth Leakage Circuit Breakers (ELCBS)

ELCBs are designed to protect a person from electric shock when he/she simultaneously contacts a ‘live’ wire or part and an earthed object. The ELCB works by sensing a difference between the supply and return currents. When the difference exceeds 30mA - indicating that current is flowing to earth (through the person) - the device switches off.

Although the ELCB is an effective safety device, it is not a guarantee against shock in every situation. The ELCB does not protect against a line-to-neutral or a line-to-line shock. Also, if ELCB-protected equipment contains a transformer, an earth fault (shock) on the secondary side of the transformer may not trip the ELCB.

ELCBs are normally installed as either circuit-breakers or receptacles. In either case, the ELCB may be wired to protect multiple receptacles. Individual ELCB plug-in adapters are also available.

ELCBs must be tested at least at 30-day intervals. Push the "test" button and observe the "reset" button pop out and the receptacle turn off. If this does not happen, the ELCB is not functional and must be replaced.

CAUTION: Testing of a ELCB will disconnect all receptacles protected by the ELCB. Before testing, determine which receptacles are protected. Verify that the interruption of power will not adversely affect other activities.

12.7.2 Insulation

When working continuously with or around electricity, rubber-soled footwear shall be worn to guard against slipping and to provide insulation.

Use rubber floor mats, gloves and adequately insulated tools when working with ‘hot’ lines or equipment.

Check the voltage stamped on the gloves and never use them for higher voltages. Also make sure that gloves are in good condition. They can be checked by holding the end closed and forcing air into the fingers; this enables cracks or spots that are worn thin to be seen. Discard the gloves if these are visible. Never use unstamped gloves.

12.8 Documentation

12.8.1 System Design Drawings

The design engineer is responsible for determining what drawings are required to conform with safety requirements and for setting up the necessary drawings for maintaining safe operations of the final system.

The electrical drawings for each system should include, as a minimum, the following:

- a complete functional diagram of the system showing the essentials of the mechanical and electrical system together with a clear explanation of the system operation.
- a complete schematic or elementary wiring diagram of the system.
- a wiring diagram of each unit of equipment together with an interconnection drawing linking all equipment showing connections at each terminal strip where connections are made.
- a plan showing the location of equipment in the facility.

Original tracings or CAD files must be retained. Drawings must be updated by the responsible DGDC engineers or their designee. An updated set of these drawings must be provided to all document holders whenever drawings have been updated in line with DGDC drawing policy.

12.8.2 High-Voltage Switching Diagrams

All high voltage switching is to be controlled by a high voltage switching order. Sets of appropriate switching diagrams for the high-voltage power distribution system (2300 volts and above) are to be made available to those persons listed on the High-Voltage Switching Orders. The responsible DGDC engineer will assure that a corrected copy of each sheet affected by modifications is provided to holders of switching diagrams sets and that outdated copies are destroyed.

12.8.3 Manhole Drawings

Two complete sets of 'master' drawings of duct banks and manhole systems must be maintained up to date, one for engineering use and one for field service use.

12.8.4 Building Drawings

Drawings of each building power distribution system must be maintained and must include the drawings listed below:

- A plot plan of each building showing the partitions and physical locations of all panel boards, motor control centres, main distribution panels, and unit power substations. This plan should include the front view of these load centre units with identification numbers shown that identify with like numbers marked on the equipment.
- A complete one-line power distribution diagram of the electrical power flow from the building unit substations to the building load centre buses showing the circuit breakers controlling the identified loads.
- A schedule of the circuits handled by each circuit breaker in each panel board must be maintained. Persons adding or deleting circuits must change this schedule to show all modifications.

12.8.5 Configuration Control of Installed Electrical Systems

A configuration change is defined as any change to equipment that deviates from the original design. Minor circuit changes to permit the insertion of instruments for measurements are not considered configuration changes.

All configuration changes to any installed electrical system included under configuration control must be critically reviewed from a safety perspective by the responsible DGDC engineer or his representative prior to implementing the changes.

Prior to the change, the procedure to be followed for implementing a change must be submitted in writing to the DGDC engineer for approval. This procedure must be verified as correct by a qualified engineer of the organisation responsible for conducting work in the area concerned. In particular, the engineer must verify that the capacities of the elements involved in the new arrangement will be operated within their ratings and each step in the procedure can be performed safely. If applicable, a safety analysis report (SAR) that updates the existing SAR in accordance with the proposed changes must also be included.

Approval for performing the work in a facility that will result in a control or power system configuration change must be withheld by the facility safety representative until the following additional requirements are met:

- a sketch or drawing of the proposed change is properly dated and signed by the responsible electrical engineer
- the signed drawing or sketch is affixed to the existing master drawing of the system maintained at the site

- the facility safety representative is satisfied with the SAR update or calls for an equivalent review to be made with resultant documentation placed in the facility file.

In an emergency, where a configuration change is involved but lack of time prevents the preceding procedures from being followed, the electrical engineer must be contacted to review the action proposed and the additional steps required to assure safe operation. The engineer is also charged with the responsibility for providing all the documentation specified above for configuration changes.

12.8.6 Facility Modifications

Experimental electrical or electro-mechanical equipment that is under development, and therefore subject to frequent modifications, can present a particular hazard to personnel. The operating and emergency procedures and attendant hazards may change from day to day. While the project manager of a program is responsible for the safety of personnel and equipment associated with the development of experimental apparatus, a responsible member of the development team should be designated to establish correct working procedures and make a gross safety and hazard analysis as well as establish proper emergency procedures. Particular emphasis should be placed on de-energisation of the equipment.

12.8.7 Initial Energising of Electrical Installation

The responsible engineer is responsible for the safety tests listed below to be performed prior to energising electrical installations for the first time or after a major repair or overhaul.

- All power circuit breakers, other than sealed moulded case, must be checked for proper operation in the trip ranges required. The contacts must be inspected and all adjustments reviewed to ensure proper contact-making on all units in accordance with the manufacturer's instruction.
- All protective relays and other devices must be tested to ensure their capability of operating in the range required. Tests must include, where possible, loading in at the current transformer secondaries to obtain protective circuit validation as well as relay verification.
- All wiring must be checked for conformity to the design drawings and fabrication and functional requirements.

- High-voltage verification tests must be taken of motors, cables, and switch gear to determine their capability of successful operation.
- Initial energising of all new electrical equipment will be done only in the presence of the engineer.

12.8.8 Protective Relay Settings

Before energising any load, protective relays or overloads monitoring the equipment must be set at values established by the responsible engineer.

Documentation of all protective relay settings shall be kept up-to-date in a register of all protective relays in use. A copy must be made available for field checking and calibration of the relays on a periodic basis, preferably annually.

Protective relay systems must be co-ordinated to provide selective tripping discrimination in accordance with best practice.

12.8.9 Circuit Interruption Devices

All circuit interruption devices must be rated to interrupt the maximum short circuit current of the power system at the point of application of the device.

Short circuit system studies must be made to obtain updating data as required on short circuit interrupting duty requirements whenever large loads or major system changes are made on the power system that may affect the short circuit duty of the circuit breakers in use on the system.

In systems above 500 volts, after any circuit breaker operation occurs in which the circuit breaker opens under short circuit conditions or fault, the circuit breaker must be immediately inspected and checked by the engineer to ensure that the circuit breaker is suitable for reuse in the circuit.

All 11kV circuit breakers must be operated to assure satisfactory mechanical operation at least once every 12 months.

12.8.10 Accessibility

All fixed electrical equipment must be accessible for maintenance, repair, and de-energisation. The area around electrical equipment, as indicated by yellow markings on the floor, must be kept clear.

High-voltage circuit breaker switchgear requires two meters of clear space at the front and one meter at the rear. Motor control centres, panel boards, and terminal cabinets require a minimum of one meter in front.

Rooms housing fixed electrical equipment shall not be used as general storage areas.

Dominica Geothermal Development Company Limited
Powering a New Generation...

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-020: Hazardous Substances
Revision 0

Contents

13. Hazardous Substances

13.1 Introduction

A hazardous substance is a substance which can affect human health and/or the environment. The substance may possess the following hazards:

- poisonous (toxic to human health and the environment)
- corrosive
- flammable
- reactive with other materials (e.g. oxidising chemical and/or reactive with water)
- radioactive
- explosive
- exotoxin.

A substance may have a combination of two or three of these hazards.

Due to the nature of DGDC operations, hazardous substances are transported, stored, used and handled on a regular basis. If handled and used correctly, hazardous substances are safe. If mishandled or used incorrectly, hazardous substances can cause damage to the human body, property, equipment and the environment.

13.2 Classification of Hazardous Substances

13.2.1 Hazard Class Diamonds

Hazardous substances are classified according to the predominant type of risk involved. This classification is based on the recommendations of the United Nations Committee of Experts on the Transportation of Dangerous Goods.

Class 1: Explosives

These are any substances or mixtures or combination of substances which, in their normal state, are capable of either decomposition at such a rapid rate as to result in an explosion or can produce a pyrotechnic effect.

Examples: ammunition, dynamite, ammonium nitrate

Class 2: Gases

These substances are gaseous under atmospheric pressure at ordinary temperatures and are contained under pressure as a gas or liquid, or are dissolved under pressure, or are in deeply refrigerated liquid form.

For labelling purposes, gases are divided into three groups depending on their properties:

i) Flammable Gas

Examples: propane, methane

ii) Poisonous Gas

Examples: chlorine, methylene chloride

iii) Inert, Non-Flammable and Compressed Gas

Examples: Carbon dioxide, oxygen

Class 3: Flammable Liquids

These substances are liquids, or liquids containing solids in solution or suspension, that have flashpoints up to and including 61°C, the flashpoints being determined by a closed-cup method.

Flammable liquids shall be assigned to one of two subclasses in accordance with their flashpoint as follows:

a) Class 3(a)- Highly flammable liquids. These are liquids, and liquids containing solids in solution or suspension, that have closed-cup flashpoints of less than 23°C;

Examples: petrol, acetone, toluene

b) Class 3(b)- Flammable liquids. These are liquids or liquids containing solids in solution or suspension that have closed-cup flashpoints not less than 23°C and up to and including 61°C.

Class 4: Flammable Solids

Substances liable to spontaneous combustion or which, on contact with water, emit flammable gases.

Class 4.1: Flammable Solids

Solids other than explosives easily ignited by external sources.

Examples: sulphur, paraformaldehyde

Class 4.2: Substances Spontaneously Combustible

Solids or liquids possessing the common property to heat and ignite spontaneously.

Examples: molten phosphorous, hafnium powder

Class 4.3: Substances Flammable by Reaction with Water

Substances which, in contact with water, are liable to become spontaneously flammable or to emit gases in dangerous quantities.

Examples: potassium metal, zinc ashes, magnesium powders.

Class 5: Oxidising Substances and Organic Peroxides

These are materials, that although not necessarily combustible in themselves, may stimulate combustion of other materials and intensify the violence of a fire, usually by supplying oxygen.

Class 5.1: Oxidising Agents (Oxidisers)

These are all oxidising substances other than organic peroxides.

Examples: inorganic salts such as chlorates, nitrates, permanganates chromates and the like, and inorganic peroxides of all types such as hydrogen peroxide, metallic peroxide

Class 5.2: Organic Peroxides

These are all organic peroxides.

Examples: cymene hydro peroxide, p-methane hydro peroxide

Class 6: Poisonous (Toxic) and Infectious Substances

This class comprises:

Class 6.1: Poisonous (Toxic) Substances

These are substances liable either to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact.

Examples: organophosphates, carbamates, copper chrome arsenic

Class 6.2: Infectious Substances

Substances containing viable micro-organisms or their toxins which are known, or suspected, to cause disease in animals or humans.

Examples: medical samples, anthrax

Class 7: Radioactive Materials

These are materials which have a specific activity greater than 100 Becquerel's per gram. Three substances defined (I,II,III) in accordance with the criteria set by the International Atomic Energy Agency.

Examples: radioactive laboratory isotopes, non-destructive testing sources.

Class 8: Corrosives

These are substances which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other freight or the means of transport; they may also cause other hazards.

Examples: sulphuric acid, caustic soda, hydrochloric acid, sodium hypochlorite

Class 9: Miscellaneous Dangerous Substances

These are substances and articles which during transport present a danger not covered by other classes. It also includes environmental contaminants, such as some herbicides and fungicides.

United Nations Number

All hazardous substances (dangerous goods) have been allocated a four-figure number by the United Nations Committee of Experts on the Transportation of Hazardous Substances.

NAME	UN NO
CHLORINE	1017

- This four-figure number must appear on the labels of all hazardous substances.
- The number is unique to that particular substance.
- The UN number is a quick an effective means of identifying a hazardous substance.
- The UN number can be checked against a master list to get the specific hazardous substance's name and properties.

Listings of UN numbers are published in the United Nations Orange Book, International Air Transport Authorities, Dangerous Goods Regulations, the International Maritime Dangerous Goods Code and hazardous substances emergency response handbooks.

13.3 Exposure to Hazardous Substances

13.3.1 Toxicity and Effects

Anyone involved with the handling of hazardous substances should know what the possible hazards to health are, especially if there is an 'uncontrolled hazardous substance incident'.

Hazardous substances are said to be TOXIC.

- Toxicity is the ability of a chemical to cause injury to the human body.

Exposures to hazardous substances can be either:

- Acute: of short duration and refers to a single exposure. Acute exposures are normally associated with immediate effects such as vomiting, nausea, headaches, but in some instances produce longer term effects (including death).
- Chronic: exposure of a long duration and refers to repeated or prolonged exposures, measured in days, months or years. Chronic exposure is normally associated with longer term effects such as cancer, genetic defects, neurotoxicity.

Hazardous substances can affect the body in many ways.

- Locally: The action of the hazardous substance occurs at the point of contact, e.g. corrosives - cause burns to the skin at the point of contact.
- Systemic: The hazardous substances have an effect on the body, but at a site other than the point of contact, e.g. organophosphate insecticides are absorbed into the body through the skin, but attack the nervous system not the skin.
- Cumulative: Materials that tend to build up in the body as a result of numerous chronic exposures. The effects are not seen until the critical body burden is reached. Examples: heavy metals.
- Synergistic: When two or more hazardous material exposures occur the resulting effect can be greater than the effect of the individual exposures. This is called a synergistic or potentiating effect.

Other factors that can affect toxicity are the **rate of entry** and **route of exposure**. Age can affect the capacity to repair tissue damage. Previous exposures may lead to tolerance, increased sensitivity or make no difference. State of health, physical condition and life style can affect the toxic response. A pre-existing disease can result in increased sensitivity. Environmental factors such as temperature and pressure may also affect the exposed individual as well as host factors including genetic predisposition and the sex of the exposed individual

Individuals react differently when they are exposed to the same hazardous substance for the same length of time.

- Some may show no signs of poisoning whatsoever.
- Others may show signs of mild poisoning.
- Some people may become severely or fatally poisoned.

13.3.2 Exposure Routes

There are three main routes by which hazardous chemicals enter the body:

i) Absorption or injection through the **skin or eyes**.

ii) Digestion with absorption through the **digestive tract**, this can occur through eating or smoking with contaminated hands or in a contaminated work area.

Common cause of child poisoning, e.g. rarely causes poisoning in an emergency situation.

iii) Via the lungs. Absorption through the respiratory tract through **inhalation**. This is the most important in terms of severity, breathing in the fumes, e.g. toxic fumes from spilled hazardous substances are common in emergency situations.

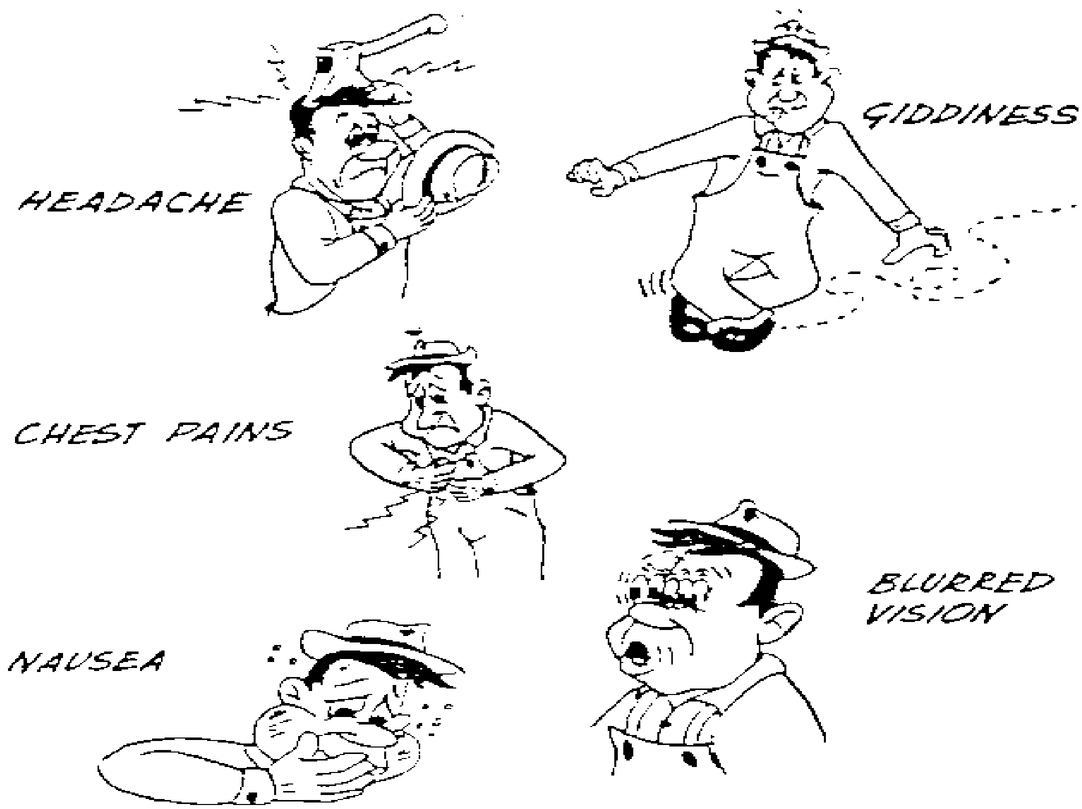
TO PREVENT POISONING IN AN EMERGENCY SITUATION, PROTECTIVE CLOTHING SHOULD BE WORN (ESPECIALLY WHEN HANDLING SPILLED OR LEAKING HAZARDOUS SUBSTANCES).

13.3.3 Symptoms of Poisoning/Exposure

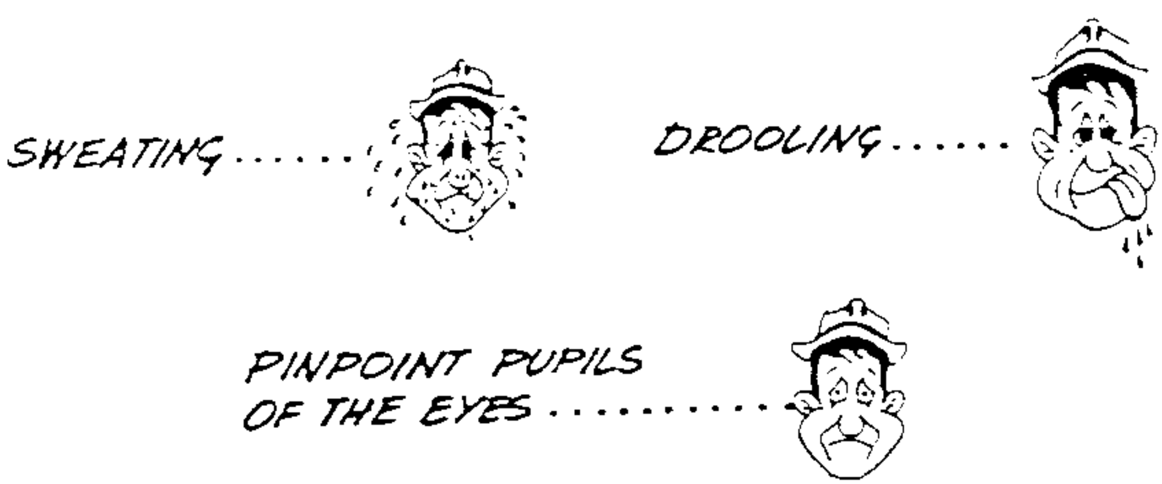
What are the symptoms of poisoning?

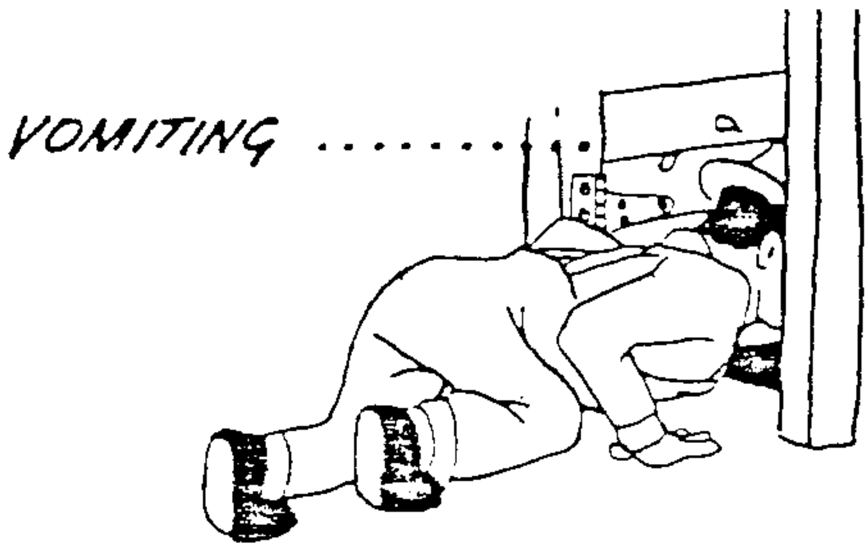
The symptoms of poisoning are various;

Initial symptoms may be:



More serious symptoms may be:





In severe cases, the symptoms may be coma then **DEATH**.

In a spillage situation, the exposure to the hazardous substance is normally of a short duration, but is usually of a high concentration.

In a normal hazardous substance handling situation so long as the handling precautions specified on the label or the Material Safety Data Sheet are followed, which includes wearing the required level of personnel protective equipment, the chances of poisoning are negligible. Exposure in a normal situation tends to be of a 'long duration' (chronic exposure), i.e. over a number of repeated episodes.

IT IS IMPORTANT TO READ THE DRUM'S LABEL AND MSDS AND FOLLOW THE MANUFACTURER'S RECOMMENDED HANDLING PROCEDURES.

13.3.4 Exposure Standards

Most standards (Threshold Limit Values (TLVs), Permissible Exposure Limits (PELs) etc), are based on the inhalation route of exposure. They are normally expressed in terms of either parts per million (ppm) or milligrams per cubic metre (mg/m3) concentration in air. If a significant route of exposure for a substance is through skin contact, the MSDS will have a "skin" notation. Examples include pesticides, carbon disulphide, phenol, carbon tetrachloride, dioxane, mercury, thallium compounds, xylene, and hydrogen cyanide.

13.4 Control of Hazardous Substances

13.4.1 Hazardous Substances Inventory

A chemical inventory of all hazardous substances (solids, liquids and gases) that are held at a facility shall be prepared. The inventory shall contain the following information:

- product name
- proper chemical name
- material type (solid, liquid or gas)
- manufacturer's name
- Hazard Class Number
- usage area at the site (where substance is usually, if more than one area, list all areas)
- storage areas (area where hazard stored, if more than one area list areas)
- quantities held in each area
- Material Safety Data Sheet held for that substance (Yes/No).

A key area listed in the inventory (usage and storage) will be used to identify, for example:

PP	=	Power Plant
MaW	=	Maintenance Workshop
MS	=	Mechanical Shop
IGS	=	Inwards Good Store

The inventory will estimate only maximum quantities held at any particular hazardous substance in a particular area.

The inventory should be reviewed and updated every three months to take into account changes in the hazardous substances purchased and held at the site.

A template for a Hazardous Substances Inventory is presented in Form 13.1 at the end of this section.

13.4.2 Material Safety Data Sheets

Material Safety Data Sheets (MSDS) are used internationally to provide information required to allow the safe handling of chemicals and mixtures in the working environment. The MSDS describes:

- the properties of the chemical product or formulation
- health hazard information
- precautions for use, e.g. personnel protective equipment requirements
- safe handling procedures
- emergency information, e.g. chemical spillages.

An example of the format of a typical MSDS and the generic information retained is presented in Table 13.1.

Table 13.1 : Example of an MSDS[1]

Statement of Hazardous Nature	*(statement indicating any specific classification of the product as a hazardous substance under legislation)*
Company Details	
Company Name:	*(Company name with logo, if desired)*
Address:	*(Should be a Dominica address)*
Telephone Number:	*(Should be a Dominica telephone number with STD code)*
Emergency Telephone Number:	*(Must be a Dominica telephone number where additional health and safety information can be obtained. Times of operation should also be given)*
Identification	
Product Name:	*(Name by which the product is known)*
Other Names:	*(Other names or synonyms by which the product is known)*
Manufacturer's Product Code	*(Any internal identification code)*
UN Number:	*(Correct entry from UN Orange Book)*
Dangerous Goods Class:	*(Any classification under International Regulation)*
Hazchem Code:	*(The emergency action Hazchem Code of numbers and letters)*
Uses:	*(List all major uses and methods of application in descending order)*
Physical Description/Properties	

1 Source: Guidelines for the Preparation of Material Safety Data Sheets in New Zealand. Department of Labour, 1997

Appearance:	*(Describe colour, odour, form)*
Boiling Point/Melting Point:	*(ºC)*
Vapour Pressure	*(Pascals or mm of Hg at 25ºC)*
Specific Gravity:	*(Specific gravity of product compared to water being equal to one)*
Flash Point:	*(ºC)*
Flammability Limits:	*(Give upper and lower limits expressed as a %)*
Solubility in water:	*(Should be stated in g/L at a given temperature)*
Other Properties	*(Include all relevant data on other physical properties)*
Ingredients	
Chemical Entity Proportion	Cas No.
(Must include all substances hazardous to health)	
Health Hazard Information	
Health Effects	*(Including all relevant data on known health effects, both short and long term)*
Acute:	
Swallowed	
Eye	
Skin	
Inhaled	
Chronic:	

First Aid:	*(Should give simple instruction for use by exposed individual, bystanders and first aid officers)*
Swallowed	
Eye	
Skin	
Inhaled	
First Aid Facilities	
Advice to Doctor:	*(Should be compiled in consultation with persons with medical expertise)*
Precautions for Use	
Exposure Standards:	*(Should list relevant AGCIH TLV-TWAs)*
Engineering Controls:	*(Should define requirements for engineering controls suitable for use with the substance. Engineering controls include mechanical ventilation and process modification)*
Personal Protection:	*(Should list the requirements for personal protection, including respirator and gloves.*

	Recommendations should be specific, defining respirator type, glove type, etc)
Flammability:	*(Define the need for ventilated areas, earthing, avoid sources of ignition, special equipment, e.g. flame proofing)*
Safe Handling Information	
Storage and Transport	*(Define safe storage requirements, e.g. location, temperature or incompatibility)*
Spills and Disposal	*(Specify where materials should be disposed of, e.g. landfill, incineration and disposal, neutralising tank, settling pond etc. Identify materials to be used in absorb or neutralise spill and draw attention to the need for compliance with local codes/bylaws for proper disposal)*
Fire/Explosion Hazard	*(Define the explosive and flammability characteristics, including Hazard: description of types of extinguishers and listing possible dangerous decomposition products)*
Other Information	*(An open section to provide any additional information which a manufacturer wants to provide. Examples of information such as biodegradability or persistence in soil and water, any other ecotoxic information)*
Contact Point	*(Should give the direct telephone number where named personnel can be contacted.*

It should be noted that this form is a double sided A4 sheet.

Some MSDSs may not contain all ten sections or the information may be in a slightly different order. Some MSDSs are more complete than others.

- Do not assume that all you need to know is contained on the MSDS.
- Do not assume if a section is left blank that there is no risk.
- Consultation with further references may be necessary.

All staff who handle hazardous substances on a regular basis shall be trained in how to read and abstract information from an MSDS.

Reference shall be made to Material Safety Data Sheets, in order to determine what are the correct handling procedures and personal protective equipment requirements prior to using or handling the substance.

In all instances, the procedures stated on the MSDS for handling and personal protective equipment shall be adhered to by DGDC personnel. This, however, does not negate any further safety requirements that DGDC may dictate.

13.4.3 Obtaining Material Safety Data Sheets

DGDC shall obtain MSDSs from the suppliers of all products containing substances hazardous to health, that will be used at the site.

When a new substance is to be used at the site, an MSDS should be obtained from the supplier in advance in order to assess any potential hazards and to ensure the site has adequate controls in place.

The Site Health and Safety Officer will be advised by the Purchasing Officer of any changes to hazardous substances being purchased. The Health and Safety Officer will undertake an assessment of the proposed hazardous substance to be purchased and forward a report to the Health and Safety Committee for approval. The report will identify:

- potential hazards
- risks
- whether current controls are adequate
- if the substance proposed is less or more hazardous than that currently used.

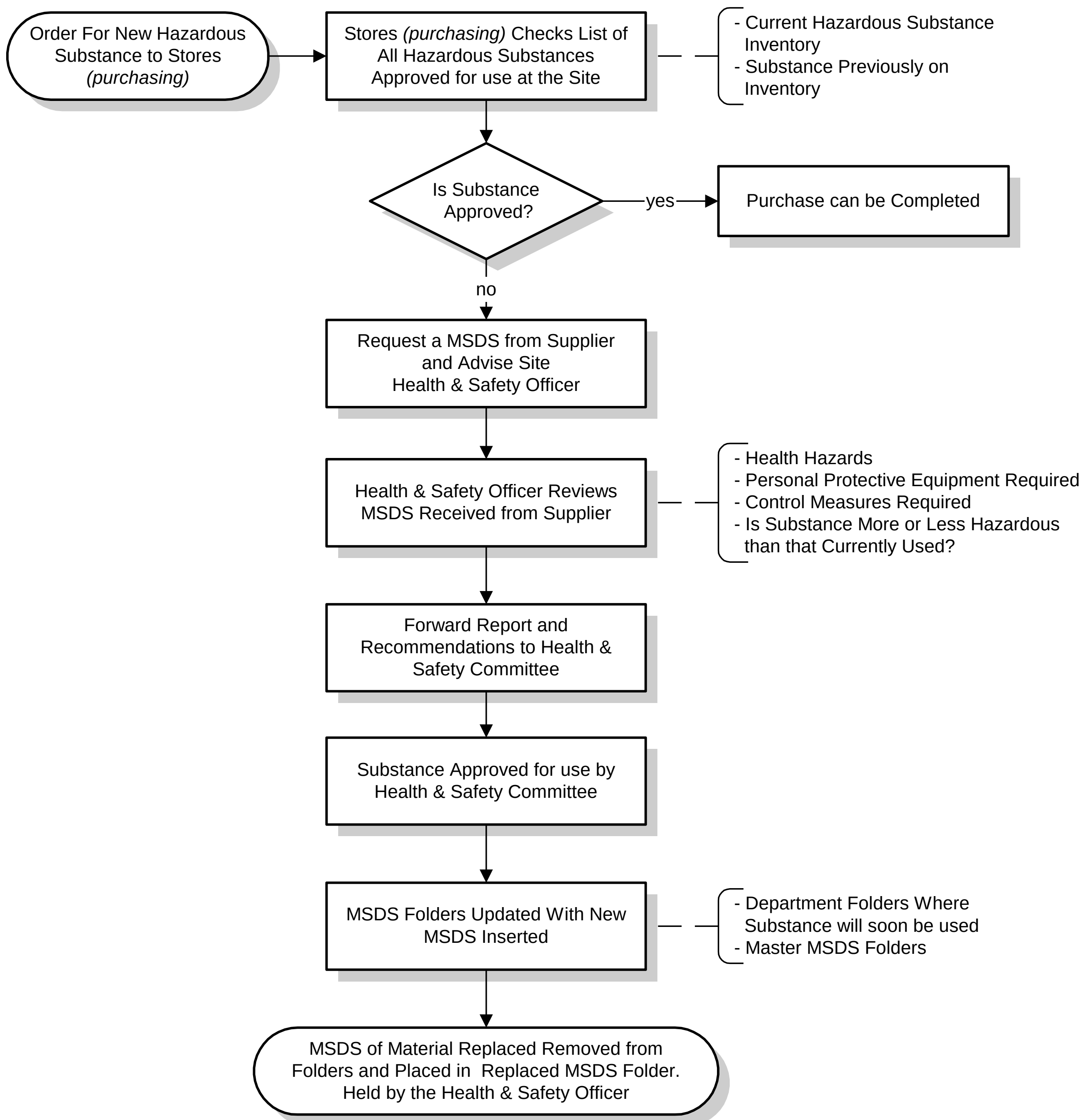
In all instances, the change to a more hazardous chemical shall not occur.

If the information contained in the MSDS is not sufficient or an MSDS is not available another supplier should be sought irrespective of costs.

The steps in approving a hazardous substance for use at the site are set out in Figure 13.1.

Figure 13.1 Hazardous Substance Approval Procedure

Before a New Hazardous Substance can be used at the Site it Must be Approved using the Following Procedures:



13.4.4 Location of MSDSs Held

Hard copies of MSDS shall be held at the site, if information is supplied in electronic form a hard copy will be made.

Each department will hold copies of the MSDS for the specific hazardous substances stored or used by that department.

Master folders which hold MSDS for all the hazardous substances used at the site will be held in the Paramedic's office and in the Administration office.

These folders will be updated when changes to the hazardous substances used by any department are made. Old MSDSs for substances, no longer used will be removed from the folders, but retained in the Replaced MSDS file, held by the Site Health and Safety Officer.

The Department MSDS folders will be held in a location which allows ease of access for all employees who handle, use or come in contact with the hazardous substances and will allow ease of access in the event of an emergency.

MSDSs obtained from the supplier should not be altered except where the MSDS is provided from overseas. Any additional information should be appended to the MSDS and clearly marked to indicate it is not part of the supplier's MSDS.

13.5 Handling Procedures

13.5.1 Introduction

Personnel involved in operations involving the storage, use and handling of hazardous substances at the site shall be made fully aware of the hazards associated with the substances they may come in contact with.

They shall be trained in the appropriate handling procedures, the correct use of personal protective equipment, emergency procedure in the event of a leak, spillage or incident and appropriate first-aid measures.

This section sets out the general handling procedures which shall be followed at the site. For specific handling procedures, reference should always be made to the hazardous substances MSDS for details.

The correct use and maintenance of personal protective equipment is detailed in the Safety Equipment section of this manual.

13.5.2 General Handling Requirements

- A foreperson trained in hazardous substances use will initiate a handling operation.
- The foreperson must be in possession of the relevant MSDS for the hazardous substance to be handled.
- Only approved hazardous substance handlers trained in hazardous substance handling and use, should undertake the handling operations.
- The handler must be made aware of the hazardous substance to be handled, their hazards and wear the appropriate personal protective equipment in accordance with the requirements of the MSDS.
- Emergency procedures must be identified and emergency equipment (spill containment, eye wash baths, fire extinguishers) be readily available prior to the commencement of the handling operation.
- Where the handling operation occurs within a Designated Hazardous Area, a Master Permit-to-Work must be completed before work can commence.
- Breathing apparatus (self-contained) should be worn, whenever operations are carried out when a toxic gas, vapour or mist maybe encountered when breaking a line or draining or venting down equipment. This work is covered by the Master Permit-to-Work system and the reader should refer to this section in the manual.
- At completion of work, workers must wash hands before eating and smoking. No eating or drinking in areas where hazardous substances are handled, used or stored is permitted because of possible contamination.

13.5.3 Using Hazardous Substances

Before hazardous substances are used at the site, checks should be made to ensure:

- the machinery and equipment in which the hazardous substance will be used is working correctly
- ventilation systems are working correctly
- the persons using the substance know what the hazards are and the precautions that need to be taken with these
- the persons using the substance know what the early symptoms of poisoning are
- the persons using the substance have available protective equipment they will need during the checking and for emergencies.

Drum Handling

- Handle drums carefully to prevent leaks and damage to linings.
- Suitable protective equipment should be worn, especially safety goggles and footwear. Read MSDS.
- On delivery, drums should be examined for leaks. If leaks are found, the source of leakage should be turned upper most and drum contents transferred.

a) Adequate ventilation should be provided at the drum disgorging point to ensure that the Threshold Limit Value (TLV) is not exceeded.

b) Never open a drum which shows signs of being pressurised. The drum top when pressed is tight and is curved showing signs of pressure build-up. This is common when drums are stored outside on pallets.

- When filling or emptying drums, support them by a cradle or block.
- Drums should not be lifted manually.
- Replace a bung with a tap before pouring, to allow liquid flow to be controlled.
- An empty drum that has contained hazardous substances must be handled and stored as if it still contains hazardous material, until it has been thoroughly cleaned.

13.5.4 Tanker Off-Loading Procedures

Detailed procedures for off-loading bulk tankers must be agreed to between DGDC and the supplier.

- A person from DGDC must be in attendance during the off-loading to ensure the correct safety precautions are observed.
- The road tanker should be positioned correctly within an area filled with spill containment. Bund lips or dedicated drainage sump, and for hydrocarbon procedures and earth connection present.
- The tanker wheels should be chocked, in addition to setting the brakes. The engine must be switched off.
- Restrict access, i.e. no unauthorised personnel allowed near unloading area while tanker is transferring products.
- Prior to delivery, DGDC personnel must ensure that the tank to which product will be unloaded to has sufficient capacity to take the tankers contents.
- All base connections should be well maintained with regular inspections for wear and tear.
- The whole transfer operation is in the control of the tanker driver who must be present throughout the operation.

- During the discharging operation of hazardous liquids and/or gases from road tankers, warning notices shall be displayed on either side of the transfer point to restrict access and warn of the potential danger.
- Emergency equipment in the event of a spillage or leak should be on hand, during the transfer operation.
- Smoking and naked flames are prohibited at the tanker transfer point.
- Lighting suitable for flammable gas hazardous areas shall be provided to allow product transfer at night.
- Eye wash bath and emergency shower shall be situated at the transfer point.
- As a minimum, workers involved in the transfer of product shall wear gloves, overalls and eye protection (goggles or a face shield).

13.6 Storage Requirements

- Hazardous substance held at all DGDC facilities shall be stored in designated storage areas.
- All storage areas will be labelled with the appropriate hazard class diamonds to show the type of hazardous substance stored.
- Hazardous substances shall be stored separately from other stores.

13.6.1 Flammable Materials

A specifically designed Dangerous Goods Store will be used to hold all Class 3 Flammable liquids drummed materials. The store shall be:

- properly ventilated to reduce the build-up of a flammable gas atmosphere
- labelled with hazard class diamond and NO SMOKING Signs
- non-combustible and capable of containing a fire, explosion (concrete, concrete blocks and steel)
- situated away from populated buildings by a minimum separation distance of 15 meters and have restricted access.
- fitted with lights and electrical devices approved as being intrinsically safe for a hazardous atmosphere.
- fitted with fire alarm systems and firefighting equipment.

All containers held in the store shall be kept tightly closed.

13.6.2 Corrosives, Toxic Substances, Oxidisers and Solids

For housekeeping reasons and to prevent drums from becoming over pressurised due to heat build-up from exposure to direct sunlight, all designated storage areas will be fully covered.

Separate storage areas will be provided for drummed/bagged material

- acids
- alkaloids
- poisonous (toxic) substances
- oxidisers
- flammable.

Each storage area shall be caged and locked to prevent unauthorised access.

Substance shall only be stored in their designated areas to prevent non-compatible chemicals interacting. MSDS sheets should be referred to for chemical non-compatibility.

Acid	**Alkali**	**Oxidiser**	**Toxic Substance**

The storage areas shall be enclosed by a bund wall, or spill containment lip to contain any leaked material in the area, or will be fitted with a designated sump of sufficient capacity to contain the contents of the drums held in the store.

- Emergency eye wash stations and showers will be provided near the storage area. These shall be clearly identified by visible signs.
- All storage areas will be labelled with hazard class diamonds and NO SMOKING signs.
- Oxidising agents should be stored away from easily combustible material and water.

Stacking of drums, within stores should not be more than three pallets high. If stored outside temporarily, they should only be one pallet high.

- All drums should be clearly labelled with hazard class diamond, UN number, product name and manufacturer's name and address.

- If labels become removed in transit, they should be replaced with new labels which specify the above minimum labelling requirements.
-

13.6.3 Bulk Tanks

- Above ground bulk storage tanks and process vessels shall be situated in bund enclosures which have a capacity to contain 110% of the capacity of the largest tank.
- All pipework associated with the tank, fittings, valves. etc is to be housed within the bund enclosure.
- The bund enclosure walls shall be positioned so that they will contain all leaks and prevent liquids by hydraulic pressure spraying over the bund walls.
- Tanks shall be fitted with vents which cannot be closed.
- The tank shall be labelled with a hazard class diamond, materials name and UN number.
- The tank overflow pipes shall discharge into the bund enclosure.
- The following colour codes should be used to clearly identify pipework and the products they contained.
    - Water : Green
    - Oil : Brown
    - Air : Blue
    - Steam : Grey
    - Gas : Yellow
    - Acid : Violet
    - Electrical : Orange
    - Other liquids : Black
- Bunds should be fitted with drain valves to release any collected storm water. These valves must be locked in the OFF position.
- Tanks holding flammable liquids, will be signed posted in the immediate vicinity with NO SMOKING signs.
- Permit-to-Work system is required to authorise entry into any tank or pipeline used to hold hazardous substances.

13.6.4 Underground Storage Tanks

- Underground storage tanks should be dipped on a regular basis to ensure they are not leaking.

- The area around vent pipes from petroleum underground storage tanks should be classified as a Designated Hazardous Area.
- No Smoking or Ignition Sources signs should be erected by vent pipes.

13.6.5 Gas Cylinders

Specifications for the safe handling and storage of gas cylinders are covered in the following sections.

Acceptance of Cylinders from Vendors

- The contents of cylinders must be identified with stencils, glued or wired on tags, or other markings on the cylinders (includes hazard class diamonds). Colour codes alone or tags hung around the necks of cylinders are not acceptable as these do not provide easy identification for all personnel.
- Cylinders must not be accepted from the vendor unless the valve safety covers are in place and properly tightened.

Handling and Storage of Compressed Gas Cylinders

- Personnel should receive training on storage, handling and hazard precautions prior to using compressed gases.
- Gas cylinders shall be stored when not in use in an appropriately designed gas cylinder storage rack.
- Compressed gas cylinders must not be removed unless the protective valve cover is in place. These provide protection for the contents should the cylinder become damaged in transit.
- The valve safety covers must be left on the cylinders until they are secured to walls, benches or stable pieces of equipment, or until no-tip bases are attached.
- Cylinders must not be dragged or rolled for distances greater than one metre.
- Do not let cylinders strike against each other. Avoid dropping cylinders.
- Cylinders of compressed gas must be secured at all times so they cannot fall. Each cylinder in the rack shall be individually chained (twice) to prevent the cylinders falling over. What a cylinder is secured to must in itself also be secure.
- All cylinders (oxygen/acetylene) etc shall be chained (twice) to their portable hand cart or portable racks.
- The main valve cylinder should be opened only as far as is necessary to produce the required gas flow and closed when the gas is not required.
- Full and empty cylinders must be clearly marked and stored separately if possible.
- Cylinders containing flammable gases should not be stored adjacent to oxidisers.

- Never attempt to refill empty cylinders.

Empty Cylinders

- Empty cylinders should be labelled as such and promptly removed. Generally, this requires marking (EMPTY or MT) on a large piece of adhesive or masking tape stuck on the cylinder. If the cylinder has a tag wired to the valve that identifies the contents, the bottom half of the tag may be removed to indicate an empty cylinder
- A small amount of gas must be left in the cylinder and the cylinder valves must be closed to prevent contamination of the inside of the cylinder.
- Cylinders without proper tags or labels must not be used. Label cylinder 'contents unknown' and place in the empty stack for return to the supplier.
- When a cylinder is no longer required or is due for hydrostatic testing disconnect it and remove it to the pick-up location.

Pressure Regulators and Needle Valves

- The valve fittings of cylinders used to store different families of gases are specific and will allow only regulators or needle valves that are safe for use with those gases to be attached. Only pressure regulators and needles valves approved for a specific gas may be used.
- Cylinders must not be purchased or accepted whose fittings do not conform to appropriate standards.
- Personnel must not attempt to lubricate threads or fittings. This may contaminate the gas.
- When attaching regulators or needle valves, connections must be firmly tightened. Non-adjustable wrenches of the proper size should be used. Pliers or adjustable wrenches, which may damage the brass nuts, should not be used. Leaks at the unions between the regulators and the cylinder valves are usually due to damage to the faces of the connections.
- After the pressure regulator is attached to the cylinder, turn out the delivery pressure adjusting screws of the regulators until they turn freely.
- Slowly open the cylinder valves. Avoid standing directly in front of the regulators at this time as the pressure of the cylinders may blow the glass from the front of a faulty gauge.
- Cylinder valve handles should be left attached to the valves while the cylinders are in use. Cylinder valves that 'stick' and do not open when the usual amount of force is applied may be damaged. Return to vendor stating on the cylinder that the valves are stuck.

- Pressure in full cylinders should be as indicated on the cylinders or labels. Lack of full pressure may indicate leaks at the connections between the cylinders and valve regulators, damaged regulators, or incompletely filled cylinders.
- Delivery lines should be connected to the low pressure outlet of the regulator valves or to the needle valves. Where low pressure lines are used, their valves should be closed and line pressure adjusted by turning the regulator delivery pressure adjusting screws until the desired pressures are shown on the delivery pressure gauges.
- If the gases are not to be used within a 24-hour period, close the cylinder valves, bleed the lines, and turn back the pressure adjusting screws until they turn freely. Damage to the gauges may result if pressure is left on the gauges during extended periods of non-use.

Leak Testing
Leak testing is the use of a solution, such as a soap solution, to observe a leak under pressure by the formation of bubbles as gas escapes from the leak.

- Compressed gas cylinders are tested for leaks when they are filled; however, leaks may be detected after cylinders have been received.
- Suspected cylinders should be tested both before and after attachment of the regulator.
- Leaking cylinders will be returned to the vendor, if toxic then immediate action.

13.6.6 Explosives

- All explosives shall be stored in a designated, appropriately designed explosive stores which must comply to OSHA regulations
- The store shall be labelled with the appropriate hazard class diamond, NO SMOKING signs. The store shall be located with two locks with one set of keys (to one lock) held by DGDC and the other held by the local police. Both keys are required to unlock the store.
- The procedures to be followed in handling and storing explosives are set out in the OSHA Blasting and the Use of Explosives 1926.905.
- A copy of this publication shall be held by the Site Health and Safety Officer.
- Blasting caps and boosters shall be transported in cap boxes acceptable to OSHA Blasting and the Use of Explosives 1926.905.
- All personnel involved in the handling and use of explosives shall be appropriately trained and hold certificates of competency.

13.6.7 Hazardous Wastes

Some of the wastes produced at DGDC facilities can be classified as hazardous. This includes items such as:

- cooling tower sludge which contains high concentrations of heavy metals
- waste oils
- solvent waste, etc

The handling precautions that shall be followed are the same as for hazardous substances. They are dependent on the inherent hazards of the waste. Cooling tower sludges have high heavy metal concentrations and therefore have to be handled in accordance with procedures used for materials containing heavy metals. (poisonous substances).

- Gloves, boots, overalls and dust masks should be worn by person handling sludge.
- Sludge should be kept damp.
- Sludge should be treated to inactivate leaking of heavy metal into environment (cement/lime stabilisation).
- Waste oils and solvents should be handled as flammable liquid which may contain toxic elements.

13.7 Emergency Procedures

- Emergency showers and eye wash stations installed next to all major equipment and storage areas using corrosive substances must be regularly inspected and maintained, so that they will function when required.
- Should corrosive product enter the eye or contact with the skin, the exposed area should be treated with copious quantities of clean water.
- All contaminated clothing should be removed as quickly as possible.
- While flushing of the affected party is being carried out, inform the nearest trained first-aider or medic, so that further treatment can be administered as required.
- For chemical spillages etc, please refer to DGDC-OHS-038 : Emergency Procedures.

13.8 Personal Protective Equipment

The use, maintenance and care of personal protective equipment for handling hazardous substances is covered in the Safety Equipment section of this manual.

13.9 Training

13.9.1 General Requirements

All DGDC personnel involved in the use, handling or storage of hazardous substances at the site will receive training.

Supervisory staff will receive in-depth training on the requirements for handling hazardous substances so as to be able to provide on-site training to hazardous substance handlers.

Induction training shall be provided before a person begins working with substances hazardous to health. This training shall ensure that the person is able to use the substances hazardous to health safely and is also able to use and maintain correctly any protective clothing and equipment.

Supervision shall be provided until an employee can demonstrate competence and an understanding of the process involving substances hazardous to health. Ongoing supervision and training should be commensurate with the risk to health as identified in the assessment process.

Elements of a Training Programme
While the content of both induction and ongoing training shall be suited to the tasks to be performed, the elements listed below would normally be incorporated.

- Information about the substance
  - recognising and interpreting the information on a label of a substance hazardous to health; and
  - how to access the MSDS and the information each part of the MSDS can provide.
- Information on using the substance:
  - specific work practices or procedures to be followed when using or handling a substance hazardous to health; and
  - any control measures in the workplace, including any information required by an employee to ensure the correct use and maintenance of the control measure(s).
- Information on personal health and safety:
  - the routes of entry into the body of a substance hazardous to health and ways of limiting exposure;
  - the correct use, fit and maintenance of protective clothing and equipment;

- the nature of, and reasons for, any monitoring required and access to the results of monitoring;
- the nature of, and reasons for, any health surveillance required in order to detect the effects of exposure to a substance hazardous to health; and
- the importance of asking a supervisor if the employee is unsure about the requirements for the safe handling of a substance hazardous to health.

- Emergency procedures
  - any procedure to be followed in case of an emergency involving a substance hazardous to health, including the use of all emergency equipment and any special decontamination procedures to be followed; and
  - first-aid and incident reporting procedures to be followed in case of injury or illness.

Training effectiveness will be validated by checking that employees understand and can apply the knowledge gained. The method used for validation could, depending on the nature of the work, range from written and practical tests to simply observing the tasks performed.

Basic training in handling of hazardous substances will be undertaken prior to a staff member commencing work. Refresher courses will be attended every two years. A more in-depth course will be attended within 3 months of starting work.

13.9.2 Training Records

A record should be maintained of the competencies that the employees gain for working with substances hazardous to health. This will allow for the scheduling of refresher training and assist in ensuring that a match between allocated tasks and competence is maintained.

OSHA Regulations
The procedures to be followed in the handling and storage of explosives and chemicals are set out in OSHA Blasting and the Use of Explosives 1926.905.

Form 1 OSHA Blasting and the Use of Explosives 1926.905. 3.1: Hazardous Substances Inventory

Product Name	Chemical Name	Material Type	Manufacturer	Usage Area	Storage Area	Total in Stock	MSDS Y/N

Dominica Geothermal Development Company Limited
Powering a New Generation...

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-021: Stress Due to Temperature Extremes
Revision 0

Contents

14. Stress Due to Temperature Extremes

14.1 Introduction

The purpose of this procedure is to reduce the incidence and effects of employee exposure to heat and cold through the provision of information and establishment of requirements for protection.

This procedure shall apply to all activities which need to be carried out in extremes of temperature at any time.

14.2 Definitions

Acclimatisation
Processes (physiological changes) by which people adapt themselves to be able to work safely and comfortably in an environment of temperature extremes.

Heat Strain
Short or long-term consequences of exposure to heat stress on a person's mind and body.

Heat Stress
Net heat load on the body with contributions from both metabolic heat production and external environmental factors including temperature, relative humidity, radiant heat transfers and air movement, as they are affected by clothing.

Heat Stroke
Extreme state of heat strain, occurring when the core body temperature reaches very high levels of 41°C or above. Can be fatal if immediate and appropriate treatment is not given.

Metabolic Heat
Heat created within the body.

Prickly Heat
Skin rash occurring in skin saturated with sweat.

Thermal Discomfort
State where a person is very conscious of being either too hot or too cold, but where no harm is suffered from the thermal environment. (This is very subjective).

WBGT (Wet Bulb Globe Temperature) Index:
The most widely accepted index used to determine environmental heat stress. It can be explained as a temperature reading that takes into account air temperature, humidity, radiant heat and air speed.

14.3 Responsibilities

- Every employee shall at all times wear suitable clothing appropriate to the work being undertaken and the temperature. This applies to employees, contractors and sub-contractors alike. Any requirement for specific clothing items required in either sign posting or in the Safe Work Practices shall be adhered to.
- Regular monitoring of heat and cold stress indicators shall be carried out where work is being done in extremes of temperature.
- DGDC shall provide a medical assessment to determine suitability of workers required to carry out high or low temperature work.
- DGDC shall assess effects of exposure to heat or cold stress.
- DGDC will undertake appropriate control measures for all work that must be carried out in temperature extremes.
- DGDC shall ensure that employees are trained for work in hot or cold environments. This shall be included in the induction training, Specific training must be provided for work in extreme temperatures

14.4 Background

There are six main factors that influence a person's perception of hot or cold:

- air temperature
- humidity
- radiant heat (emitted from anything that is hot e.g. direct sunlight)
- air movement
- physical activity
- clothing.

In addition to these six factors that affect everyone, there are personal factors that affect the individual. These include:

- weight (Overweight people are more at risk.)
- health (A number of medical conditions increase risk.)
- level of fitness (A physically fit person will acclimatise and generally cope with heat better than an unfit person.)
- age (As a person approaches middle age (45+), lifestyle health issues may make people more susceptible to heat stress.)
- use of drugs (prescribed or non-prescribed, including alcohol and cannabis).

14.5 Effects of Heat Exposure

Excessive heat can cause mental responses such as irritation, anger and depression as well as physical responses such as increased heart activity and sweating. A combination of these responses results in a lack of efficiency in performing heavy tasks, loss of concentration and increased error rates. The symptoms of heat strain are detailed in Table 14.1.

Table 14.1 : Symptoms of Heat Strain

Early Warning Signs	• Headaches • Muscle cramps • Changes in breathing patterns and pulse rates • Weakness • Heavy perspiration • Prickly heat • Dizziness or faintness • Reduced performance
Later Warning Signs	• Increased disturbance of breathing patterns • Initially strong, rapid pulse changing to weak, rapid pulse • Severe headaches • Severe muscle cramps • Cold clammy skin changing to hot dry skin • Cessation of perspiration

Any worker who stops sweating is at extreme risk of suffering serious harm. When sweating ceases, the body's core temperature will rise very rapidly. If the core temperature reaches 41°C or higher, the condition commonly known as 'heat stroke' can occur.

These symptoms are indications of the following medical conditions:

Dehydration	The body loses heat by sweating. Cooling occurs as the sweat evaporates. Water and salt lost through sweating must be replaced when working in hot conditions. Symptoms of dehydration are fatigue, irritability, headaches, nausea and giddiness.
Fainting	Fainting may result from a drop in blood pressure during prolonged standing in heat, or may be due to a sudden change from sitting to standing. In some industrial situations, the faint may itself be dangerous if the person is held upright in a confined space and the fall in blood pressure is sustained.
Heat Rash	The most common heat rash is prickly heat which usually occurs in areas where clothing is restrictive, and gives rise to a prickling sensation, especially when sweating.
Heat Cramps	Heat cramps are spasms in the voluntary muscles that occur following a reduction in the concentration of salt in the blood. Cramps can be readily alleviated by rest, drinking water, and correction of electrolyte imbalance in the body fluids.
Heat Exhaustion	This is a more serious disorder which is linked to dehydration and a lack of salt. It is a result of increased dilation of blood vessels and decreased blood volume.

Heat Stroke	Heat stroke is the most severe degree of heat strain, with a high mortality rate. It causes a major disruption of the central nervous system and is characterised by: convulsions, mania, coma, dilated pupils, core temperature of 41ºC or greater, and a hot dry skin.

14.6 Effects of Cold Stress

The three key factors are:

-
- temperature
- air movement
- physical activity.

The most likely situations where cold stress could develop are where employees are working outside in winter, at altitude or in wet conditions.

In moderately cold environments, the body's core temperature does not fall by more than 1°C below its normal level of about 37°C. However, in extremely cold environments, without proper protective clothing, the body's normal thermal regulatory mechanisms are not able to maintain this core temperature. A worker's core temperature should never be allowed to fall below 36°C (rectal) or 35.5°C (oral). Cold can affect both the body's extremities and the core temperature. Examples are given in Table 14.2.

14.7 Identification and Assessment of Exposure to Extremes of Temperature

Employees must inform management when they feel they are adversely effected by heat or cold. Any activities having the potential to cause hot or cold stress should be identified. These activities should be recorded and workers kept fully informed of the hazards.

14.7.1 Heat Stress

Where heat stress has been identified as a hazard, the Wet Bulb Globe Temperature (WBGT) must be measured regularly. The frequency is dependent on the severity of the heat stress and the duration/frequency of the exposure. This must be done by a suitably qualified and experienced person following the international standard: ISO 7243 Hot Environments: Estimation of the heat stress on working man, based on the WBGT index.

For ongoing work in a situation where heat stress is identified as a hazard, observation of employees is necessary to allow early intervention. All employees who work, or supervise work, in hot environments should be trained to recognise the symptoms and effects of heat strain. They should be able to readily identify heat strain in themselves or others when it occurs.

Heart rate monitoring shall be done when employees are exposed to a high degree of hazard (as determined by WBGT index). Changes in heart rate can reflect the core body temperature. Heart rate can be monitored during work using a portable device equipped with an alarm that will sound if the heart rate exceeds the safe level for that worker. If the alarm sounds, the worker must withdraw from the hot environment until the heart rate falls to a satisfactory level. Heart rate monitoring shall be overseen by a medical practitioner or suitably qualified person.

14.8 Medical Surveillance

Subject to Human Rights and Privacy provisions, all workers likely to be exposed routinely to hot or cold working conditions should be medically examined to confirm their ability to carry out such work without risk of harm.

The questionnaire (Form 14.1) should be used as a screening medical test. Blood pressure, pulse, temperature, weight and height should also be recorded at this time.

Further clinical examination may be necessary if any question is answered "yes" in the questionnaire.

This should be a comprehensive examination, conducted by a physician and concentrating on the following factors:

- obesity
- lack of physical fitness
- pre-existing disease of the:

- cardiovascular system, e.g. hypertension, valvular disease, cardiac enlargement;
- respiratory system, assessed clinically and by spirometry, e.g. obstructive or restrictive airways disease
- thermoregulatory system e.g. thyroid disease, other endocrine disease, prescription (home) medication.

Form 14.1: Screening Questionnaire Prior to Exposure to Heat or Cold Stress

Name: ______________________________

Date of Birth: ____________ Sex: Male/Female

Present Job: ________________

Years in Job: ____________

	YES	NO
Have you ever been affected by hot/cold conditions, making you think that you have a low tolerance to heat/cold? If yes, state the circumstances and treatment (if any):		
Have you ever experienced attacks of loss of consciousness, fits or faints?		
Do you suffer from diabetes or any other medical condition which you think may be affected by heat or cold?		
Do you suffer from heart disease or high blood pressure?		
Do you suffer from any chest disease, e.g. asthma, emphysema? If yes, please specify:		

Do you suffer from any skin disease, e.g. eczema, dermatitis? If yes, please specify:		
Have you had any treatment which reduces your ability to sweat, e.g. scarring from burns?		
Are you on any medication, either prescribed by your doctor or bought over the counter at a pharmacy? If yes, please specify:		
Have you had any of the following: If yes, please tick: Infection Fever Diarrhoea Vomiting Immunisation		
Are you on a salt-free or salt-reduced diet?		
Do you get little or no physical exercise?		
Do you drink alcohol? If yes, please specify how many units per week (1 unit = 0.5 L beer, glass wine, single nip spirit:		
Do you smoke or chew tobacco?		

Further investigations (X-ray, ECG, etc) can be ordered at the physician's discretion.

Pre-task health assessments should be carried out prior to a specific task, or block of work in a hot or cold environment. For people regularly working in hot or cold areas, the frequency of assessments should be decided by the physician.

14.9 Training

People who work in hot or cold environments, or who supervise that work, should be adequately trained to avoid heat or cold strain and associated conditions.

Training should include information about:

- the hazards to which they are exposed
- recognition of the symptoms of heat or cold strain or injury in both themselves and others
- appropriate systems or control measures put in place
- what employees need to do to protect themselves from the hazard
- the correct type of personal protection to be worn

- physical fitness and other personal factors
- emergency procedures.

Employees and contractors who have not been fully trained must be supervised by someone who has been trained.

14.10 Signposting

DGDC management will clearly identify hot working areas as part of the site's hazard identification process.

Access to hot working areas and working in hot or cold environments should be restricted to persons medically assessed and trained in first-aid and the effects of heat/cold stress.

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DGDC-OHS-022: Noise and Vibration
Revision 0

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15. Noise and Vibration

15.1 Introduction

The purpose of this procedure is to reduce employee exposure to noise through the provision of information and establishment of requirements for noise control and protection.

This procedure shall apply to all activities for which personal hearing protective equipment is required as specified by the safe work practices contained in this manual.

15.2 Background

15.2.1 Effects of Noise Exposure

Too much noise for long periods of time, or certain types of noise for even short periods of time, can cause loss of hearing. Initially, the excessive noise causes a temporary hearing loss. Hearing recovers to normal over a period of time away from the excessive noise source. Constant exposure to excessive noise will prevent recovery of normal hearing and will result in permanent loss of hearing, known as 'noise-induced hearing loss'. Severe noise exposures can also cause 'noise induced hearing loss'. For most noise-induced hearing losses, there is no cure, so that prevention of exposure to excessive noise is the only way to avoid hearing damage.

Humans lose hearing naturally with age, which is unavoidable. However, the increased degree of hearing loss that results from excessive occupational exposure is avoidable.

People suffering from noise-induced hearing loss have a tendency not to hear higher frequency noise. Noise is also distorted, with words becoming difficult to distinguish.

Personnel who take care to control noise exposures will be better able to:

- continue to communicate with family and friends
- concentrate more easily and be able to perform their work with greater efficiency
- reduce likelihood of accidents
- feel less tired and irritable at the end of the day
- appreciate the sounds of the birds, the stereo, TV, children's voices, etc.

15.2.2 Sources of Noise Exposure

Noise levels are normally described using a logarithmic scale called the decibel scale. Figure 15.1, below shows the noise levels (in decibels) for some common sounds.

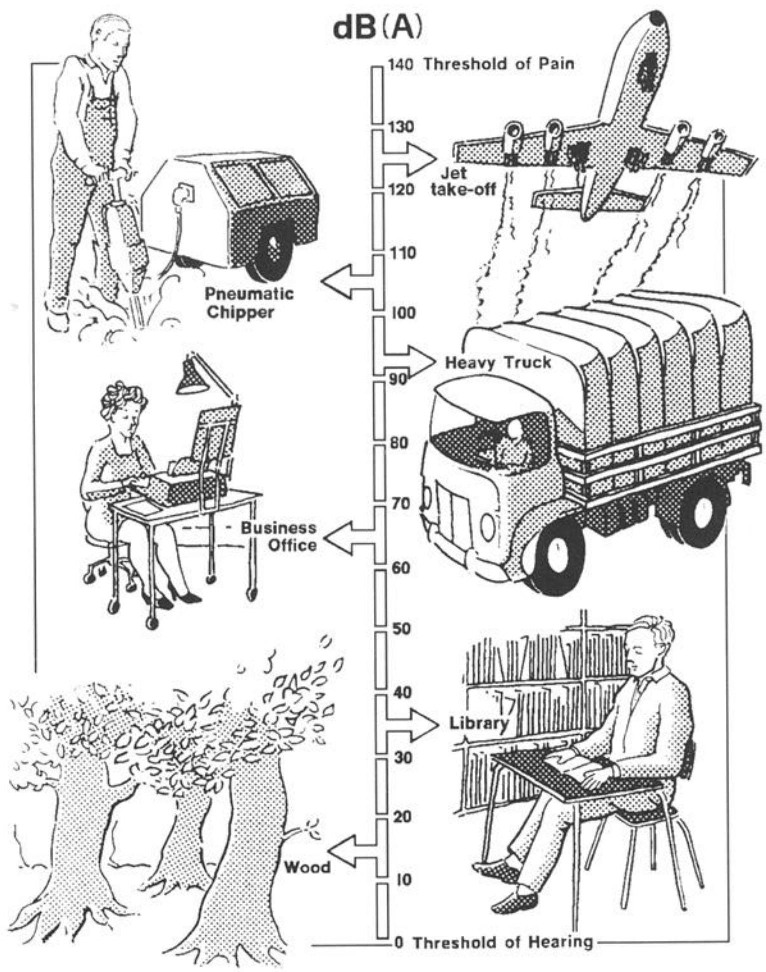
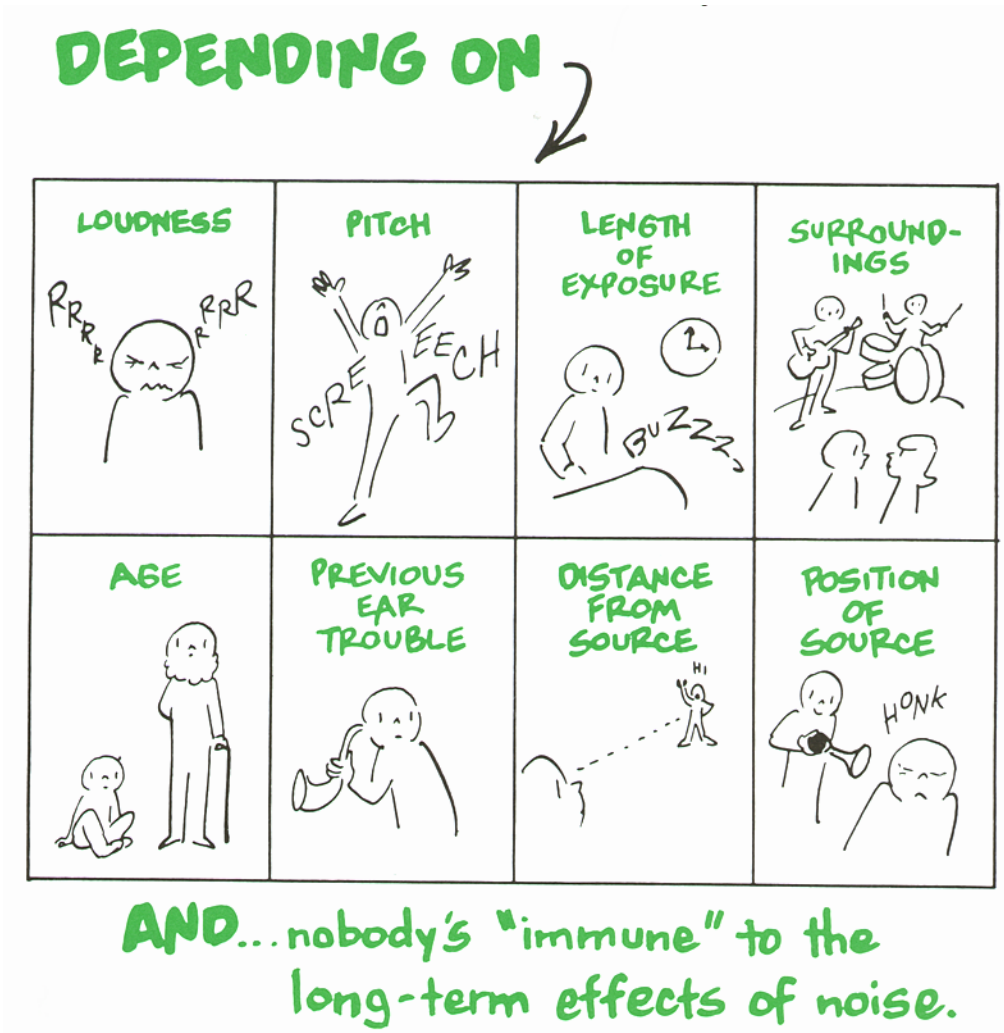


Figure 15.1 Decibel Levels of Common Sounds

The extent of noise-induced hearing loss depends the following:



The more time a person is exposed to any particular excessive noise level, the greater the degree of hearing loss. More time equals more acoustic energy and hence greater damage (see Figure 15.2).

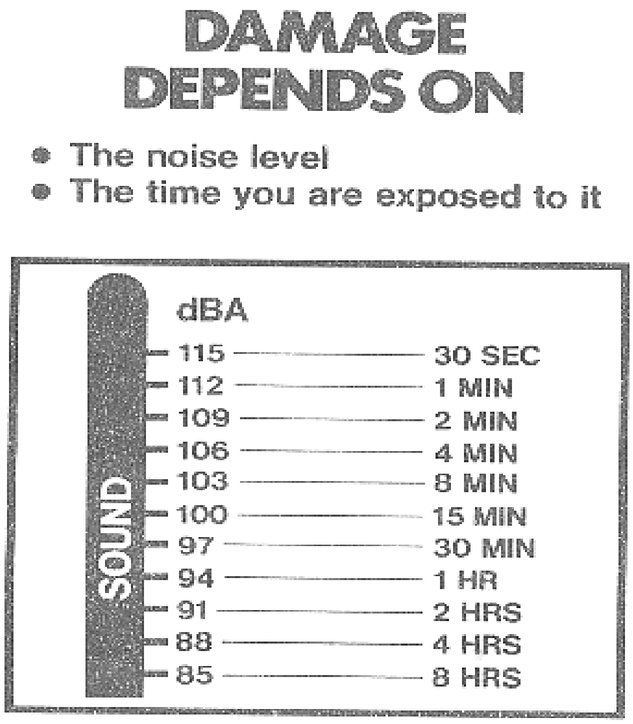


Figure 15.2 Hearing Damage

15.2.3 Guidelines for Prevention of Hearing Loss

Some individuals are more susceptible to noise than others and will lose hearing more readily through noise exposure. It is generally accepted that the average worker is unlikely to suffer long term effects if exposed to 85 dB(A) of noise for a maximum of eight hours per day, 40 hours per week. This is an average exposure; higher peak exposures may be acceptable for short periods of time.

15.2.4 Control of Occupational Noise

Many loud noises can be controlled at their source by good safety design of equipment, engineering controls and maintaining the equipment properly.

15.2.5 Vibration

Noisy processes are often associated with vibration. Intense vibration may be transmitted to employees who operate some vehicles, equipment, and hand-held tools. Vibration can cause muscular pain and possibly damage.

15.3 Responsibilities

- Every employee when working at the site shall wear suitable hearing protection appropriate to the work being undertaken and the noise levels. This applies to employees, contractors and sub-contractors alike. The requirement for hearing protection is specified in Volume 3 documents: Site Specific Safety, or by location-specific signs and notices.
- Regular monitoring of occupational noise shall be carried out by DGDC to determine areas where the 8-hour guideline level of 85 dB(A) is likely to be exceeded.
- DGDC management will keep records and undertake appropriate control measures in all locations for which either the 85 dB(A) for 8-hour guideline's or the short term guideline of 115 dB(A) is exceeded. This shall include sign posting of areas in which guidelines are exceeded.
- DGDC will strive to reduce noise exposure by controlling noise at the source wherever practicable.
- DGDC shall ensure that appropriate hearing protective devices are available to all employees, and that a record of supply and distribution of non-consumable equipment is kept.
- Site management shall ensure that employees are trained for work in noisy locations and in the use of hearing protection. This shall be included in the induction training and updated regularly according.
- Site management must ensure that all members of a work party and all contractors and sub-contractors are wearing appropriate hearing protection.
- All employees shall be responsible for the care of personal protective equipment issued to them, including the correct use, cleaning and maintenance of the equipment.
- If personal protective equipment is not available, or is inadequate for a task, or insufficient training has been provided, the employee shall inform their supervisor so that suitable equipment can be provided.
- Site management shall ensure that noise hazard areas are identified and assessed initially and every two years.

- DGDC shall take steps to minimise vibration hazards in the workplace

15.4 Actions

15.4.1 Identification and Assessment of Noise Exposure

An assessment shall be carried out to determine the areas where noise levels are likely to, or actually exceed the guidelines. These areas should be graded according to the level of hazard and the level of hearing protection required.

The baseline site-wide assessment will constitute the following steps:

Step 1: preliminary assessment and site walk-over

Step 2: initial survey of potentially noisy workplaces with sound level meter

Step 3: monitoring of representative individuals for noise dose

Step 4: monitoring of specific machinery/processes to consider control measures.

Step 1, the preliminary assessment shall determine the potential for noise exposure throughout DGDC activities.

Further assessment (step 2, and steps 3 and/or 4) should be carried out if one of the conditions listed below exist.

- There is difficulty in communication between two people at 1 metre distance. (Difficulty means that the speaker must raise his/her voice, or that the listener may not understand what is said).
- The workers notice a reduction in hearing over the course of the day. (This reduction may not be noticed until after work.)
- Employees experience ringing in the ears or blurred/dull hearing.
- Hearing protection is being used.
- Noise appears louder than 85dB(A) using scale presented in Figure 15.1.
- There have been employee complaints regarding noise levels.

The initial noise survey should be done for all areas identified with potential for noise exposure. This will be used to establish graded hearing protection zones and may in some instances include the preparation of contour plots.

Following this review of noise exposures, various areas will be designated hearing protection zones. They will be graded in accordance with the requirements specified in Table 15.1 and personnel will be required to wear the appropriate grade of hearing protection devices when working in designated hearing protection zones.

Table 15.1 Hearing Protection Grades

Hearing Protection Grade	Noise Level (dB(A))	Approved Hearing Protectors
1	86 - 91	Earplugs, Earmuffs
2	92 - 97	Earplugs, Earmuffs
3	98 - 103	Earmuffs
4	104 - 109	Double ear protection
5	110 - 115	Double ear protection

Steps 3 and 4 of the noise exposure assessment will be undertaken to consider appropriate control measures:

- Personal exposure monitoring (step 3) shall be carried out using dosimeters for full shift exposures.
- Source monitoring shall include octave band analysis where appropriate.
- Both personal exposure and source monitoring may be required to determine appropriate control measures.
- The noise assessment shall be conducted by an experienced and knowledgeable person who can not only assess noise exposure of personnel, but also gain insight into noise control solutions. This may be a specifically trained and experienced DGDC employee or external contractor/consultant.
- All measurements and observations should be carefully recorded.

Stage 1 and 2 of noise assessment should be recorded on the forms attached (Forms 15.1 and 15.2). Personal monitoring is done using a dosimeter and results are data-logged. Thus the recording of result should be done using the computer printout. Source noise monitoring results shall be recorded as appropriate for the particular situation, including the details of octave band monitoring. In all cases, any control measures recommended must be recorded, together with the date of implementation of those measures if appropriate.

The baseline monitoring programme will establish the levels of noise associated with normal operations. This monitoring should be repeated every two years. Similarly, new processes should be assessed for noise potential initially, and every two years following implementation. In addition, noise levels should be reassessed following the implementation of any control measures to determine the effectiveness of such control measures.

15.5 Hearing Protection Signs

DGDC management will clearly identify by signs to label areas, plant, and equipment where hearing protection devices shall be worn.

Access to designated hearing protection zones should be restricted to persons trained in the use of hearing protection. Personnel found not wearing hearing protection in zones requiring hearing protection to be worn will be subject to disciplinary action.

The sign to indicate hearing protection is required is shown below. The sign shall include the hearing protection grade (1-5) for the area.

15.6 Audiometric Testing

Audiometry is the measurement of hearing threshold. These tests will give an estimate of hearing loss. Where hearing loss is due to noise exposure, it may take months or even years of repeated noise exposure before permanent hearing loss becomes measurable. This is why it is important to conduct noise exposure monitoring in conjunction with audiometric testing. If results of audiometric tests and exposure monitoring do indicate that hearing loss due to noise exposure has occurred, then control measures must be reviewed and improved as appropriate.

DGDC will provide for audiometric testing for all employees required to wear hearing protection. The testing must be carried out by a trained and qualified person.

Audiometric testing should be done:

- within three months after an employee commences employment

- at any time, when reasonably requested by a health and safety representative
- at least every two years.

Details of testing carried out and the results must be recorded. Results will be provided to the employee concerned and explained in full.

15.7 Noise Control

Noise should be controlled at the source wherever possible.

The determination of appropriate control measures should be the result of the baseline and subsequent noise assessments and thus performed by a suitably qualified individual. The noise assessor must take into account not only the intensity of the noise, but also frequency and the degree of disturbance caused by the noise.

However, some noise control measures must be part ongoing work activities. Individual employees and supervisors should control noise in their work area as appropriate, including consideration of the items listed below:

- Plant and Equipment Maintenance: Badly worn bearings and gears, poor lubrication, loose parts, slapping belts, unbalanced rotating parts and steam or air leaks all create vibration and noise which can be reduced by good maintenance.
- Noise sources should be isolated by using barriers, noise enclosures, vibration isolation mountings, lagging to dampen vibrating surfaces, mufflers or silencers for air and gas flows, or reducing air velocity of free jets.
- Noisy elements such as pumps, fans, air compressors, etc should be isolated using purpose designed mountings and connections.
- Vibrating plant or guards should be securely fixed and stiffened to prevent drumming and vibration.
- Consideration should be given to the replacement of noisy plant and equipment by installation of newer, less noisy equipment.
- Specific noise sources may be corrected by minor design changes.

Work activities can also be tailored to reduce noise exposure.

- Metal-to-metal impact should be avoided or reduced where possible.
- Noisy devices should be switched on only when actually in use.
- Fall heights onto hard surfaces should always be minimised.

- Air supply pressure should be matched to the actual needs of air-powered equipment.
- Where possible, work should be conducted at distance from noise source (preferably in another room).
- Breaks should be taken in another room.

15.8 Hearing Protection

Where noise levels cannot be sufficiently controlled, hearing protection must be worn. Guidelines for the wearing of hearing protection and its care are provided in DGDC-OHS-031: Personal Safety Equipment.

15.9 Procurement

The noise levels produced by new equipment must be a consideration in the purchase of new equipment as part of the new equipment hazard identification and assessment process as specified in DGDC-OHS-011: Hazard Identification, Assessment and Control.

15.10 Vibration

15.10.1 Introduction

Vehicles (air, land and water), as well as machinery expose man to mechanical vibration which can interfere with comfort, working efficiency and, in some circumstances, health and safety. Effects are varied but include nervousness, irritability, sleeplessness, fatigue and lack of concentration. Normally, vibration is reduced to increase comfort and to eliminate any reduction in performance.

15.10.2 Procedure

Exposure to vibration must be minimised in all situations. In situations where vibration cannot be reduced to a comfortable level, the level of vibration must be reviewed and assessed by an expert in accordance with International Standard ISO 2631/1 or equivalent.

In most cases, the minimisation of exposure to vibration will involve similar measures to the control of noise exposure, including the following:

- maintenance (tightening fittings, balancing etc)
- isolate vibration using springs or dampeners (e.g. foam, rubber, plastic, cork)
- minimise machinery in contact with vibrating part

- enclose vibrating machinery
- locate vibrating machinery on thick, rigid surfaces
- minimise worker contact with vibrating surfaces by job rotation and work planning.

Vibration is one of the hazards that should be identified in any design review as part of DGDC’s approach to new plant and equipment, as specified in the Safety in Design Manual.

15.11 Training

If an employee’s exposure to noise is likely to exceed 85 dB(A), DGDC will provide training on the following:

- the effects of exposure to noise
- any control measures implemented
- details of audiometric testing
- selection, fit and maintenance of hearing protection devices.

Training shall also be provided for supervisors of employees likely to be exposed to noise.

New employees will receive training before they begin work in a noisy environment. This training will be repeated every two years.

Form 15.1 Noise Assessment-Preliminary Survey

DGDC Division:	
Site Name:	
Site Location:	
Name of Noise Assessor:	
Date of Assessment:	

Sources of Noise: (mark on Site Plan on the reverse of this form)

Persons working	**Proximity to source**	**Length of time close to source**

To be completed in consultation with the employees working in area			
	Yes	**No**	**Comment**
Difficulty communicating at 1 m?			
Reduction in hearing over the course of the day?			
Ringing in the ears or blurred/dull hearing?			
Hearing protection is being used?			
Noise appears louder than 85 dB(A)?			
Employee complaints regarding noise levels?			

A "yes" answer to any of the above questions will necessitate further assessment

Control measures recommended?	
Control measures implemented?	

Site Plan
Mark on noise sources

Form 15.2 Initial Noise Assessment Survey

DGDC Division:	
Site Name:	
Site Location:	
Name of Noise Assessor:	
Date of Assessment:	

Location	Nose @ (dB(A))	No. of Workers	Control Measures Recommended	Date of Implementation

*Details of the number of employees working near the source and the time spent near the source should be included in the preliminary assessment (Form 15.1)

If the initial noise survey shows that noise levels are unacceptable, and recommended control measures are inadequate, further personal and/or source monitoring must be carried out.

Measured noise levels should be marked on the site plan (Form 15.1).

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16. Lifting Equipment and Lifting

16.1 Introduction

This section provides guidance for all those persons having responsibility for safety in the selection and use of lifting plant and equipment.

It is not possible in a document of this nature to cover every lifting application in detail. However, it is anticipated that most problems can be settled by reference to the principles contained within this document.

16.2 General Lifting

16.2.1 Definitions

Lifting Appliance
Any machine other than a crane used to raise or lower a load, but does not include a conveyor, elevator or an excavator handling soil, aggregate, mineral or a like substance.

Load Indicating Device
A device that measures and displays the weight being lifted or force being applied.

Minimum Breaking Load (MBL)
The maximum certified test load that the rope will carry without parting.

Qualified Person
A person who, by possession of a recognised degree, certificate or professional standing, or who by knowledge, training or experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the subject.

Safe Working Load (SWL)
The maximum rated load which can be safely handled by a machine under specified conditions.

Lifting

- All personnel involved in lifting of any kind shall have the required skill, knowledge, experience and qualifications for the task being performed.

- Before starting any lift, the weight to be lifted, together with the lifting tackle to be used shall be determined.
- Lifting areas must be properly lit for safe handling of the load.
- Unless unavoidable, personnel shall never walk or stand under suspended loads and, as far as possible, all personnel shall keep clear of the area of operations.
- Particular care shall be used in moving or lifting heavy equipment especially around pressure vessels, lines, and wells. It may be necessary, or required, to shut in or bypass a system where such lifts are made.

16.2.2 Use of Lifting Equipment

- No lifting gear is to be used unless it is certified to be safe by an appropriate Dominican authority or OSHA standards 1926.251 1926.251(a)(4)1926.32 1926.32(q)
- New or serviced items shall not be used unless a test certificate has been received.
- Lifting equipment out of its statutory life is not to be used.
- No lifting equipment is ever to be loaded above its SWL, except for the purpose of proof testing.
- If a lifting appliance is fitted with a SWL indicator, or alarm, this shall not be disconnected at any time while the equipment is in service.
- All items of lifting equipment shall be clearly marked (die stamped if possible) with its SWL and identification number.
- Those parts of lifting appliance wire-lines which are liable to suffer wear or deterioration, are to be examined at intervals of 7 days.
- When lifting gear is damaged or worn beyond repair, it shall be destroyed in such a fashion as to be rendered useless. Records shall be adjusted and the test certificate cancelled.
- Examination and Testing of Lifting Equipment
- All lifting gear and appliances shall be examined and tested to the requirements of the relevant statutory legislation.
- Details of all examinations and tests are to be recorded in the official register and be available, along with test certificates, for inspection.

16.3 Cranes

16.3.1 Definitions

Crane
Any appliance equipped with mechanical, hydraulic, pneumatic or electrical means for raising and lowering a load by ropes or chains and transporting the load while suspended. It includes all chains, ropes, slings, shackles, swivels, rings, hooks, or other tackle used in the operation of a crane but does not include:

- a hoist block running on a fixed rail or wire
- a stacker or conveyor whereby a load is moved by means of a belt or platform
- an earth moving or mineral moving or excavating appliance not fitted with a grab.

Crane Operator
A person who through training and experience is assessed as competent to operate a particular make and model of crane and holds a valid certificate.

Dogman/Pilot
A person who through training and experience is qualified to sling loads and direct the lifting and placing operations of a crane.

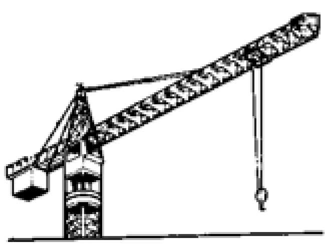
Safety Ropes or Boom Arresters
Ties fitted between the underside of the boom to a fixed part of the crane to prevent whip back. Safety ropes may also be fitted between the underside of a fly jib and boom.

16.3.2 Crane Operation

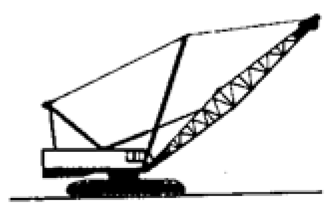
- All cranes shall be operated by a trained and certified operator. They shall be operated within the scope of their rating, and shall be maintained in good order and condition at all times.
- Before any crane is used, it shall have a valid test certificate or be in date for test.
- Immediately before being put into use after installation, re-installation, substantial alterations or repair, or at maximum intervals of 1 year, the crane must be re-tested. The person performing the tests shall not be an employee of the company.
- A check is to be completed at the commencement of each shift. The check is to cover cables, fittings, drums, dog brakes, boom, hooks and guards. Limit switches are to be tested to ensure that they are working correctly. Sheaves and other

rotating parts are to be greased on a regular basis as recommended by the manufacturer.

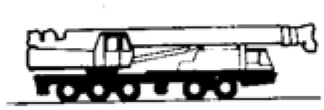
- Crane safety load indicators and alarms shall be inspected and tested at intervals of seven days.
- A table showing the SWL and radius limitations of the crane shall be prominently displayed in the crane cabin. The table shall take into account the number of lines that are being used with regard to concluding the SWL. For any change of boom length, the table shall be changed to clearly show the new SWL and radius limitations.
- The crane operator shall be advised of the weight of each load to be lifted.
- The crane boom and hook shall be safely secured before the operator leaves the crane.
- Cables on the drum are never to be run off to less than two remaining turns.
- Crane activities shall stop in the event of a potentially dangerous situation.
- Crane hoisting mechanisms shall never be used for any purpose other than lifting or lowering.
- No crane operation will take place without an appointed ‘dogman’, and an adequate system of communication between the ‘dogman’ and the crane operator being established (see the hand signals shown in section 16.3.7).



Tower Crane

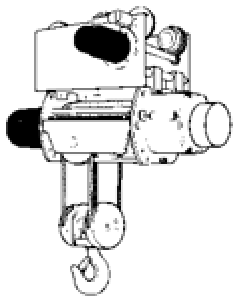


Track Crane



Mobile Crane

All Terrain Crane



Gantry Crane

Figure 16.1: Types of Crane

16.3.3 Training and Qualification for Crane Driving

- No person under the age of 18 years shall drive or operate a crane.
- Cranes are only to be operated by persons who have been trained and qualified to an appropriate level.
- Only personnel with good sight (corrected with spectacles if necessary) and good hearing are to be selected as crane drivers.

16.3.4 Operator's Responsibilities

Teamwork in cranage is essential. In order to achieve this, there must be ongoing communication between all involved in crane operations. Operators shall:

- operate the machine safely
- operate the crane or lifting appliance in accordance with the manufacturer's instructions and within its safe working load (SWL)
- not interfere with or disconnect any limiting or safety device intended for the safe operation of the crane or lifting appliance
- not continue to lift a load which causes the safe load indicators to alarm
- report any defect in their crane or lifting appliance to their supervisor
- carry out each lift in a safe and efficient manner
- beware of hazards in the vicinity of the lifting operation.

16.3.5 Loads

- Whenever loads are being handled, the operator shall be alert to the potential hazards involved. Some of the more obvious points that operators must take into consideration, include:
  - crane or lifting appliance capacity rating, at required position
  - the weight of each load to be handled
  - the safe working load of any rope, sling, chain or shackle used.
- All loads shall be secured to prevent slipping or displacement. The security of each load shall be checked after it has been raised a few centimetres.
- Loads shall never be left suspended if the crane is unattended.

16.3.6 Safety Devices

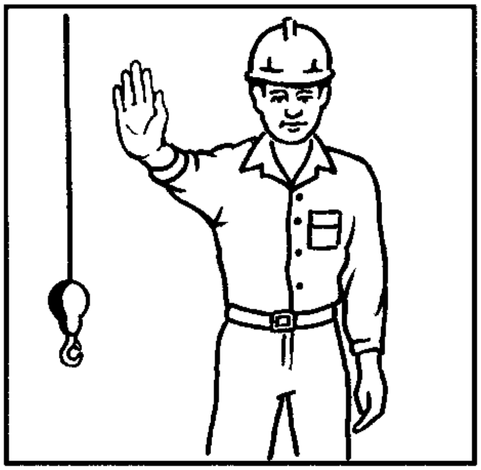
All safety devices provided on cranes which indicate an unsafe or an overload condition shall be kept in first-class working order and shall be tested at least once a week. The adjustments are to be in the right range and the device in good working order. These tests are to be recorded.

16.3.7 Signalling

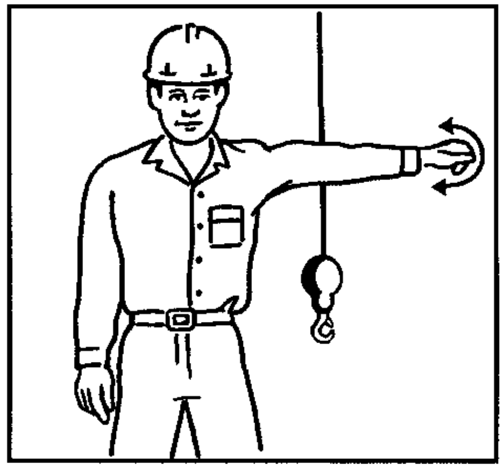
Signalling to operators shall be done in accordance with recognised standards, and then only by persons who have the required knowledge and experience and are fully conversant with the operation.

- The signaller shall stand in a secure position where they can see the load and can be clearly seen by the driver.
- The signaller shall face the driver if possible.
- Each signal shall be distinct and clear.

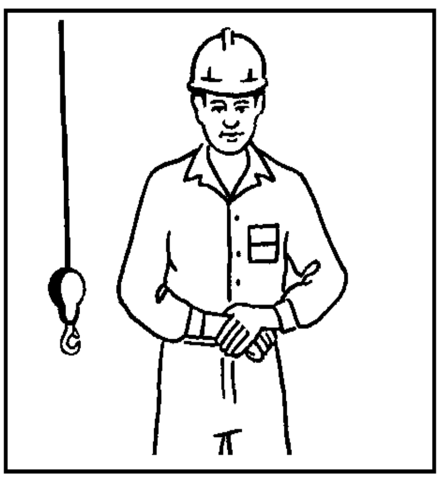
Illustrations that show recommended crane signals are included on the following pages.



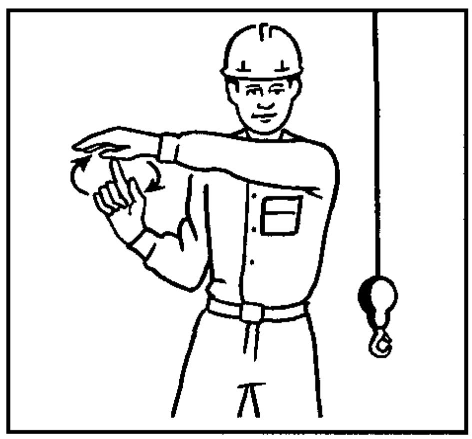
STOP A. Extend one arm forward.
EMERGENCY STOP is indicated by
extending both arms.



STOP B. Arm extended, palm down, move
hand right and left.
Usually for tower crane operation.

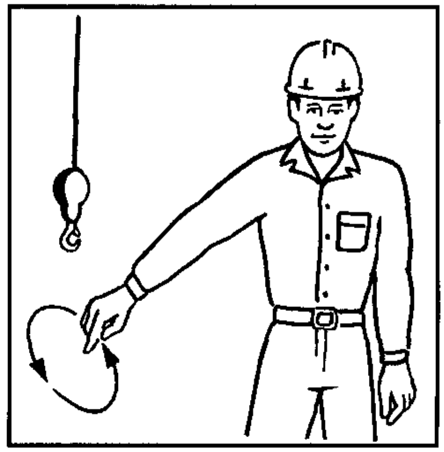


HOLD EVERYTHING. Clasp hands
in front of body.

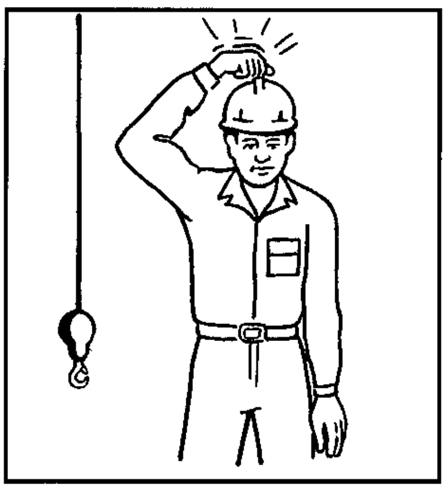


MOVE SLOWLY. Use one hand to give any
motion signal and place other hand motionless
in front of hand giving the motion signal.
(HOIST SLOWLY shown as example.)

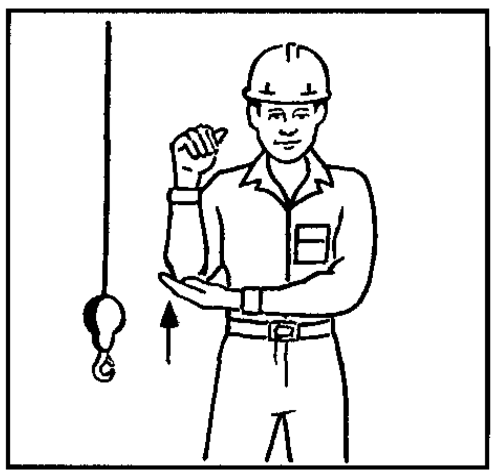
HOIST. With forearm vertical, forefinger pointing up, move hand in small horizontal circles.



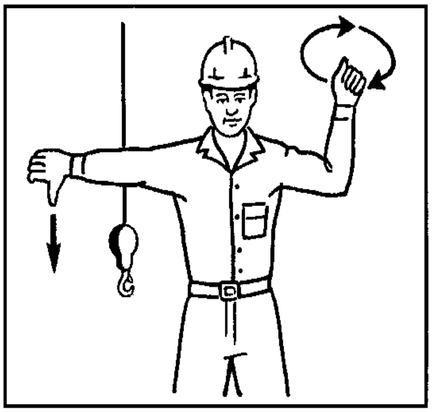
LOWER. With arm extended downward, forefinger pointing down, move arm in horizontal circles.



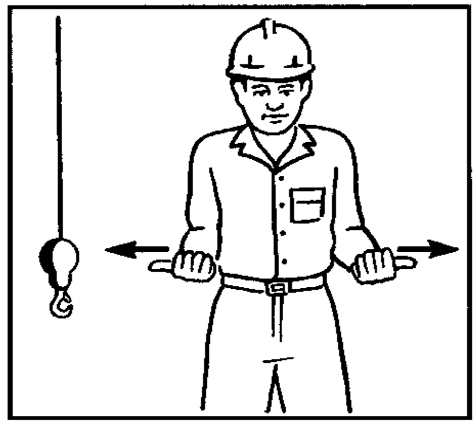
USE MAIN HOIST. Tap fist on head, then use regular signals.



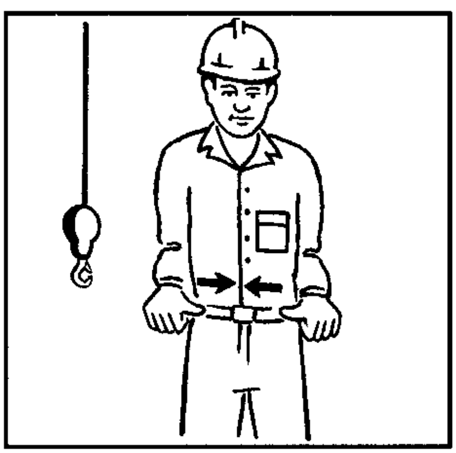
USE FLYLINE (auxiliary hoist). Tap elbow with one hand, then use regular signals.



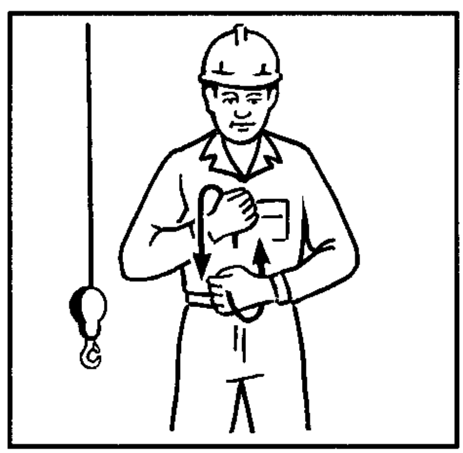
LOWER THE BOOM AND RAISE THE LOAD. Right arm extended, thumb pointing down and left forearm and forefinger vertical, move left hand in small horizontal circles.



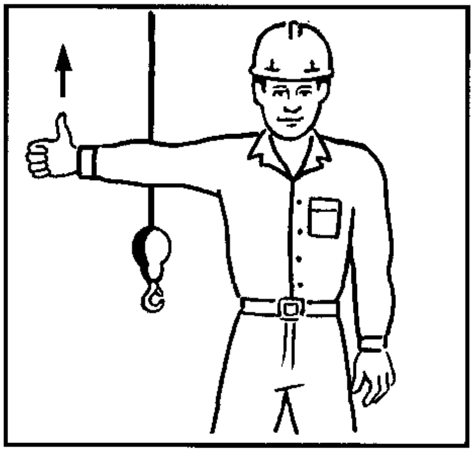
TROLLEY OUT or EXTEND BOOM. Both fists in front of body with thumbs pointing outward.



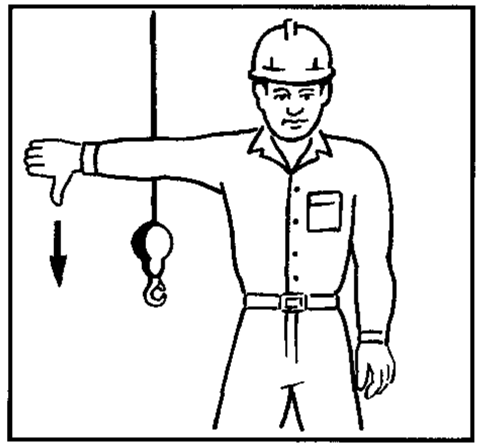
TROLLEY IN or RETRACT BOOM. Both fists in front of body with thumbs pointing toward each other.



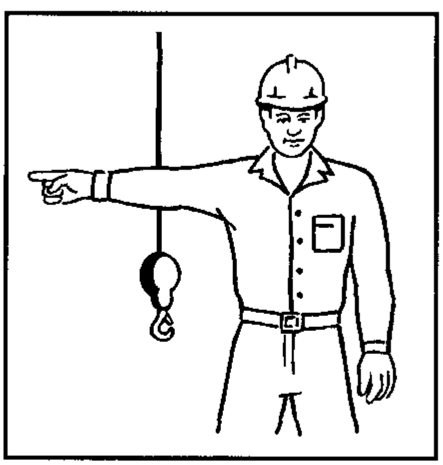
TRAVEL. Arms each bent at elbows, fists clenched, rotate both forearms around each other. Then point in the direction of travel.



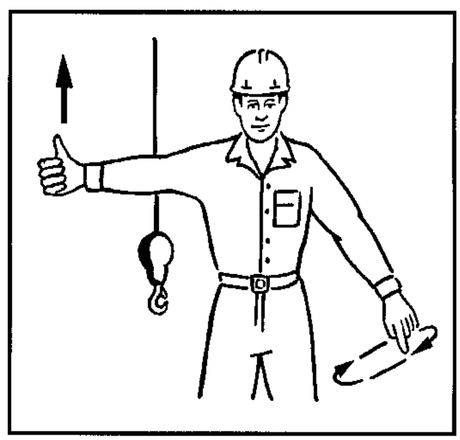
RAISE BOOM (luff up). Arm extended, fingers closed, thumb pointing upward.



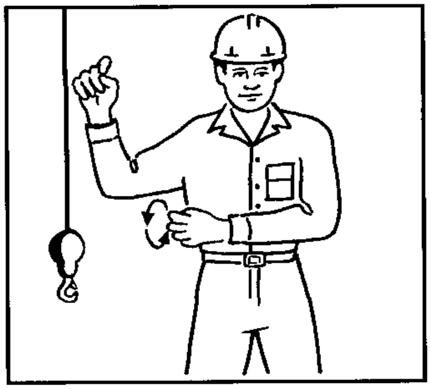
LOWER BOOM (luff down). Arm extended, fingers closed, thumb pointing downward.



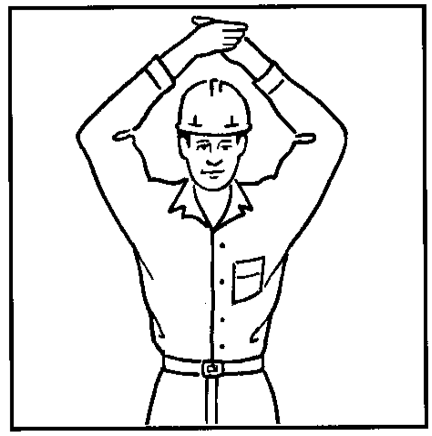
SLEW. Arm extended, point with finger in direction of swing of boom.



RAISE THE BOOM AND LOWER THE LOAD. Right arm extended, thumb pointing up, left arm extended downward swinging in horizontal circles.



TRAVEL (one track). Lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist rotated vertically in front of body. (For crawler cranes only.)



FINISHED WITH CRANE. Place arms above head and cross arms.

16.3.8 Mobile Cranes

- A 'mobile crane plan' (refer to Form 16.1 Mobile Crane Plan) shall be completed prior to using a mobile crane at the site.
- Where outriggers are fitted to wheels of cranes, they shall be fully extended and firmly jacked before lifting operations commence.
- Only cranes specifically designed for the purpose shall be used to transport loads. The hoisting mechanism of a crane shall not be used for any other purpose than lifting or lowering the load vertically.
- Hooks shall be properly and safely secured while the crane is in transit, with the jib in the 'shut-down' position.

16.3.9 Gantry Cranes

- Warning notices shall be posted in prominent positions, especially at access points, to indicate that a crane operates in the area.
- An audible warning device must operate whenever a gantry crane is in use or tracking.
- No work may be carried out on or near the crane tracks or in way of the crane's travel, until the crane has been rendered inoperable by electrical isolation.

16.3.10 Multi-Lifting

Multi-lifting is a hazardous operation that requires close team work between operators, dogman, and machines.

The following rules must be observed:

- A detailed work method statement is to be prepared and checked before the work is carried out. This statement should include the duties and responsibilities of all personnel involved and the safe practices to be followed.
- Operators and dogman shall be experienced, not trainees unless under the direct supervision of an experienced person.
- The multi-lift is to be under the direction of one experienced person.
- Directions between dogman and operators may be direct line of sight using signals (set out above) or by two-way radio or telephone with a dedicated channel.
- It is recommended that the crane safe working load (SWL) ratings be reduced by 25% on each crane.
- The weight of the lift shall be made known to all involved.
- Where cranes are used to lift a load beyond their individual capacity, the load should be distributed between each crane by means of equalising tackle.
- Each crane shall be set up level and stable.
- Throughout the lifting operation, the hoisting ropes shall be vertical.
- Where practicable, a trial lift shall be made.
- All lifting equipment, shall be certified, checked and any faulty equipment discarded from use.

NOTE: While it is accepted that there are some lifts that can only be carried out using more than one crane, it is not a work practice that is recommended.

16.3.11 Snagged or Stuck Loads

Any load that may overload a crane even though the weight is less than its SWL, due to vacuum or bonding between load and/or support should be wedged or levered free. Never try to free a snagged or stuck load by slewing or luffing out line. Beware of exceeding the safe working load (SWL) when trying to free a stuck load.

16.3.12 Tag Lines

Where there is a likelihood of load-spin, tag lines should be attached and used (see Figure 16.16).

16.3.13 Wind Conditions

Consideration needs to be given to wind speed prior to undertaking any lift. Loads with large surface areas can be hazardous, as the wind may cause the load to spin, resulting in loss of control.

16.3.14 Crane-Lifted Work Platforms

The use of a crane to suspend a working platform is restricted to work that cannot reasonably be carried out safely by other means. Conditions that apply to the use of a crane-suspended working platform are listed below:

- The working platform shall be certified as safe by an appropriately qualified person.
- The occupied platform shall be raised and lowered under power. Free fall is not permitted.
- The crane operator shall have had at least 80 hours safe operating experience on the machine being used.
- The operator shall remain at the controls at all times when the platform is in use.
- The perimeter of the work platform shall be fitted with sides or guard rails, mid-rail and toe boards.
- The platform's weight and safe working load shall be clearly displayed on the platform and not exceeded.
- All shackles shall be moussed and the hook shall have a safety latch.
- Personnel working from the platform shall wear a safety harness attached to a suitable independent point and/or line.

16.3.15 Crane-Hoisted Personnel Baskets

Personnel working in or working from personnel baskets shall wear a safety harness and have their lanyards attached and secured while aloft. Refer to DGDC-OHS-023: Working at Height.

The use of a crane to suspend a personnel basket is restricted to work that cannot be carried out safely by other means.

16.4 Rigging

16.4.1 Rigging of Loads

- All slinging of loads shall be done by experienced personnel and care must be taken in assessing the correct weight, the load, and the correct size of slings required.
- All chains, ropes, slings and lifting tackle shall be free of any obvious defects, shall be of adequate strength, shall be constructed of sound material, and shall be maintained in good order and condition.
- Slings and lifting tackle shall be examined as required by the manufacturer's instructions and records kept of all examinations.
- Any defective items shall be removed from use.

16.4.2 Factor of Safety

This is the ratio of the load that would cause failure of a member or structure to the load that is imposed upon it in service. Unless otherwise prescribed, the factor of safety should be a minimum of 3.

Table 16.1: Lifting Equipment Factors of Safety

Lifting Equipment	Required Factor of Safety
Wire Rope	5
Chain	4
Hand Haulage Fibre rope	6
Electric and air operated hoists	10
Webbing Slings	6
Shackles	4

16.4.3 Safe Working Load (SWL)

This is the maximum load calculated in accordance with sound and accepted engineering practice taking account of the appropriate factors of safety identified in Section 16.4.2, which can be supported safely under normal working conditions.

- The safe working load (SWL) of each sling shall be clearly identifiable to the user.
- The SWL must not be exceeded.

- Slings should always be used as near vertical as possible.

On two leg slings, always be aware of the changing SWL factor with changing angles of the sling. In general, if L is greater than S, as shown in Figure 16.3, then slinging is acceptable. Refer to Section 16.4.5 for more details on slinging methods and sling angles.

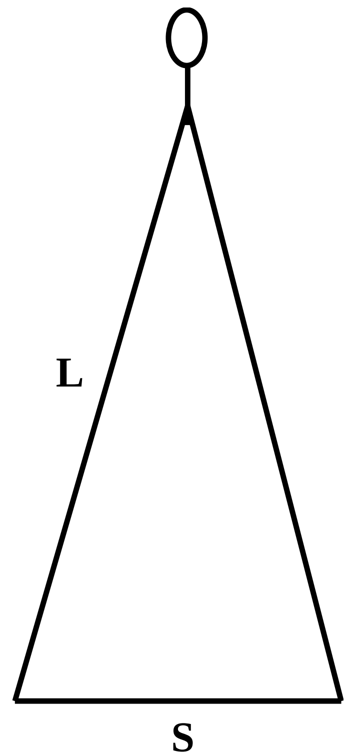


Figure 16.2: Sling Ratio

16.4.4 Safe Use of Slings

The basic objective of good slinging practice is to ensure that the load is safe and, when slung, is as secure in the air as it was on the ground. The basic principles are listed below:

- The sling and its method of use shall be suitable for the load.
- The method of attachment of the sling to the load and the sling to the lifting appliance shall be secure.
- No part of the sling shall be overloaded either by the weight of the load or the method of slinging
- The slinging method shall ensure that the load is secure and the load will not fall from the sling

- The load shall be balanced and stable so that it cannot violently change its attitude when lifted.
- The load shall not be damaged by, or cause damage to, the sling.

16.4.5 Methods of Slinging

Slings can be used in a variety of ways according to the requirements of the job. The lifting capacity or sling safe working load (SWL) required, is calculated by:

- determining the weight of the load to be lifted
- determining the slinging method ensuring that restrictions of the sling-load connection/attachment method (Section 16.4.6) are met
- adjusting the SWL of the slings for the chosen slinging method as per this section
- adjusting the required sling SWL by the sling-load connection/attachment rating (column 3 of Table 16.2) by multiplying the sling SWL by the rating of the chosen attachment method.

Two-Leg Sling

A two-leg sling comprises of two legs permanently connected at their upper ends by a suitable ring or link and marked as an assembly. Two-leg slings may be used to handle a wide range of loads. (See figure 16.3)

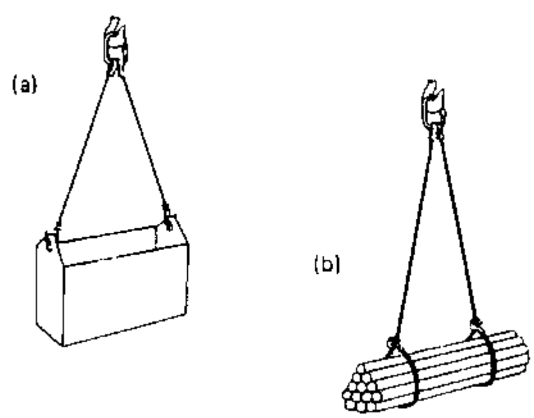


Figure 16.3: Two-Leg Slings

Where the included angle between legs is from 0o to 90o, or each sling leg is not more than 45o to the vertical, the safe load limit of the two leg sling assembly is calculated by multiplying the SWL of one sling leg by 1.4, i.e. SWL x 1.4 = safe load limit of the two leg sling assembly.

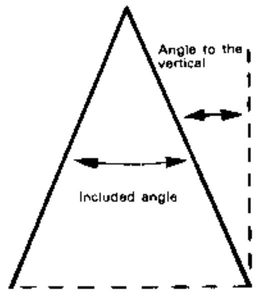


Figure 16.4: Diagram Showing Restriction Angles for Two Leg Slings

Three-Leg Sling

A three-leg sling comprises three legs permanently connected at their upper ends by a suitable ring or link assembly and marked as an assembly. Three-leg slings are commonly used to handle circular or irregularly shaped loads where the legs can be equally spaced. (See figure 16.5)

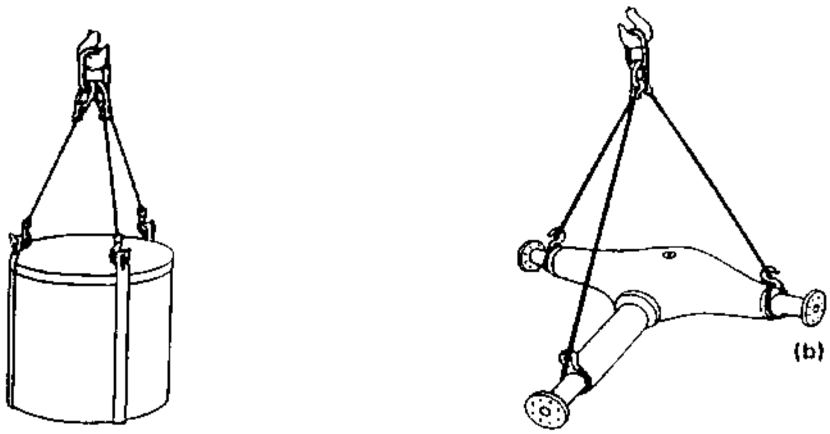


Figure 16.5: Three-Leg Slings

Where the maximum included angle between any leg and vertical is not greater than 45o, the safe load limit of the three leg sling assembly is calculated by multiplying, the SWL of one leg by 2.1, i.e. SWL x 2.1 = safe load limit of the three leg sling assembly.

Where the maximum included angle between any leg and vertical is greater than 45o, but not more than 60o, the safe load limit of the three leg sling assembly is the SWL of one leg multiplied by 1.5, i.e. SWL x 1.5 = safe load limit of the three leg sling assembly.

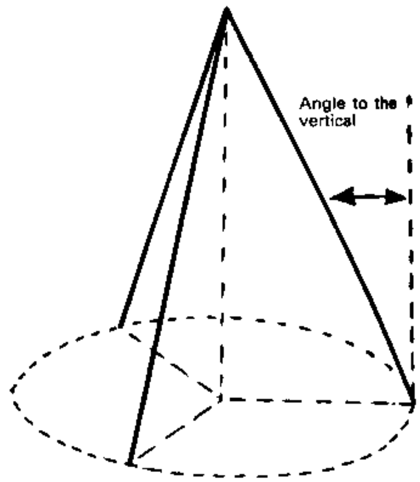


Figure 16.6: Diagram Showing Restriction Angles for Three Leg Slings

Four-Leg Sling

A four-leg sling comprises four legs permanently connected at their upper ends by a suitable ring or link assembly and marked as an assembly. Four-leg slings are mainly used to handle square or rectangular (four cornered) loads. (See Figure 16.7)

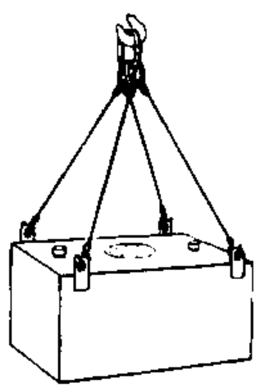


Figure 16.7: Four-Leg Sling

Where the maximum included angle between either set of two diagonally opposite legs is not greater than 90o or the maximum angle between any one leg is not greater than 45o to vertical, the safe load limit of the four leg sling assembly is the SWL of one leg multiplied by 2.1, i.e. SWL x 2.1 = safe load limit of the four leg sling assembly.

Where the maximum included angle between either set of two diagonally opposite legs is between 90o and 120o, the safe load limit is the SWL of the four leg sling assembly of one leg multiplied by 1.5, i.e. SWL x 1.5 = safe load limit of the four leg sling assembly.

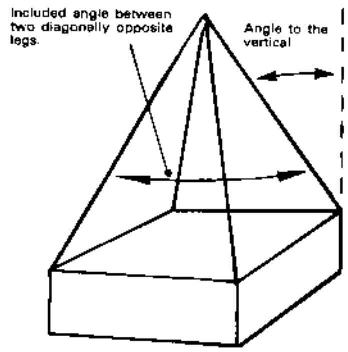


Figure 16.8: Diagram Showing Restriction Angles for Four Leg Slings

16.4.6 Methods of Sling Attachment

Endless Slings

Endless slings are generally used in a choke hitch (see figure 16.9) and may need derating as recommended by relevant standards or the manufacturer or supplier. (Also, refer to Table 16.2: Sling Load Connection/Attachment Rating Chart.)

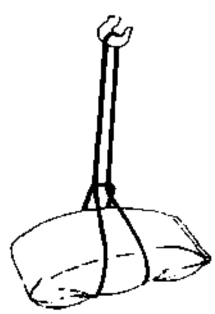


Figure 16.9 Endless sling

Straight-Leg Slings

A single or multi-leg sling may be used with the legs straight if, for example, the legs are terminated in hooks which can be attached directly to a suitable lifting point on the load.

Choke Hitch

Single-leg or multi-leg slings may both be used in choke hitches. The basic advantages of a choke hitch are firstly that a sling may be attached to a load which has no suitable lug or eye bolt etc and secondly, that the sling tends to bind the load together.

A choke hitch using a hook is sometimes known as 'snickling'.

In forming a choke hitch, the sling is bent round a small diameter which may be the eye of the sling itself or the saddle of a hook, link or other fitting. In these circumstances, the load in the sling will be increased at the point of choke and for this reason some derating may be necessary in order to prevent the sling being locally overloaded. For instance, for chain slings, fibre rope slings and webbing the safe working load should be reduced to 0.8 of the safe working load of the straight leg (refer to Table 16.2: Rating Chart).

Slings should never be 'battered' down.

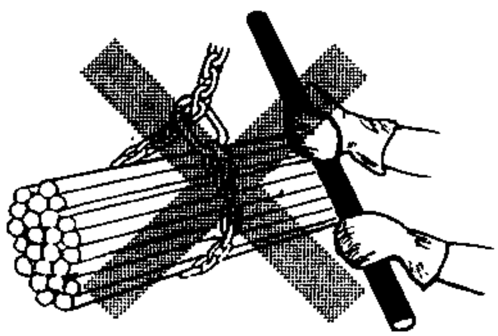


Figure 16.10: Battering Down of Choke Hitch

Double-Wrap Choke Hitch

A double-wrap choke hitch is a variation on a choke hitch where the sling is passed one complete turnaround the load before being choked. This increases the binding effect and should be used on loose loads such as bundles of tubes.

The sling shall be derated by the same amount as for an ordinary choke hitch.

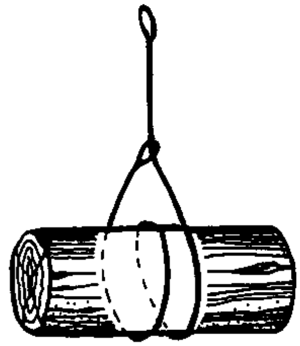
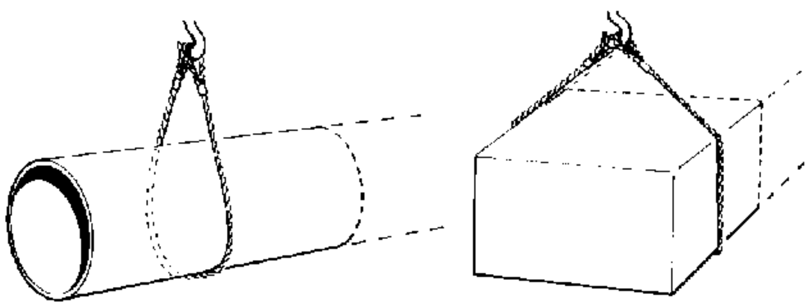


Figure 16.11: Double-Wrap Choke Hitch

Basket Hitch

The basket hitch is normally used with slings in pairs for handling loads such as a large roller but it is not suitable for cradling loose bundles. If only one sling is used, the sling shall be passed through the load at a point above the centre of gravity to ensure it is safely secured.



The use of two hooks is necessary for stability of basket hitches

Figure 16.12: Basket Hitch

If a sling in basket hitch is used with both legs parallel, i.e. with an included angle of 0o between the legs of the basket, then twice the safe working load of the sling may be lifted.

With the terminations of both ends of the sling on the hook the load lifted may be increased to not more than 1.5 times the safe working load of the sling provided the included angle does not exceed 90o.

If two slings are used in basket hitch in the same manner the load may be increased to 2.0 times the safe working load of the sling, again provided that no included angle between adjacent or diagonally opposite legs exceed 90o. The above factors for basket hitches assume that all sharp edges are adequately packed.

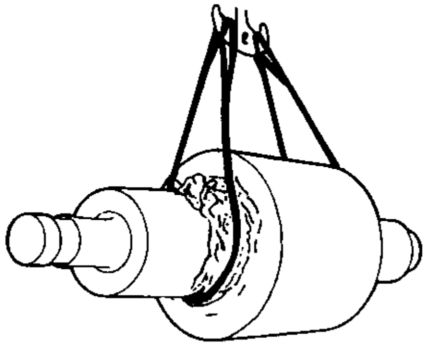


Figure 16.13: Two Sling Basket Hitch

Double-Wrap Basket Hitch

In double-wrap basket hitch the sling is passed completely around the load. This will help to ensure the security of loose bundles. If security of the load is the prime consideration, then a double-wrap choke hitch is recommended. The factors are the same as for a basket hitch.

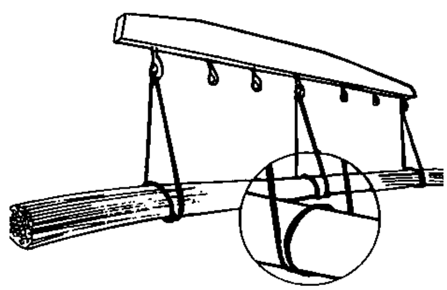


Figure 16.14: Double -Wrap Basket Hitch

Double and Choke Hitch

The double and choke hitch is a variation of a choke hitch where the load is carried on two parts and for this reason the safe working load in the choke hitch may be varied in accordance with the manufacturer's or supplier's advice. Where this is not available, the single choke hitch rating shall be used. This is sometimes known as 'halshing'.

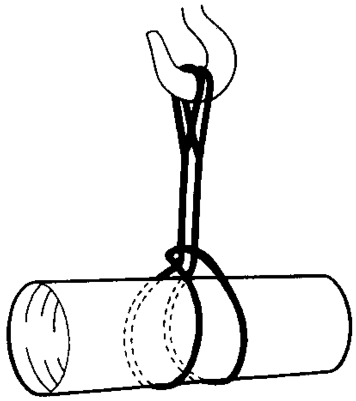


Figure 16.15: Double and Choke Hitch

Table 16.2: Sling-Load Connection/Attachment Rating Chart

This table shall be used in conjunction with the slinging method rating requirements outlined in Section 16.4.5.

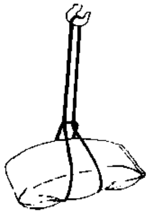
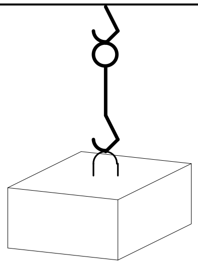
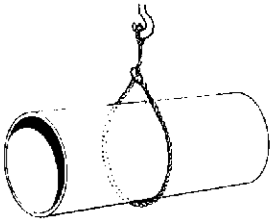
Diagram of Slinging Method	Connection/Attachment method	Rating
	*Endless Sling*	0.80
	*Straight Leg Sling*	1.00
	*Choke Hitch* Included angle ≤ 120°	0.75

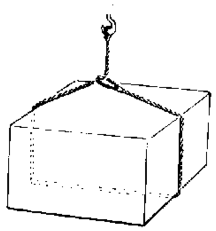
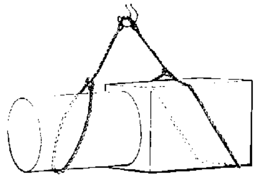
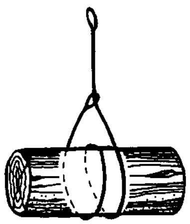
Diagram of Slinging Method	Connection/Attachment method	Rating
	*Choke Hitch* Included angle $\geq$ 120°	0.50
	*Choke Hitch* Two slings, included angle between any two legs $\leq$ 90° - round Two slings, included angle between any two legs $\leq$ 90° - square	1.00 0.66
	*Double Wrap Choke Hitch* Included angle $\leq$ 120° Included angle $\geq$ 120° Two slings, included angle between any two legs $\leq$ 90° - round Two slings, included angle between any two legs $\leq$ 90° - square	0.75 0.50 1.00 0.66

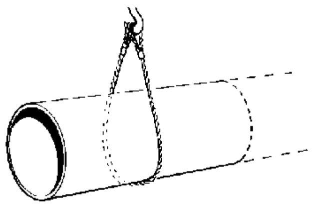
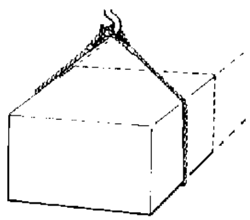
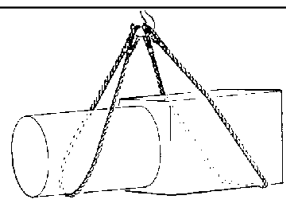
Diagram of Slinging Method	Connection/Attachment method	Rating
	*Basket Hitch* Included angle = 0^0	2.00
	Basket Hitch Included angle $\leq 90^o$	1.50
	*Basket Hitch* Included angle $\geq 90^o$	1.00
	*Basket Hitch* Two slings, included angle between any two legs $\leq 90^o$ - round Two slings, included angle between any two legs $\leq 90^o$ - square	2.00 1.33

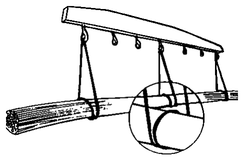
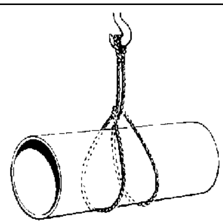
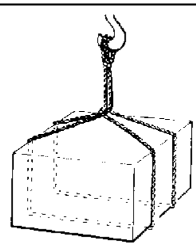
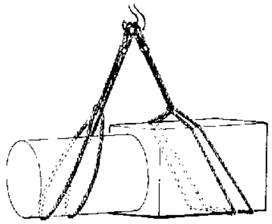
Diagram of Slinging Method	Connection/Attachment method	Rating
	*Double Wrap Basket Hitch* Included angle = 0º Included angle ≤ 90º Included angle ≥ 90º Two slings, included angle between any two legs ≤ 90º - round Two slings, included angle between any two legs ≤ 90º - square	 2.00 1.50 1.00 2.00 1.33
	*Double and Choke Hitch* Included angle ≤ 120º	1.50
	*Double and Choke Hitch* Included angle ≥ 120º	1.00

Diagram of Slinging Method	Connection/Attachment method	Rating
	*Double and Choke Hitch* Two slings, included angle between any two legs ≤ 90º - round Two slings, included angle between any two legs ≤ 90º - square	2.00 1.33

16.4.7 *Some Essential Precautions*

Before Lifting the Load:

- The weight of the load shall be ascertained before lifting and the lifting material shall be suitable for the load.
- The sling shall be strong enough for the load, both in terms of its safe working load and its actual condition. The sling shall be carefully inspected for obvious defects before use.
- The load shall be secure, stable and balanced when lifted so an assessment of the position of its centre of gravity is necessary to ensure that the lifting point is approximately over it.
- Failure to ascertain the centre of gravity is likely to cause the load to swing wildly on being lifted, or even to fall out of the sling.
- Any loose parts of the load shall be adequately secured either by the lifting method or by other means.

When Fitting the Sling to the Load:

- The sling must be firmly secured to the load, e.g. by means of hooks on to purpose designed lifting points, eye bolts, etc or by a suitable method of slinging. The sling must not be twisted, knotted or kinked in any way, nor shall the lifting points be overloaded by the slinging method.
- The rated included angle (90o or 120o) must not be exceeded and the angle at any choke shall not exceed 120o or at any basket shall not exceed 90o.

On raising or Lowering the Load:

- A recognised code of signals shall be used between the slinger and the crane driver (see section 16.3.7). Ensure that the load is free to be lifted, e.g. all holding down bolts and/or dowels have been released.

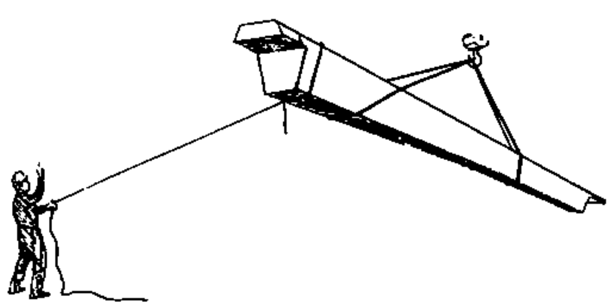


Figure 16.16: Taglines

- A suitable setting down area shall be selected before lifting. Make sure that the load is placed on battens, etc so that the slings can be easily withdrawn.
- Having set the load down correctly, the empty sling legs shall be manually withdrawn by the slinger and hooked back on to the crane hook or upper terminal fitting to prevent accidental 'hook-up' of surrounding objects or the striking of an individual.

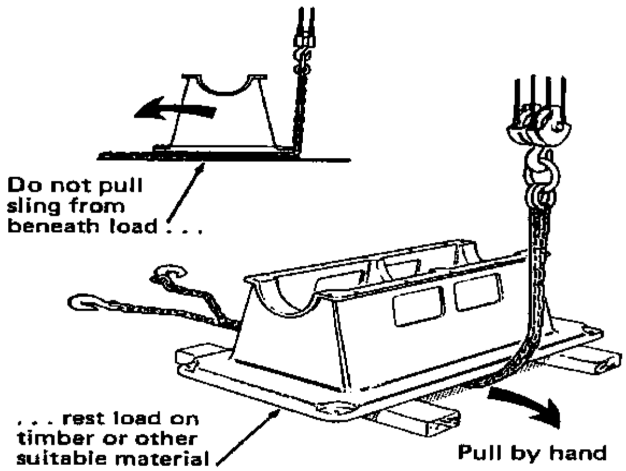


Figure 16.17: Place, Load on Batterns

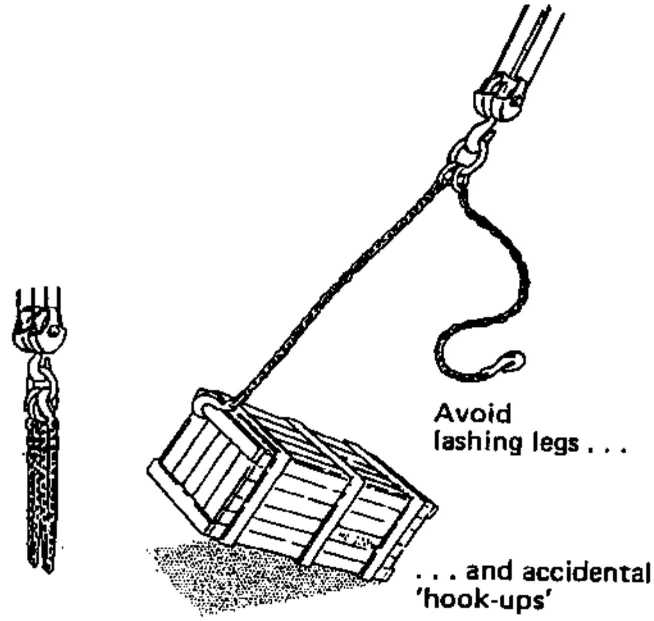


Figure 16.18: Tying of Sling Legs

Packing:
Care must be taken, by the use of wood or other similar material, when slinging a load, to ensure that the sling is not bent over a small curvature or sharp edge, since this may damage the slinging. It is important also not to damage the loads. The objects of packing are:

- to provide an adequate radius around which a sling may pass without unacceptable loss of load carrying capacity
- to assist the sling in gripping the load
- to prevent damage to the load itself.

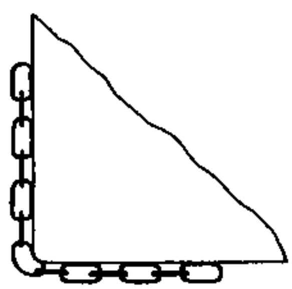


Figure 16.19: Chain Link Bent

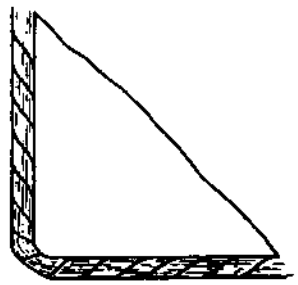


Figure 16.20: Wire Rope Kinked

Various materials are suitable for packing. Whatever is used must be capable of taking the crushing forces which will be imposed upon it, and it should be positioned to make best use of its strength (as is shown in Figure 16.22).

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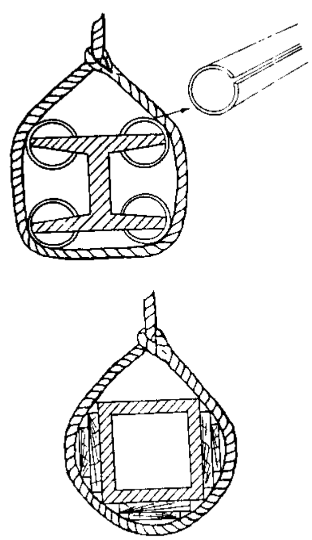
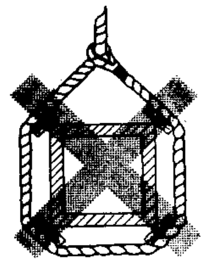


Figure 16.21: Good Packing

Two examples of bad packing are shown below in Figure 16.23. The first shows timber packing at the corners which would almost certainly split under load and the load fall out. The second shows ineffective packing bending the chain links.



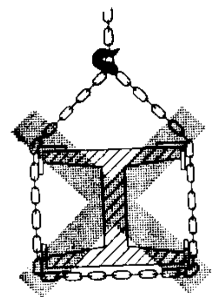


Figure 16.22: Bad Packing Practice

16.4.8 Inspection

Inspection requirements for rigging equipment are listed in Table 16.3 below.

Table 16.3: Inspection of Rigging Equipment

Items	When Testing is Required	Thorough Examination
Chains Chain slings Rings Hooks Shackles Swivels Similar items (e.g. eye bolts, turn buckles.)	Before taking into use and after repair	After proof testing and at least every six months
Wire ropes Wire rope slings	Before taking into use, a sample of the rope tackle should be tested to destruction and the breaking load recorded	After proof testing and at least every six months
Fibre ropes Fibre rope slings All textile based slings Round slings, etc.	Before taking into use, a sample of the material and/or sling should be tested to destruction and the breaking load recorded	At least every six months
All lifting machines and similar items (e.g. runways, jacks, beams, etc.)	Before taking into use and after repair	After proof testing and at least every twelve months

16.4.9 Personnel Lifts/Hoisting Devices and Aerial Lifts

The devices covered by this section include non-lift suspended snorkel, scissors lift, cherry pickers etc.

Personnel working in, or working from these lifts must wear a safety harness with a lanyard and secure their safety lanyard to the lift basket at all times (see DGDC-OHS-023: Working at Height).

- Never exceed the SWL of the machine to prevent the machine overturning or overstressing the machine's components.

- Never position the machine over persons, or allow employees to go under the working platform, unless it is essential to the operation, and on these occasions take extra safety precautions.
- The platform shall not be used as a prop, tie or crane.
- Never move the platform closer than 4m to overhead electric lines unless permitted writing by the Electrical Supervisor.

16.4.10 Wire Rope Grips

- Wire rope grips shall be correctly applied in order that the stresses within the terminal are evenly distributed.
- Always fit the grips the same way round, with the bridge on the loaded or long part of the rope and the U-bolt on the short part.
- On any wire rope a minimum of three grips must be used and spaced at a centre to centre grip distance of six rope diameters. The numbers of wire rope grips required are:
    - up to and including 19mm (3/4 in.) rope: three grips
    - over 19mm and up to and including 32mm rope: four grips
    - over 32mm and up to and including 38mm rope: five grips
    - over 38mm and up to and including 44mm rope: six grips
    - over 44mm and up to and including 56mm rope: seven grips

16.4.11 Ropes/Slings

Combination ropes, i.e. wire ropes with a fibre covering, are not to be used as lifting gear.

Chains and Wire Ropes/Slings:

- Flexible wire ropes or slings shall not be used if any broken wires are visible.
- Chains and wire slings shall not be shortened by knotting.
- Chains shall not be joined together by using nuts and bolts.

Note: Docks' splice - sometimes known as a five-tuck splice, is a splice in a wire rope which has at least three tucks with a whole strand of the rope and two tucks with one half of the wires cut out of each strand. The strands in all cases are tucked against the lay of the rope. In all other cases, e.g. a compressed (swagged) ferrule, proof load testing is necessary to prove the effectiveness of the termination.

Fibre Ropes/Slings:

- When joining fibre ropes, always use a double sheet bend or a carrick bend knot. Never use a reef knot to join ropes.
- Fibre ropes must be hung up in a free circulation of cool air when not in use. Their exposure to oils, acid, or other chemicals shall be avoided.
- Fibre rope slings shall not be used for any duty if the rope is badly chafed externally, or worn internally, or where the fibres have noticeably deteriorated to a marked degree. Ropes in this unsafe condition are to be destroyed.

16.4.12 Shackles.

- Ordinary bolts shall not be used as shackle pins.
- Hooks that anchor ropes or pulleys on suspended scaffolds/loads shall be moused to prevent accidental unhooking.
- Shackles used in scaffolding/loads shall have their SWL clearly marked and when in use the pin shall be securely screwed in and moused to the Dee-rings.
- When using a shackle to form a running noose always fit the back of the Dee-rings to the standing or running part of the rope.

16.4.13 Eye bolts

Eye bolts shall be marked with the SWL, and, unless also marked to the contrary, or fitted with an integral link, the load shall not be applied other than longitudinally. If marked otherwise or fitted with an integral link the load is not to be applied in excess of 45o from the longitudinal.

An eye bolt used for lifting shall have a screwed shank of at least 11/3 times the diameter. Both the male and female threaded portions shall be in good condition and the eye bolt be inserted completely before use.

The following table is for eye bolts according to BS 4278: 1984 and gives the maximum recommended working loads for angular loading of eye bolts with links and collar eye bolts with metric threads used in pairs.

Some eye bolts, may be marked with lower safe working loads than those shown in some standards. In these cases, the reduced safe working load for angular loading when used in pairs may be obtained by using the reduction factor given at the foot of the tables for each type of eye bolt.

Table 16.4: Maximum Working Loads for Eye Bolts with Link to BS 4278: 1984

Thread size	Axial SWL of single eye bolt	Maximum working load to be lifted by a pair of eye bolts when the included angle (a) between the sling legs is:		
Metric		0 < a < 30°	30° < a < 60°	60° < a < 90°
mm	tonne	tonne	tonne	tonne
20	1.0	2.0	1.6	1.25
24	1.6	3.2	2.5	2.0
30	2.5	5.0	4.0	3.2
36	4.0	8.0	6.3	5.0
48	6.3	12.6	10.0	8.0
Reduction Factor		1.0	0.8	0.63

16.5 Lifting Without the Use of a Crane

16.5.1 General

Riggers are often required to lift, or otherwise move, loads without the use of a crane. This usually involves the use of chain hoists, ratchet and lever pullers, winches, etc, perhaps in conjunction with gin poles, sheer legs, derricks, etc. In these situations, a minimum safety factor of three shall be maintained at all times.

16.5.2 Chain Hoists

As these hoists can easily be overstressed, the rules listed below shall be observed.

- Never exceed the SWL of the hoist.
- Ensure that the chain is not twisted.
- Never load the hoist when the chain is not in a true line from the hook to the main block.
- Keep the sheave pockets and the chain clean and lightly lubricated.
- If the chain jumps the sheave pockets, the chain may have stretched and shall be replaced.
- Do not suspend the load from the point of the hook or overstressing and distortion may occur.
- Mousing of the hooks is necessary to ensure they will not lose their load

- Frequently check the chain and hoist.

16.5.3 Ratchet and Lever Type Pullers

There are several types of pullers available which use chains or wire rope. To avoid overstressing, handles must never be extended or operated by more than one person at a time. When replacing wire ropes, the correct type and size of steel-core rope shall be used.

16.5.4 Gin Poles and Derricks

Gin poles consist primarily of a vertical pole, suitably stayed or guyed, and capable of being leaned out of vertical to a limited degree.

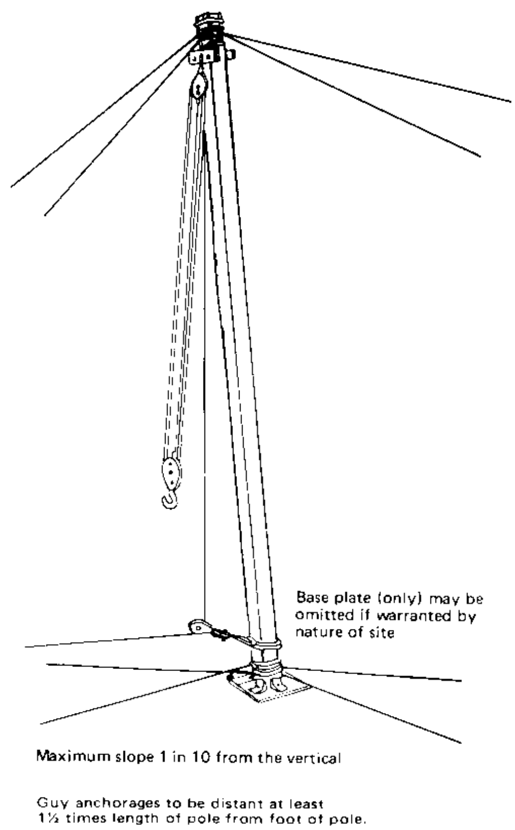


Figure 16.23: Derrick Pole

The following conditions listed below shall be complied with:

- A maximum of 1:10 slope from the vertical shall not be exceeded.
- Gin poles must be constructed of steel, with attachments at the head for suspending the load. In addition, gin poles shall be fitted with proper base plates.
- A gin pole of sufficient strength shall be used for the lifting task to prevent buckling or collapse.
- For loads greater than 10 tonnes, the guys and their end connections shall be designed by an appropriately qualified person.
- If more than one guy is used, then care must be taken to equalise the loads.
- Guys for gin poles and derricks shall be attached to proper anchorages, i.e. 'dead men' or substantial steel structures. They shall never be attached to pipelines, vessels or equipment supports.

16.5.5 Cantilevers

Cantilever beams, bolted down or held by counterweights are often used for lifting.

- No more than one third of the length of the beam shall protrude past the point of support.
- Calculations, based on the principle of moments, must be carried out an appropriately qualified person to ensure that a safety factor of three is always maintained (for consistency) in the beam and fastenings.
- Beams shall be packed to offset any change in moments due to protuberances on the surface on which the beams are resting.

16.5.6 Overhead Ropes and Flying Foxes

- Cableways with moving towers as well as flying foxes used on large construction sites shall be designed and certified as to SWL by an appropriately qualified person.
- To avoid overloading, the no-load sag shall not be less than 1/20 of the span. Under load the sag should be approximately double the no-load sag.
- The backstay angles need to be of the same slope (1 in 5) to avoid increasing the load. At steeper angles the tops of towers or poles need securing to the rope to avoid being kicked out.
- The flying fox shall have four wheels with sheave diameters not less than eight rope diameters, spaced out to avoid undue bending on the track rope.

16.5.7 Jacks and Jacking

The raising or lowering of a load by jacking is an operation that needs to be carried out with military-type precision. Generally, the requirements for safe and efficient jacking are listed below:

- The jacked load shall be held steady throughout the jacking operation.
- On long loads both ends shall not be lifted simultaneously. Stabilise one end then raise or lower the other.
- If wedges are used, to level packings or load, they shall be driven tight and secured in position to prevent accidental displacement.
- Jacks shall have their SWL marked on them. In use, a margin of 25% below the SWL should be maintained.
- Jacks shall have solid timber packers on both load-bearing surfaces in order to minimise the possibility of displacement by slipping.
- The lift in all cases shall be vertical. At any sign of jack tilt, the load shall be packed and the jack reset vertically.
- Never extend jack handles as over-stressing will result thereby reducing the safe working capacity of the jack.
- On all jacks any worn parts shall be discarded and replaced to ensure the SWL capacity is not impaired in any way.

16.6 Fork Lifts

16.6.1 Introduction

The purpose of this section is to maintain a degree of safety in the use of all forklift machines operated on DGDC sites. Forklift machines are very dangerous when not operated in a safe manner. The safety requirements in this section and the manufacturer's safety requirements shall be followed without exception.

16.6.2 Responsibility

The supervisor is responsible for ensuring that all forklift machines are operated by certified operators and for ensuring forklift machines are well maintained.

Forklift machine operators are responsible for ensuring that all the safe operations and work practices are understood and followed. In addition, they shall comply with all relevant standards, codes of practice, procedures, and be responsible for their own safety, the safety of others, and the safety of property.

16.6.3 Operator Certification

No forklift machine is to be operated by any person unless they hold current certification of operation. Any person being trained on a forklift machine shall be under the direct supervision of a certified operator.

16.6.4 Safe Forklift Operating Procedures

- It is the operator’s duty to check that the machine is in a safe and satisfactory working condition before operating the forklift and that any faults detected are reported to the person in charge.
- Operators shall not start or operate the forklift machine, any of its functions or attachments, from any place other than from the designated operator's position.
- Hands and feet shall be kept inside the operator's designated area or compartment. No part of the body shall be put outside the operator compartment of the forklift machine.
- No part of the body shall be put into the mast structure or between the mast and the forklift machine.
- No part of the body shall be put within the reach mechanism of the forklift machine or other attachments.
- It is essential that forklift machine limitations are understood and that the forklift machine is operated in a safe manner so as not to cause injury to personnel. Pedestrian safety shall be safeguarded at all times.
- Forklift machines shall not be driven up to anyone standing in front of an object.
- Operators shall ensure that personnel stand clear of the rear swing area before conducting turning manoeuvres.
- Operators shall exercise particular care at cross aisles, doorways, and other locations where pedestrians may step into the path of travel of the forklift machine.
- No one may stand or pass under the elevated portion of any forklift machine, whether empty or loaded.
- Passengers are not permitted to ride on forklift machines unless a safe place to ride has been provided by the manufacturer.
- Before leaving the operator's position:
  - bring the forklift to a complete stop
  - place directional controls in neutral
  - apply the parking brake
  - fully lower the load-engaging means.

- If the forklift machine must be left on an incline, block the wheels.
- A safe distance shall be maintained from the edge of ramps, platforms and other similar working surfaces.
- Care shall be taken not to contact overhead installations such as lights, wiring, pipes, sprinkler systems, etc.
- An overhead guard is intended to offer protection from falling objects but cannot protect against every possible impact. It shall not be considered a substitute for good judgement and care in load handling. An overhead guard shall be used on all forklift machines as protection against falling objects, unless both of the following conditions are met:
- Vertical movement of the lifting mechanism is restricted to 1800mm or less from the ground.
- The forklift machine will be operated only in an area where:
  - the bottom of the top tiered load is not higher than 1800mm, and the top is no more than 3000mm from the ground when tiered
  - only stable, and preferably interlocked, unitised, or containerised, loads are handled
  - there is protection against falling objects from adjacent, high stack areas.
- • A load backrest extension shall be used when necessary to guard against a load, or part of it, from falling toward the operator.
- In areas classified as hazardous, only forklift machines approved for use in those areas are to be used.
- All accidents involving personnel, building structures and equipment are to be reported to the supervisor or as directed.
- Forklift machines are not to be added to, or modified, without the manufacturer's prior written approval.
- Access to fire doors, exits, aisles, stairways or fire equipment shall not be blocked.
- Whenever a forklift machine without controls that are elevated with the lifting carriage or forks is used to elevate personnel:
  - use a securely attached work platform
  - make sure the lifting mechanism is operating smoothly and properly
  - place mast in a vertical position and never tilt forward or rearward when elevated
  - place forklift machine controls in neutral and set brake
  - lift and lower smoothly and with caution
  - watch for overhead obstructions
  - keep hands and feet clear of controls other than those in use

- move the forklift machine only for minor adjustments in positioning when personnel are on the work platform, and never at more than creep speed
- remain in the operator's position on the forklift machine
- restraining means such as rails, chains, etc should be in place, or persons on the work platform shall wear a body belt and lanyard or retractable safety device.

- Ascend or descend grades slowly, and with caution.
- When ascending or descending grades in excess of 5%, loaded rider trucks shall be driven with the load upgrade.
- Unloaded forklift machines should be operated on all grades with the load engaging means downgrade.
- On all grades the load and load-engaging means shall be tilted back, if applicable, and raised only as far as necessary to clear the road surface.
- On grades, ramps, or inclines, normally travel straight up and down, avoid turning if possible and use extreme caution.

16.6.5 Checks

A checklist is attached, (Form 16.1), as a guide for operators to use in determining that a forklift machine is safe for use. Operator's judgement is required to ensure that the machine is in a safe condition to operate. If it has defects that make it unsafe the machine shall not be used until the problem is repaired.

16.7 Manual Lifting

16.7.1 Introduction

When lifting and handling materials, it is important to know the correct method of lifting and carrying. If incorrect methods are used personnel may suffer from strains, sprains, hernias, hand and foot injuries, spinal injuries, and torn ligaments and muscles.

16.7.2 The Safest and Most Effective Way to Lift

Throughout any lifting and lowering action, follow the recommended procedures as listed.

- Check that the load is within your lifting capacity and, if necessary ask for help.
- Watch out for sharp edges, and wear gloves to protect the hands when necessary.
- If lifting something with one end heavier than the other, have the heavier end closest to the body.

- Place feet firmly, well apart, flatly on the ground, and squat down. Maintain good balance and get a good grip.
- Keep the back as straight as possible - this does not necessarily mean vertical. Lift slowly (do not jerk) by pushing with the leg muscles. Keeping the chin tucked in helps keep the back straight.
- Raise or lower the load as close as possible to the body. Avoid holding the load away from the body.
- Do not twist the body when lifting.

A strain can be caused more easily when lifting a bulky or awkward load than a compact one.

16.7.3 Safe Carrying

- Carry the load close to the body.
- Keep the back straight.
- Ensure your vision is not obscured.
- Never allow the load to interfere with normal walking. If it does, it is too heavy.

16.7.4 Stacking and Storage

- Store heavier and more frequently used items at between hip and shoulder height. Only small infrequently used items should be stored above shoulder height or below hip height.
- Stack materials so that they cannot slip or fall, by interlocking or some other method.
- Arrange stacks in clearly defined lines with working aisles or passageways between them. The height of a stack is restricted by the capability of the lower layers to withstand the weight on them.
- Chock all round objects such as drums, paper rolls and logs if they are stacked on their side.
- Check that every stack is stable.

16.7.5 Team Lifting

- It is safer for heavy, bulky or unusually long loads to use more than one person to lift them. Pairs or teams should be matched for height.
- Where more than one person is working on the lifting of a load, it is important that one person should be chosen to 'call' the lift to co-ordinate the movement

and timing. This is important to avoid the weight being thrown to one side and too much weight being put on one individual leading to injury.

16.7.6 Handling of Drums

16.7.6.1 General

- Before moving a drum, stand close to the drum with feet comfortably apart and with a hand either side, then gently rock it to get the feel of it and its contents.
- Keeping back straight, knees bent and having one foot slightly forward controls the movement of the drum. Have both feet flat on the ground, tilt the drum back towards you to a point of its balance. Once on the point of balance, the drum may be moved by wheeling it along by turning it on its rim.

16.7.6.2 Lowering of a Drum

- Place both hands over the front end of the drum with the thumbs inside the rim, and the heels of the hands and the fingers over the side of the drum. The grip is important.
- Raise the rear leg and use this as a lever using the body weight in counter balance to pull the drum back towards you.
- From this position, with feet flat on the ground and far enough apart to give good balance, bend your knees and stick your bottom out, keep back straight, lower drum to the ground.

16.7.7 Plank Handling

- Long loads are less easy to control than compact ones and their weight should be limited accordingly.
- A safe and comfortable method to handle a plank is to up-end the plank, keeping feet flat on the ground, stick your bottom out, lift one end of the plank and move towards the centre of the plank.
- Move with the forward end of the plank above head height especially when approaching doorways and the end of buildings so as to miss any unsuspecting person that may be hit.

16.7.8 Coils and Reels

These items can be lifted as with any other load. They are usually fairly easy to grip. Remember to keep feet flat on the ground, stick your bottom out keeping your back straight.

16.7.9 Lifting-Like Activities

- The same care should be taken with all lifting- like activities, shovelling, using a pick axe, using a wheelbarrow etc.
- Keep feet flat on the ground, at least hip width apart, stick your bottom out, knees bent within mid-range and back straight whenever carrying out these activities.

16.7.10 Shovelling

Keep one foot placed between the material to be moved and the loading point with that foot in line with the direction of material travel.

16.7.11 Use of Wheelbarrows

Remember to lift and lower the wheelbarrow using the key points of safe lifting.

16.7.12 Handling Buckets

Remember Points for Safe Lifting. Place one foot forward so that the bucket is in the 'centre of the foot position'. Lowering the bucket is the same procedure in reverse.

NOTE: - Using a hose to fill the bucket may avoid the need to lift the bucket while it is filling.

16.7.13 Handling Weights from Work Benches

- Ideally, the bench should be at about waist height. Get close to the weight. Feet flat, one foot may be forward of the other. Knees may be slightly bent, back straight. Use the same principles when putting the weight back down.
- Do not leave a gap between the body and the bench when lifting or putting down the weight.

16.7.14 Lifting Aids

Wherever possible, mechanical lifting and moving appliances should be used, but make sure this equipment is used only by those who are:

- trained in the use of the appliance
- authorised to use such equipment.

Form 16.1: Mobile Crane Plan

The following points need to be considered and if required a sketch drawn of the nearby hazards and the path of the load.
• Ground conditions (stability) • Underground services • Overhead lines/services • Communications/crane control • High energy systems (steam lines ….) • Causing an obstruction (i.e. fire exits ……) • Access to site • Hazardous areas (complete a 'Hazardous Area Permit')
(Sketch Plan)

Form 16.2: Operator's Checklist for Forklift Machines

All Forklift Machines

1. Hour meter
2. General Lubrication
3. Steering
4. Tyres
5. Brakes
6. Brake fluid
7. Hydraulic controls
8. Hydraulic rams
9. Hydraulic systems
10. Lifting chains, pulleys, and wire ropes
11. Forks and retaining pins
12. Overhead guard and load backrest

Battery Powered Forklift Machines

1. Battery plug connection
2. Battery charge and electrolyte
3. Battery load test

Engine Powered Forklift Machines

1. Fuel Level
2. Oil level and pressure
3. Water level and fan belt

LPG Powered Forklift Machines

1. LPG gas cylinder secure
2. Safety relief valve positioned correctly
3. Fuel in cylinder
4. Check regulator hose and fittings
5. Fuel Level
6. Oil level and pressure
7. Water level and fan belt

Dominica Geothermal Development Company Limited

Powering a New Generation...

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-024: Working at Height
Revision 0

Contents

17. Working at Height

17.1 Introduction

Falls from heights are the single most common cause of injuries and death in any industry group who work at height. Failure to recognise a hazard causes most falls.

To work safely in high places, watch for hazards such as:

- Falling from heights
- Dropped objects
- clutter and disorder
- handrails/guardrails missing or not being used
- slippery surfaces
- moving or carrying material or equipment
- ladders not secured at top and bottom and/or incorrectly positioned
- working from suspended platforms or elevated work platforms
- working on brittle material
- proper height work equipment not being used.

This section establishes the minimum standards for personnel while working at heights outside the confines of a catwalk or work platform.

17.2 Ladders

17.2.1 Definitions

For the purposes of this section the following definitions apply.

Leaning Ladder
A ladder supported in use by a separate structure, eg. a wall.

Single Section Ladder
A leaning ladder constructed and used as a single unit.

Extending Ladder

A leaning ladder consisting of two or three sections constructed so that the height can be varied, in increments of one rung spacing, by sliding the sections relative to each other.

Swing Back Steps
A standing step ladder in which the top is in the form of a tread and the back is merely a supporting frame.

Folding Platform Steps
A standing step ladder in which the top is constructed in the form of a working platform.

Folding Trestles
An arrangement of two frames hinged together, each fitted with cross-bearers suitable for supporting a working platform.

Lightweight Stagings
A working platform constructed of stiles, cross-bearers and decking, to provide a flat working surface.

Stiles
The side members to which the rungs, treads or cross-bearers are fitted.

Spacing (of Rungs, Treads or Cross-Bearers)
The distance, measured along the longitudinal axis of the stiles between the same relative positions of the members.

17.2.2 Use of Step Ladders

Portable ladders used incorrectly or in a defect condition present a serious hazard and cause many injuries. There are three main types of ladders. (Select the correct one for the task).

- Industrial: For heavy duty where relatively high frequency and onerous conditions of use, carriage and storage occur. Suitable for Industrial purposes. Duty rating 130kg.
- Light trades: For medium duty where relatively low frequency and reasonably good conditions of use, storage and carriage occur. Suitable for light trade purposes. Duty rating 110kg.

- Domestic: For light duty where frequency of use is low and good storage and carriage conditions pertain. Suitable for domestic and household purposes. Duty rating 95kg.

17.2.3 General Use of Ladders

- Keep clear of power wires.
- Never use a ladder which is not long enough 1m past.
- Do not splice two ladders together even as a temporary measure to gain height.
- Always stand ladders on a firm non-slip and level base.
- Don't climb a ladder with oil or mud on the soles of your boots.
- Ensure the ladder is not upside down.
- When ascending or descending always face the ladder and use both hands 3 points pf contact.
- Do not climb a ladder carrying anything in your hands.
- Do not throw down tools or material from a ladder.
- Do not allow two men to work on one ladder at the same time.
- Never over reach sideways from a ladder, instead, get down and move the ladder.
- Do not stand a ladder on boxes, barrels, bricks, pieces of timber or any other insecure object to get additional height.
- Do not place a ladder across a doorway or in a passageway without taking some action to guard against people walking into it. Close and lock the door or protect the foot of the ladder with a stool or box.
- Do not erect ladders on footpaths or roadways without a red flag attached to the ladder stile, approximately 2m above ground level.
- Hold step ladders open by locking the metal spreader.
- Do not attempt to work from the top or second top step of a step ladder.

Ladders shall be inspected on a regular basis, particularly before being used. Some of the items to be checked are:

- defective rungs
- warping, cracking or splintering of stiles
- faulty nails, screws, rivets, bolts and fittings:
- faulty feet
- damaged locking/hinged spreaders.

If these are found an out of service tag should be placed on ladder refer to DGDC-OHS-013: Work Control.

17.2.4 *Erection*

The following points shall be observed:

- An erected ladder shall always rest against a solid support.
- On pole work or in windy places tie the top of the ladder to the support.
- See that the foot of the ladder is secure against slipping or have it held by another person. Failure to do this results in a high number of accidents. Use a bag of sand on a concrete floor or a nail batten to a wooden floor to prevent the ladder slipping.
- The slope of an erected ladder shall not be flatter than (3 to 1). The best working slope is 4 up to 1 out.

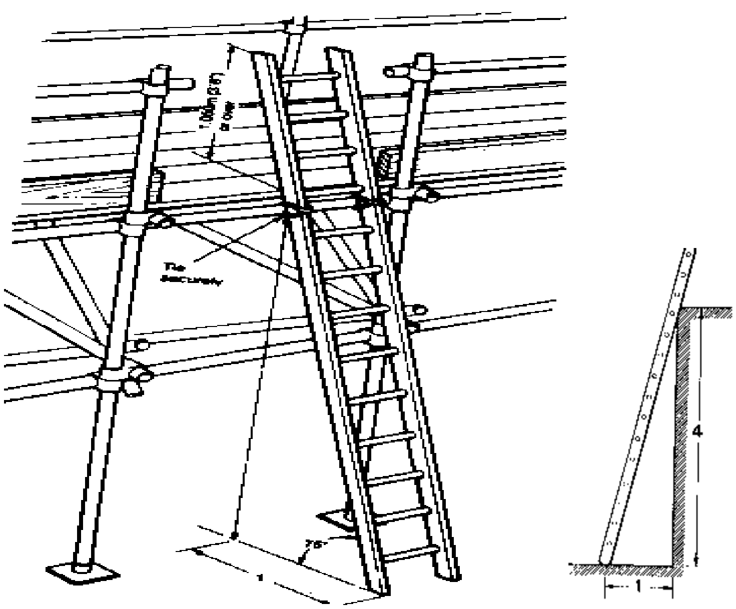


Figure 17.1: Ladder Working Slope

- A flatter slope than 4:1 is:
  - difficult to climb
  - liable to slip at the foot if not restrained
  - severe on ladder stiles
  - awkward to work from.
- A steeper slope than 4:1 is:
  - awkward to climb
  - easily pulled over backwards
  - difficult to work from and dangerous.
- Wrap the tops of the stiles with hessian if working against a smooth surface. It will protect the surface and prevent the ladder from slipping sideways.
- Where a ladder is used as access to a platform or roof it shall extend not less than 1m above the platform or roof level if no effective handhold is provided.
- Exercise extreme care when using a ladder against a springy support such as a tree branch or swaying woodwork. Secure the top of the ladder to avoid a throw-back.
- Spread step ladders properly to ensure stability.
- Always secure the ladder by lashing at the top and bottom or have someone hold the ladder.

17.2.5 Single and Extension Ladders

The lengths of single-section ladders and extending ladders when fully extended shall not exceed the lengths given in a) to c), as appropriate to the class:

a)	Class 1:	Industrial	17 metres
b)	Class 2:	Light Trades	10.7 metres
c)	Class 3:	Domestic	9.1 metres

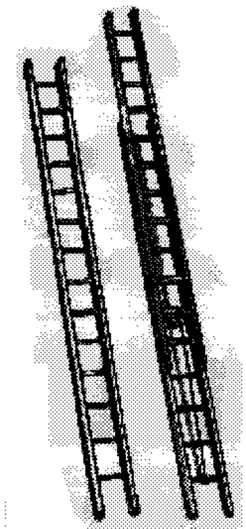


Figure 17.2: Single/Extension Ladder

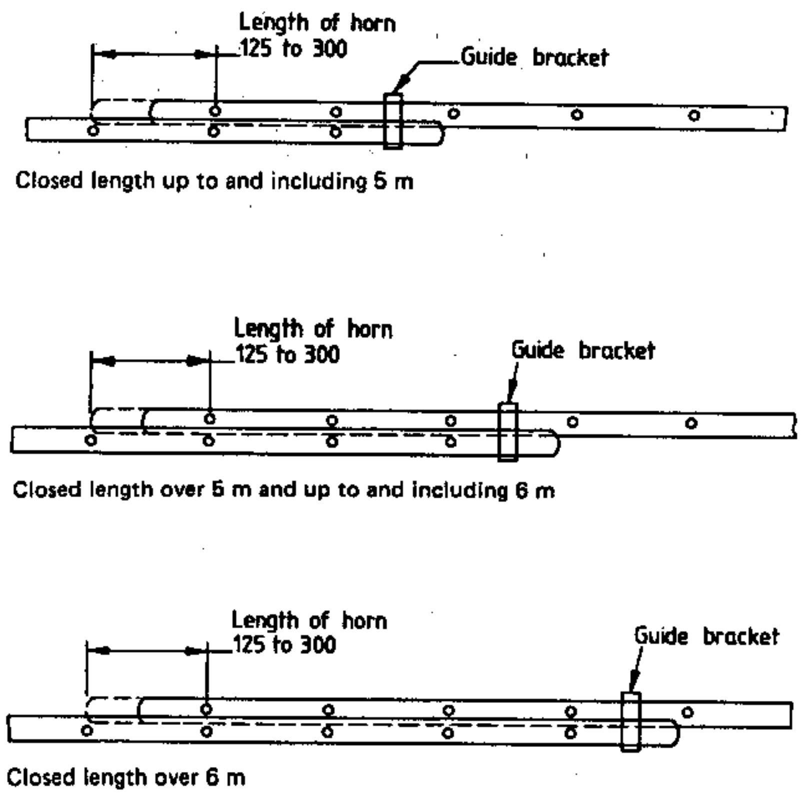


Figure 17.3: Overlap of Extending Ladders

17.3 Scaffolding

17.3.1 Introduction

This section has been prepared to provide guidance on the planning for, erection of and subsequent use of scaffolding. It is intended to provide performance requirements for scaffolding standards.

Suitable and sufficient scaffolding shall be provided where the work cannot be carried out safely by other means. Standing scaffolds, suspended scaffolds or special scaffolds may he used.

In this section advice is given on the requirements for the erection, use and dismantling of scaffolding.

17.3.2 Definitions

Factor of Safety
The ratio of the load that would cause failure of a member or structure to the load that is imposed upon it in service, and, unless otherwise prescribed or directed, shall be a minimum of three.

Free-Standing Scaffold
A standing scaffold which is not attached to any other structure and is stable against overturning on its own account or, if necessary, assisted by rakers (an inclined load bearing member) and anchors.

Guardrail
A rail or barrier secured to standards or upright members, and erected along the exposed sides and ends of working platforms to prevent persons from falling. A lower rail which is fixed to standards midway between the guardrail and platform is termed a midrail.

Hanging Scaffold-Drop Scaffold
A working platform suspended by tubes, bolts, fixed rope slings or other methods and not intended for raising or lowering while in use.

Height
In relation to scaffolding or part of scaffolding, means the greatest vertical distance from which any article may fall from the highest working platform of the scaffolding to the ground or structure on which the scaffolding is supported or above which the scaffolding is suspended or fixed, as the case may be. In determining the distance which an article may fall, no account shall be taken of any obstruction which may delay or stop the fall unless there is no possibility of the fall continuing after the obstruction is reached.

Live Load
That portion of a load which does not include any part of the scaffolding or decking supporting the load, and comprises the weight of workers and/or materials.

Putlog (or Bearer or Transom)
A horizontal member placed in the transverse direction between ledgers, standards, or other supports and used to support a working platform.

Qualified Person
A person who, by possession of a recognised degree, certificate, or professional standing, or who by knowledge, training or experience has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the subject.

Safe Working Load (SWL)
The maximum load calculated in accordance with sound and accepted engineering practice, which can be supported safely under normal working conditions.

Scaffolder
A scaffolder is a person skilled, experienced and qualified in the erection, altering and dismantling of scaffolding.

Scaffolding
(a) Means any advanced scaffolding, basic scaffolding, or suspended scaffolding or any framework or structure, of a temporary nature, used or intended to be used:

- for the support or protection of persons carrying out construction work or work connected with construction work
- for the support of materials used in connection with any such work

(b) Includes any scaffolding constructed as such and not dismantled, whether or not it is being used as scaffolding.

(c) Includes any coupling, device, fastening, fitting or plank used in connection, with the construction, erection, or use of scaffolding.

Scaffolding Process
Is defined as the planning for, the design of, the erection of, the inspection of, the use of, and the dismantling of any scaffolding. The scaffolding process does not include the erection of structures constructed using scaffolding components, such as false work, temporary grandstands, lighting towers.

Scaffold Register
A written record of inspections carried out for scaffolding.

Suspended Scaffold
A working platform suspended from overhead and intended to be raised or lowered while in use.

Sole Plate
A timber, concrete or metal bearer used to distribute the load from a standard or base plate to the ground.

Span
Means the distance measured along the member between the centre lines of adjacent supports of the member.

Tie
The attachment by which scaffolding is attached to a structure; it also means "tie and spreader" and includes the attachments used in conjunction with the spreader or putlog extension to secure a scaffold to a building or structure to prevent movement.

Toe Board
An up stand or vertical barrier at the edge of a platform intended to prevent materials, or workers' from slipping off the platform.

Working Platform
That part of a scaffolding on which workers and/or materials are supported for the purpose of carrying out construction work.

17.3.3 *Materials*

All scaffold materials shall be in sound condition and be examined before use.

17.3.4 *Scaffold Planks*

- All scaffold planks must meet the performance requirements specified by industry standards.
- Planks shall be frequently examined during use for splits, cracks, mechanical damage, excessive wear and decay. Planks which are defective shall be rendered unfit for further use.

17.3.5 *Erection*

- All scaffolding, shall be erected, altered and dismantled by competent scaffolders under proper supervision as per OSHA 3150 Scaffold Use in the Construction Industry
- Scaffolding shall not be used unless the supervisor of the work is satisfied that it is safe for use and complies with the relevant standards.
- Scaffolding shall not be altered or interfered with except on the instructions of the scaffolder. Scaffolders must ensure that members of the public are not endangered while they are erecting, altering or dismantling scaffolds. They shall also ensure that the lower working platforms are not used while the upper lifts are being worked on unless a fully decked platform, with screens if necessary, separates the part being erected or dismantled from the lower part in use.
- Scaffolding over 5m high or intended to extend over 5m, hanging scaffolds of any height and suspended scaffolding of any height may be erected, altered or dismantled only under the direct suspension of a person who holds an appropriate certificate of competency as a scaffolder.

17.3.6 *Scaffolder Competence*

A person who erects scaffolding, any part of which is 5 metres or more above the ground, must be able to demonstrate to DGDC that they are competent and experienced to the appropriate class of scaffolding, according to the following classes:

- Basic Scaffolding: - The equipment range is to include free-standing modular system scaffolding, ropes, gin wheels, static lines and fall arrest systems.

- Advanced Scaffolding:- The equipment is to include free-standing modular systems, tube and coupler scaffolding including tube and coupler covered ways and gantries, scaffolding associated with perimeter safety screens and shutters, cantilevered hoists with a load limit not exceeding 250 kg (materials only), ropes, gin wheels, safety nets for public protection, and catch nets, static lines and fall arrest systems, bracket scaffolds (tank and form work), cantilevered load platforms from a scaffold, cantilevered and spurred scaffolds, barrow ramps and sloping platforms, mast climbers, and hung scaffolding including scaffolding hung from tubes, wire ropes and chains.
- Suspended-Drop Scaffolds: - The equipment range is to include hand-haul and mechanical boatswain's chairs, building maintenance units and hand-haul and mechanical swinging stages.

17.3.7 Permit- to-Work Scaffolding

- The supervisor shall ensure that scaffolding over 5 metres in height has been issued a Master Work Permit and a work specific permit-to-work (Form 17.1 at end of this section) for scaffolding. See DGDC-OHS-013: Work Control as to the procedures for obtaining a permit-to-work.
- A contractor shall not commence any scaffolding work above 5 metres without a permit-to-work.
- The Scaffolding Permit shall be displayed on the scaffold at all times. A copy of the permit is to be attached to the Master Work Permit.

17.3.8 Inspection of Scaffolds

All scaffolds are to be inspected before first use and at regular intervals (every 7 days). Details of these inspections are to be recorded on the Scaffolding Permit (Form 17.1) on-site register (attached at the back of this section). These inspections are to be carried out by a suitably trained and qualified person.

a) Initial Inspection

Before first use, the scaffold is to be finally inspected and any defects found are to be rectified before use.

b) Subsequent inspections

The scaffold is to be inspected at the following intervals:

- daily in the case of suspended scaffolds, or weekly in the case of all other scaffolds while the scaffolds are in use
- after each structural alteration, addition or change to the nature of the scaffold or its anchorages or ties
- monthly while the scaffold is set up but not in use
- after any storm or occurrence that could adversely affect the safety of the scaffolding.

Should any defect be found during these inspections, the defect shall be rectified prior to the scaffold being reused.

17.3.9 Protection and Maintenance

All scaffolding shall be protected against accidental damage from traffic or other causes and should, where necessary, be barricaded.

17.3.10 Access to Working Platforms

Access must be adequate and safe for the working conditions and type of work carried out. Access may be provided by permanently installed stairways, temporary stairways or portable inclined ladders. Personnel shall not be expected to climb vertical ladders, or to climb the scaffold structure to gain access to working platforms.

17.3.11 Scaffolding Near Electric Power Lines

No person shall erect any scaffold at any distance, in any direction, less than that shown in the table to any conductors of an overhead electric line.

Table 17.1: Minimum Distance In Any Direction For Construction Of Scaffolding And Other Structures Near Conductors

Line Voltage	**Minimum Distance Under Normal Conditions (metres)**
Not exceeding 66 kV (maximum span 125 metres	4.0
Exceeding 66 kV (maximum span 25 metres)	5.0
Any voltage (span greater than 125 metres but less than 250 metres)	6.0

Any voltage (span greater than 250 metres but less than 500 metres)	8.0
Any voltage (span exceeding 500 metres)	As agreed with the owner of the line but not less than 8 metres

17.3.12 Scaffolding Over Gantries or Roofs

Gantries or roofs used to support scaffolding shall be certified as safe for the purpose by an appropriately qualified person. The layout of the scaffold, including details of sole plates and the propping system (if any) shall also be provided.

17.3.13 Lifting Appliances Mounted on Scaffolding

- Hoists, winches and other lifting appliances may be mounted on scaffolding only if the scaffold framework is adequate in strength or is specially strengthened and tied back to reduce vibration and whip.
- The strengthening shall be calculated with reference to an effective static load of not less than two times the safe working load of the lifting appliance.
- Where the lifting capacity exceeds 250kg (2450N), the scaffold shall be strengthened to the design requirement of an appropriately qualified person.

17.3.14 Design Loads

- Dead Load: - The dead load shall include the self-weight of the scaffold structure and components including working platforms, catch platforms, access platforms, stairways, ladders, screens, sheeting, platform brackets, suspension ropes, secondary ropes, traversing ropes, tie assemblies, scaffolding hoists, electrical cables and any other attachments, where appropriate.
- Environmental Loads: - Where appropriate, the environmental loads shall include the following:
  - wind loads in accordance with recognised standards imposed on the scaffold, including any guardrails, toe boards, stacked materials, screens, sheeting, platform ropes, guy wires and other attachments;
  - rain loads, where it is considered likely that the scaffold and cladding will be subjected to rain;
  - earthquake loads in accordance with recognised standards.
- Live Loads: - The live load shall include the following:

- the weight of persons;
- the weight of materials and debris;
- the weight of tools and equipment;
- impact forces.

- Duty Live Loads: - The live load applied to a working platform shall be categorised by the following duty conditions:
  - Light-duty, a load of 2.2kN per bay that includes a single concentrated load of 1kN:
  - Medium-duty, a load of 4.4kN per bay that includes a single concentrated load of 1.5kN;
  - Heavy-duty, a load of 6.6kN per bay that includes a single concentrated load of 2.0kN;
  - Special-duty, the largest intended load but not less than heavy-duty.

For design purposes, the single concentrated load shall be assumed to be in the most adverse position within the bay.

17.3.15 Scaffolding Foundations

- Scaffolding foundations shall be adequate to carry the whole weight of the scaffold, including the imposed loads, and shall be maintained in a stable condition during the life of the scaffold. Steel base plates shall be used under all standards.
- When scaffolds are supported on the ground, suitable sole plates shall be used to spread the load. The sole plates shall be long enough to support at least two standards as per OSHA standards.
- Timber sole plates shall be not less than 200 x 38 x 500 mm long. Unsuitable support material may not be used i.e. blocks, bricks or ply etc.
- All base plates shall have screw Jacks.

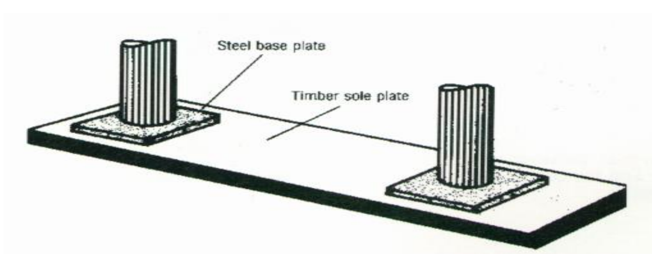


Figure 17.4: Support for Tubular Scaffold Standards

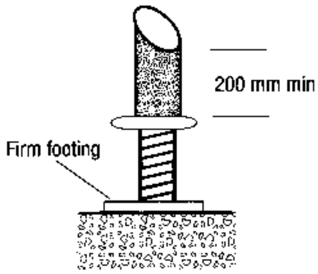


Figure 17.5: Adjustable Screw Extension

17.3.16 Working Platforms

Working platforms are classified as light duty, heavy duty or special duty.

a) Light duty working platforms are platforms that are:

- supported in spans of not more than 2.4m
- not more than 1.5m in width
- designed to support concentrated live loads not exceeding a load of 2.2kN per bay that includes a single concentrated load of 1kN
- maximum height of a scaffold constructed in accordance with this standard is 33m.

b) Medium duty working platform are platforms that are:

- supported in spans of not more than 2.4m
- not more than 1.5m in width
- where the span exceeds 2.0m, one intermediate putlog shall be provided at mid span to support scaffold planks, a load of 4.4kN per bay that includes a single concentrated load of 1.5kN
- maximum height of a scaffold constructed in accordance with this standard is 33m.

c) Heavy duty working platforms are platforms that are:

- supported in spans of not more than 1.8m

- not more than 1.275m in width
- designed to support a load of 6.6kN per bay that includes a single concentrated load of 2.0kN
- maximum height of a scaffold constructed in accordance with this standard is 33m.

d) Special duty working platforms are platforms that:

- do not conform to the requirements of either a light duty or heavy duty platform with respect to loading and/or dimensions
- are of adequate strength and stability and have been approved by the supervisor before use
- may require an appropriately qualified person's design certificate for a special duty platform.

17.3.17 Decking

The decked width shall be not less than 675mm, with sufficient additional width to leave 450mm minimum clear walkway at all times.

Guardrails and Mid-Rail

- Guardrails, including mid-rail, shall be provided on the exposed sides and ends of all working platforms. The height to the top of the guardrail shall be not less than 0.9m or more than 1.1m from the deck to be protected.
- Each rail, when secured to the standards or upright members, shall be capable of sustaining without failure or undue deflection a force at any point of 70kg (690N) vertical and 45kg (440N) horizontal, acting separately.

Toe Boards
A toe board or equivalent protection shall be fitted on the outside edge of every working platform more than 1.8m in height. The toe board shall be of sufficient height and strength to prevent the tools or materials from falling and shall be secured to the inside of the standards. A scaffold plank of 225mm minimum width may be used as a toe board.

Screens
Where the scaffold platform is above a thoroughfare, and due to the nature of the work falls of material are possible with injury to passers-by, special precautions shall be taken. Scaffolds that are screened shall be designed by an appropriately qualified person.

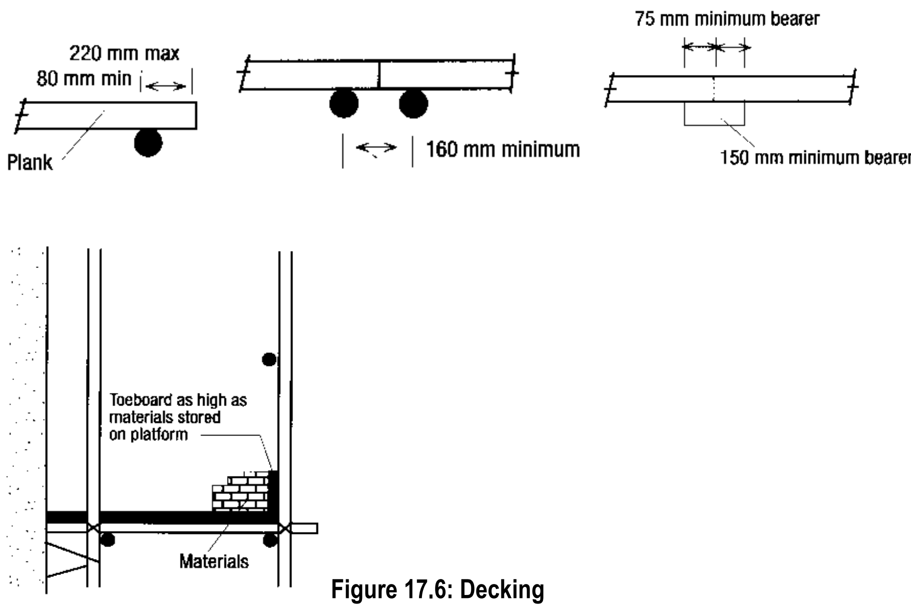


Figure 17.6: Decking

Headroom

- A scaffold platform used as a regular walkway or for the wheeling of loads shall have a clear headroom of at least 1.8m along the mid-half width.
- Where a succession of platforms is used to work up or down a face, the vertical spacing of lifts shall not exceed 2.1m except for the first lift, which if necessary may be up to 3m to allow for satisfactory working conditions at ground or floor level. When the height of the first lift exceeds 2.1m, extra bracing shall be provided on each pair of standards, commencing at approximately 1.8m from the ground.

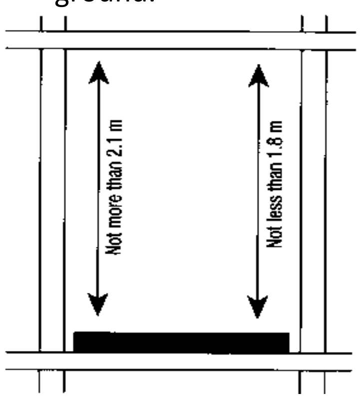


Figure 17.7: Headroom

17.3.18 Ties

- Ties shall be provided to prevent inward and outward movement of the scaffold and to assist the standards to act as load-carrying vertical members. Ties shall be fixed to standards and as close as practicable to ledger intersections. Ties shall also be uniformly spaced, vertically and horizontally, over the face of the scaffolding, including the level of the topmost working platform.
- A tie shall be capable of safely withstanding a horizontal force equivalent to 10% of the weight of the scaffold plus the full live load on the area of scaffolding in the vicinity of each tie. The safe load of a tie shall not exceed one-quarter of the breaking load of tie and anchorage.

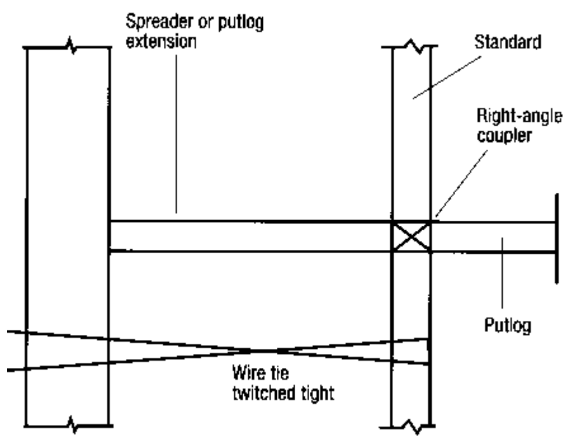


Figure 17.8: Detail of a Tie (Ledger Omitted for Clarity)

17.3.19 Bracing

- Adequate bracing shall be provided. Where it is impracticable to fit ties as required, dogleg bracing shall be provided. With such bracing the distance between tie points shall not exceed 8.4m or four lifts.
- Temporary ties may be required to ensure stability of the scaffold during erection and dismantling.

17.3.20 Requirements for Metal Tubes

The general requirements for metal tubes and fittings of steel or aluminium are:

- Metal tubes shall be purpose made with outside diameters accurately gauged to fit properly into the metal couplings and to allow complete interchangeability.
- Tubes in use on a scaffold shall be in good condition, free from bends and defects that might affect strength, reasonably free from corrosion and cut square at the ends. Tubes which are 3m and over in length should be reamed, if cut, to ensure safety when using internal joiners.
- When the loss of metal by corrosion or other causes reduces any cross section of a tube so that its corresponding weight is less than 90 percent of its original weight, the affected length of tube is to be discarded and rendered unfit for further use in scaffolding.
- Steel tubes shall be hot dipped galvanised or painted when used in scaffolds which are exposed for prolonged periods to marine or corrosive atmospheres.
- Fittings and couplings shall be specially made for the tubes in use and must be of a satisfactory quality as to strength and performance.
- Fittings shall be carefully maintained in good order and condition. They shall not be left lying around but stored in bags, boxes or bins, and kept well-oiled and protected from rusting.
- Special attention shall be given to the care and checking of screw threads and nuts; worn or distorted parts shall be discarded or replaced. Cracks or other flaws shall be watched for.

17.3.21 Framed Scaffold

- Prefabricated frames shall not be mixed up with frames of a different make or manufacture. The problem scaffolders will face is where frame scaffolding is used for heavy duty working platforms.
- Where heavy duty working platforms are to be used in conjunction with frame scaffolding, ledgers of scaffold tube will have to be provided in order that putlogs can be positioned mid span to reduce the span of scaffold planks.
- It is important that all tubes and clamps used for frame scaffolding are consistent with the 48.3mm outside diameter scaffolding tube.

17.3.22 Mobile or Rolling Scaffolding

- Erection of mobile scaffolding shall be carried out by competent workmen and in all other aspects shall comply with this standard for scaffolding.
- Scaffolders shall ensure that the scaffolding is fully braced, both horizontally and vertically, in order that distortion in any direction does not occur.

- The scaffolding shall be used on firm, level surfaces. Always inspect the area in which the scaffold is used, especially for live overhead power lines (refer to Table 17.1).
- When in use, the scaffolding wheels shall be locked or chocked to prevent movement. On large mobile scaffolds it may not be necessary to do this as a considerable force is needed to shift them.
- Under no circumstances are persons permitted to ride the working platforms of a mobile scaffold while it is being moved.
- Access shall be provided to all of the working platforms and it is a wise method to position this access on the ends of the scaffold thereby reducing the overturning moment.
- As with all scaffolding, working platforms over 3m in height shall be equipped with correct guardrails.

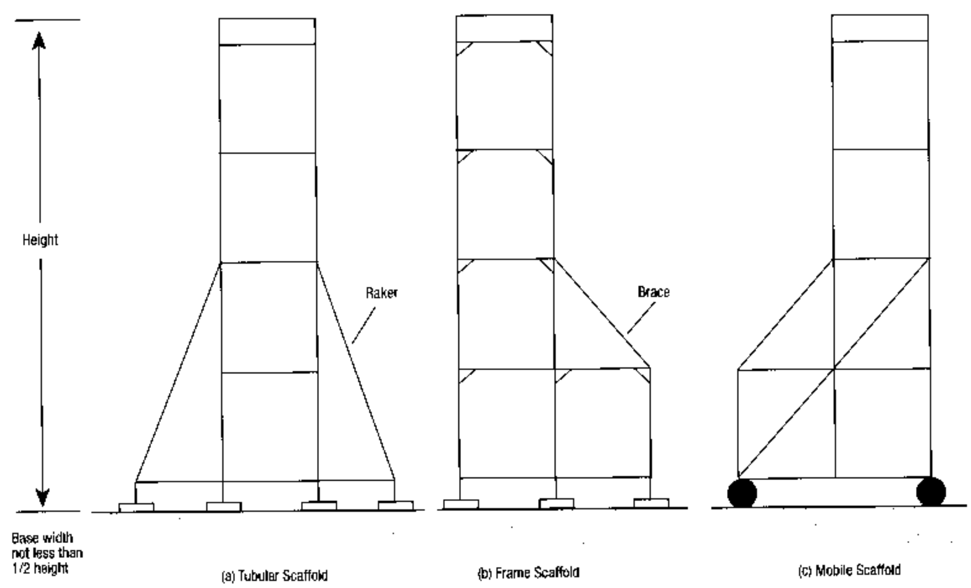


Figure 17.9(a) : Free Standing Scaffolds

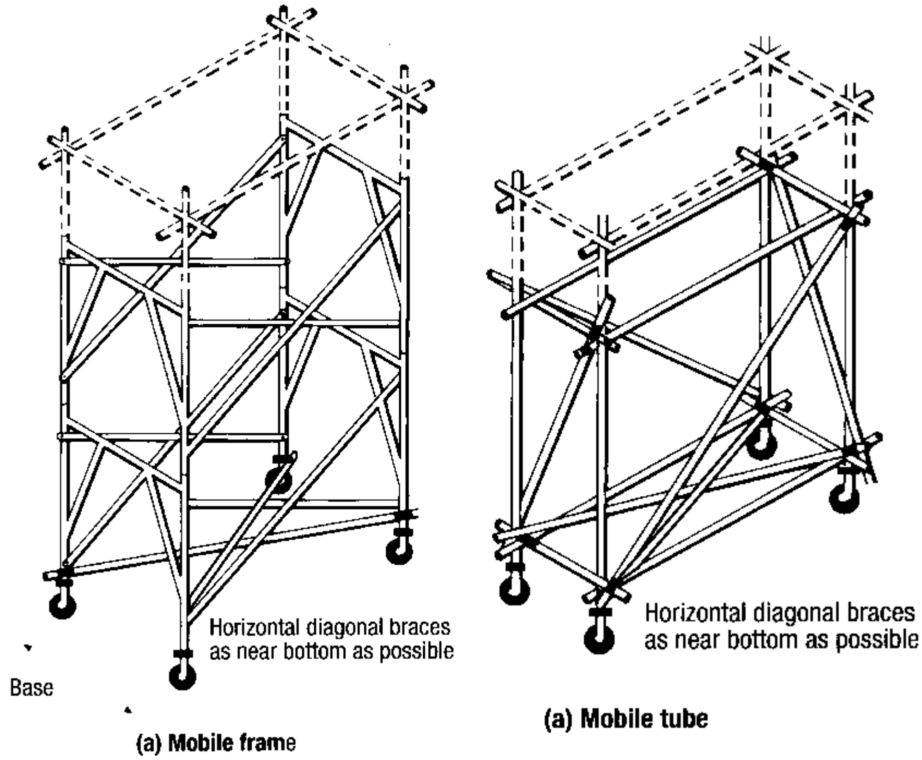


Figure 17.9(b) : Free Standing Mobile Scaffolds

17.3.23 Suspended and Swinging Scaffolding

- The scaffold shall be inspected as well as the anchorage, the ropes, and all of the fastenings. Always ensure that the maximum permissible safe working load is not exceeded.
- In the case of single overhead support, it shall not be more than 115kg.
- With double overhead support, it shall not be more than 340kg gross. Care shall also be taken when using a mechanical stage that the safe working load is not exceeded.
- Access to and Egress from Working Platforms
- All working platforms that form part of any scaffold shall have suitable and safe means of access and egress from each platform.

- The scaffolder shall ensure that whatever the access, be it ladders, external stairs or access from adjacent buildings, persons are not in any way endangered by using it.

17.4 Fall Prevention

17.4.1 Introduction

This standard Practice establishes the minimum standard for personnel while working at heights outside the confines of a working platform, any worker who works outside a working platform above 1.8m must wear a harness and be 100% hooked up.

17.4.2 Definitions

Competent Worker
Any worker who is adequately qualified, suitably trained and with sufficient experience to safely perform work assigned with only a minimal degree of supervision.

Fall Arrest Device
A device that provides a means of arresting the accidental fall of an individual.

Fall Arrest System (FAS)
A system comprised of various components which together serve to protect workers who may be exposed to a fall hazard.

Full Body Harness
A device made primarily of straps for containment of the torso and pelvic area designed to support the user during and after the arrest of an accidental fall and/or during a rescue operation and/or during work activities, depending on the group classification of the harness.

Lanyard
A short flexible line, rope or strap used to secure a wearer of a safety belt or harness to a lifeline. A lanyard is affixed to the harness and its anchor point by hardware (typically snaps).

Lifeline
A heavy line between two anchorages which may run either horizontally or vertically. Lanyards are attached to the lifeline allowing workers freedom of movement.

Pendular Effect
In situations where workers fall and are not directly in line with their anchor point, there is a tendency for the worker to swing as the fall is arrested.

Qualified Person
A person who, by possession of a recognised degree, certificate, or professional standing, or who by knowledge, training, or experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work or the subject.

Rope Grab
An arrester which moves over the lifeline and requires no manual adjustment during position changes. If an individual should fall, the arrester automatically locks onto the line. (There are several variations of rope grabs available.)

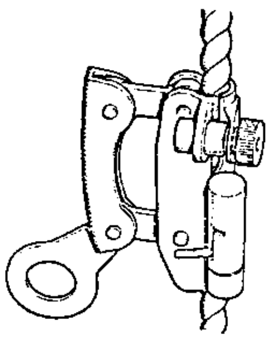


Figure 17.10(a): Rope Grab

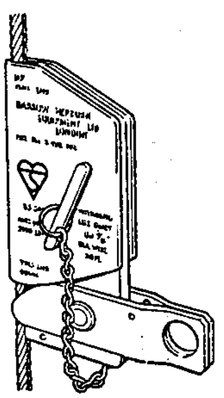


Figure 17.10(b): Rope Grab

Safety Belt
A simple or compound strap with means of securing it about the waist and equipped with a "D" ring for lanyard attachment usually located in the back.

Shock Absorber
A component of a personal fall arrest system that is normally attached to the body support device that dissipates kinetic energy and limits deceleration forces during fall arrest.

17.4.3 Responsibilities

The responsibility for establishing and administration of Fall Arrest Systems (FAS) lies with the supervisor. The authority for administration of the Fall Arrest program may be delegated to a competent worker. Responsibilities include, but not limited to ensuring that:

- FAS is adequate for its intended purpose
- personnel are trained and competent to use the FAS
- equipment is inspected and maintained in accordance with manufacturers specifications and the Standard Practice for Fall Arrest
- a rescue plan is prepared and reviewed in the event a worker falls and becomes suspended
- all elevated tools are analysed to identify as well as provide adequate fall protection systems
- compliance to recognised standards relating to fall arrest.

Responsibility for the proper care and use of personal Fall Arrest System lies with the user.

17.4.4 Standards

Generally speaking, personnel are required to wear FAS when the possibility exists for a worker to fall a vertical distance greater than 1.8m.

Management shall recognise that a Fall Arrest System (FAS) is the last resort and shall only be used when the work cannot be conducted within the confines of a guarded catwalk or work platform. This form of passive protection is preferred over wearing harnesses etc.

Fall Arrest Systems have the two key objectives:

i) To arrest the fall without failing under load.

ii) To be capable of distributing the fall energy to the user in a manner which will minimise injury.

Historically, the safety belt has been the first choice as a personal fall arrest device. The reason being, the simple design allows workers to put the belt on and take it off quickly. This results in a higher level of (workers) compliance to fall arrest protection.

Unfortunately, safety belts are unable to distribute fall energy throughout the body. When a fall is arrested by a belt, the body jackknifes at the waist. As a result, the individual has a high probability of sustaining a severe injury to internal organs, or even compromise breathing. Potential for fracture of the spinal column exists if the lanyard is in the front or on the side.

The second area of risk relates to the post fall suspension when there may be compression of internal organs or loss of consciousness. It is for these reasons that the full body harness has been designated as a minimum standard for FAS. Also there is a greater chance of slipping out of a belt harness if the wearer falls head first.

Note: Safety Belts are allowed for limited applications such as a work positioning device. In this application, the wearer is free to move around on a work platform, but the lanyard restricts the worker to positions where a fall is not possible. In this situation belts with either the single Dee-ring in the back or with a Dee-ring on each hip are acceptable.

Horizontal Lifelines

- Horizontal Lifelines shall be made of at least 10mm wire rope cable properly supported to withstand at least 24kN. impact. Alternate materials for specific cases (eg. use of synthetic fibre rope) must be pre-authorised for use.
- Horizontal lifelines shall be positioned to provide points of attachment at the waist or higher to the operator/worker utilising them.
- Lifelines shall not be used for any purpose other than fall protection.

- Horizontal lifelines shall be installed by competent personnel and inspected prior to use by personnel who are familiar with good rigging practices.

Vertical Lifelines

Vertical Lifelines are used for personal fall protection when vertical mobility is required and may be comprised of static lifelines made of synthetic fibre rope or cable which has been equipped with approved sliding rope grabs or they may consist of self-retracting reel type lanyard/lifelines which are attached directly to a safety harness.

These types of lifelines can be used to provide fall protection for operations such as scaffold erection and structural steel erection where tie off points are limited and vertical mobility is required.

Sliding rope grabs approved for the size of rope used are the only method for securing a safety lanyard to a vertical lifeline and must be positioned at least above the user's shoulder.

Lifeline Placement/Installation

- All horizontal lifelines placed in skeletal steel structures (eg. pipe racks, etc.) shall be 10mm cable as a minimum and shall be secured on each end by three cable clamps.
- Intermediate supports shall be adequate to minimise sag and vertical deflection to a maximum of seven degrees under loading. These lines shall be installed and maintained by the rigging crew.
- Lifelines shall be arranged to provide adequate mobility in all areas of the structure while maintaining maximum fall protection for personnel. All horizontal lifelines shall be arranged to provide tie off points at least waist high for personnel using them and are not to be used for any purpose other than fall protection.

Note: Softeners shall be used where lifelines contact sharp edges such as beam flanges.

17.4.5 Ladders

- Permanent caged ladders may be ascended or descended without additional fall protection.

- When ascending or descending ladders, personnel shall maintain a three-point contact. Materials or tools shall not be carried in the hands whilst ascending or descending ladders.

17.4.6 Personnel Lifts/Hoisting Devices

Aerial Lifts (JLG, Man lift, Snorkel, Scissors, etc.)
Personnel working from these lifts shall secure their safety lanyard to the lift basket at all times.

Crane Hoisted Personnel Baskets
Personnel working from personnel baskets shall have their lanyards secured whilst aloft.

17.4.7 Skeletal Steel/Open Structures

- Fall protection is required when personnel are required to gain access to, travel and work in skeletal steel/open structures such as pipe racks. This includes travelling on or working on any elevated surface which is not designed as a personnel work surface or walk way (eg. pipe, cable tray, etc.).
- Personnel working or travelling in elevated skeletal steel/open structures shall secure their lanyards to a life line or structure capable of supporting 24kN. at all times. In lieu of lifelines, personnel may secure safety lanyards to substantial structural steel members, pipe and pipe supports. Personnel shall avoid securing lanyards to cable tray, conduit and small bore threaded pipe.

17.4.8 Permanent Structures/Stairs, Caged Ladders

- Personnel working or travelling in incomplete permanent structures where fall exposure exists such as floor openings and open side floors, shall be tied off when within 1.8m of any fall exposure.
- Priority shall be given to installation and securing of permanent floors and walking surfaces and all guard rails and other permanent fall prevention devices.
- When required, temporary guard rails and floor opening covers shall be installed to eliminate fall exposures. When floor opening covers are installed they must be firmly secured, capable of withstanding load capacity equal to that of the floor and be painted and/or marked to indicate, ‘Open hole, do not move’.
- Personnel working within the confines of a completed scaffold platform equipped with all toe boards, rails, etc. are not required to be tied off.

17.4.9 Safety Nets

Safety nets may be used as secondary fall protection whenever there is a likelihood of personnel, materials, or tools falling on persons or property below. The use and installation of nets will be under the direction of an appropriately qualified person.

17.4.10 Inspection

Fall Arrest Equipment shall be inspected on a daily basis by the user. Should the user find any damage or note any defects, the equipment shall be taken out of service and examined by a competent person. In addition, Fall Arrest Equipment will be formally inspected when the units have been in use for six months. A written record of such inspections shall be retained on file.

Fall Arrest Equipment shall be inspected during General Planned Inspections and PPE compliance checks.

The following Fall Arrest Equipment shall be thoroughly inspected:

a) Harnesses and body belts.

- Inspect all buckles, Dee-rings and other metal components for cracks that may signal the beginning of metal fatigue, sharp or rough edges that could cut the webbing, rust or other corrosion, distortion, or other signs of wear.
- Check the metal wear pad at the base of the Dee-ring and make sure the Dee-ring pivots freely. Tongue buckles shall not be bent out of shape, shall move freely back and forth and shall overlap the buckle frame. Check that friction or quick-release buckles are not bent or distorted and engage correctly.
- Grommets shall be tight, not distorted or broken. Check for corrosion, dents, sharp edges or cracks. Discard a unit that has missing grommets or extra holes punched or cut into it.
- Make sure rivets are holding tightly and have not pulled through the webbing. Rivets shall not be bent; bent rivets will fail under stress. Pitted rivets indicate chemical damage.
- Examine all webbing on both sides and from end to end. Flex the webbing over your fingers, bending it to expose any signs of damage. Check webbing, straps, and reinforcing points carefully for wear and tear from fastening and unfastening buckles, and attaching snap hooks.

- Look for cut, pulled or broken stitches, or frayed or damaged strands in the woven web. Discolouration, fused, brittle or melted fibres may indicate signs of chemical, paint, solvent, burning or heat damage.

b) Lanyards and Securing Lines

- Snap hooks and locking snap hooks shall function smoothly and not be bent or wobbly. Check that the spring closes the keeper (latch) securely against the snap nose. Locking snap hooks shall hold the keeper in a closed position. Inspect snap hooks, locking snap hooks and eyes for cracks, sharp edges, corroded or pitted surfaces, or distortion.
- Look for bent, cracked or broken rivets on web lanyard. Thimbles on rope lanyard shall not be distorted or have sharp edges. They should be held securely by the rope splice.

c) Ropes

- Check that the rope is free of knots and consistent in diameter. Discard a knotted rope lanyard. Examine the rope from end to end, rotating it as you go and look for worn, broken or cut fibres. Look for damage that might be caused by welding, chemical or paints, or by exposure to heat sources. Thimble splices shall have five tucks and the hackling shall be secured from unravelling.

d) Web Lanyards

- Examine webbing thoroughly from end to end as described above, for belts and harnesses. Pay close attention to stitching and rivets, particularly at hardware attachment points. Look for swelling, discolouration, cracks or charring from chemicals or heat damage, or other signs of deterioration or wear.
- WARNING: - Discard and replace equipment if there is any evidence of excessive wear, damage or deterioration, or malfunction.

17.4.11 Personnel Training

During site safety orientation and safety meetings, employees shall be made aware of DGDC fall protection policy and their obligations to these regulations.

17.4.12 General Precautions

- Be satisfied that you have had proper training in the use of fall protection equipment. If in doubt, ask your supervisor or safety representative for assistance.
- Wear the correct size of full body harness and adjust it to fit you properly. Never cut or punch extra holes or otherwise modify the unit if it does not fit or for other reasons.
- Make a visual inspection of this equipment each time you use it.
- Equipment shall be removed from service and tagged for repair or destruction whenever signs of wear or damage are found.
- Dee-rings on harnesses are to be used only for attaching lanyards or devices connecting to an anchorage point. Never attach anything other than the fall protection system connector to a Dee-ring. Never attach a lanyard elsewhere on the full body harness.
- Lanyards shall be as short as possible. This will minimise the discomfort from gravity stopping forces in a fall arrest.
- Never tie a knot in a lanyard, knots reduce the supporting ability of a rope lanyard by 50%.
- Always use the right length of lanyard; do not tie or join two lanyards together to obtain the length required.
- Never use a ladder hook to attach a lanyard to a Dee-ring.
- A ladder snap is not designed to tie back to the lanyard. A sling or anchor strap must be used.
- Locking type rope snaps are approved to be tied back to the lanyard, however, non- locking type snaps are not.
- Lanyards with locking type snaps should be used to reduce the possibility of accidental disengagement, or roll out from the Dee-ring.
- Personal protective equipment shall not be used as slings or hoists or for other load bearing purposes. Harnesses or lanyards subjected to such alternate uses must be removed from service.

17.4.13 Attaching Lanyards/Connecting linkage to Anchorage Points

- Use the shortest possible lanyard. Always connect a lanyard above waist level to minimise the potential fall distance. Short lanyards reduce the possibility of a fall and minimise discomfort from gravity stopping forces in fall arrest. Shock absorbers also reduce the force of a fall.

- Select every anchorage point with care. The lanyard length and anchorage point of fall arrest device location shall never permit a free fall of more than 1.8m.
- Always check lanyard snap hook connections visually to ensure proper engagement. Do not rely on hearing an audible snap. Do not hook a lanyard around an anchor point and fasten the snap hook directly onto the same lanyard unless it is equipped with a locking rope snap.

17.4.14 Existing Pipe, Structures and Cable as an Anchorage

Fall Restraint Cable

- Cable lifelines shall be a minimum of 10mm wire rope. The type required will vary with application and is to be verified with the supervisor.
- Cable sag between intermediate supports of 6m - 15m spacings shall be 38mm minimum.

Note: Construction Stretch of 0.25% to 0.5% of cable length can be expected and wire rope may require periodic adjustment when used as a horizontal lifeline.

Intermediate supports shall be of sufficient height to support the cable at chest height (1.42m).

When securing to an anchorage point, the user shall take into consideration the deflection of the pipe or cable, the amount of stretch in the lanyard, the elongation of the shock absorber, plus the length of the user's legs.

Pipe
A 51mm diameter pipe of either carbon steel or stainless steel is a safe anchorage for fall restraint lanyards under the following conditions:

- pipe is in good condition (not corroded)
- span is no greater than 6-15m
- pipe spans are continuous for at least two supports on either side of the attachment.

Permanent deflection of up to 60cm can be expected in a 51mm diameter pipe should a fall actually occur.

Do not tie off to insulated pipe of any size.

Do not tie off to electrical conduit of any size.

Structural Steel

- Structural members found on a 6m - 15m span will be adequate anchorage.
- All commonly used wide-flange and channel shapes are adequate.
- 64mm x 64mm x 10mm angle is considered safe provided the span is less than 6m.
- Handrails are not to be used as anchorage points.

17.4.15 Instructions for Care and Maintenance

- Fall protection equipment shall be treated with respect when not in use. Always store equipment in a clean, dry environment free of corrosives or harmful fumes and out of direct sunlight.
- Surface dirt and grime shall be removed from the equipment after each use. Accumulated soiling can mask signs of damage, as well as shorten the service life of the equipment. All equipment shall be cleaned prior to the three-month verification inspection.

17.4.16 Cleaning

- Nylon webbing or rope shall be cleaned only by sponging with a mild solution of liquid and either cold or warm water. Equipment should be wiped with a clean cloth and hung to dry out thoroughly, away from direct sunlight or excessive heat.
- Do not use solvent-based cleaners and do not apply paints or solvent markers for unit identification.
- Warning: - Do not attempt to repair damaged equipment. Destroy or remove it from service immediately and place a tag on it that states “DO NOT USE”.

Form 17.1: Scaffolding Permit

Master Work Permit Number: ____

Project Name: _____________________________Location: ___________________________

Address: ____

Main Contractor: _______________________________ Contact: ______________________

Reason for Scaffold: ____

Scaffold Erector: ____

Subcontractors to use Scaffold: ____

Height: ____________________ Length: ___________________ No of Platforms: _________

Duty: _____________________ Limitations: _______________________________________

INSPECTION RECORD

Date:	Time:	Name of Inspector: (print)	Signature	Comments

Dominica Geothermal Development Company Limited
Powering a New Generation...

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-025: Excavations and Shoring
Revision 0

Contents

18. Excavations and Shoring

18.1 Introduction

The identification and control of hazards in all trenching work is not a simple matter. The physical hazards no longer lie on the surface, accessible to a simple inspection.

This procedure will together with the Dominican regulations or OSHA 2226 Trenching and Excavation Safety whatever is greater.

All trenching work is potentially hazardous. Attention must be paid at all times to considerations of safety by everyone involved in trenching operations.

18.2 Definitions

Excavation
Means making a hole or channel by digging.

Excavation Supervisor
The person in charge of the excavation work.

Material

- Consists of or includes solid material in such a form or state, or in pieces or particles so small, that it is capable of subsiding or flowing in such a manner as to trap or engulf a person
- Is enclosed inside a structure.

Qualified Person
A person who, by possession of a recognised degree, certificate, or professional standing, or who by knowledge, training, or experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the subject

Underground Services
Means all authorised services placed in the ground and controlled by a recognised authority. It does not include underground structures such as brick sewers, railway tunnels, etc.

Unforeseen Work
Means work that occurs at such short notice that it cannot be planned in advance.

Shoring
Means any material that is used to support the exposed faces of an excavation.

Angle of Repose
The angle to the horizontal at which the material in the face is stable and does not fall away.

Batter
The inclination of a slope, expressed as (a) vertical units or (b) horizontal units.

Benching
Excavation of a sloping ground in horizontal steps.

Face
An exposed sloping or vertical surface resulting from material.

Filling
Any ground made up using imported material or material from the excavation.

Safe Slope
The steepest slope at which an excavated face is stable against slips and slides.

Soil
All materials encountered from the ground surface to the bedrock.

Well Point System
A system of pipes, jetted or driven at close centres into the ground and connected to a suction main for the purpose of lowering ground water, particularly in granular soil.

18.3 Responsibilities

18.3.1 Raised Objects

The person in charge of the excavation shall take all practicable steps to ensure, where any employee is under any object/item that has been raised or lifted by any means to enable any work to be done, supports or other devices are placed or used under the object/item so that it cannot drop or be lowered while the employee is under it. Special attention shall be provided for loose not enclosed materials.

18.3.2 *Excavations with Faces More than 1.5 Metres High*

All excavation more than 1.5 metres high will be shored. A permit-to-work (Master Work Permit) is required for work more than 1.5m deep or where the material is unstable.

This does not apply where:

- the face is cut back to a safe slope
- the material in the face is of proven good standing quality by a qualified civil engineer under all reasonably foreseeable conditions of work and weather
- by reason of the nature of the work and the position of any employee in the vicinity, there is no danger to any employee
- the provision of shoring is impracticable or unreasonable by reason of the nature of the work and the contractor takes all practicable steps to ensure that the area is benched.

All practicable steps shall be taken to ensure that any shoring used in any excavation:

- consists of materials that are suitable for the purpose for which they are to be used, of sound quality, and adequate in strength for the particular use
- has bracing, jacks, and struts that are securely held to prevent accidental displacement, and packings and wedges that are held by nails or spikes
- is placed in a proper manner by an experienced person under competent supervision
- is not altered, dismantled, or interfered with except on the instructions of the person in charge of the excavation.

18.3.3 *Excavations of Hazardous Depth*

All practicable steps shall be taken to ensure, where any excavation is:

i) readily accessible to any person; or
ii) likely to collect or retain water of such a depth as to constitute a danger to any person

The excavation is covered or fenced so no unauthorised person has access to it.

At completion of work the excavation shall be filled.

18.4 Excavation Plan

18.4.1 Plan Approval

A formal excavation plan shall be prepared by the contractor or DGDC staff member responsible for the excavation work. This should be on Form 18.1 as provided at the end of this section. It shall be submitted at least two days before the start of any physical work.

For each excavation an Excavation Supervisor shall be appointed who shall have authority and be personally responsible for the inspection, checking and maintenance of excavation work and safety. The Excavation Supervisor will carry out a formal inspection daily of the work and complete an inspection form (Form 18.2 at the back of this section).

The appointment of an Excavation Supervisor does not negate the responsibility of the rest of the staff for the work.

18.5 Safe Work Practices

18.5.1 Introduction

DGDC will organise and carry out excavations in such a manner so as to eliminate, or at least minimise, inconvenience or damage to underground services whilst still providing safe conditions for both workers and the public.

DGDC will isolate the underground services from the excavation work in order to allow work to continue without danger to the workers or the public.

All excavation work must be planned before work commences on site. This is essential if the work is to be carried out safely.

Before work starts, there should be on-site, sufficient suitable materials to support the length of excavation expected to be open in normal circumstances, plus extra material that can be used if required.

The designer of a trench support system needs to bear in mind that the system is usually required to serve two purposes:

i) safety
ii) avoidance of damage to adjacent buildings, roads and services.

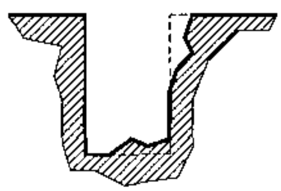
18.5.2 Modes of Failure

It should be noted that all excavations no matter what depth, may be hazardous. Modes of failure will depend on

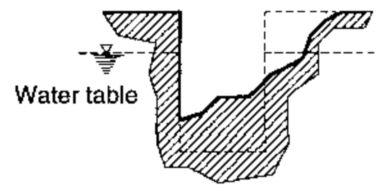
- the depth and type of soil
- bedding planes
- vibration
- the presence of moisture: rain, or a high water table level
- any superimposed loading close to the edge of the excavation
- the length of time the excavation is open
- any previous disturbance of the soil.

While some types of soil often look stable and may stand for quite a long time, a false sense of security can build up.

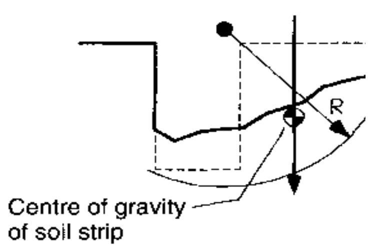
Some common failure modes are shown in Figure 18.1



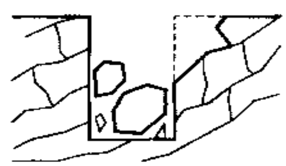
Unstable lumps fall into trench



Slump failure of soil mass



Rotational slip failure



Failure through slippage along bedding plans

Figure 18.1 Soil Failure Modes

Removal of soil from an excavation causes unbalanced soil stresses. The use of a shoring system, or the cutting of the sides of the excavation to a safe slope, will help compensate these soil stresses. A shoring system, or the design of safe side slopes, are engineering problems that involve both structural design and soil mechanics. While experience can guide operators in recognition of hazardous situations, it is only engineering practice that can provide known safe solutions. Just because a 'solution' worked previously does not mean that solution is satisfactory for the current situation. There may be additional factors that need to be taken into account.

18.5.3 Review of Site Plans

The owners of underground services shall be approached for information and plans well before excavation is due to start.

For major projects, an early approach to service owners is recommended as it may be possible to divert some services from the excavation area.

Plans shall be obtained which show the recorded line and depth of all their known services buried in the proposed work area.

Plans are not normally drawn to scale but even if they claim to be, they shall not be relied upon to obtain accurate measurements. However, plans can give a good indication of the location, configuration and number of underground services at a particular site.

Those in charge of site work, and operators of locators, shall be aware the plans may show spare ducts, and that the accuracy of plans is limited as:

- the position of reference points may have changed since the plans were drawn
- regrading of the surface may mean that the depths shown are now incorrect
- services, particularly cables may have been moved without the authority or knowledge of the owners
- in many cases service connections are not marked
- services tend to be drawn as straight lines but may in practice 'snake'. Excessively long cables may have been laid as horizontal loops outside substations, switch rooms, etc.

Even when work has to start without plans, as may be the case for emergency and unforeseen work, every effort should be made to locate buried services.

Where plans are not available in any situation, hand digging only shall be carried out.

18.5.4 Locating Devices

The position of any services in or near the proposed work area should be pinpointed as accurately as possible by using a locating device, in conjunction with any available service plans or other suitable information.

Plans will help the operator using the locator to interpret the signal, and so give the maximum information to those involved with the work before digging starts.

The degree of confidence with which buried services can be detected depends on a number of factors such as the characteristics of the device being used, the type and depth of the service, the magnitude of the current carried by the cable or other service, and the effects of other cables and metal pipes close by.

Frequent and repeated use shall be made of locators during the course of work.

Locators will not detect plastic pipes or other non-metallic ducts and services unless either:

- a metallic tracer wire has been laid with the pipe
- a small signal transmitter is inserted into and pushed along the pipe.

Locating devices shall always be used in accordance with the manufacturer's instructions and shall be regularly checked and maintained in good working order.

18.5.5 CAT (Cable Avoiding Tool).

Before using the CAT at the work site, carry out a visual survey of the area, look for some of the following:

- overhead power lines
- street lighting
- cable poles
- housing in the area
- stop cock covers
- signs of previously dug trenches.

18.5.6 Safe Digging Practice

Once a locating device has been used and/or the services are located, excavation may proceed, with trial holes dug using hand tools as necessary to confirm the position of any buried service. Special care shall be taken when digging above or close to the assumed line of such services.

Where practical, power tools shall not be used within 0.5 metres of the indicated line of the buried service.

Power tools and machinery shall not be used until services have been located and identified by hand digging

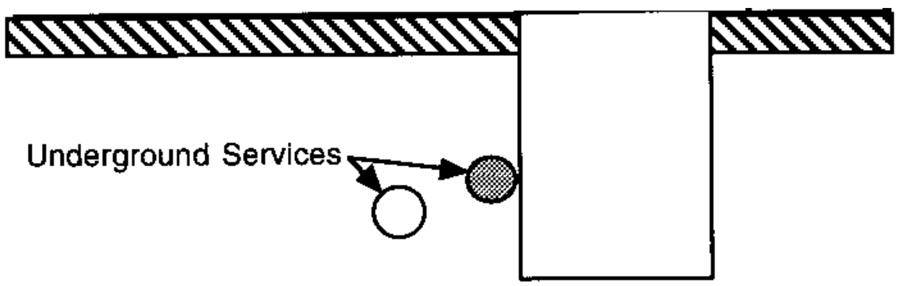


Figure 18.2: Excavating Next to Underground Services

When power tools have been used to break the surface away from the indicated line of the service, it shall then be positively located by careful hand digging under the paved surface.

If the service has not been located, where possible the CAT shall be used as a guide in or down the side of the excavation

Remember the minimum distance for any power tools used in excavation work must be no closer than 0.5 metres either side of the indicated line of the buried service. This may be reduced:

i) where congestion of buried services renders it impracticable;
ii) where surface obstructions limit the space available,

but only if the line of the service has been positively identified by plans and confirmed by a locator.

18.5.7 Excavations with a Face More Than 1.5 Metres High

Where any face of any excavation is more than 1.5 metres high, that face shall be shored unless:

- the face is cut back to a safe slope and signed off by a civil engineer and the material in the face will remain stable under all reasonably foreseeable conditions of work and weather
- the provision of shoring is impracticable or unreasonable, and safety precautions certified by an appropriately qualified person to be adequate, have been taken.

Access way of 10m will be made available in all excavations where workers are working.

18.5.8 Safe Slopes in Excavation

The safe slope of an excavation shall not exceed:

i) 1V:1H or the angle of repose, whichever is flatter, for soils above the ground water table.

ii) 1V:1.5H or the angle of repose, whichever is flatter, for saturated a submerged soil, or for excavations greater than 3m in depth.

iii) Where the slope of an excavation is benched, the maximum height between benches shall not exceed 1.5m, except for the bench adjacent to the work area which shall not exceed 1m. Overall, the total width of the benched excavation shall not be less than that required in (i) or (ii) above.

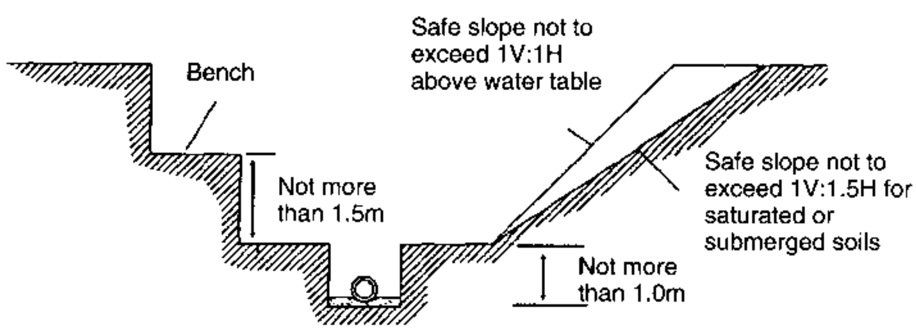


Figure 18.3: Excavation Face Benched and Battered to a Safe Slope

18.5.9 Materials and Loads Above Excavations

Excavated or other loose material shall be effectively stored or retained not closer than 600mm from the edge of the face unless the face is specially shored to allow for the increased load, and suitable toe boards or other safeguards are provided.

Mechanical plant, vehicles or any heavy loads shall not approach closer than:

- 2m from the edge of an excavation which is battered to a safe slope
- what would be the edge of the face if battered to a safe slope unless the actual face is specially shored to allow for the full effect of the additional load.

18.5.10 Excavations Adjacent to Buildings or Structures

Where it is intended to excavate alongside another structure, the precautions listed below shall be observed:

- Never excavate below the level of the foundation of any adjacent structure, or within an area which would be inside the safe slope, unless adequate precautions have been taken to ensure that the stability of the excavation face and the building or structures above are not at risk either during or after excavating.
- If an excavation is likely to affect the stability of existing structures, advice from an appropriately qualified person must be obtained before the excavation is started.
- Where pumping is being carried out to lower the ground water level, subsidence of adjacent structures may result. The characteristics of the supporting soil may be changed by pumping, causing a loss of fines and reducing the load-bearing capacity of the soil. If such works are to be undertaken, expert advice should be obtained.

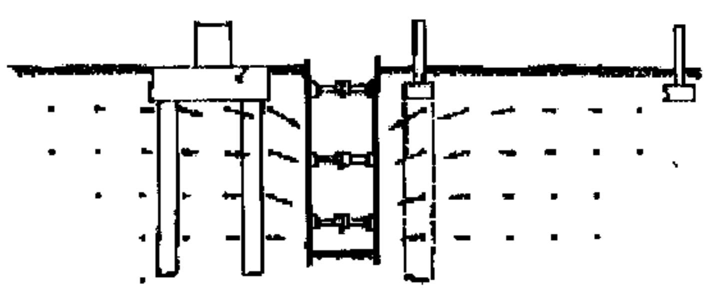


Figure 18.4: Building Foundations Adjacent to Trench

18.6 Parties with Access Affected

The Excavation Supervisor shall advise occupiers on work areas who may have their access affected by the contract works, when and where disruptions are likely to occur.

The Excavation Supervisor will advise DGDC that notice has been given.

18.7 Equipment

Equipment to be used in excavation shall be:

- specifically designed and manufactured for the purpose
- cleaned and maintained during use to ensure that performance is effective.
- Fit for purpose
- Have a flagman available for all tasks.

18.8 Barriers and Signs

- Where construction vehicles or plant use public thoroughfares, notices shall be placed at all exits and entrances to the work area to warn of the excavation.
- For all work carried out on roads, temporary warning signs shall be erected and traffic control measures used (a person with a stop/go sign).
- Fencing used for protection shall be adequate to prevent ready access to it by any person.
- Excavations carried out at any workplace to which people have, or might gain access, must be guarded to avoid danger to people. A fence one-metre-high or a combination of barriers, lights, or sentries may be necessary to provide adequate protection for the people and employees. These safety devices must be properly maintained until the excavation is complete or until there is no longer any danger.
- If an excavation is likely to collect or retain water of such a depth as will constitute a hazard to children or persons in the vicinity, the excavation must be covered or fenced off whenever workers are not present.
- Where excavation work is in or near access ways, and hazards exist, barricades, overhead protection, enclosed walkways or other means of protection shall be provided for the people.
- Where walkways or bridges are used, these shall be designed in accordance with sound engineering practice. Guard rails and mid-rails must also be provided where there is a fall hazard.

18.9 Permit-to-Work

A permit-to-work is required for all excavations with a face more than 1.5 metres high. The permit-to-work (Master Work Permit) shall be obtained from DGDC. The Excavation Plan will be submitted along with the Master Work Permit application and in some instances will be the basis of the permit. The Master Work Permit shall be completed before the work commences and the following details should be included:

- nature and location of the work
- name, address and contact details of the employer
- intended date of commencement of the work
- estimated duration of the work
- precautions to be followed.

18.10 Examination of Excavations

Excavations, including shoring and underpinning, shall be examined by the Excavation Supervisor before work starts each day, and after rain or any occurrence that could affect the stability of an excavated face.

Shoring members shall be checked for tightness against each other and against the soil face. A daily record shall be kept of examinations made, conditions found and precautions and/or actions taken (Form 18.2).

18.11 Road Surface Condition

Work shall be carried out in a manner that protects the works and which permits the safe and convenient passage of traffic with minimum delays over the whole length of road affected by the excavation.

18.12 Surface Water and Drainage

In all excavations, the safety of faces and fillings often depends on the effectiveness of the control of surface and ground water. To control surface water, cut-off drains constructed parallel and a safe distance back from the face, shall collect water and discharge it clear of the working area. Drains may also be necessary in the trench itself.

Subsurface drains, well pointing, or sump pumping should be installed to cut off, remove, or intercept ground water and channel it away from the site if this is a hazard.

Well pointing can lower the water table 4-6 metres and is most suitable in sands. The inflow from clay soils to well-pointing may be insufficient to be effective. During construction, checks should be made for inflow from springs or seepage. Any inflow should be collected in sumps and pumped clear of the excavation.

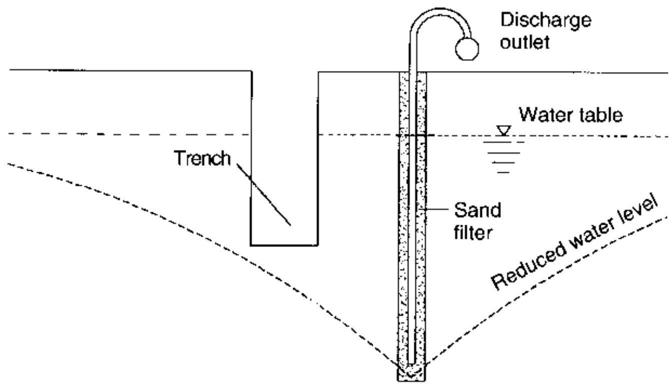


Figure 18.5: Well Pointing

Springs coming up through the floor of an excavation are another cause of unstable conditions.

18.13 Harmful Gases

Excavations being below ground are a natural receptacle for all gases heavier than air. Gas of various kinds, from quite unknown sources, can seep through the ground particularly where other work is taken place in the vicinity.

Typically, specific gases are found for certain ground types. These are summarised in Table 18.1.

Table 18.1: Typical Gas for Specific Ground Types

Type of Ground	Gases or Fumes Found
Peaty ground	methane, hydrogen sulphide
Filled and made ground	carbon dioxide, hydrogen sulphide
Reclaimed land and tip fills	carbon dioxide, methane

Thermal areas	carbon dioxide, carbon monoxide, hydrogen sulphide, sulphur dioxide, methane
Petroleum installations, service stations	petrol fumes, LPG, kerosene
City streets	natural gas, carbon dioxide, steam

Where there is any likelihood of air contamination, the works must be examined, using the correct type of detecting equipment.

18.14 Overhead Service Lines

When using excavators, e.g. backhoe, consideration shall be given to overhead services in the vicinity of the work. No part of any plant, equipment or its load shall come within the minimum approach distances (set out below) from the overhead service lines unless written permission has been obtained from the owner of the lines.

Table 18.2: Minimum Approach Distances

Type	Minimum Distance in metres
Telecommunications	4.0
Line voltage not exceeding 66kV	5.0
Line voltage exceeding 66kV	6.0

18.15 Protection and Support Systems

Diagrams that show protection and support systems that are used to shore up trenches are presented below.

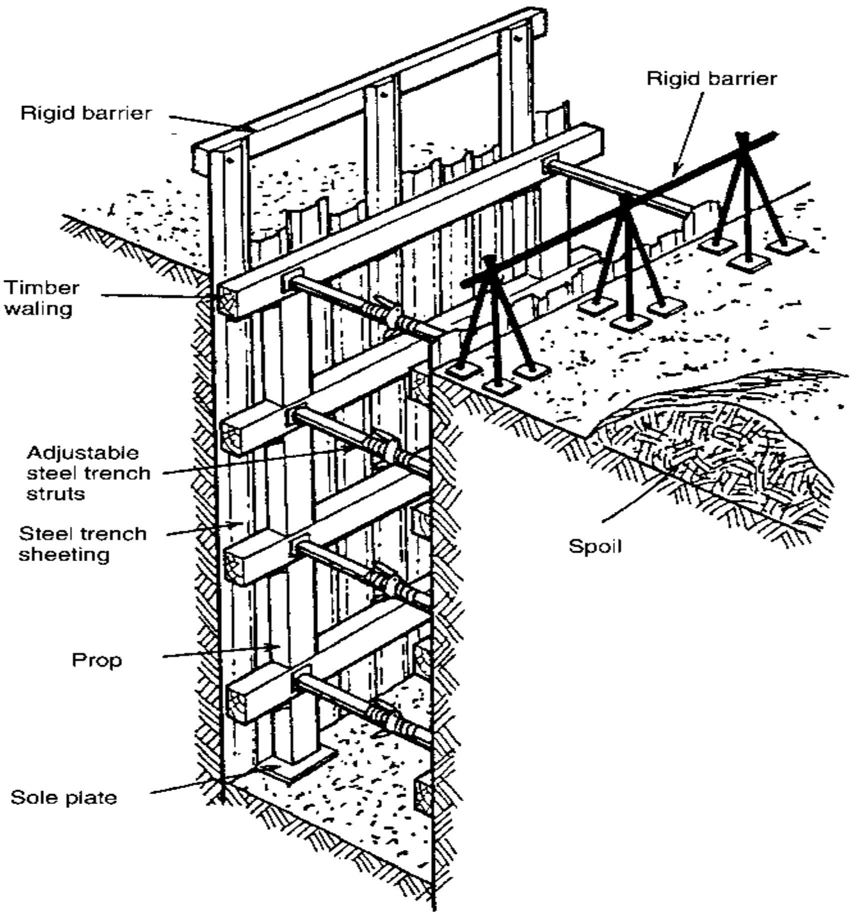


Figure 18.6: Typical Close Sheet Trench Support Method.

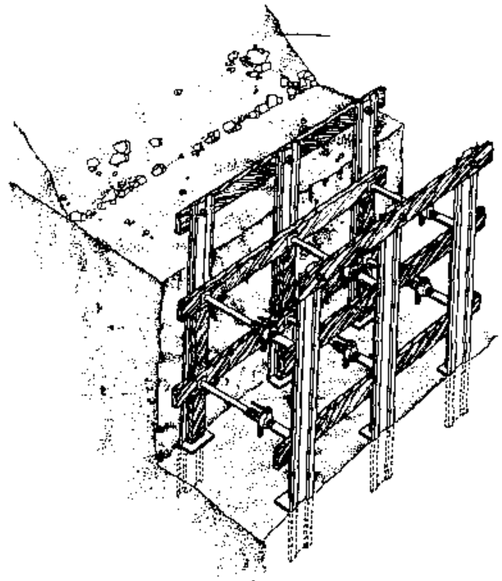


Figure 18.7: Quarter - Sheeting

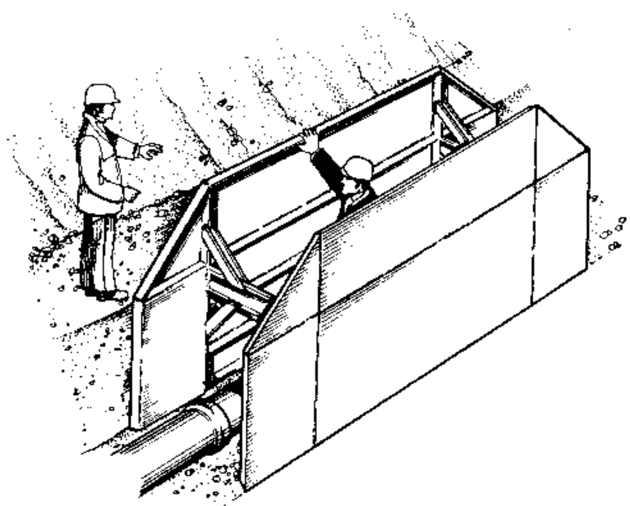


Figure 18.8: Trench Shield System

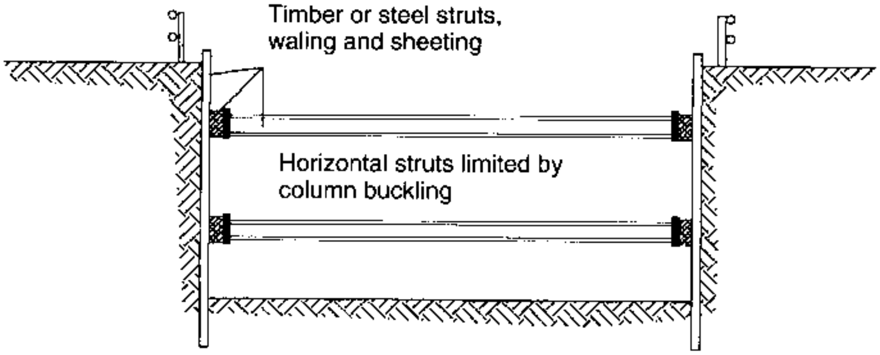


Figure 18.9: Horizontal Struts and Walings.

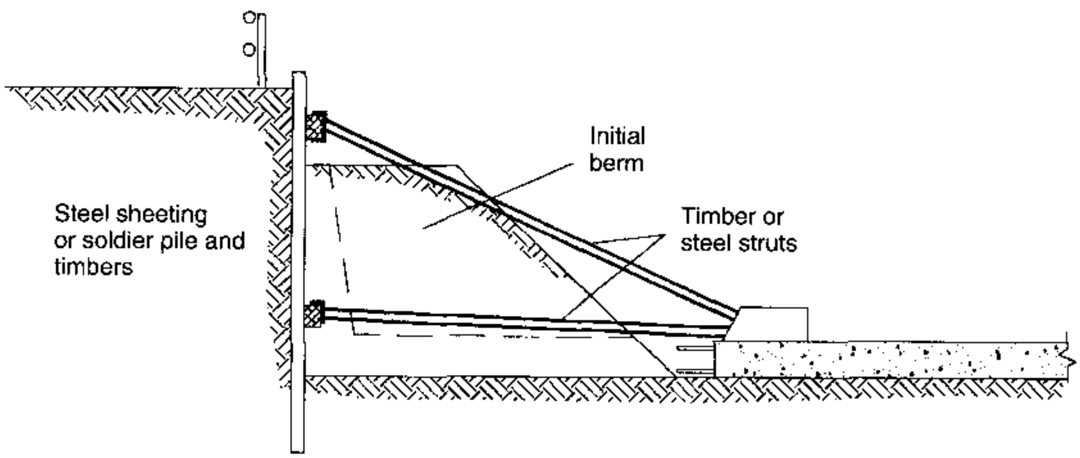


Figure 18.10: Raking Struts.

18.16 Shoring Requirements for Trench Excavations

The size and type of shoring required for trench excavations are specified in the following tables.

Table 18.3: Timber Sheeting

Soil Conditions	Trench Depth (m)	Timber Sheeting Min Dims (mm)	Timber Sheeting Horizontal Spacing (mm)
TYPE A			
Unsaturated ground; soils above ground water table or level	up to 3.0	150 x 50	1200 - 300 (a)
	3.0 - 4.5	150 x 50	600 - close (b)
	4.5 - 6.0	200 x 50	300 close (c)
TYPE B			
Saturated ground,	up to 3.0	150 x 50	close
soils with ground	3.0 - 4.5	200 x 50	close
water table or level			

Table 18.4: Timber Waling

Soil Conditions	Trench Depth (m)	Timber Waling Min Dims (mm)	Timber Waling Vertical Spacing C to C (mm)
TYPE A			
unsaturated ground;	up to 3.0	150 x 100	1200
soils above ground	3.0 - 4.5	150 x 100	1200
water table or level	4.5 - 6.0	250 x 100	1200
	Dims		Spacing C to C
TYPE B			
saturated ground,	up to 3.0	225 x 150	1200
soils with ground	3.0 - 4.5	250 x 150	1200
water table or level			

Table 18.5: Timber Struts

Soil Conditions	Trench Depth	Timber Struts (mm)(1)				
		Trench width up to			Spacing C to C	
Horizontal (mm)	(m)	1.0 (m)	2.0 (m)	2.5 (m)	Vertical (mm)	(mm)
TYPE A						
unsaturated ground;	up to 3.0	100 x 100	150 x 100	150 x 150	1200	1800
soils above ground	3.0 - 4.5	150 x 100	150 x 150	150 x 150	1200	1800
water table or level	4.5 - 6.0	150 x 100	150 x 150	150 x 150	1200	1800
TYPE B						
saturated ground,	up to 3.0	150 x 100	150 x 150	150 x 150	1200	1800
soils with ground water table or level	3.0-4.5	150 x 150	200 x 150	200 x 150	1200	1800

Table 18.6: Steel Trench Struts

Soil Conditions	Trench Depth	Steel Trench Struts (mm)(2)				
		Trench width up to			Spacing C to C	
Horizontal (mm)	(m)	1.0 (m)	2.0 (m)	2.5 (m)	Vertical (mm)	(mm)
TYPE A						
unsaturated ground;	up to 3.0	No.2	No.3	No.3	1200	1600
soils above ground	3.0 - 4.5	No.2	No.3	No.3	1200	1600
water table or level	4.5 - 6.0	2/No.2	2/No.3	2/No.3	1200	1600
TYPE B						
saturated ground,	up to 3.0	2/No.2	2/No.3	2/No.3	1200	1600
soils with ground water table or level	3.0-4.5	2/No.2	2/No.3	2/No.3	1200	1600

NOTES

1. All timber used for shoring shall be of sound quality No.1 framing grade or better.

2. Steel trench struts shall conform to OSHA regulations (Specification for Metal Pipes and Struts) or an equivalent standard. Metal props such as Acrow, Rapid Metal, etc. should not be used in place of trench struts.

3. Timber waling and sheeting made of steel or other material may be used in lieu of timber provided they are equivalent in strength to the sizes prescribed

Form 18.1: Excavation Plan

To: ....

Master Work Permit No: ....

Contract Name: ....

From: ....

Location of works: ....

Check list: Please Tick Appropriate Box.

Layout and detailed drawings.	☐	Traffic diversions.	☐
Hard surfaces/obstructions broken out.	☐	Existing services.	☐
Limitations on plant.	☐	Possibility of flooding.	☐
Presence of standing or running water.	☐	Means of draining water.	☐
Condition and stability of adjacent structures.	☐	Surcharge loads.	☐
Vibrations.	☐	Room for spoil and materials.	☐
Availability of water supply for jetting etc.	☐	Previous excavation.	☐
Evidence of hazardous contamination.	☐	Water table(s).	☐
Estimate of 'free-standing' time of ground.	☐	Ground to crack on drying.	☐
Pattern of discontinuities in rock.	☐	Special excavation techniques.	☐
Suitability of spoil for backfill.	☐	Profiles of ground depth.	☐
Full description of soils.	☐	Evidence of slope instability.	☐
Access to site.	☐	Notifiable to Client.	☐
Shoring type.	☐	Public Protection.	☐
ladders required.	☐	Gases Present.	☐
Work site condition.	☐	Controls of plant.	☐
Visibility adequate.	☐	P.P.E required.	☐
Site fenced, Etc.	☐	Emergency Procedures.	☐
Day or Night Operation.	☐	Hazard Identification.	☐

Name of Excavation Supervisor: ....

Contact Number: ....

Form 18.1 Excavation Plan (Cont.)

The proposed Excavation Plan is to show all relevant proposed shoring, use of fencing, cones and safety zones/clearances. In addition, the plan must show any other aspects that may have impact on the safety of the services, road users or site personnel.

Prepared by: Name: .... Date: ....
(print)

Sighted by: Name: .... Date: ....
(print)

Form 18.2 Excavation Inspection Checklist

This is a basic inspection sheet. Other items should be added as appropriate to a particular project.

Name: .... Contact Number: ....
Date: .... A. M. .... P. M. ....

Item	Checked	Action required
Is surface clear of plant, spoil heaps, materials	☐	....
Are spoil heaps being properly controlled	☐	....
Is the space between the trench arid spoil heap clear.	☐	....
Is the work properly fenced off and 'signed'.	☐	....
Is access adequate.	☐	....
Are ladders available and being used.	☐	....
Climbing on the timbering addressed.	☐	....
Is the trench safe from exhaust gases.	☐	....
Buried services clearly marked and protected	☐	....
Underground Services supported	☐	....
Is there any movement or deterioration of the ground.	☐	....
Is the area affected by any heavy vibrations.	☐	....
Is the pumping arrangements suitable.	☐	....
Is the work being done in accordance with Plan.	☐	....
Are materials used the correct design sizes and quality	☐	....
Are all struts horizontal and positioned squarely.	☐	....
Is the method for backfill a safe one.	☐	....
Is work tidy.	☐	....
Adequate lighting provided.	☐	....
Is PPE available and being worn by workers	☐	....
Others.	☐	....
Others.	☐	....

Comments:

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-026: Contractor and Construction Safety
Revision 0

Contents

19. Contractor and Construction Safety

19.1 Introduction

This section relates to all major work contracted by DGDC including:

- construction (see Subsection 1.3 of this manual)
- drilling (see DGDC-OHS-015 of this manual)
- major overhauls
- maintenance
- other similar work

19.2 Definitions

Assigned DGDC Representative
The assigned DGDC representatives is someone who shall:

- Oversee the construction activities, thereby ensuring that construction contractors comply with DGDC health and safety requirements.
- Maintain a line of communication with the construction contractor, to ensure proper performance of contract safety specifications.
- Ensure that an induction meeting is scheduled and conducted and that the results are documented.
- Arrange for final safety inspections of the completed work areas prior to occupancy.

Construction Work
Means any work in connection with the alteration, carrying out, cleaning, construction, demolition, dismantling, erection, installation, maintenance, painting, removal, renewal, or repair of any structure or structures.

Contractor
A contractor is any party to whom the performance of certain work is contracted out by the Dominica Geothermal Development Company.

19.3 Contractor Safety

19.3.1 Introduction

Contractors and subcontractors will often represent a high percentage of the site work force. Selection is critical to DGDC performance and how the Company is perceived in the market place as a safe owner and operator.

On occasions, DGDC contracts specific work packages to other companies. In these situations, DGDC has a responsibility to ensure that contractors and subcontractors have comprehensive programs in place which will ensure the safe and efficient completion of the work.

The objective of these programmes is to protect the health and safety of people associated with the work as well as others including the general public. DGDC expects contractors and subcontractors to take the protection of people as seriously as DGDC does.

Experience shows that an additional benefit from improved contractor safety performance is an improved overall effectiveness in the execution of the contractor's work.

In general, the contractor has independent responsibility for its own safety performance. In turn DGDC is responsible for clearly communicating its safety requirements to the contractor, and for monitoring the contractor's performance in respect of safety.

Contractors and subcontractors are to comply with the requirements outlined here in performing work for DGDC. Contractors and subcontractors are expected to implement additional measures, as necessary, to ensure exemplary workplace safety.

19.3.2 Types of Contractor

A contractor means any party to whom the performance of certain work is contracted out by DGDC. When deciding whether the contractor will be subject to the practices outlined in this section, the following three factors require consideration:

1. The type of agreement to be entered into with the contractor. The agreements fall into two main groups:

i) project agreements, where the result of the contractor's work is 'an end-product', and

ii) operational agreements, whereby services are provided to DGDC on an ongoing basis, such as maintenance, cleaning, security and transport.

2. Whether DGDC has, or could have, a prevailing influence on the behaviour of the contractor's personnel (see DGDC-OHS-039: Incident/Accident Reporting).

3. The size of the contractor's organisation. This will not be relevant to whether the contractor is subject to this section but will be important in assessing its applicability, i.e. the extent to which the contractor is required to comply with the various factors and guidelines mentioned.

The principles of this section extend to subcontractors in the sense that DGDC approves the subcontractor and monitors the contractor's performance in managing the safety of its subcontractor.

19.3.3 Selection of Contractors

The process of selecting a contractor and awarding a contract involves two stages:

- Pre-qualification
- Tendering and Contract Award

DGDC has written standards available against which the standards and performance of contractors are tested at each selection stage.

19.3.3.1 Pre-qualification

Once a project is defined, the first stage of the formal tender process takes place, i.e. pre-qualification, which aims at short-listing those contractors who will be invited to tender. This involves an up-to-date confirmation of the contractor's commercial and technical suitability to bid for the specific contract.

The safety requirements to be verified as part of this pre-qualification are those listed in Forms 1.1 and 1.2 of this section. Moreover, information on safety requirements specific to the project are requested. DGDC will require contractors wishing to tender for work and/or prior to commencement of work on site to fill in either the 'small project' pre-qualification questionnaire (Form 19.1) or the 'large project' pre-qualification questionnaire (Form 19.2).

19.3.3.2 Tendering and Contract Award

In the tendering process the contractor will have to include in its cost estimating all items necessary in order to comply with the health and safety aspects of the contract.

Since all contractors which have submitted bids are screened in the pre-qualification stage, they can be assumed to be capable of meeting DGDC' safety requirements.

Subcontractors are approved following a similar evaluation as applied for contractors.

19.3.4 The Contract

DGDC' contracts generally have a separate clause dealing with the contractor's compliance with health and safety requirements.

19.3.5 Post Contract Award Requirements

19.3.5.1 Site Specific Safety Plan

DGDC requires contractors and subcontractors to develop a site-specific health and safety programme to cover their own site activities.

A contractor shall not start work without a health and safety programme that has been accepted by DGDC.

Before starting work a contractor shall inspect the work site to ensure that it is safe for its employees and shall provide DGDC with written notification of acceptance of the site.

As a minimum the contractor's health and safety plan shall include the items listed below.

- A formal declaration (policy) confirming a commitment to comply with all relevant legislated codes and standards, including DGDC project-specific health and safety rules and standards.
- Identification of key project management personnel complete with their qualifications, experience and certification.
- Appointment of an on-site health and safety representative.
- A pre-project hazard analysis complete with an action plan to eliminate or reduce the risks associated with those hazards. The identification process outlined in Section 11: Hazard Identification, Assessment and Control should be used.

- A pro-active safety monitoring and reporting system.
- Details of the accident and incident reporting and recording procedure, complete with forms, that will be used to deal with significant events and mishaps such as accidents, injuries, security and environmental incidents, affecting the health and/or safety of any person under the contractor's supervision. (See Section 39: Incident/Accident Reporting).
- The contractor's emergency response system for the handling of emergencies or imminent danger arising while involved on the project.
- Confirmation that all employees have been trained in the safe use of plant, equipment, chemicals, substances and products they will work with.
- Details of all products, chemicals, and/or other substances that the contractor expects to use in providing its services. A Material Safety Data Sheet must be provided for each hazardous product.
- Details of the contractor's project-specific health and safety orientation/training processes.
- Requirements for planned health and safety inspections including the frequency of inspections of plant, machinery, personal protective equipment and its usage, and work practices for the duration of the contracted work.
- Details of the screening and selection process for subcontractors and consultants contracted by the company to perform work on the project.
- Confirmation that all employees are medically fit to perform the required work on the project.

Documentation shall be available for verification and auditing of the above and any additional information of procedures that may be added.

19.3.5.2 Induction Meeting

Once on site DGDC. will require the contractor and subcontractors to attend an induction meeting. This will cover all activities being carried out in the vicinity and a clear indication of the potential hazards as well as DGDC standards for the site, including:

- smoking limitations
- work permit procedures
- traffic and parking regulations
- restrictions on the use of drugs and alcohol
- limitations on places for eating and drinking

- standards of dress
- limitations on movements on DGDC premises
- housekeeping standards
- prohibition of the use of solvent, chemicals and oil products for any purpose, unless specifically authorised
- dangers and handling procedures for any noxious or hazardous substances
- hazards of excavation operations, e.g. damaging underground cabling or piping
- use of safety equipment such as personal protective equipment, fire extinguishers and life-saving devices
- meaning of, and required action upon, fire and gas alarms
- action in the event of discovering fire or loss of containment
- action in the event of accident.

All contractors' and subcontractors' employees, prior to commencing work on site are required to attend an induction session covering the health and safety standards expected on site and for the duration of the contract.

The contractors' and subcontractors' employees shall sign an attendance sheet to show that they have attended a session covering the contract health and safety requirements. A copy to be forwarded to the assigned DGDC representative prior to work commencing on the site.

The contractor and subcontractor shall liaise with the assigned DGDC representative as to scheduling of induction sessions.

19.3.6 Contractor Responsibility

19.3.6.1 General

The contractor shall, in the execution of the work, be fully responsible for compliance with:

i) relevant local, national and international laws and regulations;

ii) local, national and international standards or codes of practice whichever are the more stringent, unless specified otherwise; and

iii) DGDC regulations.

The contractor shall be fully responsible for supervision of its personnel to ensure that they strictly adhere to all applicable safety requirements.

The contractor shall appoint one of its personnel on the work site as its safety adviser and shall seek DGDC' approval for the individual so appointed.

During the construction programme DGDC will monitor the performance of contractors and subcontractors and make sure they comply with their health and safety plan and the contract.

DGDC will include the contractors and subcontractors during site reviews so as to ensure that any significant hazards are being properly controlled and that there are good, safe practices being followed.

If the contractor and/or subcontractor do not follow good safe practices, DGDC will take effective enforcement action as agreed in the contract documents.

19.3.6.2 Training and Key Personnel

When asked to do so by DGDC, the contractor's personnel shall demonstrate their ability and skills relative to their qualifications.

The contractor shall submit details of its supervisors in key positions and other key personnel for DGDC approval.

The contractor shall at its own expense ensure that all its personnel and subcontractors personnel have been given the necessary safety, survival and job-related training required by law, DGDC regulations and good practice, prior to the start of the work, and will provide certificates to that effect (if so required).

The contractor's personnel shall participate in any additional training which may be provided by DGDC.

DGDC may refuse access to its work site by any of the contractor's personnel who, in its opinion, do not comply with DGDC standards for safe and good workmanship owing to attitude, lack of skill or insufficient training or experience.

19.3.6.3 Safety Meetings

The contractor shall be responsible for maintaining and enhancing the safety awareness of its personnel and subcontractor's personnel, including arranging its own safety meetings and participating as appropriate in safety meetings held by DGDC or its other contractors.

The contractor shall inform the DGDC representative of the time and place of safety meetings which it arranges.

Copies of minutes of the contractor's safety meetings shall be sent to DGDC. The contractor's and subcontractor's personnel are to be encouraged to contribute actively to safety meetings and to identify safety topics for inclusion in the agenda for a safety meeting.

19.3.6.4 Accident/Incident Reporting and Investigation

The contractor and subcontractor shall follow DGDC' accident/incident reporting and investigation procedure. (see Section 39: Incident/Accident Reporting.)

- All accidents, no matter how minor, and incidents where serious harm may have arisen, shall be reported promptly to the assigned DGDC representative.
- Investigation shall be conducted immediately to determine causes. Most importantly, corrective actions are to be taken to prevent recurrence.
- In the event of an incident, the contractor and/or subcontractor involved shall co-ordinate the draft notification and report to the Site Superintendent within 24 hours, with the final copy to follow within another 48hrs. Only through written approval from the site manager will an extension be given.
- Each contractor and subcontractor is required to maintain an accident register for minor and major injuries.
- The contractor and subcontractor are responsible for complying with the reporting requirements and completing the necessary forms for the Authorities.
- The assigned DGDC representative will be available to assist the contractor and/or subcontractor in completing these forms.
- The scene of an accident resulting in serious harm must not be disturbed unless authorised by the assigned DGDC representative and/or the Authorities, or if it is necessary to save life or prevent further loss or damage to property.

- It is the policy of the DGDC Appointed Representative to initiate an investigation into an accident/incident as soon as practically possible after the event.
- It is the responsibility of the contractor to complete and forward an Incident Report Form to the Site Superintendent.

19.3.6.5 Occupational Health and Hygiene

The contractor and subcontractors shall be responsible for the supply of first aid for their employees and shall provide for:

- facilities for administering first aid
- periodic medical examinations
- arrangements for professional medical treatment
- hospitalisation.

The contractor must supply a first-aider trained in, and qualified to administer, first aid and provide transport when necessary to a medical centre.

The first aid facilities provided by the contractor and subcontractors shall be available for vendors and suppliers who may have an accident while attending the site.

The first-aider will be responsible for completing and filing any reports or documentation required by legislation or site requirements.

The contractor shall ensure that all its personnel and subcontractor's personnel are medically fit to perform their work. If requested by DGDC, the contractor shall provide health certificates for its own and subcontractor personnel.

If applicable, the contractor shall adhere to government regulations or DGDC' guidelines for medical surveillance or industrial hygiene monitoring.

The contractor shall ensure that its personnel and subcontractor's personnel shall maintain the highest standards of hygiene.

If separate accommodation is provided for contractor's personnel (e.g. contractor huts), the contractor shall comply with DGDC' standards for sanitation, sewage, water supply, sleeping quarters, food establishments, laundry and garbage disposal.

19.3.6.6 Permits

The contractor shall be fully aware of the details of the DGDC work permit system.

The contract will specify whether the contractor uses the DGDC permit system in full or their own system under one enabling Master Work Permit. In all cases the work control point will be agreed.

Unless DGDC expressly states otherwise, the contractor shall obtain a Master Work Permit signed by an DGDC Supervisor before any work is started. The work permit shall be accompanied by associated specific permits, such as a hot work permit or permits for specific work areas.

For specific specialised work such as that requiring radioactive sources, a specific work safety plan will be required.

It is essential that contractor's personnel read, understand and follow any conditions or precautions laid down in work permits and if any doubts exist, guidance from the assigned DGDC representative shall be obtained.

All contractors and subcontractors who will require a permit shall, whenever possible, notify the relevant DGDC Supervisor 24 hours prior to work commencing on site. Failure to comply with this requirement could delay starting on the project.

19.3.6.7 Shutting Down Unsafe Work.

The contractor and/or subcontractor shall not undertake or carry out any work if it could cause injury and/or imminent danger.

The assigned DGDC representative reserves the right to shut down a contractor's and/or subcontractor's job or portion of their job due to potential danger resulting from unsafe conditions, unsafe acts or unsafe work.

The assigned DGDC representative will work co-operatively with the contractor and/or subcontractor to prevent these situations.

However, if a job must be shut down due to health and safety reasons, the contractor and/or subcontractor must submit a written report to the assigned DGDC representative explaining how and why the work proceeded to the point of being shut down.

This report will include the contractor's and subcontractor's safe work procedure for starting and completing the work safely.

Work will not re-commence until the safe work plan is formally approved by the assigned DGDC representative.

19.3.6.8 Subcontractors

The contractor shall inform DGDC of names of subcontractors and obtain DGDC approval prior to their engagement.

The contractor shall ensure that subcontractors be informed of, and have the opportunity to participate in, the safety activities required by DGDC and which the contractor is obliged to instigate pursuant to the contract. The contractor shall stipulate in any subcontract that the subcontractor shall take active steps in the field of safety identical to those required of the contractor. The contractor shall regularly check subcontractor's compliance with safety requirements.

19.3.6.9 Emergencies

The contractor shall establish with DGDC what the arrangements are in the event of an emergency.

In particular, it has to ensure that its staff are familiar with the relevant essential emergency equipment, such as breathing apparatus, life jackets and fire extinguishers, the use of which shall be demonstrated and practised.

The contractor shall check the emergency procedures and the location and condition of emergency equipment. If the contractor considers these to be unsatisfactory or not fully appropriate for the work, it shall take steps in consultation with DGDC to improve them.

19.3.6.10 Equipment

The contractor's equipment is to be correctly maintained, inspected prior to coming on site. Prestart checks and maintenance checks in line with manufacturers specifications will also be carried out.

19.3.7 Safety Equipment and Personal Protective Equipment

The contractor shall provide adequate first aid equipment, fire extinguishers and other safety equipment of an approved type and quantity, as may be specified (or expected in accordance with good working practice), and shall maintain this equipment in a professional manner as dictated by legal and industry standards. In addition, the contractor shall keep up-to-date records of all such equipment.

Free access by all persons on site to all fire extinguishing and safety equipment must be maintained at all times.

All contractor and subcontractor personnel on the job site shall wear appropriate personal protective equipment as required by DGDC or by law, decree, administrative rule or regulation, or other legally binding policy, interpretation or pronouncement of a legal jurisdiction or authority. Contractors or subcontractors shall pay for and provide such equipment unless otherwise agreed with DGDC in writing. Contractors and subcontractors shall post signs specifying where personal protective use is required.

All personal protective equipment shall be used and maintained by contractors or subcontractors in accordance with the manufacturer's recommendations.

19.3.7.1 Facilities

All canteen, toilet, rest areas and office facilities supplied shall be cleaned by the contractor and/or subcontractor twice a day and shall be maintained in a safe and hygienic condition.

19.3.7.2 Guard Rails/Barricades

No person shall remove a guard rail/barricade from areas that expose an individual to a fall unless they have permission from the contractor's and/or subcontractor's safety supervisor. Such barricades shall be erected after the completion of the day's work and/or when the site is left unattended and should be brightly coloured, etc.

19.3.7.3 Lighting

The contractor and subcontractor shall provide temporary lighting when natural lighting becomes inadequate on all walking access ways, at work areas and at specific task work areas.

19.3.7.4 Waste Material

At the conclusion of each working day and/or as required, the contractor's and subcontractor's employees shall clean up and dispose of all waste material and rubbish in the waste disposal bins provided. Contractors and subcontractors are responsible for keeping all work areas free from accumulated rubbish at all times.

Contractors and subcontractors shall supply central rubbish containers and ensure that these are emptied off site on a regular basis.

Contractors and subcontractors shall appoint a person with sole responsibility for the removal of waste material. This person shall not be allocated other duties that will affect the clearing of waste material and maintaining the site in a clean and tidy condition.

Waste must be disposed of in accordance with the Dominica 2002 SOLID WASTE MANAGEMENT ACT, Dominica Litter Act40:61

19.3.7.5 Housekeeping

Contractors and subcontractors shall maintain good housekeeping at all times and shall keep all working areas clean and free of obstructions.

Contractors and subcontractors shall keep access to emergency exits clear at all times.

Contractors and subcontractors shall ensure that all ditches, holes, excavations, overhead work, etc are properly barricaded and, where necessary, provided with warning lights.

19.3.7.6 Entrance to Property

DGDC will advise contractors of security requirements imposed during travel to Company facilities and during residence. Contractors and subcontractors shall comply with all security requirements.

Contractors and subcontractors shall ensure that only those persons having authorised business in connection with the contract are allowed on the work site.

19.3.7.7 Security Fencing/Barricades

Contractors and/or subcontractors shall fence/barricade the perimeter of the site providing one entrance. The entrance is to control deliveries and visitors entering the site. Visitors to the site must be informed of the safety standards required and are not to be permitted to wander the site unescorted.

19.3.7.8 Traffic and Vehicles

All contractor and subcontractor traffic on DGDC property shall observe the posted speed limit, or if not posted, a safe speed in light of existing conditions.

Contractors and subcontractors shall ensure that all vehicles, cranes and rigging, vessels, and equipment they provide are maintained in safe operating condition and that operators are properly qualified, licensed and/or certified.

Vehicles provided by contractors and subcontractors shall be equipped with appropriate seat belts for driver and passengers. Contractors and subcontractors shall ensure that vehicle seat belts are always used.

19.3.7.9 Storage Area

Construction materials and equipment shall be unloaded in areas allocated by the assigned DGDC representative. The contractor and/or subcontractor shall be responsible for the proper protection and guarding of equipment and for DGDC equipment from the time that it is handed over for construction to the time when it is completed and returned to the assigned DGDC representative.

No covered storage will be provided by DGDC and all necessary covers shall be provided by the contractor and/or subcontractor at their expense.

19.3.7.10 Safety Signs

All employees of contractors and subcontractors must observe all safety and information signs displayed about the site. These signs inform personnel both of safety equipment that is required and hazards that personnel may encounter in special areas.

19.3.7.11 Plant and Equipment

All plant and equipment used on a project must be designed in accordance with sound and accepted engineering practices and certified safe for use on the project. This includes all plant and equipment used by contractors and subcontractors. A copy of the certificate for safe use must be submitted to the assigned DGDC representative prior to work commencing.

19.3.7.12 Food and Drink

No food and/or soft drink is to be taken or consumed on the construction site. Facilities must be provided that allow workers to take meals and drinks in reasonable comfort.

Alcohol and illegal drugs and substances are not permitted on-site. Personnel must not bring, possess, or consume alcohol on-site.

19.3.7.13 Smoking, Matches and Lighters

Smoking is prohibited in all areas containing flammable liquids, gas processing and compression equipment, solid wastes (combustibles), and separation or treating equipment, except in designated authorised areas.

DGDC have the right to order persons observed smoking in unauthorised areas to cease or to leave the area.

'Strike-anywhere' matches and plastic disposable lighters shall not be carried or used in hazardous areas. Safety matches are preferred, but facility or work site rules shall apply and control in case of conflict.

19.3.7.14 Hazard Identification

Contractors and subcontractors have the responsibility to inform each other of health and safety hazards they may be exposed to and the controls in place to protect them.

19.3.7.15 Radios

Radios are not allowed on site.

19.3.7.16 Children

Children under the age of 15 are NOT permitted on site unless specifically authorised by the Site Superintendent.

19.4 Construction Contracts

19.4.1 Scope

This section describes policies and the minimum safety and health requirements for construction activities on DGDC' sites. The minimum safety requirements defined herein shall have appropriate and full compliance by contractors and contractor personnel.

DGDC' work practices as laid down in the Company's Safety Manual shall be followed unless specifically replaced by other agreed practices. The sections of DGDC' Safety Manual listed below shall be applied to all construction activities unless expressly excluded by the contract. (Others may be included if required.)

- Training
- Hazard Identification, Assessment and Control
- Natural Hazards
- Work Control
- Hydrogen Sulphide (H2S)
- Safety with Hand Tools and Portable Equipment
- Electrical
- Hazardous Substances
- Heat Stress
- Noise and Vibration
- Lifting Equipment and Lifting
- Working at Height
- Excavation and Shoring
- Hot Work
- Confined Space
- Traffic
- Safety Equipment
- First Aid and Medical
- Fire Prevention and Fire Fighting Equipment
- Emergency Procedures
- Incident/Accident Reporting
- Monitoring of Safety Systems
- Painting
- Housekeeping.

19.4.2 General Requirements

Construction safety requirements have been established to protect the life, health and physical well-being of all DGDC and contractor personnel and to protect the public from hazards resulting from operations of the DGDC' contractors.

- Each construction contract shall contain provisions that define safety and health requirements.
- All construction activities must be performed under DGDC safe work practices and all relevant Government regulations.
- An induction meeting shall be held between the construction contractor and DGDC. Personnel from the safety, security, and environmental organisations shall participate in the meeting and be notified of the details at least one week prior to the date scheduled.
- DGDC will inspect the contract work site on a random, yet frequent basis. The inspections will be conducted for the purpose of observing, recording, and enforcing compliance with health and safety requirements. Violations of health and safety requirements shall be corrected immediately.

19.4.3 Construction Safety Monitoring

Form 19.3 is a Safety Hazard Checklist for a construction site. This is to form the basis for safety spot checks.

19.4.4 Responsibilities

Construction Contractor
In addition to the requirements specified earlier the construction contractor shall be required to carry out the actions listed below:

- Prepare a written site-specific health and safety plan and submit it to DGDC prior to the initiation of field work.
- The health and safety plan shall identify hazardous operations related to the intended work, including use of lock-out/tag-out, hand and power tools, barricades, scaffolding, cranes, and issues associated with wall openings, materials handling and rigging, fire protection, hazardous materials, excavations, demolition, waste removal, and ladders, etc.

- The plan shall also describe how the contractor intends to protect the life, health and wellbeing of the employees of DGDC and the contractor, and the public. Appendix A at the end of this section contains more detailed guidelines.
- Designate in writing for each contract, a safety manager who will ensure compliance with contract health and safety requirements.
- Designate competent person(s) for each planned operation.
- Implement health and safety requirements and be held accountable for these matters.
- Maintain lines of communication with subcontractors and the assigned DGDC representative, to ensure that contract safety provisions are understood and followed.
- Co-ordinate with the assigned DGDC representative all operations that involve safe access to hazardous work areas, shutdowns of mechanical and electrical equipment, testing, and interaction between contractor and DGDC operations personnel.

19.4.5 Specific Requirements

19.4.5.1 Hazardous Substances

The contractor shall:

- maintain on site a list of hazardous chemicals that are present on site
- label all chemicals at the construction site properly
- maintain proper Materials Safety Data Sheets (MSDSs) for all chemicals at the construction site.

19.4.5.2 Signs, Signals and Barricades

Construction signs must:

- contain company name, subcontractor name, contractor emergency contact.
- be visibly displayed while construction is underway and promptly removed when the project is completed.

Barricading of construction sites is required using metal fencing or other physical barricades. Orange cones or yellow caution tape are not considered adequate barriers.

19.4.5.3 Fall Protection

Fall protection is required when working at heights of 2m or greater. (Refer to Section 24: Working at Height.)

19.4.5.4 Personal Protective Equipment (PPE)

(Refer also to Section 31: Safety Equipment for full requirements which must be complied with.)

- As a minimum, hard hats and steel toed safety shoes are required to be worn at construction sites.
- Other safety PPE should be worn when planned operations pose hazards to employee health and safety. The PPE shall include, but not be limited to, safety goggles, face shields, gloves and harnesses or other fall protection.
- Respirators and chemical protective clothing may be needed for special jobs.

19.4.5.5 Roofing

Fall protection is required for all roofing operations at heights greater than 2m unless other protective systems are employed.

19.4.5.6 Tools and Equipment

(Refer also to Section 18: Safety with Hand Tools and Portable Equipment for full requirements which must be complied with.)

All tools must be in good condition and inspected prior to each use. Tools and equipment may be used only by qualified personnel. Do not alter tools or guards, and use only for the designated purpose.

Form 19.1: Contractors/Subcontractors Health and Safety Pre-Qualification (Small Projects) Questionnaire Form

Contract for:

Name: ____

Address: ____

____

Occupation/Activity: ___________________________________

		yes	no
1)	Do you have a written safety policy? (Attach copy)	☐	☐
2)	Do you have a safety orientation programme for new employees?	☐	☐
3)	Do you have safety meetings for staff? How often?...	☐	☐
4)	Do you conduct safety inspections ? By whom? .... How often.?..	☐	☐
5)	Do you give instructions on the following?		
	a) safe work practices	☐	☐
	b) safety supervisors	☐	☐
	c) toolbox safety	☐	☐
	d) emergency procedures	☐	☐
	e) first Aid procedures	☐	☐
	f) accident investigations	☐	☐
	g) fire protection and prevention	☐	☐
	h) new worker's orientation	☐	☐
	i) chemicals hazardous to health	☐	☐

6) How many work accidents has your company had in the last twelve months? ....

Signature Date

Name/Position /

Form 19.2: Contractors/Subcontractors Health and Safety Pre-Qualification (Large Projects) Questionnaire Form

As an ongoing commitment to health and safety DGDC requires all contractors/subcontractors to complete the information below. This information is to be submitted with your tender document. However, your company must show that it is maintaining a health and safety programme that complies with changes in the legislation, published and industry standards and codes of practice appropriate for the work.

NOTE: All questions must be answered

1. Safety Policy and Management Commitment: **yes** **no**

a) Do you have a formal written safety policy? ☐ ☐
(Attach copy)

b) Is the safety policy communicated to and understood by all employees? ☐ ☐
How?..

c) Do you have a safety organisation chart defining responsibilities? ☐ ☐
(Attach copy)

d) Who is responsible for co-ordinating health and safety matters on this project?

Name(s): ____

List Experience & Qualifications: ________________________________

____

2. Procedures: **yes** **no**

a) Do you have a health and safety manual? ☐ ☐

b) Do you have written working practices, procedures and safety instruction? ☐ ☐

c) What experience do you have with permit systems?

d) What formal procedures do you have for maintaining plant, equipment and vehicles? **yes** **no**

- inspection check lists? ☐ ☐
- manufacturers manuals? ☐ ☐
- plant and equipment register? ☐ ☐
- engineer's design certificates? ☐ ☐
- can we visit your premises to see? ☐ ☐

3. Hazard Identification **yes** **no**

a) Do you have a system to identify existing and new hazards during the term of the contract? ☐ ☐

b) Where hazards have been identified is there a system to determine and control of:

- significant hazards? ☐ ☐
- new hazards? ☐ ☐
- process, activities, task control systems? ☐ ☐
- reporting of new systems? ☐ ☐
- site-specific control system? ☐ ☐

4. Safety Training **yes** **no**

a) Do you give safety training to employees in the following areas?

- hazard identification? ☐ ☐
- emergency procedures? ☐ ☐
- plant and equipment use? ☐ ☐
- personnel protection requirements? ☐ ☐
- first aid? ☐ ☐

b) Have the personnel who will undertake specific work received formal training in safe working practices, the use of protective equipment relating to the personnel hazard exposure of that work? ☐ ☐

c) Have the personnel who will be using the protective equipment been trained and know how to use it? ☐ ☐

d) Please supply details of staff possessing formal first aid qualifications who will be engaged on this contract.?

Names:

1.____

2.____

3.____

e) Have the personnel selected for this project been medically examined? ☐ ☐

5. Safety Records **yes** **no**

a) What type of formal safety records/reports are kept by your organisation

	yes	no
• accidents/incidents all types?	☐	☐
• weekly safety meetings?	☐	☐
• monthly safety meetings?	☐	☐
• site safety inspections?	☐	☐
• plant and equipment inspections?	☐	☐
• specific work permits?	☐	☐
• hazard control systems?	☐	☐

b) Please supply your organisation's safety record for the last five years

- Number of fatalities : _____________

- Number of injuries where staff we’re off work for one day or longer : _____________

- Number of work days lost due to machinery failure or breakdown : _____________

c) Please supply the number of accidents resulting in environmental damage or pollution : ____________

d) Has there been any caution or prosecution by an enforcement authority given to your organisation in the last five years? ☐ ☐

6. Accident Investigation **yes** **no**

a) Has your organisation a procedure for investigation, reporting and follow-up of serious accidents, incidents and occupational illnesses? ☐ ☐

b) Are the results of any investigations communicated to employees? ☐ ☐

c) Do you have a procedure for investigating subcontractors' accidents? ☐ ☐

d) Do you have a system for reporting serious harm accidents to the authorities? ☐ ☐
(Attach copies of reports for the last 12 months)

7. Safety Awareness **yes** **no**

a) Do you have in-house safety meetings? ☐ ☐

b) Does your organisation conduct safety inspections on its own operations? ☐ ☐

c) Are all staff involved in, and do they understand the safety programmes relating to the project? ☐ ☐

d) Do you include subcontractors in a) and b) above? ☐ ☐

e) Do you have a site health and safety induction programme? ☐ ☐

f) Do you have a disciplinary procedure for employees, and sub-contractors' employees? ☐ ☐

8. Subcontractors **yes no**

a) What health and safety information do you require subcontractors to provide prior to contract acceptance?

Specify: ____

____

____

b) Do you have procedures for control of the health and safety performance of subcontractors? ☐ ☐

c) Do you have a procedure for the control of subcontractors who do not perform to the required health and safety standards? ☐ ☐

d) Do you carry:

- Public Liability Insurance? ☐ ☐
- Motor Vehicle Insurance? ☐ ☐
- Motor Vehicle Insurance (third party)? ☐ ☐
- All contractor's Risk Insurance? ☐ ☐
- Others ☐ ☐

Specify: ____

9. Emergency Procedures **yes no**

a) Are employees involved in the development of emergency plans? ☐ ☐

b) Do the emergency plans identify responsibilities and procedures to be followed? ☐ ☐

c) Have all staff received formal training in emergency procedures? ☐ ☐

d) Have emergency drills been carried out within the last 6 months? ☐ ☐

e) Do you have an audible alarm system to cover the work site area? ☐ ☐

Comments

Signed: ____

Position: ____

Company: ____

Date: ____

Form 19.3: Safety Hazard Checklist for a Construction Site

The following is a safety hazard checklist: the list doesn't cover everything but it shows the kinds of questions to ask. Add questions relevant to your workplace to the list and photocopy it. Each inspection can then be similar and a written record kept of them.

Date of Inspection __________________

Description/Location of Site ____

FIRST AID	**yes**	**no**	ACTION TAKEN
First Aid kit provided...............................	☐	☐	....
First Aid kit kept maintained....................	☐	☐	....
First Aid kit is dustproof	☐	☐	....
First Aid kit is easily accessible to employees	☐	☐	....
ACCIDENTS			ACTION TAKEN
Accident Register records:			
- Type of accident	☐	☐	....
- How it happened	☐	☐	....
- Personnel involved	☐	☐	....
- Working time lost	☐	☐	....
....	☐	☐	....
WATER			ACTION TAKEN
Adequate equipment supplied and easily accessible for prompt rescue of drowning person when work is in proximity of water..	☐	☐	....
....	☐	☐	....
FIRE			ACTION TAKEN
Firefighting equipment is supplied:			
In site offices...	☐	☐	....
All worker's accommodation	☐	☐	....
In all storage rooms where there are combustible materials	☐	☐	....

	yes	no	
In every place where there are welding or flame cutting processes going on	☐	☐	....
On every floor of building site	☐	☐	....
Equipment is clearly marked for workers to see	☐	☐	....
Workmen trained in their use	☐	☐	....
....	☐	☐	....
EYE PROTECTION			ACTION TAKEN
Eye protection supplied having regard to type of work being carried out	☐	☐	....
Eye protection supplied in windy, dusty and/or sunny conditions	☐	☐	....
HELMETS			ACTION TAKEN
Helmets supplied to all workers on site by contractors and subcontractors	☐	☐	....
‘Safety Helmet Area’/ ‘Hard Hat Area’ sign clearly displayed	☐	☐	....
Helmets worn on site by workers when overhead dangers are present	☐	☐	....
Site management ensures that helmets are worn by workers including subcontractors	☐	☐	....
DRINKING WATER			ACTION TAKEN
Supply of clean cool drinking water is adequate..	☐	☐	....
Water is easily accessible	☐	☐	....
Boiling water supplied at break times	☐	☐	....
....	☐	☐	....

SANITARY	**yes**	**no**	ACTION TAKEN
Urinals - at least one urinal for every 50 workers	☐	☐	....
Closets - one water closet supplied for the first 20 workers employed and one for every additional 30 persons employed	☐	☐	....
Sanitary facility connected to sewerage where possible	☐	☐	....
Closets and urinals conveniently accessible	☐	☐	....
Facilities are cleaned and disinfected regularly	☐	☐	....
Facilities are made of sound construction and have flooring of impervious material	☐	☐	....
Facilities have good lighting and ventilation	☐	☐	....
Water closets fitted with hinged door with lock and pans having lift seat and flap	☐	☐	....
Supply of toilet paper maintained for workers	☐	☐	....
Separate facilities for male and female workers on site	☐	☐	....
WASHING FACILITIES			ACTION TAKEN
Washing facilities supplied with adequate supply of running water and washing materials (soap and towels)	☐	☐	....
Hot water supplied if workers are using materials which are difficult to remove with cold water	☐	☐	....
Wash basins or troughs are suitably drained	☐	☐	....
Facilities are cleaned and disinfected regularly	☐	☐	....

WORKERS' ACCOMMODATION	**yes**	**no**	ACTION TAKEN
Built of sound construction having weatherproof walls and roof and suitable floor	☐	☐	....
Has adequate lighting, ventilation...........	☐	☐	....
Heating supplied when necessary...........	☐	☐	....
Adequate space, seating and tables provided for workers to have their meals in reasonable comfort	☐	☐	....
Accommodation kept in clean and tidy condition	☐	☐	....
Utensils used are cleaned after use on a regular basis	☐	☐	....
A receptacle with tightly fitting cover supplied for rubbish and emptied and cleaned at regular intervals	☐	☐	....
Hat and coat hooks or lockers provided...	☐	☐	....
Provision for proper storage of food supplied, e.g. cupboards or refrigerator. Possibly oven or hot plate for preparing food	☐	☐	....
WORK AREA - GENERAL			ACTION TAKEN
Safe access to site	☐	☐	....
Building materials stacked safely around site	☐	☐	....
Area clear from obstructions/materials:			
stairways	☐	☐	....
passageways	☐.	☐	....
work area in general, as is practical so as not to put at risk health and safety of workers	☐	☐	....

	yes	no	
Adequate lighting (artificial/natural)			
work areas	☐	☐	....
passageways	☐	☐	....
stairways	☐	☐	....
Good ventilation in all areas	☐	☐	....
Handrails are erected around floor perimeters and around lift shafts	☐	☐	....
Holes in floor are covered with heavy plywood or suitable material with adequate warning signs..................	☐	☐	....
General comments			
....	☐	☐	....

HOISTS			ACTION TAKEN
Suitable person and/or material hoist in use..	☐	☐	....
A relevant certificate (test certificate if applicable) for hoist clearly displayed showing notice of maximum load or persons to be carried	☐	☐	....
Hoists have safe access and egress	☐	☐	....
Qualified or suitable operators to operate hoist...	☐	☐	....

TOOLS			ACTION TAKEN
Tools provided are in good sound condition	☐	☐	....
Regular basic maintenance checks are done on power tools, power leads, isolating transformers and junction boxes................................	☐	☐	....

	yes	no	
Machinery being used e.g. bench saws, skill saws are maintained in good working condition with all respective guards working and in place	☐	☐	....
Ramset firing equipment being used has current warrant of fitness	☐	☐	....
Workers own tools are in good sound condition	☐	☐	....
CRANES			ACTION TAKEN
Crane in use has relevant current certificate and notice of maximum load to be carried is clearly displayed	☐	☐	....
Equipment associated with cranes (chains, straps, slings) are in sound working condition ..	☐	☐	....
Properly trained operator driving crane and with suitable person dogging or directing loads	☐	☐	....
Is crane used when hazardous or unsafe conditions are present? (If YES, give date and details)	☐	☐	....
SCAFFOLDING			ACTION TAKEN
Scaffold is erected by trained scaffolders	☐	☐	....
Contractor has received permit for scaffold	☐	☐	....
Scaffolding erected by workers on site, e.g. 'H' frames or kitset scaffold, is erected in safe manner and having regard to planks and handrails for safety of workers using equipment	☐	☐	....
LADDERS			ACTION TAKEN
Ladders are secured properly when used in their respective operations	☐	☐	....

	yes	no	
Ladders that are used as access and egress from floor to floor are secured both top and bottom and extend at least 1 metre above landing point	☐	☐	....
All ladders are maintained in good sound condition	☐	☐	....

HARMFUL SUBSTANCES ACTION TAKEN

Stored safely	☐	☐	....
All containers are labelled showing:			
• contents	☐	☐	....
• proper use	☐	☐	....
• safety precautions	☐	☐	....
Site office holds material safety data sheet (MSDSs)on chemicals in use	☐	☐	....

Appendix A: Health and Safety Plans - A Guide to Minimum Safety and Health Requirements

Site Specific Health and Safety Plans should contain health and safety information that is directly related to the hazards associated with the planned/required operations of a particular project. All plans should contain the information described in this appendix:

General Information

Name of Contracting Company

Name of Construction Project

Location of Project

Project Summary
A description of the work to be accomplished (e.g. this project entails the excavation of previously identified and sampled soil which is contaminated with xyz chemical).

Crew Composition
Identify crew composition including who the Safety Manager is and designate all competent persons necessary to carry out required operations (by name and the specific operation that they are qualified to oversee).

Name of subcontracting companies and the operation(s) that they will perform
(e.g. Abacus Corporation will be the subcontractor of Barabus Company and will perform the removal, loading and transportation/disposal of all contaminated soil encountered).

Hazard Analysis

Hazard Analysis
For each planned or required operation provide information on what the hazards are, how they will be controlled and how personnel will be protected from these hazards.
(For instance: This project requires the excavation, loading, removal and disposal of contaminated soil. Employees will be provided with proper PPE including safety helmets, steel toed shoes, safety glasses, gloves, etc. Proper protective systems will be used in excavations to prevent possible collapse. Ground moving equipment will be operated by properly trained and certified persons. Traffic control operators will be provided to direct trucks to, and from disposal site, etc.)

Standard Types of Information

Employee Training
Describe what the training requirements are and how they are to be met.

Identification of PPE to be used (see Hazard Analysis discussion above for example).

Standard Procedures
Discuss what they are and how they will be employed in this project. Examples include first aid procedures, accident response procedures, fire safety and response procedures, etc. Standard procedures may include, but not be limited to, the following:

- plant and equipment operation
- hazard communication information
- emergency preparedness plan and emergency procedures
- barricade system(s)
- ladder safety
- power tool program
- flammable liquids, quantities and protective systems
- traffic control plan
- pressurised systems control plan
- lock-out/tag-out procedures
- respiratory systems
- emergency evacuation plan.

Where appropriate special procedures shall be written and used to cover unusual situations.

Operational Specific Requirements

Specific Operation Requirements
A detailed description of specific operations, the hazards associated with these operations and the hazard control processes to be employed. These operations include, but are not limited, to the following:

- barricade system description
- demolition and waste removal plans
- hot work
- confined spaces(s)
- scaffolding
- cranes
- heavy equipment
- rigging
- concrete/masonry
- roofing
- trenching
- asbestos, lead and mercury
- toxic or hazardous materials and waste.

The above information is intended to serve only as a guide and is not exhaustive. Specific safety plans may vary based on the nature of the construction project and the types of operations required.

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20. Painting

20.1 Introduction

This section covers the safety aspects of painting and similar surface coating procedures likely to be carried out at DGDC sites.

20.2 Spray Painting

Spray painting equipment may only be used, set up and tested by an experienced person who is suitably trained and has a good knowledge of safe operating procedures.

Spray operators shall be trained and experienced in the following:

- operation of spray equipment
- selection and inspection of equipment
- the necessity for wearing an airline respirator and other protective clothing and the correct use of this equipment including its storage
- spillage procedures
- first aid procedures
- safe work procedures, methods and practices
- the reporting of defects in safety devices and equipment.

20.2.1 General

Always follow the manufacturers recommendations stated on the label of the paint can.

Most paints are toxic and must be treated as hazardous substances no matter what painting technique is used. For handling precautions see Section 20: Hazardous Substances. The following precautions should be taken when using a spray gun:

- adjust the atomisation pressure so there is not too much mist
- ensure that no one is between the gun and any ventilation point
- spray downwind when outside so as fumes are blown away from the operator

- release pressure in the gun before clearing a blocked nozzle or dismantling any part of the hose or gun
- never fix the trigger in the open position by wiring or any other method
- never spray on to hands, face or the body
- read paint can label for information on storage, protective equipment, health hazards, hazardous substances content, etc
- if available, obtain Material Safety Data Sheet on paint.

The solids content of substances sprayed are toxic. The solids may contain antimony, lead, silica or zinc. The solvents used (toluene, xylene, etc) may be harmful to the lungs or skin. Refer to paint can label or MSDS for details on human health effects and precautions to follow.

Isocyanates are also commonly present in polyurethane paints (two pot mixtures), lacquers, adhesives and binders. Exposure to isocyanates will irritate the membranes of the nose, throat, lungs and eyes producing systems of watering eyes, dryness of the throat and tightness of the chest. After prolonged exposures some individuals may become sensitised. The sensitivity reaction takes place in the form of an asthmatic attack which may occur immediately or sometime after exposure. Individuals may also become sensitised after a single high exposure.

Positive pressure airline type respirators must be worn when spraying isocyanate paints in enclosed areas.

20.2.2 Paint Spillages

- Any spillage should be cleaned up immediately and reported
- Refer to paint can label or MSDS for instructions
- Small spills (less than 1 litre) can be wiped up with cotton waste.
- Larger spills should be mopped by spreading non-combustible absorbent material, such as sand over the spillage and placing the collected mixture in an outside bin.
- The area affected by the spill should be decontaminated with a solution of dilute ammonia and detergent or other decontaminating mixture.
- The area should be roped off and 'No Smoking' signs erected

20.2.3 Spray Paint Application

Mixing of paints shall only occur in well ventilated areas.

20.2.3.1 Spray Booths

- All spray painting should be carried out in a properly designed spray booth in which adequate air movement is provided by mechanical ventilation.
- The mechanical ventilation should be interlocked with the spray gun so that the gun cannot be operated unless the ventilation is on.
- A respirator must be worn at all times while working in a spray booth where a spray gun is operating.
- The respirator shall be supplied with compressed air from an uncontaminated source that is free of carbon dioxide and carbon monoxide. The supplied air shall also be free of odour and filtered to remove dust, water, and oil mist.
- Mechanical ventilation of the spray booth following spraying must continue until the work area is free of all residual spray mist.

20.2.3.2 Spray Painting Outside the Spray Booth

- When spraying occurs outside the spray booth, the whole of the enclosed area shall be regarded as hazardous and warning signs shall be posted to prevent unauthorised personnel inadvertently entering the hazardous area.
- Suitable respirators must be used if there is not adequate ventilation.
- Personnel should stay clear of freshly painted interior areas while they are being painted and until they have been ventilated and the painted surfaces are dry and not giving off fumes.
- If the spraying operation is carried out in the open air, the area within 15m of the spraying operation is considered to be a hazardous area. There shall be no ignition sources in the vicinity and smoking is banned.

20.2.4 Equipment

All equipment must be designed, manufactured, set up and maintained to be safe.

Paint containers which work under pressure should have these fittings:

- a valve to reduce the pressure of the air going into the appliance
- a safety valve
- a tested and sealed pressure gauge.

There should be a red line on the dial of the pressure gauge which shows the maximum safe working pressure

20.2.5 Cleaning of Equipment

Clean equipment only in a well ventilated area.

Avoid skin contact with thinners. Use elbow length rubber gloves whenever possible.

20.2.6 Storage

Enamels because of their solvent content are classed as Class 3: Flammable Liquids under international transport regulations. A Class 3 hazard diamond is usually affixed to the outside of the paint container. Paints classified as Class 3: Flammable Liquids must be stored in a specially designed store. Their use and storage must be in line with the requirements specified in Section 20: Hazardous Substances.

20.2.7 Safety Equipment

In addition to respiratory and eye protection, spray operators shall wear overalls, gloves and a head covering in the case of respirators which leave the head exposed.

Eye wash facilities must be available near the work area.

Positive pressure, full face respirator connected to an airline when spraying high solvent content and isocyanide paint.

20.3 Surface Preparation

There are a number of techniques used for surface preparation prior to painting. These include:

- abrasive blasting (sand, shot, and bead blasting)
- chemical stripping
- acid dipping
- power brushing (use of abrasive disks and wheels)
- water blasting.

These processes all have inherent hazards that will need to be managed. The Master Work Permit aids in identifying these hazards and in the setting of control measures to minimise the identified hazards. For any major painting activities at the site, the permit system must be used prior to commencing work.

20.3.1 Abrasive Blasting

20.3.1.1 Blasting Enclosures

Abrasive blasting should only have performed at DGDC sites by persons trained and experienced in abrasive blasting and the safety requirements associated with blasting.

No abrasive blasting shall be done except in a blasting enclosure, unless due to the shape or size of the article to be blasted, this is impracticable.

Every door of a blasting enclosure shall be kept closed while blasting is being performed.

The blasting enclosure shall be ventilated and the ventilation system shall be passed through a filtering device to remove any entrained dust.

The ventilation system shall operate continuously during blasting and for a period of at least five minutes after blasting has ceased.

20.3.1.2 Protective Equipment

The person undertaking the abrasive blasting within the blasting enclosure shall wear the following protective equipment:

- abrasive blasting helmet fitted with a positive pressure airline fed respirator
- leather gauntlets
- heavy overalls
- leather apron
- safety footwear and spats.

All personal safety equipment will be inspected before use and defective items replaced.

Vacuum cleaners shall be provided to remove dust from clothing.

Compressed air shall not be used for removing dust from clothing.

20.3.1.3 External Blasting

As far as practicable, the work should be cleaned by hydro (water) blasting or wet abrasive blasting, with dry abrasive blasting limited to final clean-up.

As far as practicable, screens will be erected to contain the abrasive sand within a limited area.

An isolation distance of 20m will be set up around the item to be blasted.

Any personnel required to work within the isolation area will wear positive pressure respirators and protective clothing.

Work areas shall be kept free of deposited sand.

Waste and unused sand shall be stored in enclosures to minimise dust.

The area will be cleaned up at the end of each day, with used sand being placed in the appropriate enclosure.

Signs will be erected to warn people that abrasive blasting is being undertaken and that the area around which blasting is occurring is restricted. Hazard tape can be used to rope off isolation area.

Wherever possible, silica-free or low active silica content sand should be used in sand blasting.

The operator shall be equipped with the same level of protective equipment as used in the blasting enclosure.

20.3.2 Chemical Stripping

Read the label on the container as to protective equipment that should be worn when using the chemical stripper.

Personnel undertaking chemical paint stripping should, as a minimum, wear:

- a full face shield
- overalls
- chemical resistant gloves
- chemical resistant apron
- safety footwear.

If fumes are being given-off, an air purifying respirator should also be worn. If the area in which paint chemical stripping is being undertaken is poorly ventilated, then a positive pressure air feed respirator should be worn.

In addition, a portable eyewash station should be located near the area that work is being carried out.

20.3.3 Acid Stripping

The acid bath should be located in a well ventilated room.

Eye wash stations and emergency showers should be located near the acid bath.

Operators should wear the minimum level of protective clothing as specified for chemical stripping operation.

20.3.4 Power Brushing

Personnel undertaking power brushing with electric hand tools should observe all requirements pertaining to the use of small electric tools. (See Section 11: Safety with Hand Tools and Portable Equipment).

Personnel should be wearing:

- eye protection
- hearing protection
- hand protection (leather gloves).

20.3.5 Water Blasting

Personnel undertaking water blasting shall wear water resistant clothing and eye protection.

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21. Hot Work

21.1 Introduction

This section outlines 'hot work' safe work practices that will be followed at DGDC sites. Hot work is any work that involves the generation of intense heat such as welding, grinding, and flame cutting, etc. that could cause ignition. Hot work can present a significant hazard if not planned and controlled.

In particular, this section covers DGDC safety requirements for:

- electric arc welding
- gas welding and cutting
- hazardous hot work on tanks and drums.

21.2 Training

Welding or gas cutting equipment shall not be used by personnel unless they are adequately trained and familiar with its safe use. Training is to include all safety related aspects as well as welding procedures. Welders must be qualified for the application. If being trained, then the trainee must be under strict, qualified supervision. A person should never operate equipment that they do not understand.

All printed rules and operating instructions supplied by the manufacturer of either the welding/grinding equipment or that being worked on or situated nearby are to be followed.

21.3 General

The work area must be kept free of flammable liquids or combustible material (such as oil, wood, paper, or piles of rubbish in which sparks could smoulder and burst into flame. Any oil spillages should be cleaned up and the area 'sponged' or 'mopped' with sand or a proprietary cleaner.

Suitable and sufficient fire extinguishing equipment must always be stationed in the immediate vicinity of the work area. All workers should know how to operate the fire extinguishing equipment. Firewatchers must be appointed in locations where any fire risk exists (see below).

Hot work should not be carried out whilst an automatic fire sprinkler system or drench system is out of action in the area that the work will be carried out, (refer to Section 36: Fire Prevention and Fire Fighting Equipment) unless the system may be activated by the hot work itself.

Never use an empty drum, tank or container as a work platform or as a support for welding, cutting or grinding, etc. The torch flame or sparks may ignite vapours or solid residues inside it. Either use a proper support or clean the container as described in Subsection 11: Hazardous Hot Work on Tanks and Drums.

Physical protection, and chalked warnings, are to be used if there is any danger of other people touching or standing on work pieces that are, or may become, hot.

Care must be taken that heat, sparks and slag from welding or cutting operations do not damage existing or surrounding surfaces and equipment or injure people.

Before using any welding or cutting equipment, it must be checked that everything appears to be in good condition and in operating order. If this is not the case, then the equipment must not be used until repaired (Refer also to Subsections 8: Gas Welding and Cutting and 9: Electric Arc Welding for specific checks that should be done prior to using welding/cutting equipment).

Special care must be taken when welding pesticide spray equipment as many insecticides decompose and produce the toxic phosgene gas when heated.

21.4 Firewatchers

Firewatchers are required whenever any fire hazard exists, and whenever the ‘hot work permit’ states that one is required. It is the responsibility of the ‘person in charge’ that the firewatcher understands the dangers of hot work, the hazards involved with the work to be undertaken, the duties of the firewatcher, and how to use the appropriate firefighting equipment.

Deciding the requisite number of firewatchers required on the installation for a job is the responsibility of the ‘person in charge’ in conjunction with the supervisor who authorises the hot work permit. The decision should be based upon what is reasonably practical whilst ensuring safety, as well as the time period involved.

The sole duty of the firewatcher(s) during the work shall be to act as firewatcher. The duties of a firewatcher shall never be combined with that of a welder’s mate.

21.4.1 Firewatcher Training

Fire watch personnel assigned to fire watch duties should be given initial basic training on the general aspects of fire prevention and first aid firefighting. Further training should include the following:

- types of portable fire equipment available
- general procedures and permit-to-work systems applicable to hot work operations
- firewatchers' duties.

21.4.2 Fire watch Duties

The duties of the assigned firewatchers include the following:

- checking all hot work areas for possible ignition sources and/or presence of combustible materials prior to, during and after, hot work operations,
- ensuring that suitable portable fire extinguishers, fire hose reels, fire blankets, etc. are located and readily available for emergency use at all hot work sites. A fire extinguisher is to be at immediate hand.
- maintaining a constant watch during actual hot work operations for possible sparks, hot slag, or hot spots etc. which could cause fire. This duty may require inspection of both sides of walls, under floors, and in roof spaces.
- initiating emergency actions in the event of the start of a fire. This includes immediately warning the welder and nearby workers, and attempting to extinguish it whilst it is still small. If the fire is not quickly put out the firewatcher is to ensure that the site alarm is activated.
- re-checking the area after completion of hot work to ensure that all work surfaces have been cooled to normal temperature and that no hot slag, smouldering debris or any other ignition source remains and then if necessary, thoroughly wetting down the area and all areas in which a spark may have penetrated. Re-inspection of an area may have to be continued regularly for 30min after task finished. In the case of controlled cool-down of the work place this period may run into many hours.

21.5 Ventilation

The work area should always be well ventilated when welding. Ultraviolet light from welding changes oxygen in the air to ozone that irritates the lungs. There are toxic substances in fluxes, filler rods, coatings and cleaning agents. Other poisonous fumes are produced by welding, cutting or grinding metal coated with paint, resin or varnish. Carbon monoxide is also produced; it is odourless and leads to unconsciousness and even death at concentrations of greater than 50ppm.

21.6 Elevated Welding

(Refer also to Section 24: Working at Height.)

Welding or cutting in elevated positions shall be conducted only under safe conditions. A full safety body harness connected to safety lines shall be worn at heights above 1.8m. Warning signs, warning tape and ceramic rugs shall be placed below areas where welding or cutting is being conducted where slag and sparks would fall down and may injure personnel, damage equipment, or cause ignition.

21.7 Pre-heating and Post-heating

Extra planning is required where it is required to pre-heat and/or post-heat a work piece as part of the welding procedure. In particular, the need to provide safety cover for the total work period, including the natural cool-down phase must be borne in mind. In many cases, where heavy gauge plate work or large sections are involved, it may be many hours before all heat has been dissipated and the temperature is low enough to be considered safe.

21.8 Confined Spaces

This procedure for entering and working in a confined space is set out in Section 29: Confined Space

Never enter a tank or vat to carry out cleaning or hot work unless you are suitably trained. Any work in confined spaces is extremely dangerous and should not be attempted by inexperienced people.

Do not attempt to weld, cut or grind if the presence of explosive vapours or dusts is suspected. Test the atmosphere with a suitable gas detector.

Keep welding plant outside the confined space and run leads only to the work area.

When welding in a confined space ensure that the attendant understands the welding plant being used and is able to shut it down properly and quickly in an emergency.

Remove gas torches and hoses or leads from the space every time that work stops - even for tea breaks. A small leak, even for a short time, could result in an explosion when work re-starts.

21.9 Gas Welding and Cutting

21.9.1 General Safety

Never use oxygen to blow dust off clothing as the increased oxygen concentration trapped in the fabric can cause clothing to become highly flammable, burning as if were soaked in petrol. Likewise, never use oxygen to 'sweeten' the air.

Acetylene forms an explosive mixture with oxygen at concentrations ranging from 2% - 82%. Leaking acetylene is easily identified by its garlic or onion smell.

Copper forms an explosive compound (copper acetylate) with acetylene which is likely to explode on impact. For this reason, never use copper or any material containing more than 70% of copper to join acetylene hoses. The proper fittings must always be used.

Acetylene is an unstable gas and dangerously so at pressures over 100kPa. For this reason, the regulator on the gas equipment must never be set higher than this pressure.

LPG (used in cutting) is heavier than air and will therefore collect in low-lying places. For this reason, it should not be used in trenches, holes or places where it can spill down to a lower level. LPG forms an explosive mixture with oxygen at concentrations of between 2% and 10%.

When lighting up gas welding and cutting equipment always use friction or electric lighters, never use a cigarette lighter or matches. Correct light-up and shut-down procedures and sequences must always be followed.

Flashback arresters must be used on all gas welding and cutting equipment.

Key spanners shall be left in position on cylinders when in use so that they can be closed quickly in an emergency.

Hoses must not be wrapped around cylinders or regulators, as a leak or flashback could cause even more damage. Instead, they should be looped around a hook or similar.

Gas equipment should be regularly (see the site Planned Maintenance Schedule for details) checked for leaks by using soap and water or a proprietary leak finding solution such as 'Snoop'.

Care should be taken to keep hoses and other equipment from obstructing passageways, ladders and stairways.

Never use oxygen to run pneumatic power tools as any oil or grease in the tool may burst into flames or explode.

Never fill oxygen cylinders with compressed air from an oil lubricated compressor. This is because residual oil in the air will be deposited in the cylinder. If the cylinder were then refilled with oxygen, an explosion will occur. Any oxygen equipment that has been used with compressed air must be downgraded and not used for oxygen again.

Never lubricate with grease or oil, any equipment that will be used for oxygen service. These substances can ignite violently in the presence of oxygen, and if the oxygen is under pressure an explosion may result.

21.9.2 Storage and Handling of Cylinders

Do not use unlabelled or unmarked cylinders. If cylinders are unlabelled or unmarked, then they must be returned to the supplier.

Cylinders are to be stored safely and securely in such a way that they are prevented from falling. Cylinder Caps must always be fitted before a cylinder is moved, unless it is secured in a purposed made trolley. Do not store cylinders near elevators, stairs or gangways or in unventilated enclosures such as cupboards. All cylinders must be kept away from electrical apparatus, heat and other sources of ignition.

Oxygen cylinders shall be stored separately from fuel gas cylinders and empty cylinders must be stored separately from full ones and with their valves closed and caps on.

Cylinders must be handled one at a time and if necessary, lifting assistance should be provided only by means of rope slings, not by chains or magnetic lifts.

Keep all oxygen cylinders and fittings in a place where they cannot be contaminated by oil or grease.

Always store and use acetylene cylinders in the upright position. Acetylene cylinders are filled with a porous material that contains acetone into which the acetylene is dissolved. The acetone keeps the acetylene stable. If the valve is opened when the cylinder has been on its side, the liquid acetone will be withdrawn with the gas. If a cylinder has been on its side, stand it upright for at least one hour before use.

Similarly, LPG cylinders should be stored and used upright as LPG is a liquid which is likely to seep through the valve.

For more details on the storage of gas cylinders, refer to Section 20: Hazardous Substances.

21.9.3 Checks

All gas cylinders, supply hoses and ancillary equipment must be checked regularly to ensure they remain in good condition. Special attention should be given to ensuring that supply hoses are free of any signs of cracking of the rubber coating.

21.10 Electric Arc Welding

All care must be taken through the use of appropriate shielding to protect personnel, including passers-by, from the hazards of 'arc-eye'.

Under normal operating conditions it is not possible to get an electric shock from an electric welder. Should anyone receive one, the power supply must be shut off and disconnected. The machine must not be restarted until it has been cleared by a registered electrician.

Always treat all electrical equipment as 'live'. Do not take chances. Keep water and other liquids away and keep yourself dry. Do not arc weld in wet conditions. A reliable automatic control must be fitted to reduce the no-load voltage if it is unavoidable for AC welding to be performed under wet conditions. This is to prevent shock.

- Use an isolating transformer with all portable electrical equipment.
- Keep leads and cables clear from obstructing passageways, ladders and stairways.
- Use only cables of a sufficient capacity to carry the current used. Do not overload.
- Use only a proper earthing clamp or bolted terminal. Never earth to pipelines carrying gas or flammable liquids, or to conduits carrying electric wires.

- Use only standard cable connectors.
- Use only an insulated hook or other suitable device to hold the electrode holder when it is not actually being used.
- If using a welding generator driven by an internal combustion engine inside a building or confined area, the engine exhaust must be ducted to the outside air.
- Input cables and extension leads should be kept tidy and as short as practical (try to use suitable lengths with as few connectors as possible).
- Take particular care in earthing portable welding machines driven by an internal combustion engine. Where an earthing connection is provided, it must be used in accordance with the manufacturer's instructions. (This is also very important when using ancillary power supply for drills, grinders and other equipment.)

21.10.1 Checks

The checks listed below should be carried out before using electric welding equipment.

- If the machine has become wet, disconnect the primary power and dry out before use
- Check the welding cable for insulation damage
- Reject all welding leads spliced within 3m of the holder
- Check MIG or TIG gas hoses and fittings for leaks
- Check electrode holders for loose or exposed connections to reduce shock hazard
- Check the welding machine is earthed, paying particular attention to the condition of the earth connections.

21.11 Hot Work Permit

Before any hot work can be carried out in a designated area or on tanks and drums a 'Hot Work Permit' must be obtained. This will always be under cover of a Master Work Permit (Refer to Section 13: Work Control). The Hot Work Permit is presented at the end of this section.

Before hot work requiring a permit is carried out, the need for hot work should be questioned. If it is practical to carry out the jobs without hot work then hot work should not be done.

The 'hot work permit' identifies whether a fire watcher is required and, if so, how many.

A 'hot work permit' is required for the following situations:

- any hot work either welding, oxy cutting or grinding
- any hot work within the power plant
- any hot work within buildings
- any hot work near or adjacent to operating mechanical equipment, pressure piping or pressure vessels, hydrocarbon pumps, producing wells, gas compressors or any other fuel source
- any hot work in a hazardous area
- any hot work on vehicles
- any hot work on tanks or drums no matter the location
- any hot work anywhere that a 'confined space permit' has been raised
- any other time when a relevant hazard is perceived to exist.

A 'hot work permit' is not required under the following situations:

- normal hot work within the workshop
- hot work in approved areas designated as safe for unrestricted hot work.

21.11.1 Safe Hot Work Areas

These areas will be identified by the site safety committee and communicated in map form in the appropriate Volume 3: Site Specific Safety.

21.11.2 Considerations

A shift or department supervisor who is satisfied that it is safe to proceed with the work is the only person able to approve a 'hot work permit'.

Prior to performing any hot work in other than an approved safe hot work area, the 'person in charge' shall review the operations to be performed with the relevant supervisor.

21.11.3 Precautions

The following precautions must be taken.

- When working on pipe systems, all lines in the work area shall be traced to confirm both that the correct system has been identified, and that there is no risk from other systems nearby. Associated hazards are to be considered carefully.
- All lines on which welding is to be performed shall be blown down. In certain cases, where it may be unsafe to blow down the line being worked on, a hot tap procedure approved by the Operations Senior Supervisor/Production Senior Supervisor may be used.
- Operation of valves, on affected systems, is prohibited during welding operations.
- Portable gas detectors shall be used to ensure no combustible mixtures are present before and frequently while, performing hot work around tanks, pressure vessels, compressors, all enclosed areas or other areas where gas may be present.
- Where hot work is to be carried out near to ventilation intakes and compressor suctions, ensure that the equipment is shut down and tagged off under the relevant Master Work Permit. Do not untag the equipment until the fumes and smoke have cleared.

A copy of hot work permit form and a hot work checklist can be found at the end of this section.

21.12 Hazardous Hot Work on Tanks and Drums

21.12.1 General

Severe explosions and fires can be caused by the application of heat to pipes, tanks, drums and similar vessels which have contained flammable materials. In some cases, only a pin point of heat or a spark can be enough to set off an explosion.

Personnel should be wary of trusting what container labels say. A label may not correctly indicate the contents, as a container may have been used to store other substances.

If one compartment of a two-compartment tank has to be repaired, cut or ground, then both compartments must be made safe.

21.12.2 Hazardous Hot Work Substances

Substances that pose a hot work threat are and may have been in tanks or drums:

- any volatile liquid that releases flammable vapour at atmospheric pressure (e.g. petrol, acetone, white spirits, etc.)

- any non-volatile oils or solids that release flammable vapour when heated (e.g. diesel oil, tar, greases, linseed oil, tallow, soap, etc.)
- any acids that react with metals to form hydrogen (e.g. sulphuric acid, nitric acid, hydrochloric acid, etc.)
- any combustible solids or finely divided particles which may be present in the form of an explosive dust cloud (e.g. fibreglass, milk powder, sulphur, etc.)
- any chemical compound that decomposes and forms a hazardous vapour when heated.

21.12.3 Cleaning of Tanks and Drums

There are essentially three cleaning methods which are:

- the 'washing method' for soluble substances
- the 'boiling method'
- the 'steaming method' for insoluble substances.

Care must be taken to ensure that a container is properly cleaned before hot work is carried out. Shortcuts at this stage may be fatal.

Prior to cleaning, the container must be thoroughly emptied of the substance which must be disposed of carefully check Material Safety Data Sheet (MSDS). If caps or bungs need to be removed, then non-sparking type tools (e.g. those made of bronze) are to be used. If the container has held a corrosive or toxic substance then, rubber or PVC gloves and a face shield or goggles to protect eyes from splashes are to be worn.

21.12.4 Washing Method

The container must be filled with water and drained several times. This method is suitable only for water soluble substances. This method is particularly suitable for acids such as hydrochloric or sulphuric acid.

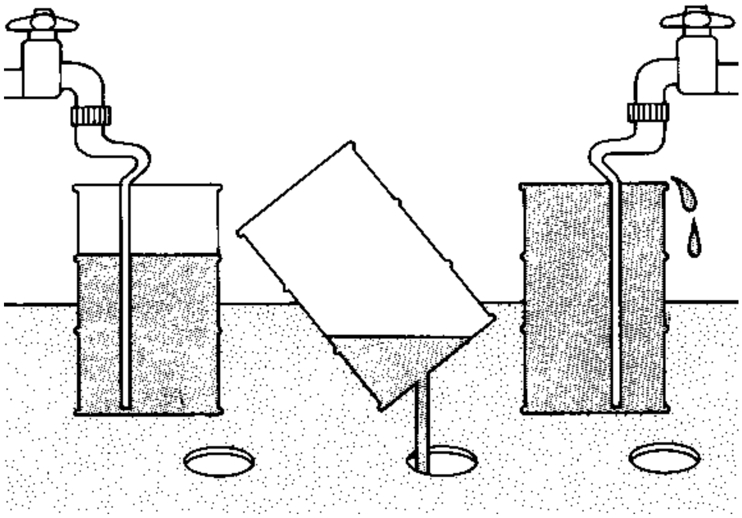


Figure 21.1: Washing with Water

21.12.4.1 Boiling Method

The item to be cleaned must be completely immersed in the boiling water so that water fills, as well as surrounds, it. It is essential that proprietary degreasing detergent (not household detergent) is added to the water, particularly if the tank has held petrol, paraffin, diesel, oil, grease, etc.

Strong alkalis such as caustic soda will attack aluminium and its alloys, producing hydrogen. If containers need to be treated with alkalis, then one of the weaker cleaners should be used. Overalls, a PVC apron, gloves and safety glasses or a face shield must be worn to prevent strong alkaline cleaners being splashed onto skin or into eyes.

Fabric or leather gloves should be worn when handling containers that have been steamed or boiled as the metal becomes very hot.

21.12.4.2 Steaming Method

Steam volatilises oils and greases and is particularly suitable for tanks and drums that have held these substances.

If the container has held a highly flammable substance, then precautions must be taken to prevent the accumulation of static electricity. The tank and steam pipe should be earthed and the steam pipe should be electrically bonded to the tank.

It is important that an outlet be provided for the steam so that pressure does not build up and to allow condensates and sludge to drain away.

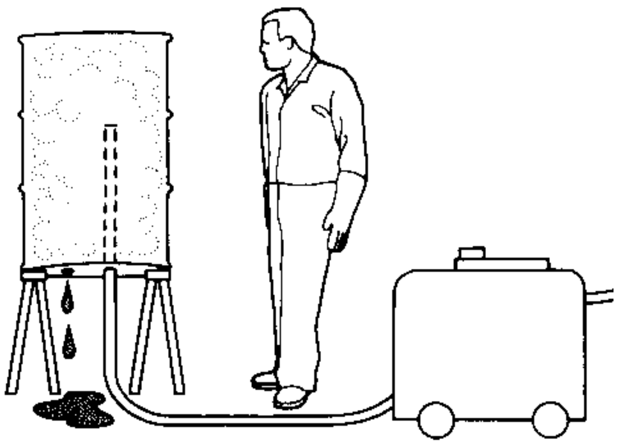


Figure 21.2: Steaming

Containers should be steamed for no less than 30 minutes after every part of the container has become too hot to touch. Checking that the condensate is free of oil or other material is a good indication of whether cleaning is complete.

21.12.4.3 Trichloroethylene (or 1,1,1-Trichloroethane)

(These products must be used with great care as they are highly toxic and are generally not recommended)

Stubborn oil sludge deposits may be washed out with trichloroethylene (or 1,1,1-trichloroethane) but these products must be used with caution in well ventilated areas as they have a narcotic effect. Treatment must be followed by a further cycle of steaming because of the possible fire or toxic hazards and the risk of forming poisonous phosgene gas when heat is applied.

21.12.4.4 Cleaning Methods NOT to be Used

Blowing out with compressed air as this method does not remove solids and residual deposits that are capable of producing fumes.

Cleansing with carbon tetrachloride as this solvent is inherently toxic and may form poisonous phosgene gas when heat is applied. It may also react with the metal on the drum.

Cleansing with trichloroethylene or 1,1,1-trichloroethane is not recommended and must only be used as a last resort as discussed previously.

21.12.4.5 Checking

Following cleaning, the inside of the container must be checked for residual vapours or solids. It should be noted that any equipment such as torches etc. must be safe for use in flammable atmospheres.

An item can be considered safe for hot work when no solid residues or vapours can be detected by sight or smell. If an instrument such as an explosimeter is used, the absence of a reading does not necessarily mean that the container is safe to weld. This is because the meter tests at atmospheric temperature, not at welding or grinding, etc. temperatures.

If following cleaning flammable vapours or sludge deposits are detected, then the cleaning process should be repeated or the vessel should be 'inerted' prior to carrying out hot work.

21.12.5 Additional Precautions - 'Inerting'

21.12.5.1 General

As an additional precaution, but not instead of cleaning, the vessel can be 'inerted' by replacing the air in the vessel with water, steam or an inert gas.

21.12.5.2 Filling with water

If using electric welding gear to make a repair, then the vessel should be completely filled with water. A vent should be fitted to relieve any pressure generated by steam. Care must be taken to ensure the welding equipment does not get wet.

If making a repair by soldering, brazing or oxy-acetylene welding near an opening in the vessel, the vessel should be filled with water leaving a small free air space at the point where the repair is to be made.

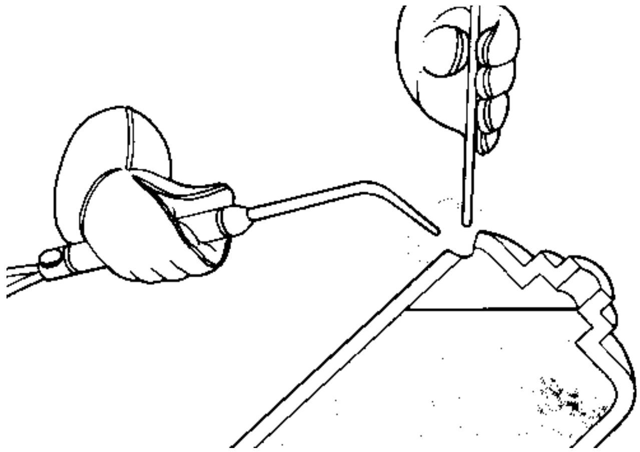


Figure 21.3: Filling with Water

21.12.5.3 Continuous Steaming

This procedure is essentially the same as for steam cleaning, except that steam is allowed to continually flow through the tank during the welding operation.

21.12.5.4 Filling with Carbon Dioxide

Care needs to be taken that all the air in the tank is displaced and also that the carbon dioxide does not leak from an exit point at the bottom of the tank as carbon dioxide is heavier than air.

As a general guide at least 0.5kg of dry ice should be added per 250 litres of tank capacity to ensure that the tank is completely filled with CO2. Note that dry ice is very cold and should only be handled with gloves or tongs. This method is only suitable for small tanks (up to about 1000 litres). In larger tanks, the CO2 gas will be so cold and heavy that only the atmosphere at the bottom of the tank will be inerted.

While CO2 is not toxic, it does not support life and no one without breathing apparatus is to enter a tank containing it. Adequate ventilation must be provided in the area or vicinity of the tank.

21.12.5.5 Filling with Nitrogen

It is recommended that only people with the necessary expertise use this method. Nitrogen is suitable for inerting the atmosphere in large tanks (e.g. in the oil industry). It is important that the tank is completely filled with nitrogen. A light flow of gas must be maintained throughout the welding operation and during breaks.

While nitrogen is not toxic, it does not support life and no one without breathing apparatus is to enter a tank containing it. Adequate ventilation must be provided in the area or vicinity of the tank.

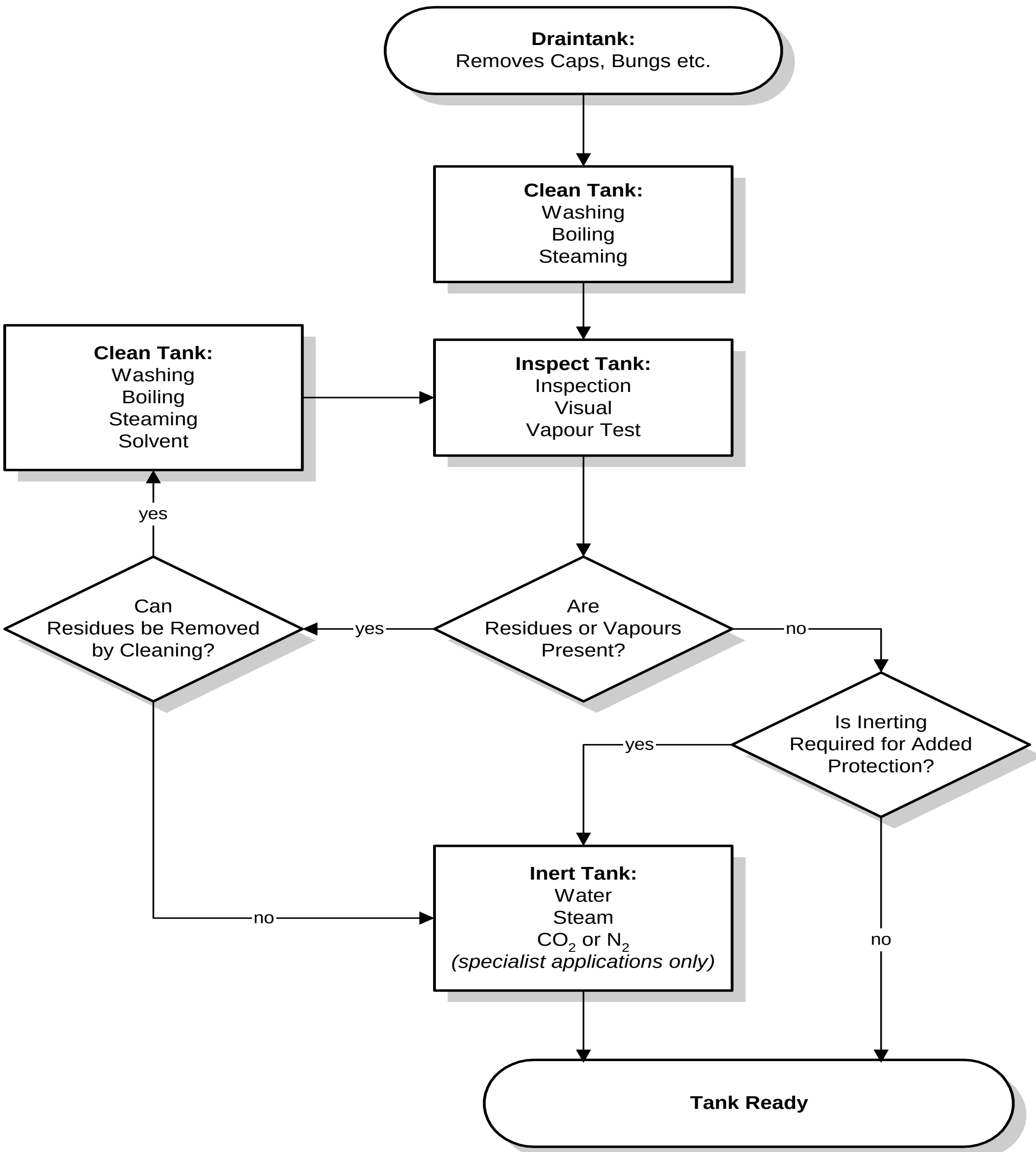


Figure 21.4: Cleaning of Tanks and Drums for Hot Work

21.12.6 Returning to Service

In addition to the usual closing up checks tanks, drums, or vessels should be checked for residues of chemicals, solvents and cleaners as, they may react with the substances that the vessel is to hold (check the MSDS).

21.13 Safety Equipment

Goggles, face shields or protective glasses shall be worn when burning, welding, grinding, or striking metal, no matter how small the job may be. Also, all persons employed as assistants to a welder, or those who have to work near the welding point, shall wear suitable eye protection. Helmets or shields that have cracks, splits or pinholes shall not be used. Similarly, a cracked or broken filter glass shall not be used even for the smallest job.

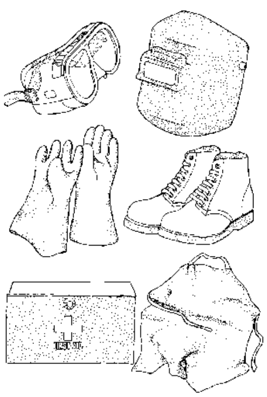


Figure 21.5: Safety Equipment

Safety goggles must always be worn for chipping or grinding, or when in an eye danger area.

All welding operations in the open air and close to fellow workers or other people shall be suitably screened to prevent eye injury, ingress of wet weather, to contain flying sparks and to protect others from ultraviolet radiation and the effects of 'arc-eye'.

Hearing protection must be worn when performing noisy operations such as grinding and chipping. Refer to Section 31: Personal Safety Equipment.

Industrial, overalls (made from flame resistant fabrics such as cotton) and appropriate eye protection shall always be worn when engaged in welding and cutting operations. Overalls should be kept fastened up to the neck, with the sleeves down and fastened about the wrist. Gloves or gauntlets shall be worn for arc welding, as protection against shock, burns and radiation burns.

If fumes given off from the work are highly toxic, such as those from cadmium, chromium, or beryllium, then some form of respiratory protection, such as an air-supplied helmet, is still necessary even if the work is in a well ventilated area.

Hot Work Permit

Date ________________________________ Master Work Permit Number ______________

Work Location ________________________________

Description of Hot Work to be done: ____

Special precautions required:

Permit expires __________________________________

Is fire watch required? Y/N Name(s) of Fire Watcher(s) __________________________
____
____

Permission is granted for this work: Signed_____________________________
(Technical/Area Supervisor)

The location where this work is to be done has been examined, necessary precautions taken, and personnel are aware of their duties, particular hazards, and any special precautions. (See Hot Work Check List).

Signed ____________________________
(MWP Holder)

Time started ___________________________________ Completed _________________________

FINAL CHECK-UP

Work area and all adjacent areas to which sparks and heat might have spread (including floors above and below and on opposite sides of walls) were inspected after the work was completed and were found safe.

Signed _______________________
(First named Fire Watcher)

Hot Work complete:

Signed _______________________
(MWP Holder)

The permit is to be attached to the MWP on completion of the work.

Hot Work Checklist

Before approving any cutting and welding work the Master Work Permit Holder and where appropriate, the area supervisor, is to inspect the work area and confirm that precautions have been taken to prevent fire.

PRECAUTIONS

- ☐ Sprinklers in service (or disabled if work may cause mal-operation of system)
- ☐ Cutting and welding equipment in good repair

WITHIN SURROUNDING AREA

- ☐ Area clear of combustibles
- ☐ Combustible floors wetted down, covered with damp sand, metal or other shields
- ☐ No combustible material or flammable liquids
- ☐ Combustibles protected with covers, guards or metal shields
- ☐ All wall and floor openings covered
- ☐ Covers suspended beneath work to collect sparks
- ☐ Covers over sensitive equipment

WORK ON OR NEAR WALLS AND CEILINGS

- ☐ Construction non-combustible and without combustible covering
- ☐ Combustibles moved away from opposite side of wall

WORK ON ENCLOSED EQUIPMENT

(Tanks, containers, ducts, dust collectors, etc.)

- ☐ Equipment cleaned of all combustibles
- ☐ Containers purged of flammable vapours

FIRE WATCH

- ☐ To be provided during and at least 30 minutes after operation
- ☐ Supplied with extinguisher, sand bucket, small hose or other suitable equipment
- ☐ Trained in use of equipment and in sounding fire alarm

FINAL CHECK-UP

- ☐ To be made 30 minutes (or greater period if applicable) after completion of any operation

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-029: Confined Space
Revision 0

Contents

22. Confined Space

22.1 Introduction

This section covers the precautions necessary for safely entering and working in confined spaces. It is the intention of DGDC to minimise the need for personnel to enter confined spaces through the use of careful job planning and good design.

Related requirements and safe work practices for ensuring general occupational health and safety (for example, welding safety, safe use and care of respiratory protective equipment, and gas testing) are covered in more detail in other sections of this manual.

22.2 Definitions

Hole watcher
An individual stationed outside a confined space, who monitors the authorised worker to enter a confined space and assists in maintaining their safety.

Confined Space
Any enclosed or partially enclosed space, either above or below ground, where there is some risk of reduced oxygen supply or accumulation of toxic, flammable or explosive materials, or where means of entry or exit are limited.

Confined spaces may include, but are not limited to:

- storage tanks, tank cars, process vessels, biofilters, pressure vessels, silos and other tank like compartments
- open topped spaces such as pits, sumps, cellars or booths
- pipes, sewers, shaft and sumps
- cargo, ballast or void spaces of marine vessels.

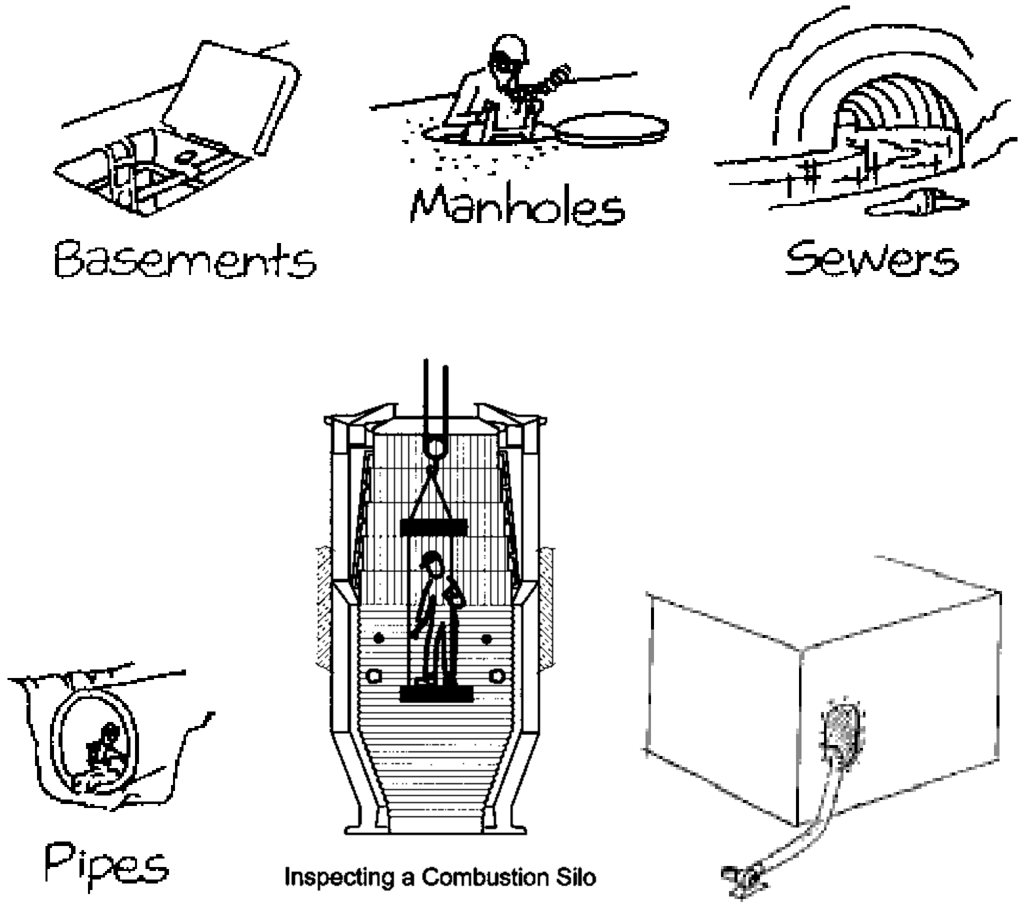


Figure 22.1: Examples of Confined Spaces

Entry
Refers not only to complete body entry into the confined space, but also partial entry when only the head is inserted, e.g. into pipe ends, manhole openings, hatches etc.

Flammability Range
Gives a measure of the proportion of flammable vapour to air and/or oxygen necessary for combustion (explosion) to be possible. The limits of flammability (or explosive) range is the range between the lower explosive limit (LEL) and upper explosive limit (UEL), (% by volume) in the form of an explosive/flammable mixture.

Gas Test Certificate
A signed statement by an authorised gas tester who is experienced and qualified in gas monitoring (toxic, flammable and oxygen) that tests have been undertaken within the confined space to be entered prior to other entering.

Isolation/Clearance
The process by which the confined space and systems within the confined space are removed from services, and completely protected against the inadvertent release of energy by placing them in a neutral mechanical/electrical state. (Refer to work control section of this manual.)

Purging/Ventilation
The method by which contaminants are displaced from the confined space.

Safe Oxygen Level
A minimum oxygen content of 19.5% by volume and a maximum oxygen content of no greater than 21.5% by volume are the normally accepted limits. However, these figures do not take account the effects of altitude. The lower limit for oxygen is set by physiological effects on the human body. It is the absolute oxygen level that is important and the true lower limit must be expressed as a partial pressure.

The accepted lower level of oxygen before alertness is affected is 183mbar. It can be seen from the table overleaf that altitude has a marked effect on the actual oxygen level if percentage (%) volume readings only are taken into account. To ensure a suitable margin for instrument inaccuracies, a minimum partial pressure of 195mbar shall be used where possible. Above 600m altitude, the minimum safe oxygen level in a confined space shall be deemed to be the normal ambient level reading taken in fresh air.

Table 22.1: Approximate effect of altitude on actual oxygen level

Approximate effect of altitude on partial pressure of oxygen (Read down column to find partial pressure of O_2 for a given percentage)						
Height (ft)	Height (m)	Standard Atmospheric	Partial Pressure of Oxygen mbar			
		Pressure (mbar)	20.93% O_2 by vol.	20% O_2 by vol.	19.50% O_2 by vol.	19% O_2 by vol.
0	0	1013	212	203	198	192
1000	305	977	204	195	191	186
2000	610	942	197	188	184	179
3000	914	908	190	182	177	173
4000	1219	875	183	175	171	166
5000	1524	843	176	169	164	160
6000	1829	812	170	162	158	154
7000	2134	781	163	156	152	148
8000	2438	752	157	150	147	143
9000	2743	724	152	145	141	138
10000	3048	697	146	139	136	132

22.3 Responsibilities

22.3.1 General

Entry into a confined space is part of the DGDC Permit-to-Work system and management shall ensure that personnel entering confined spaces are trained in the entry permit practices stated in this system.

22.3.2 Entrants

Entrants shall

- complete the confined space training course and hold a current certificate of competency
- use personal protective equipment as directed by the Entry Permit

- verify that atmospheric tests have been conducted and the results are known
- enter the confined space only after ensuring all the precautions listed on the Entry Permit have been completed
- sign the Entry Permit to verify that requirements of the permit have been reviewed and followed
- alert the attendant and exit confined space whenever:
  - any warning sign or symptoms of exposure to a dangerous situation is recognised
  - a prohibited condition is noted.
- exit confined space if attendant orders an evacuation.

22.3.3 Hole Watcher

The duties of the attendant(s) or standby person(s) outside the confined space are specifically related to those inside the enclosed space and include:

- checking person(s) into, and out of, the confined space
- being alert to all situations which may adversely affect those inside, including the danger of leaving the space unattended
- maintaining continuous contact (visually or verbally) with personnel inside
- summoning help if anyone inside gets into difficulties, eg. via phone or radio communications
- being aware of possible behavioural effects of exposure to low oxygen or toxic chemicals
- ordering entrants to evacuate confined space if:
  - a condition is detected that the Entry Permit forbids
  - if the hole watcher leaves the area
  - symptoms or behavioural effects of exposure are detected
  - a situation that could endanger the entrants is detected inside or outside the confined space.
- warning unauthorised person(s) to keep away from the confined space
- trained in first aid and cardiac pulmonary resuscitation.

22.3.4 Entry Supervisors

Entry Supervisors shall:

- ensure that the entrants and attendants are properly trained and competent
- identify hazards of the confined space
- prepare the Entry Permit. Ensure entrants and attendant(s) read the Entry Permit and sign it
- post the approved Entry Permit in a conspicuous location near the entrance of the confined space. Use the Entry Permit to ensure necessary safety precautions have been taken.
- verify that the confined space and equipment within the confined space have been appropriately isolated and locked-out/tagged-out in accordance with the Master Work Permit (see Section 13: Work Control).
- ensure that atmospheric tests have been conducted and that the results meet the acceptable environmental standards
- verify that the required alarms, ventilation equipment, monitoring equipment, communications equipment, and rescue equipment are present and operational
- ensure that entry operations are consistent with the terms of the Entry Permit and that acceptable environmental conditions are present
- sign the Entry Permit, thereby affirming that all the safety measures listed on the Entry Permit have been taken and that they allow for safe entry into the confined space.
- ensure that the standby person/attendant remains outside of the confined space at all times during the entry operations
- cancel the Entry Permit and terminate entry if acceptable environmental conditions are not present or if the conditions or work procedures described on the Entry Permit change
- take the necessary measures to conclude the entry operation, such as closing off the confined space and cancelling the Entry Permit once the work inside the confined space has been completed.

22.4 Confined Space Hazards

Before entering confined spaces, the following particular hazards need to be considered and safeguarded against:

- oxygen deficiency/enrichment
- flammability, fire and explosion
- chemical hazards

- physical hazards
- other hazards such as noise or inert gases.

22.4.1 Oxygen Deficiency/Enrichment

Oxygen deficiency in the air results in loss of alertness, light headedness, degraded performance and asphyxiation. Typical causes of low oxygen levels are the presence of CO2 or other gases replacing oxygen, or the use of oxygen by personnel working in a confined and poorly ventilated space. It is of note that persons suffering from lack of oxygen will not be aware of the onset of problems.

Other common causes of reduced oxygen levels are slow oxidation of metals (rusting), combustion, welding, the displacement of oxygen by other gases (inerting with nitrogen or CO2) and the use of inert gas welding with inadequate ventilation.

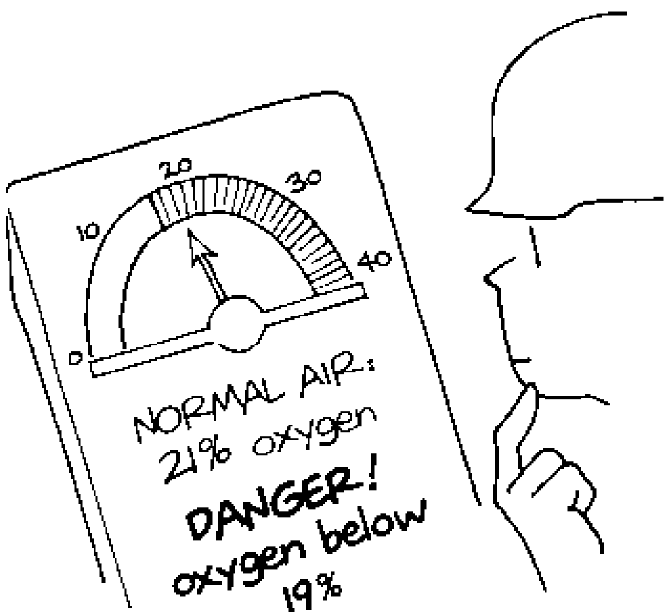


Figure 22.2: Oxygen Deficiency

Since the rate of combustion is closely dependent upon the concentration of oxygen present, an enriched oxygen atmosphere (greater than 21.5% by volume) becomes a hazard. (Note: at 22% O2 spontaneous ignition can occur in some situations.)

There are four main causes which may result in oxygen enrichment:

i) Leaks from oxygen containing equipment
ii) Inadvertent use of oxygen instead of air or inert gas
iii) Deliberate addition of oxygen
iv) Oxygen generation from chemical reactions.

The most common oxygen containing equipment is that used in cutting operations. Storage cylinders, gas hoses, and valves must be handled with care and should be inspected daily for damage.

Gas cylinders must not be taken into confined spaces. Cutting and welding equipment must always be removed from confined spaces during breaks and at the end of the working day.

22.4.2 Flammability, Fire and Explosion

Fires and explosions can result from accumulations of flammable vapours and/or dust in the presence of a source of ignition.

Figure 22.3: Explosion or Fire Hazards

Mixtures of flammable vapours and air can be ignited only if the hydrocarbon to air ratio is within flammable range, ie. between the Lower Explosive Limit (LEL) and the Upper Explosive Limit (UEL). LEL and UEL are identical to the terms, Lower and Upper Flammable Limits (LFL, UFL) which are defined in section 2.

Explosive/flammable mixtures may develop typically during the emptying of vessels or tanks and the opening of confined spaces, due to air entering and mixing with the residual gases.

A source of ignition can be any heat source having enough energy to ignite the flammable gas/air mixture or to raise the temperature above the auto-ignition temperature. In addition to naked flames, other possible sources of ignition include:

- sparks or arcs produced by electrical equipment, lightning and electrostatic charges
- grinding sparks
- cigarettes
- hot surfaces raising the temperature above the auto-ignition temperature (eg. hot pipes, hot exhausts)
- thermic reactions from aluminium, or other alloy tools striking against rusted iron or steel
- heat of friction during drilling or other non-flame cutting operation
- pyrophoric materials (eg. iron sulphide)
- any other highly reactive material capable of producing sufficient heat for combustion (eg. strong oxidising substances such as hydrogen peroxide, or chemicals undergoing self-accelerating exothermic reactions when a critical temperature is reached, such as ethylene oxide).

Note: On no account should a confined space be entered if the explosive meter reading is equal to or greater than 5% LEL (LFL).

Hot work must not be undertaken if the explosive meter reading exceeds 1% LEL (LFL).

22.4.3 Chemical Hazards

Chemical substances can be toxic. These substances can cause injury, acute or long-latency illness, or death, depending on the concentration and duration of exposure and the characteristics of the substances.

Operations previously carried out in a confined space may have produced toxic gases or vapour which still remain. Some toxic gases are particularly dangerous because they cannot be detected by sight or smell.

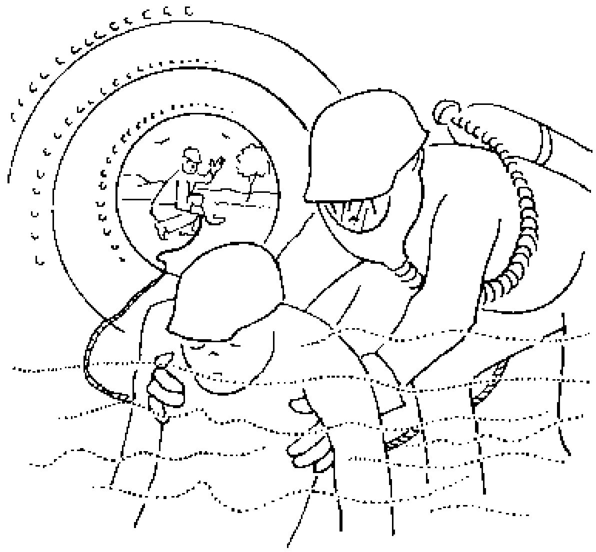


Figure 22.4: Toxic Gases or Vapours

A toxic substance can cause harm by inhalation, ingestion, skin or eye contact. It can affect the tissue at the point of contact, or organs elsewhere in the body. Corrosives destroy the tissue and may leave permanent injury or scars.

Toxicity information (eg. Material Safety Data Sheets) about specific substances should be sought from the supplier of materials, and local and state regulatory bodies. They are to be made available on site.

The Occupational Exposure Standards (OES) referred to in this document are those published annually by the American Conference of Government Industrial Hygienists. Unless there are different national/local requirements, it is recommended that a level not greater than 50% of the relevant published occupational exposure standard is adopted as a safe limit. This additional safety margin is recommended because readings are based on regular spot sampling.

Typical toxic substances are carbon monoxide, hydrogen sulphide, hydrocarbon gases, sulphuric acid, ammonia, chlorine, biocides, caustic substances such as lye (sodium hydroxide), solvents and refrigerants

Contaminated personal protective equipment forms a hazard that should not be neglected.

22.4.4 Physical Hazards

Physical hazards may exist in confined spaces and include:

- structural failure, e.g. the internal floating cover or roof may not support a worker's weight
- falling tools and materials
- improper shoring, eg. cave-ins may occur while personnel are working in trenches or excavated areas
- failure to positively isolate confined spaces, eg. blank-off or break pipe connections
- failure to disconnect or make inoperative electrical or mechanical equipment
- migration of gases from adjacent places, eg. sumps
- restricted working space and obstructions
- slippery surfaces
- inadequate lighting
- inadequate or faulty personal protective equipment
- noise levels in excess of site standards, eg. hammering in confined spaces
- temperature extremes (high or low temperatures)
- sharp edges
- difficult access.

22.4.5 Other Hazards

These include:

- poor visibility, eg. due to misty or dusty conditions
- persons being trapped in the event of an accident or loss of consciousness
- live electrical contacts (circuits) with the risk of electrocution
- high energy systems
- odours

- undrained fluids
- unrelated medical conditions leading to incapacity.

22.5 Practices for Entry into a Confined Spaces

22.5.1 Entry Permit

Conditions necessary for safe work in or around a confined space will vary greatly depending on its location, configuration and use.

Entry into a confined space is controlled via the DGDC permit-to-work system (for more details, refer to Section 6: Work Control). As part of this system a specific work permit must be completed which authorises entry into the confined space and records that the necessary precautions have been actioned.

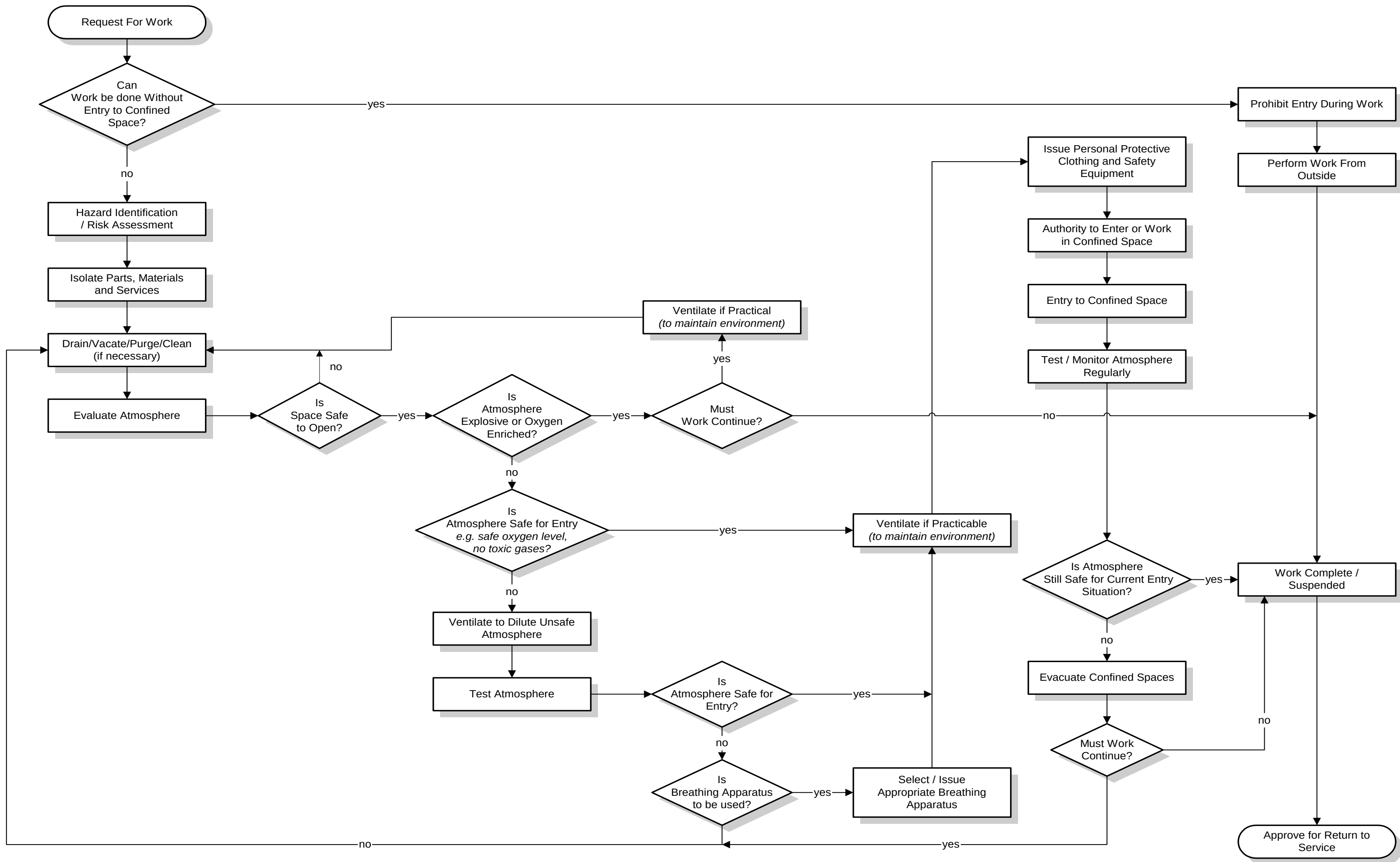
The entry permit:

- identifies the job and the associated hazards
- indicates the date and duration that the permit is valid
- links the entry to a specific Master Work Permit (MWP)
- bears the appropriate signatures authorising entry and showing that the safe work practices have been followed.

A copy of the completed entry permit shall be displayed in a prominent position outside the entry point to the confined space. The original will also be held with the MWP.

A flow chart showing the steps to be followed in filling out an entry permit is presented in Figure 5.

Figure 22.5 Confined Space Entry Process



Form 22.1: Confined Space Entry Permit

Reference - Master Work Permit #................	Original posted at entry point. Copy kept with MWP
Description of Confined Space: **Location:** **Expected Duration of Work in Space:** **Entry Supervisor:** **Department:**	
Use Check List over as prompt to complete this permit **Anticipated Gaseous Hazards (list):**	**Persons Entering** **I understand the entry conditions: Signature / Date / Time**
Draining/Vacating/Purging Requirements (state):	
Gas Test Requirements (state):	
Other Identified Hazards (list):	
Special Precautions required (list):	
PPE Required (list):	
Continuous Forced Ventilation Required: Y/N	
Systems connected to space (list them):	
All connected systems isolated (confirm):	
Gas Test Certificate raised and attached (confirm):	
General Safety Check List Completed (confirm):	
Entry Authorised under above restrictions:	(Technical Supervisor)
Isolation checked. space drained/vacated/purged - safe to open:	(Entry Supervisor)
Pre-entry safety requirements met - safe to enter:	(Entry Supervisor)
Work package completed/space vacated and sealed/permit closed:	(Entry Supervisor)

22.5.2 Prerequisites for Entry

Prior to personnel entering the confined space the provisions listed below shall be met. (Refer also see 5.3)

- The Permit Applicant has verified that entry into the confined space is necessary. (See Section 13: Work Control for definition of permit applicant).
- The potential hazards of the confined space and work to be performed in the confined space have been identified, assessed and recorded on the Entry Permit.
- All persons involved in the confined space entry (entrants, attendants, standby) are trained in these procedures, that training is verified, and they have been briefed.
- A Lock-out/Tag-out is in place as required by the Master Work Permit. This should ensure that:
- the confined space is isolated from potential dangers by blinding, disconnecting and blanking or ties connected to the space; and
- all electrical equipment in the confined space has been de-energised and locked/tagged out.
- DGDC Lock-out/Tag-out practices shall be followed. Personnel shall confirm Lock-out /Tag-out is properly enforced.
- All ignition sources are removed if there are flammable or combustible materials in the vicinity of the work area.

22.5.2.1 Atmospheric Testing (Gas Test)

- The atmosphere both in and around the confined space must be tested before entry to determine if entry is permissible.
- Gas test results are to be entered on the Gas Test Certificate Form (Form.2) and posted at the entry point to the confined space (see Check List at 8).
- The initial tests for flammable gases, toxic gases, and oxygen deficiency should be made from outside the confined space, using a long probe or tube extension.
- Gas testing should be carried out only by authorised personnel who have been trained in the use of the equipment and who can interpret the results correctly.
- The confined space may be deficient in oxygen. Check the air with an oxygen meter. If oxygen concentration is outside the safe range (see Form 2) DO NOT ENTER UNDER ANY CIRCUMSTANCES without wearing an external air-supplied

respirator or self-contained breathing apparatus. (Canister-respirators must not be worn.)

- If oxygen level is within the safe range it is permissible to enter but, the atmosphere should be continuously monitored while in the confined space.
- Before entering, also test that the confined space does not contain flammable vapours with a flammable gas or explosive meter. These vapours may not be picked up as a reduced oxygen level. Continuously monitor for flammable vapours while in the confined space if liquid residues are present.
- On no account should a confined space be entered if the explosive meter reading is equal to or greater than 5% LEL. Between a reading of 1% to 5% of LEL self-contained breathing apparatus (SCBA) will be required to be worn by those entering the confined space.
- Before entering the confined space, test for the presence of toxic gases (e.g. hydrogen sulphide) using personal detectors and/or continuous monitors.
- On no account should a confined space be entered when the level is within 50% of the Occupational Exposure Standard (TLV-TWA) for that containment without appropriate respiratory protective equipment being worn. (Refer to ACGIH publication on Threshold Limit Values and Biological Exposure Indices.)

Gas tests must be carried out in such a way that the result obtained is representative of the condition of the entire space paying particular attention to locations where toxic or flammable gases may accumulate eg, sumps.

It is essential that all testing equipment used is:

- suitable for the test required
- of approved type, eg. intrinsically safe
- correctly maintained and calibrated
- frequently checked against standard samples.

The results shall be recorded on the entry permit, but a separate written record must be kept of all test results.

Monitoring should be repeated at regular intervals as required by the entry permit while work is in progress and always after a work break, especially prior to re-entering the work area. The use of continuous monitoring equipment may be considered, but care should be taken in its positioning.

Form 22.2: DGDC.
Entry Permit Gas Test Certificate
(To be Posted at Entry Point - Issued in Conjunction with Entry Permit)

Confirmed space name / location: .... MWP Number: ....

Tests Required			**Initial Test Time**	**Frequency**
Explosive Atmosphere				
Oxygen				
Toxic Gas	H_2S			
to enter	CO			
without	CO_2			
breathing apparatus.	Other			
all readings				
must be below 50% of TLV				

Signed: ....

Operations Supervisor
Drilling Supervisor

INITIAL TEST RESULTS

State Test Done and Where	**Result**	**Sign if Satisfactory**	**Date**	**Time**

22.5.2.2 Ventilation

- If necessary, the confined space should be purged continuously or force ventilated for some period prior to entering. The Entry Supervisor shall verify by signing the entry permit that this task has been completed.
- Atmospheric tests should be repeated and the results recorded (after purging/ventilating).
- Ventilation of the space may be continuous in some situations.
- Never attempt to 'sweeten' air that is deficient in oxygen by introducing pure oxygen from a cylinder.

22.5.2.3 Safety Equipment

NOTE: The Entry Supervisor is to ensure that all equipment to be taken into the confined space is suitable (electrical equipment connected to earth leakage breakers, etc).

- A risk assessment should be carried out to determine if a self-contained breathing apparatus escape set (ELSA) should be carried by each person entering the confined space.
- Each person entering the confined space should wear a safety harness. A lifeline shall be available by the entry point.
- Personal monitors for gas and/or flammability shall be worn by persons entering confined spaces.

22.5.3 Prior to entry

- An observer (hole watcher) has been appointed and stationed outside the confined space.
- The attendant has verified that all communications equipment is present and operational.
- The attendant has verified that rescue equipment is present and operational.
- The Entry Supervisor has verified on the entry permit, that all required ventilation equipment, monitoring equipment, communication equipment and rescue equipment is present and operational.
- Personal protection equipment has been inspected by the entrants.

- The standby person has been instructed by the Entry Supervisor to remain outside the confined space at all times during entry operation.
- The calibration date on monitoring equipment has been checked and verified by the Gas Tester.
- The general work area is marked off with hazard tape or temporary barriers to prevent unauthorised access.
- The authorised entrants, attendants and Entry Supervisor have signed the Entry Permit to confirm that the requirements of the Entry Permit have been followed to allow for safe entry.
- The attendant is positioned outside the confined space and records the time and date of those authorised persons who enter and exit the confined space.
- The Entry Supervisor posts the Entry Permit in a conspicuous location close to the entrance of the confined space.

The Entry Supervisor is responsible for ensuring that all the requirements specified on the Entry Permit have been followed prior to entry.

If the conditions or work conditions described on the Master Permit-to-Work or Entry Permit change, the existing Entry Permit is no longer valid and a new Entry Permit shall be completed and approved.

22.5.4 Entry into Gas-Free Spaces

Immediately after the authorised entrant has entered the confined space, the following action shall be followed:

- Communications between the entrant and attendant are to be tested to confirm effectiveness, e.g. voice, radio, etc.
- Throughout the duration of the Entry Permit the requirements listed below should be met.
- Regular gas tests will be carried out to check atmosphere conditions at intervals specified on the Entry Permit.
- The gas test results will be recorded on the Entry Permit.
- Continuous ventilation of the confined space shall be monitored.

- Communications between the entrant and attendant shall be maintained to ensure the safety of entrant.

If any of the conditions specified on the Entry Permit changes, or the nature of work in the confined space changes, the entrants must exit the confined space and a new Entry Permit completed and approved prior to re-entering.

22.5.5 Entry into Non-Gas Free Spaces

- When every effort has failed to gas-free the confined space as specified in Section 5.2, entry may still be permitted subject to very stringent precautions.
- Entry to a space with the following oxygen and explosive meter readings is permitted only with an appropriate self-contained or compressed air line-fed breathing apparatus:
  - oxygen content: out of safe range
  - explosive meter reading: greater than 1% but not more than 5% of LEL
  - toxic gas concentration exceeds 50% of TLV (H2S, etc).
- Details of the gas test(s) should be entered on the Entry Permit and Gas Test Certificate.
- Continuous gas testing is required while entrants are in the confined space to ensure there are not significant changes in atmospheric conditions.
- Persons must wear air-supplied breathing apparatus and a lifeline/guideline. Air-purifying respirators cannot be used.
- A suitable number of attendants must be on duty. Some of whom shall be fitted with the appropriate equipment (SCBA) and so be effectively prepared to undertake an immediate rescue if necessary.
- In certain circumstances, such as work inside spheres or tall columns, it may be necessary to use a safety harness in conjunction with a special winch or pulley, or additional manpower, to ensure prompt response in an emergency requiring the removal of person(s) from the confined space.
- The number of persons permitted to enter a confined space should be limited according to the available space, the number of escape routes and the rescue facilities.
- The Entry Permit will specify the precautions necessary for the entry, the subsequent work to be carried out, knowledge of emergency procedures and also the period of validity.

Note: Where there is a life threatening situation, or in case of extreme emergency, or to prevent the development of a potentially dangerous situation, it may be necessary to permit entry under less stringent conditions. In such circumstances special authorisation is required and appropriate breathing apparatus must be worn.

22.5.6 Completion of Work

At completion of the work within the confined space, the actions listed below shall be performed.

- The attendant shall verify and record in their log that all entrants have exited the confined space.
- The entrants and Entry Supervisor shall restore or arrange to put the item of equipment back into service.
- The Entry Supervisor shall cancel the Entry Permit and forward the completed permits to the Senior Supervisor's office.

22.6 Training Requirements

22.6.1 DGDC

All DGDC employees and contractors involved with entry into, and working in, confined spaces shall be trained in confined space entry. A certificate stating the person(s) level of competency shall be issued on completion of the training and the training records noted.

Training shall familiarise authorised personnel with the following:

- types of confined space found at the site
- physical and chemical hazards involved and the signs and symptoms of exposure to the hazards
- the need for atmosphere testing and use of personal monitors
- atmosphere testing and monitoring of the confined space
- cleaning, purging and ventilation techniques
- isolation and lock-out/tag-out procedures
- personal protective equipment, in particular correct use of respiratory protective equipment

- responsibilities of attendant, entrant, Entry Supervisors, Senior Supervisor
- rescue and emergency response actions
- the Entry Permit requirements.

22.6.2 Contractors

DGDC shall ensure that all contractors involved with confined space entries shall have had confined space training within the last two years. In addition, these contractors shall have attended an DGDC specific work site induction course prior to commencing work at the site.

Contractors shall produce evidence proving their employees who have completed Confined Space Entry Training and the dates when training was completed.

22.6.3 Refresher Training

Refresher training for all personnel who may be required to enter confined spaces shall be completed every two years.

22.6.4 Training Records

Training records and competency levels shall be documented and submitted to the appropriate DGDC Human Resources Department.

22.7 Emergency and Rescue Action

The procedures listed below must be followed during an emergency and rescue action.

-
- On no account must the attendant(s) stationed at the entrance attempt to enter the space until additional help has arrived.
- No rescue must be attempted without wearing self-contained breathing apparatus and a harness. Whenever possible, a lifeline/guideline should be used.
- The restoration of the casualty's air supply at the earliest possible moment is of paramount importance. An ELSA may prove useful for the first few minutes whilst a proper breathing supply is prepared for use.
- The victim must be brought out with the least delay and then their physical injuries can be attended to.

- Every moment is vital but this should not induce the rescue team to take unnecessary risks.
- Unless the person is gravely injured, eg. a broken back, any physical injury which has been sustained is of secondary importance to maintaining a safe air supply. The victim must be brought out with the least delay.
- To rescue personnel from an in-ground manhole, a man winch, fitted to a tripod will be required.
- If air is being supplied to the person(s) in the space through an airline, a check that the supply of air is being maintained at the correct pressure must be made continuously by the attendant(s)
- Any attempt at rescuing a person who has collapsed within an enclosed space should be based on a rescue plan developed for the site, having regard to the site location and any peculiarities or special requirements of each individual space.
- If the rescue operation is a long one, the continued supply of fully charged air cylinders for the self-contained breathing apparatus of the rescue team and/or the provision of a continuous air supply to those at the scene of the accident from a reliable source of compressed air of breathing quality is an essential requirement.
- Drills must be held at regular intervals to prove the capability of the rescue team under different and difficult conditions. The need to allocate personnel to relieve or back-up those first in action must always be anticipated.
- Pre-planning is essential if any success at all is to be achieved since survival after loss of air supply is dependent on time. Restoring the victim's oxygen requirements is a first priority.

Every site and task will have its own special problems, each of which may require a different rescue procedure. Notwithstanding this, many procedures have common elements which are universally applicable as the following paragraphs illustrate.

- The successful rescue of any person(s) from an enclosed space is dependent on a pre-existing plan, trained personnel and good, well maintained equipment. All breathing apparatus, safety harnesses, lifelines and resuscitation equipment provided for use in, or in connection with, entry into confined spaces and particularly for use in emergencies must be properly maintained. This must be controlled by a planned maintenance system.
- All items of breathing apparatus should be periodically examined, and as soon as possible after every occasion on which the apparatus has been used.

22.8 Checklist

To be completed/checked by the Entry Supervisor before starting work.

	Yes	No
Have all entrants/attendants received training for this task?		
Is (are) there the necessary work-permit(s)?		
Are you familiar with the company's procedures for entering confined spaces?		
Do you fully understand your specific responsibilities with respect to this task?		
Are you and the work force wearing the appropriate personal protective clothing?		
Have you arranged for the appropriate fire protection and safety equipment?		
Are all connections to the confined space isolated/removed?		
Are all electrical/hydraulic connections in and outside the confined space locked-out and tagged (see MWP)?		
Are there radiation or other unusual hazards?		
Is the confined space gas free?		
Is the oxygen level satisfactory?		
Are there physical hazards in the confined space? If so, what has been done to minimise their effect?		

	Yes	No
Is (are) the necessary attendant(s) for standby responsibility assigned?		
Is the work force (those who enter the space and attendant(s)) familiar with the necessary safety procedures?		
Is the work force physically and mentally fit?		
Have you tested that all breathing apparatus and other safety equipment is functioning properly?		
Have lifeline(s) or harness(es) been provided?		
Does the electrical equipment meet requirements?		
Is the attendant/standby person(s) aware of his/her duties regarding communication with and rescue from the confined space?		
Is access and egress adequate for persons entering or leaving the confined space?		
Will continuous monitoring take place during work to ensure confined space is gas free and has sufficient oxygen?		
Is there a contingency plan (rescue plan) available and are all relevant personnel familiar with it?		
Have precautions been taken to make unauthorised access impossible, especially when work is temporarily suspended?		
Do you know whom to refer to in case of uncertainty?		

To be checked jointly by the attendant(s) and persons to enter the space after relevant checks in the above have been made.

	Yes	No
Have you been trained in enclosed space entry procedures and the responsibilities of an attendant?		
Have you been given instructions or permission by the Supervisor, or person in charge, to enter the space?		
Are you satisfied all relevant checks in the above have been completed?		
Do you understand the arrangements made for communication?		
Are you aware that you should leave the space immediately in the event of ventilation or communication failure?		

Where breathing apparatus is to be used, this section must be checked jointly by the Supervisor and the persons who are to enter the space.

	Yes	No
Are you familiar with the apparatus to be used?		
Have you checked the communications equipment?		
Have you checked the apparatus as follows:		
i) Adequacy of air supply?		
ii) Low pressure audible alarm?		
iii) Face mask - air supply and tightness?		
iv) Availability of emergency air supply when working in inert atmosphere?		
v) Operating time limits calculated and checked?		
Have the emergency signals and other emergency arrangements been agreed?		

Person(s) entering the confined space should show their completed checklist to the attendant before entering.

Dominica Geothermal Development Company Limited
Powering a New Generation...

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-030: Traffic
Revision 0

Contents

23. Traffic

23.1 Introduction

This part of the manual deals with road and traffic safety. It sets out the safe practices which must be followed at all times when driving.

23.2 Road and Traffic Safety

Safety on the road is just as important as safety when operating dangerous machinery. A car, van or lorry can be very dangerous when used wrongly and the company's attitude to road safety reflects this.

There are severe penalties for failure to comply with the requirements on:

- speed limits and other rules of the road
- use of seat belts
- vehicle safety
- reporting accidents.

Failure to follow these may lead to:

- an approved contractor being banned from the site; or
- an employee being disciplined or dismissed.

While these safe practices are mainly designed for use while driving on public roads, they should also be followed when driving on site. When on site a driver should also:

- be aware of potential hazards such as pedestrians, machinery and plant and drive accordingly
- use horn or lights if appropriate to make others aware of their presence.

23.3 Defensive Driving

Before driving, notice that all drivers must ensure that they have a current valid driving licence.

Defensive driving means showing an awareness of what is going on around one. Drivers should observe not just where the road is going, but also what others on the road are doing or might do. It means, for example:

- noticing when there are children playing near the road and slowing down in case one of them runs into the road; or
- watching traffic coming the other way and anticipating whether someone might overtake and come over onto the wrong side of the road.

The first part of defensive driving is that a driver must look all round for other traffic and road users.

Remember that road users mean pedestrians and cyclists as well as cars and vans.

The second part of defensive driving is to react correctly to any hazards.

This means being prepared to slow down or stop or pull over to avoid another road user.

Defensive driving is a skill which can be learnt both through practical experience and by attending suitable training courses.

Speed Limits are very important in defensive driving. A driver must always:

- observe speed limits
- drive at the appropriate speed for the conditions, below the speed limit if necessary.

More about speed limits is included in Section 6.

Another part of defensive driving is to always obey the rules of the road, for example, giving way to other traffic at junctions. In order to do this driver should make sure they are familiar with what all road signs and markings mean.

These tell the driver, for example, when they are approaching a possible hazard such as a junction or bend.

Things happen quickly on the road and warning signs can only cover a few of the worst hazards. A defensive driver will be aware of potentially dangerous areas.

This includes areas where there are children or cyclists, or where there are a lot of pedestrians, for example markets and bus stations.

A good driver will be able to:

- "read" the road ahead and anticipate what is going to happen
- be prepared for others to make mistakes.

Someone who drives like this will be proud of their driving skills and the fact that they are able to avoid the pain and misery which road accidents lead to.

Before setting off on a journey, a defensive driver will take a number of steps to ensure the journey will be safe and comfortable:

- remember that, even in small quantities, alcohol and drugs can impair a driver's judgement and slow down their reactions
- do not drive when feeling unwell
- ensure that eyesight is good; wear spectacles if necessary
- always use a seatbelt and ensure that passengers do the same (where fitted)
- do not drive a vehicle which may be unsafe (see also Section 7).

Finally, a good driver will undergo driver training at regular intervals in order to maintain their skills in peak condition and to keep up with the latest developments. DGDC can arrange this for employees.

23.4 Wide Vehicle/Long Load Procedures

Vehicles with wide or long loads are particularly hazardous for other road users. This is because

- they take up much more road space than other traffic
- they move more slowly than other traffic
- they are difficult for the driver to manoeuvre.

For these reasons, there are some special rules which oversize vehicles must follow.

Firstly, use escorts (pilots) when needed to warn others of the presence of an oversize vehicle.

This means having another vehicle or vehicles, such as a motorcycle or small van, which can go in front of the load and warn other vehicles who may need to stop or pull over to make way. The escort vehicle should carry a warning sign showing clearly what is the hazard, for example “Wide Load”.

Secondly, adjust speeds appropriately for the size of load.

Because larger vehicles take longer to stop and are harder to manoeuvre than normal size ones, it is even more important to travel well within speed limits and to slow down well in advance of hazards such as bends or junctions. The driver of the escort vehicle must also remember this.

Thirdly, journeys should be timed to avoid meeting other wide loads.

The route used by wide loads visiting the plant is narrow and there are few, if any, places where two loads can safely pass each other. Drivers of wide loads should therefore coordinate their movements to avoid this situation; for example, by making upward journeys on even dates and downward on odd dates.

Finally, travel at night whenever possible.

By travelling at a time when there are few other road users, either in vehicles or on foot, the possible conflicts which lead to accidents can be minimised. However, when driving in the dark remember:

- one should drive more slowly than in the daytime
- hazards such as pedestrians or animals will be harder to see.

23.5 Accidents

Even in a well-managed road system with well-trained drivers, accidents do happen. Everybody hopes they won’t be around when an accident happens - many people never will be - but employees must make sure they know what to do if they are. It is essential that all employees are familiar with the correct procedures to follow in the event of an accident. Prompt action could literally make the difference between life and death for an accident victim.

In order to be prepared for an accident

- all drivers should have first aid training
- all vehicles shall carry first aid kits which meet a minimum standard.

All drivers of DGDC' vehicles will be provided with training in first aid.

For a person who is involved in an accident there are three important steps which must be taken immediately:

- send for help if anyone is injured
- try to prevent other accidents happening, for example by warning other drivers
- give first aid.

As soon as possible, the person should then record all details of the accident.

The company has standard forms for recording accident details which should be carried in all vehicles. When an accident has happened, these forms should be used to record the basic details of what happened. If there is no form handy, another piece of paper should be used but the form should be completed as soon as possible. It is more important to get the information than to have it on the proper form.

The following details of the accident are required:

- location
- what happened
- those involved, including names, addresses, vehicle registrations (if any)
- any witnesses, including names, addresses, vehicle registrations (if any)
- time of day
- weather
- any injuries
- anything else of importance (eg there were roadworks, it was market day, there was a bus-stop nearby)

All accidents must be reported to the site superintendent as soon as possible but at least within 24 hours.

23.6 Speed Limits

Speed limits are designed to increase safety for all road users.

Speed limits also apply on site. They vary according to the site and the vehicle being driven.

It is essential that drivers never go faster than the speed limit, both for their own safety and that of other road users. However, speed limits are the maximum safe speed.

A good driver will drive below the speed limit when necessary.

This means slowing down:

- when the weather is bad, for example in rain or fog
- during the hours of darkness
- where there are a lot of pedestrians
- on narrow or twisty roads
- when there are other hazards such as road works.

Speed limits are different for different vehicle types. This is because larger vehicles do more damage and take longer to stop than smaller ones. Drivers who normally drive a smaller vehicle should remember this if they have to drive a larger one.

Remember there are speed limits on site as well as on public roads - they are just as important there.

23.7 Vehicle Safety

As vehicles are used, parts of them become worn. Tyres and brake pads get thinner, joints in the steering mechanism wear and become loose. All these things affect vehicle performance and safety. A vehicle which has worn brake pads takes much longer to stop.

A vehicle with worn tyres takes longer to stop and is much more likely to skid when stopping or cornering.

For all these reasons, it is essential that all vehicles are checked regularly to make sure they are fit to be on the road.

The following items should be checked periodically (every 6 months or more frequently) as part of a programme of regular maintenance:

- brakes - check all parts for signs of wear, check fluid levels, all moving parts working
- all lights - all bulbs working, no cracked or broken lenses
- steering - all moving parts working and showing no signs of wear
- tyres - satisfactory tread (1.5mm minimum) and correct pressure
- seatbelts - correctly attached, no sign of wear, buckles working.
- chassis and bodywork - no excessive wear or rust, all joints correctly tightened.

A vehicle safety checklist is given at the end of this section.

Other regular maintenance, as specified by vehicle manufacturer, should be carried out in accordance with the manufacturer’s instructions. This includes items such as oil changes.

While it takes a trained mechanic to carry out a proper vehicle inspection, any driver can do a few simple checks to make sure their vehicle is fit to use. If the steering feels “wobbly”, if the brakes take a long time to work or seem to pull to one side, or there are other obvious problems, this should be reported immediately and the vehicle should not be used until it has been checked.

Before taking a vehicle out, the driver should carry out a few simple checks by walking around the vehicle and testing the equipment inside:

- tyres do not look worn or flat
- lights (including indicators) are working properly
- equipment such as horn and windscreen wipers are working properly

Finally

- never drive a vehicle which appears to be unsafe
- report any faults to the vehicle maintenance supervisor.

23.8 Pedestrians

All road users are pedestrians sometimes. Unfortunately, when a car hits a pedestrian it is the pedestrian who comes off worse. Although good driving is encouraged, it is in pedestrians' own interests to take precautions to protect themselves.

When walking on the road, pedestrians should

- beware of traffic - use their eyes and ears
- face oncoming traffic if at all possible
- take extra care where they have limited vision, such as at bends
- take extra care at places like corners where drivers will be watching other traffic
- help to protect old and young people who are less aware of the danger of traffic.

23.9 Road Safety Checklist

Everything in this part of the manual is important and could literally mean the difference between life and death. Employees should always remember these 'Ten Commandments':

- learn what is meant by defensive driving and practise it
- obey all rules of the road
- drive at or below the speed limit
- make sure you are fit to drive
- make sure your vehicle is safe and roadworthy
- remember that special rules apply to wide and long loads
- carry a first aid kit and have first aid training
- report all accidents
- when walking, beware of motor traffic
- apply safe driving practices on site as well as on the road.

Form 1: Vehicle Safety Checklist

DGDC
Vehicle Safety Inspection Checklist

Date :	**Inspection :**	**Empl. # :**
Vehicle :	**Type :**	**Odometer:**

No.	**Inspection**	**OK**	**Unsafe**	**Remarks**
	Steering and Suspension			
1.	Free play & steering wheel: .... inches	....	....	....
2.	Tires (Tread wear, Condition, Inflation)	....	....	....
3.	Alignment	....	....	....
	Brakes and Hydraulic System			
1.	Pedal Travel	....	....	....
2.	Fluid Level	....	....	....
3.	Hand Brake	....	....	....
	Clutch and Transmission Linkage			
1.	Clutch Pedal Free Play	....	....	....
2.	Clutch Linkage (free and smooth)	....	....	....
	Safety and Security			
1.	Seat Belt Installed and Anchored Securely	....	....	....
2.	Seat Belt Condition	....	....	....
3.	Seat Adjuster (moves free, lock securely)	....	....	....
4.	Door Latches and Locks	....	....	....
5.	Windshield and Other Window	....	....	....

No.	Inspection	OK	Unsafe	Remarks
6.	Rear-view Mirrors	....	....	....
	Electrical and Instruments			
1.	Headlights (High/Low Adjustment)	....	....	....
2.	Tail Lights	....	....	....
3.	Brake Lights	....	....	....
4.	Turn Signals	....	....	....
5.	Instrument Panel Lights	....	....	....
6.	Windshield Wiper Operation	....	....	....
7.	Windshield Wiper Condition	....	....	....
8.	Horn	....	....	....
9.	Warning Lights	....	....	....
10.	Speedometer	....	....	....
11.	Fuel Gauge	....	....	....
12.	Other instrument	....	....	....
13.	General Wring Condition and Fuses	....	....	....
	Engine Compartment			
1.	Belt (Condition and Tension)	....	....	....
2.	Hoses (General Condition)	....	....	....
3.	Radiator (Condition and Security)	....	....	....
4.	Battery (Secure, Condition)	....	....	....
5.	Fuel Lines (Routine, Condition)	....	....	....
	Undercarriage			
1.	Exhaust System (Security and Condition)	....	....	....
2.	Fuel Tank (Security and Condition)	....	....	....

No.	Inspection	OK	Unsafe	Remarks
	Leaks			
1.	a. Master Cylinder	....	....	....
	b. Lines/Hoses	....	....	....
	c. Wheel	....	....	....
2.	Engine Oil	....	....	....
3.	Engine Coolant/Radiator	....	....	....
4.	Power Steering Fluid	....	....	....
5.	Transmission Oil	....	....	....
6.	Rear End/Differential Oil	....	....	....
7.	Fuel			
	Emergency Equipment	....	....	....
1.	Jack and Lug Wrench	....	....	....
2.	Spare Tire (Condition/inflation)	....	....	....
3.	Warning Reflectors/Flares	....	....	....
4.	First Aid Kit	....	....	....
5.	Fire Extinguisher	....	....	....

	General Vehicle Condition	Good	Bad	Remarks
1.	Exterior			
	a. Body Damage	....	....	....
	b. Rust	....	....	....
	c. Paint	....	....	....
	d. Fittings	....	....	....
2.	Interior	....	....	....
	a. Upholstery	....	....	....
	b. Housekeeping	....	....	....
	Road Test	....	....	....
	Engine			
1.	Starting (cold)	....	....	....
2.	Starting (hot)	....	....	....
3.	Idling	....	....	....
4.	Driving	....	....	....
	Clutch			
1.	Engagement	....	....	....
	Transmission			
1.	Shifting	....	....	....
2.	Noises	....	....	....
	Drivetrain			
1.	Smooth/Quit/Tight	....	....	....
	Steering and Suspension			
1.	Tracks True	....	....	....

	General Vehicle Condition	**Good**	**Bad**	**Remarks**
2.	Shakes/Wobble	....	....	....
3.	Steering Effort	....	....	....
	Brakes			
1.	Stop Straight and True	....	....	....
2.	Shudder/Squeal	....	....	....

Checked by:____________________ Reported to DGDC Supt.:__________________

Comments Safety Officer:

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Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-031: Personal Safety Equipment
Revision 0

Contents

24. Personal Safety Equipment

24.1 Introduction

The purpose of this section is to control the use, maintenance and selection of personal protective equipment.

Where a hazard cannot be controlled through other measures, the use of personal protective equipment or clothing is appropriate. The use of personal protective equipment must be considered carefully to ensure that it is of the correct type and is properly used and maintained.

This requirement stated in this section shall apply to all activities for which personal protective equipment is required by appropriate safe work practices.

24.2 Definitions

Respiratory Protection
Protective equipment designed to enable persons to breathe when toxic gases, vapours or dusts are present, or there is insufficient oxygen.

Oxygen deficiency
Insufficient oxygen in air.

Dusts
Particles formed when solids are broken down, such as by sanding or grinding.

Fumes
Fine particles in air formed when metal is melted, vaporised, then quickly cooled.

Mists
Tiny liquid droplets suspended in air.

Gases
Gas-phase contaminants that can be toxic.

Vapours
Substances that evaporate from a liquid or solid.

Particulate
Includes dusts, mists and fumes.

Irritant
Substances that can cause discomfort or minor irritation but no tissue damage

24.3 Responsibilities

- Every employee when working at the site shall wear suitable protective clothing and use protective equipment appropriate to the work being undertaken. Protective clothing/equipment shall be worn and/or used as required without exception. This applies to employees, contractors and sub-contractors alike. The requirement for personal protective equipment may be specified in the Safe Work Practices Manual, or in location-specific signs and notices.
- DGDC shall ensure that all protective equipment required for the safe execution of tasks is available to all employees, and that a record of distribution of non-consumable personal protective equipment is kept.
- Line Managers and Supervisors shall ensure that employees are trained in the use and maintenance of protective equipment.
- Supervisors shall ensure that employees are supplied with appropriate personal protective equipment, and that the equipment is maintained.
- Supervisors must ensure that all members of the work party and all contractors and sub-contractors are wearing appropriate protective clothing and/or equipment.
- Management shall ensure that all employees are directed and instructed in the use, care, fitting and maintenance of personal protective equipment.
- Management shall keep a record of details of training and persons approved for use of respiratory protection.
- All employees shall be responsible for the care of personal protective equipment issued to them, including the correct use, cleaning and maintenance of the equipment.
- If personal protective equipment is not available, or is inadequate for a task, or if insufficient training has been provided, the employee shall inform Management so that suitable equipment and appropriate training can be provided.

24.4 Respiratory Protection

24.4.1 Training

All staff required to wear respiratory protective equipment on a regular basis shall participate in a Respiratory Protection training programme. Following this initial training, staff will be required to participate in a day refresher courses annually. New staff must complete the Respiratory Protection training programme before carrying out any work that requires the use of respirators. On completion of the course, staff will be issued with a certificate of competence which will be valid for the following year, and will be renewed after they have done their refresher course.

The training shall cover:

- conditions under which Respiratory Protection should be worn
- types of Respiratory Protection
- fit testing
- maintenance.

Staff required to wear respiratory protection (other than dust masks) on an occasional or emergency basis shall undergo a 1-day training and fit testing programme. Training will be provided by external agencies or by appropriately trained and experienced DGDC personnel.

Management shall keep a record of details of training and persons approved for use of respiratory protection.

24.4.2 Selection

Any respiratory devices used by DGDC staff shall have NIOSH/OSHA or similar international standard approval.

In general, the type of respiratory protection required will be defined in the appropriate Safe Work Practice. The level of protection will be selected based on the type and level of contamination, and the type of work being done. The selection of respiratory protection shall be done by specifically trained health and safety personnel.

Note: Occupational monitoring will normally be required as part of this selection.

There are two main types of respirators to be used by DGDC employees:

i) air purifying, and
ii) supplied air.

An air purifying respirator filters the air breathed, either mechanically (in the case of particles) or chemically (e.g. solvents are filtered by absorption onto charcoal). Air-purifying respirators can be used only for specific contaminants as specified on the manufacturers canister/cartridge selection criteria and must not be used when there is insufficient oxygen or extremely high levels of contaminants. A summary of types air purifying respirators and what they should be used for is given in Table 24.1.

A supplied air respirator provides clean air to the worker. Details of supplied air respirators are given in Table 24.2.

A regime for selecting the appropriate type of respiratory protective equipment to use is presented in Figure 24.1.

Table 24.1
Respirator Types - Air Purifying

	Name	**Type**	**Use**	**Limitations**
	P2 Dust Mask	Half face disposable dust mask (2 elastic straps)	Protection against nuisance dusts and mist.	Not to be used for toxic dusts or oxygen deficiency. Clean shaven important for good fit.
	Half-face Respirator	Reusable plastic or rubber mask, fitted with disposable cartridges and/or high efficiency filters	Protection against specific gases, vapours and toxic dusts	Mask needs to be fitted and maintained. Cartridges need to be replaced. Facial hair not permitted. Not to be used for oxygen deficiency.
	Full-face Respirator	Similar to half-face except that it covers the whole of the face (including eyes)	Similar to half-face. Better seal possible. Also gives eye protection.	Mask needs to fitted and maintained. Cartridges need to be replaced. Not to be used for oxygen deficiency. Should not be used with beards.
	Powered Air-Purifying Respirators (PAPR)	These includes a half or full-face respirator, cartridges and/or filters, a blower and a battery pack to supply air at positive pressure	Seal is not as important (can be used with beards if contaminant concentrations not greater than 10 times “safe level”). Cooler and more comfortable to use.	Mask needs to fitted and maintained. Cartridges need to be replaced. Not to be used for oxygen deficiency

Table 24.2
Respiratory Types - Supplied Air

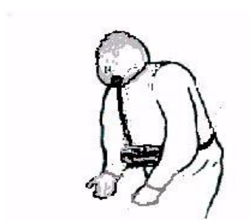
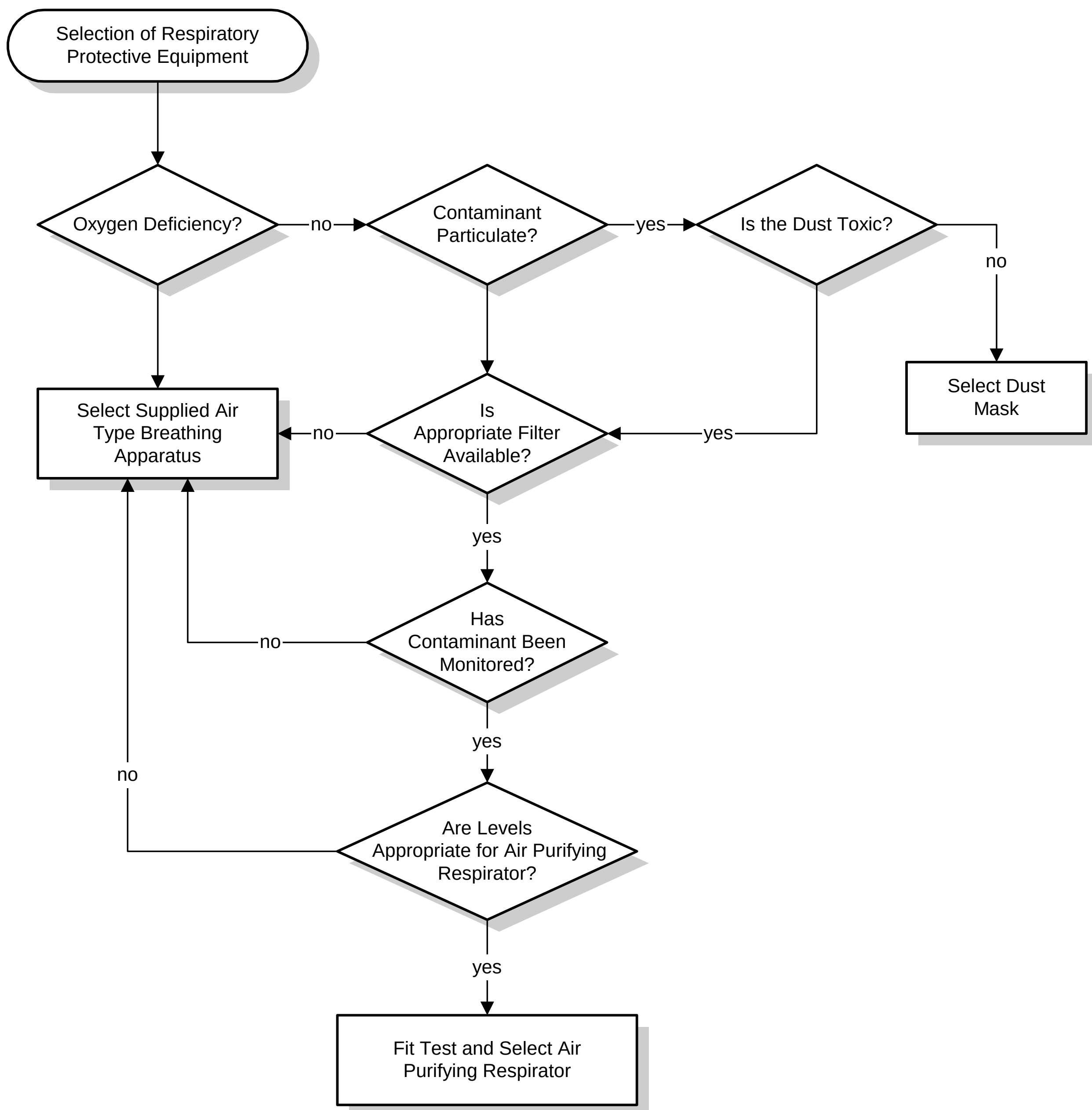
	Air Line, Continuous Flow	Supplies air at a constant rate through a hose to respirator or cloak.	Seal not necessary (can be used with beards). Cooler and more comfortable to use. Requires clean air source and air pump.	Mobility restrictions. Not to be used if IDLH (immediately dangerous to life and health) conditions exist, unless escape apparatus also used.
	Self - contained Breathing Apparatus (SCBA)	Supplies air from tank worn by operator to sealed mask,	Can be used in oxygen-deficient atmospheres. Should not be used if facial hair present.	Mobility restrictions. Time limited.
	SCBA - Escape Pack (ELSA)	Supplies air from small tank to hood worn over workers head.	Can be used with facial hair. Can be used in oxygen-deficient atmosphere.	Must only be used for escape purposes. Duration of use: 5 to 8 minutes.

Figure 24.1 Selection of Respiratory Protection Equipment



24.4.3 Fit-tested

All wearers of respiratory protection must be fit-tested with the appropriate type of respirator. This will normally be done during training and should include:

- negative pressure test
- positive pressure test

Employees should not wear any respirator type for which they have not been specifically fit-tested.

The positive pressure and/or negative pressure fit tests are to be carried out each time an individual puts on a respirator.

24.4.3.1 Negative Pressure Fit Test

- Place the palms of the hands over the openings in the filter retainer (if so equipped).
- Inhale and hold breath for about five seconds.
- If the face piece collapses slightly and no air leaks between the face piece and the face are detected, a good fit has been obtained.
- If air leaks are detected, reposition the face piece on the face and/or re-adjust the tension of the elastic straps and repeat the negative pressure check until a tight seal is obtained.

24.4.3.2 Positive Pressure Fit Test

- Hold thumb or palm of hand over outlet of exhalation valve guard.
- Create a slight positive pressure inside face piece by exhaling gently.
- If the face piece bulges slightly and no air leaks between the face piece and face are detected, a tight fit has been obtained.
- If the air leaks out between the face piece and the face, re-adjust the tension of the elastic straps to eliminate the leakage. This check must be repeated until a tight seal of the face piece is obtained.

Moustaches and stubble growth may spoil the fit of a respirator. Bearded persons cannot expect to achieve adequate respiratory protection when wearing a full-face respirator or a half-face air purifying respirator, Accordingly, no one who requires respiratory protection shall attempt to wear either a full-face or half-face air purifying respirator over a beard. Positive pressure respirators can be worn with a beard. However, with a beard the amount of breathing time a SCBA bottle can provide may be reduced.

If necessary, a bearded person may use a continuous flow airline fitted with a cloak (rather than a full or half face respirator).

Employees must qualitatively check the fit of their mask before each use.

It is DGDC policy that personnel who in the course of their regular duties are required to wear a respirator then they must be clean-shaven. Beards are allowed for those persons who on limited occasions are required to wear respiratory protection.

24.4.4 Issue

When used regularly, air purifying respirators will be issued to individuals (as practicable) for his or her exclusive use. A record of respirator issue and usage should be established and maintained.

Respirators will only be issued to persons medically fit to wear them. The following medical conditions may be seen as restrictive to issue of respiratory protection (excluding for escape only):

- chronic lung conditions such as emphysema and asthma
- circulatory diseases such as heart disease and anaemia
- epileptic seizures
- claustrophobia.

Facial features and/or the presence of facial hair may interfere with the fit of respirators, as can the use of spectacles. Respirators shall not be issued to any person where a respirator cannot be found to give a good fit. Neither shall they be issued to any person who has not achieved the appropriate certificate of confidence.

Where respirators and supplied air sets are infrequently used, these will be pooled and available for use by any trained individual.

24.4.5 Use

Respirators should only be used if the conditions listed below are met:

- The respirator is required in a Safe Work Practice.
- An appropriate and current certificate of competence is held by the wearer.
- The respirator type has been successfully fitted to the individual concerned;
- If a respirator has been fitted on a clean-shaven basis, the respirator is worn on a clean shaven face.
- The respirator will provide sufficient level of protection.
- Respirator is adequately maintained.

Respirators should not be removed in a contaminated area. Removal for even a short time will dramatically reduce the effectiveness of the control measure.

24.4.6 Storage, Cleaning and Maintenance

24.4.6.1 General

A clean store (Safety Equipment Store), at a convenient part of the site, shall be equipped for the cleaning and storage of respirators. One person shall be responsible for the storage and maintenance of pooled respirators in each area. All persons who issue respirators shall be trained specifically in the issue, selection, upkeep, maintenance and control of safety equipment.

Where a respirator is issued to an individual (air-purifying respirators only), that individual is responsible for its cleaning and use. When used routinely, respirators shall be cleaned daily. The employee will be trained in the cleaning of their respirator. The respirators shall be kept in the Safety Equipment.

Pooled respirators must be cleaned and disinfected after each use. No device should be issued unless it was cleaned and disinfected after its last use. Prior to re-issue, respirators should be inspected in accordance with the manufacturer's instructions to ensure correct operation of the respirator.

The Safety Equipment maintainer will ensure that:

- details of all respirator use are recorded
- exhalation and inhalation valves are checked on return
- respirators are inspected for defects
- filters and cartridges are stored correctly
- filters and cartridges are replaced as appropriate (see below)
- respiratory protective equipment is repaired and replaced as necessary.

24.4.6.2 Filters and Cartridges

Filters should be stored in sealed containers bearing the date of last inspection. No filters should be stored for longer than 6 months.

When in use, filters should be changed regularly. The following is a guide:

Particulate filters: Change filter when breathing resistance noticeably increases (ie., the filter pores are clogged).
Gas Respirators: Change filter when odour or taste is perceived by wearer; or when wearer coughs or experiences discomfort; or after a maximum of 4 hours of continuous use.

Note: the length of time for which a filter can be used is dependent on the concentration of the contaminant.

Used filters must be disposed of in an approved manner.

24.4.6.3 Self-Contained Breathing Apparatus

All SCBA should be maintained and stored in a condition that allow them to be used immediately. Cylinders of compressed oxygen or air shall be fully charged and stored at the recommended working pressure. Only fully charged cylinders shall be issued for use. Partially charged cylinders should be discharged and refilled.

24.4.6.4 Air Check

Cylinders should be checked on a regular basis to ensure the air is clean and free from contaminants. Checks should be made to ensure the air is not contaminated with hydrocarbons, carbon monoxide and/or carbon dioxide.

Simple on-site checks can be performed by releasing air from a cylinder into a gas tight bag. From the bag a sample of air can be drawn through a gas detector tube in order to measure for the presence of possible contaminants (CO, NO, and/or CO2). Additional checks include smell and venting air through a clean cloth.

On a regular basis cylinders should be sent to an approved laboratory for contaminant testing.

As well as testing the cylinders, if a compressor is used on site to fill air cylinders a weekly inspection should be performed to ensure discharge air is clean and safe to breath.

24.4.6.5 Straps and Harnesses

SCBA and respirator masks should be stored with all straps and harnesses adjusted to maximum size. On return to the store, the condition of all straps and the operation of all buckles checked.

24.5 Emergency Breathing Apparatus

SCBA that is assigned to emergency use to be kept solely for this use and is never to be used for normal work related duties.

24.5.1 Emergency SCBA Sets

Emergency SCBA sets are to be maintained full and ready for use. Straps are to be fully loosened and face mask straps are to be pulled back over the front of the mask ready for immediate use.

Emergency SCBA is to be inspected weekly to ensure bottles are fully charged.

24.5.2 Emergency Life Support Apparatus (ELSA)

ELSA sets are designed for emergency escape only and are never to be used for any other purpose.

ELSA sets are to be stored in all areas deemed to present a significant fire or gas hazard. They are to be clearly marked and easy to access locations within each area.

In dusty and outdoor areas, they are to be stored in a purpose designed box that has a quick release catch. In other areas they are to be on purpose designed storage shelf.

In addition, ELSAs are to be available to workers, on an as required basis for work that may require emergency escape.

All ELSA sets are to be inspected weekly and on issue. They are always to be maintained fully charged and ready to use.

24.6 Hearing Protection

24.6.1 General

This section should be read in conjunction with Section 5: Noise and Vibration. As stated in Section 5, alternative measures to reduce noise levels effectively should be carefully considered before hearing protection is implemented.

Hearing protection must be worn under the following circumstances:

- in an area sign posted “hearing protection required”

Figure 24.2: Sign Indicating Hearing Protection Must be Worn in this Area

- for tasks where hearing protection is required as defined in appropriate Safe Work Practices
- where noise levels have been measured to be above 85dB(A) over a period of 8 hours
- where noise levels have been measured to be over 115dB(A) over any length of time
- where one needs to raise one’s voice to communicate with someone within 2 metres.

Training for the use of hearing protection will be done as part of the general induction training. (Refer to Section 3: Training). Hearing protection training should be repeated every three years. Employees will also be fitted and issued with hearing protection at this training as appropriate.

Audiometric testing shall be performed within three months of employment and then every two years for persons regularly required to use hearing protection.

24.6.2 Selection

There are two main types of hearing protection that can be used:

- ear plugs
- ear muffs.

There are several types of ear plugs, but the basic principle is the same for all types: they are a form of bung that is pushed into the ear canal.

A list of the advantages and disadvantages of air plugs and air muffs is given below in Table 24.3.

Table 24.3: Advantages and Disadvantages of Ear Plugs and Ear Muffs

Advantages	Disadvantages
Ear Plugs	
• Easier to wear for most people - they are not hot or bulky and can be worn with other equipment • Disposable types are available	• Must be carefully fitted and periodically checked • Clean hands must be used to insert or remove plugs • Do not provide protection over 97dBA
Ear Muffs	
• One size will fit most people • Can be attached to hard hats • Greater protection can be provided (Note some activities will require the use of high efficiency ear muffs) • They are easy to remove and replace - an advantage for people who frequently move from a noisy place to a quiet place	• May make ears hot • Are bulky • Efficiency may be reduced if worn with spectacles, respirators etc.

Following an initial review of noise exposures (see Section 15: Noise and Vibration), various areas will be designated hearing protection zones. They will be graded as listed in Table 24.4:

Table 24.4: Hearing Protection Grades

Hearing Protection Grade	Noise Level (dB(A))
1	86 - 91
2	92 - 97
3	98 - 103
4	104 - 109
5	110 - 115

The hearing protection grades are standard. Hearing protective devices will be labelled as to meeting one of these grades. Grade 5 Ear muffs provide the highest level of hearing protection. In some instances, ear plugs and Grade 5 ear muffs will be required to be worn in order to provide sufficient protection (double ear protection). For example, work in the vicinity of the venting of steam via a rock muffler.

In most situations there will be a selection of protective devices that have the required hearing protection grade (i.e. a choice of ear muffs or plugs). In these cases, the individual workers will select the type of hearing protection that is most practicable for them. This is because the most important factor in achieving a high degree of hearing protection is that the hearing protection be worn at all times when the employee is exposed to excessive noise.

24.6.3 Use

The removal of hearing protectors for even very brief periods of time can dramatically reduce their effectiveness and lead to under-protection for the wearer. Where hearing protection is required, it must be used at all times. Failure to wear hearing protection when required could result in damage to hearing.

Management must ensure that “quiet” locations or periods are available for employees to have breaks from noisy activities and wearing hearing protection.

When using hearing protection, it is much more difficult to hear instructions or warning noises. This should be taken into account for work practices, and alternative arrangements made for communication and warnings.

24.6.4 Maintenance

Employees should regularly inspect hearing protectors to detect damage or deterioration. Disposable earplugs must not be reused due to the risk of ear infection. Reusable ear plugs must only be used by one person.

Ear muffs must be replaced if their acoustic packing becomes loose, or where the padding is worn, damaged or missing. Checks should be carried out to ensure padding and packing condition is adequate.

Adequate provision should be made for clean storage of protectors when not in use. Facilities should be readily available for the cleaning of reusable protectors. Hearing protection devices should be cleaned and disinfected according to the manufacturer's instruction.

24.7 Eye Protection

24.7.1 General

Personnel working on a task which has the potential to cause eye injury shall wear appropriate eye protection such as full-face shields or safety glasses. Examples are working with grinders, breaking glass, lathes, drills, etc as specified in appropriate Safe Work Practices. Other areas in which eye protection is required (e.g. the laboratory) will be signposted with the following:

Training for the use of eye protection will be done as part of the general induction training (see Section 10: Training).

24.7.2 Selection

The types of eye protection available, together with their description and uses is included in Table 24.5.

Table 24.5: Types of Eye Protection and Their Use

Type	Description	Uses
Normal glasses	Prescription lenses, sun glasses.	Not to be used as safety protection on DGDC sites
Safety glasses	Glasses providing splash protection from most angles.	Minimum level of eye protection for signposted areas. Should not

		be used when in high risk situation (medium impact)
Safety goggles	These are fitted to the shape of the face, providing full eye protection from accidental splashing.	Preferred level of protection. Necessary for high risk situations e.g. splashes to eyes possible from corrosive chemicals. They may, however, be hot to wear for long periods of time and may fog.
Face Shield	Usually helmet with transparent visor. Provides face protection.	Used for Grinding and other activities requiring full face protection. Will be specifically signposted.

24.7.3 Use

Where eye protection is required, it must be used at all times. Failure to wear eye protection when required could result in permanent eye damage or blindness.

Glasses or visors should fit well, so that they do not move or slip whilst being worn.

24.7.4 Maintenance

Employees should inspect eye protectors regularly to detect damage or deterioration.

Lenses must be kept clean; otherwise visibility will be obscured. Warm water and washing liquid applied with a soft cloth is effective for lens cleaning. Facilities should be readily available for the cleaning. Adequate provision should be made for clean storage of protectors when not in use.

24.8 Head Protection

24.8.1 General

Safety helmets (or 'hard hats') are the primary form of protection. Bump caps are often more comfortable to wear, but offer less protection. Hoods and neck protection may also be necessary where there is a risk of hazardous substances entering via the collar.

Hard hat areas may be specified in Safe Work Practices or signposted as follows:

24.8.2 Selection & Use

Bump caps are not acceptable for use in hard hat areas, as these do not provide adequate protection against falling objectives.

Where hard hats are required, they must be worn at all times.

24.8.3 Maintenance

Plastic helmets become more brittle and weaken over time, due to UV degradation. They should be stored out of direct sunlight, and replaced in accordance with the manufacturer's recommendations (usually every two years).

Helmets which are cracked or otherwise damaged must be replaced immediately.

24.9 Protective Clothing

24.9.1 General

Overalls provide general skin protection, and are available in a variety of different materials and styles. They may be disposable, breathable, waterproof, fire resistant, or chemical resistant, and may have a hood to protect the head and prevent substances entering via the collar.

Further skin protection is available via the use of gloves and gauntlets where there is a risk of skin contact with harmful materials, sharp objects, or hot/cold surfaces.

24.9.2 Selection & Use

Synthetic overalls must not be worn. Cotton clothing is recommended due to the fact this its intrinsically safe and if catches on fire will not stick to the skin.

Aprons constructed of chemical resistant material (PVC, neoprene) should be worn when handling chemicals (pouring etc) or washing out containers.

Synthetic clothing and underwear must not be worn where there is a risk of burning or electrocution, as it will melt onto the skin and cause severe burns. Natural fibres are recommended.

24.9.3 Maintenance

Where overalls and other protective clothing are provided, they must be washed on a regular basis to avoid skin infection. Where hazardous substances are present on the clothing, the laundry should be informed of the risk.

24.10 Foot Protection

24.10.1 General

Safety boots have protective toecaps, and some also have sole plates which protect against penetration injuries

24.10.2 Selection & Use

Safety Boots will be issued to individuals as appropriate by DGDC management.

Boots also offer ankle protection. In some industrial situations, there may be caustic or acidic materials on the floor, and so it is necessary to select a sole compound which is resistant to these substances. Otherwise, selection should be based on comfort.

24.10.3 Maintenance

Safety footwear should be repaired or replaced once the sole is excessively worn, if the sole is parting from the upper, or if the protective parts are significantly damaged.

24.11 Hand Protection

24.11.1 General

Gloves provide protection against specific chemical agents, temperatures extremes, traumatic injury cuts and act as barriers to protect the skin.

24.11.2 Selection and Use

The type of hand protection required depends on the tasks to be performed. Hand protection will be issued to individuals as appropriate by DGDC staff after a risk assessment is conducted.

Gloves shall be worn, when handling chemicals, or objects which could cut, splinter the hand.

Proper selection of gloves is important, check with a supervisor on glove suitability chart to obtain the correct glove for the task. In general, the following selections should be made:

- Leather -protects hand against, splinters, scratches, etc and should be worn in general manual handling situations, e.g. grass only, general labour.
- PVC - protects against mild corrosives and irritants.
- Latex - provides light protection against irritants and limited protection against infectious agents.
- Natural rubber - protects against mild corrosive material and electric shock.
- Neoprene - for working with solvents, oils or mild corrosive materials.
- Cotton - absorbs perspiration, keeps objects clean, provides some limited fire retardant properties.
- Zetex - for hot work including welding, etc. These are a good replacement for asbestos.

24.11.3 Maintenance

When working with extremely corrosive materials, wear thick gloves. Take the extra precaution in checking for holes, punctures and tears.

Gloves must be discarded after handling chemical and biological hazards.

Hand washing is required after removal of gloves to ensure no contamination in removal of gloves.

Reusable gloves should be cleaned or decontaminated and stored in a clean area.

Oil contaminated gloves should be disposed of when use has finished.

24.12 Barrier Creams

Barrier creams should be applied to hands, in situations where oil, grease etc will contaminate hands over the working day. The barrier creams prevent this material entering skin pores and makes cleaning of hands at the end of the day easier.

Barrier creams will be provided on an as required basis, for the workshop and maintenance staff at the site.

It should be noted barrier creams provide additional protection against skin irritants and substances which remove natural oils from the skin. Sun screen is a specific form of barrier cream, which reduces the risk of burning and melanoma by filtering the UV component of sunlight.

People with sensitive skins or skin allergies may suffer irritation from certain barrier creams.

Barriers provide very limited skin protection when handling solvents/degreasers, etc. Gloves must be worn when handling these substances.

24.13 Safety Harnesses

Safety harnesses must be worn when persons are working at heights and when there is a chance of falling 1.8m or more.

Refer to Section 24: Working at Height for more details on the types of fall restraint equipment to use, checks to perform before use and the maintenance of body harnesses and lifelines.

24.13.1 Selection and Use

Full Body Harness - required when there is a risk of a free fall whether the fall is from, through or into any place or thing. The maximum fall allowed is 1m and maximum fall factor 1 but the stress on the lanyard cannot exceed 6kN so a shock absorbing system has to be in place.

Work Positioning Harness - used when the angle of the working area is greater than 15 degrees (angled roofs, window cleaners etc). The restraint line should always be under tension, however, maximum free fall allowed is 600mm.

Belts (Restraint/lineworkers) - used where there is no possibility of a free fall or when the lanyard/polestrap is under tension and the surface (roof) is not greater than 15 degrees, maximum free fall allowed is 600mm.

Lanyard Assemblies - used with a fall arrest harness to an anchorage point or a lifeline to transmit and partially absorb forces generating and arresting a fall.

Restraint Line - limited to use where neither a free nor restrained fall is possible.

Attachment Hardware - snaphooks and karabiners shall be self-closing and self-or manual-locking except in specific situations where it can be clearly demonstrated that the requirements for a second locking device will place wearer at risk in a particular situation.

Anchor Points - should be located as high as equipment permits as it is dangerous to work above the point of anchorage. There should be a minimum of slack in the safety line between the person and attachment to the anchorage. The lanyard or fall arrest system should be designed to limit a free fall to a maximum of 1m and a maximum fall factor of one. Anchorage should have a design capacity of 1500kg. Anchor points should not be sited below the attachment point of the harness e.g. dorsal position.

Fall Factor - is the length of the fall divided by the length of the lanyard assembly

e.g. 1: length of lanyard is 1m, length of fall is 1m, fall factor equals one
e.g. 2: length of lanyard is 1m, length of fall is 2m, fall factor equals two.

Maximum fall factor allowed is a fall factor of one.

Lifelines:

- Cable (permanent) Static Line: should be a diameter of 10-12mm and should provide a minimum safety factor of 10. It should have a guaranteed breaking strain of 4000 kg. Industrial shock absorbers should be used to ensure the force generated will not exceed 15kN onto the anchor points.
- Temporary Static Line: Line to be used should be 16mm nystrom or nylon or kernmantle construction and should provide a minimum safety factor of 10. The line should have a guaranteed breaking strain of 8000kg. Tension should be achieved by a self-tensioning block capable of automatically locking the line and manually releasing the line. The tensioning block should be designed to reduce shock loading to the anchor points by a dynamic friction facility. The maximum continuous span should not be greater than 20m.

Maximum Ground Clearance - whether it be extension of the industrial shock absorber, personal energy absorber or the dynamic sag factor of the temporary line, the distance produced in activation during a shock load must be taken into account when calculating maximum ground clearance.

Shock Loading - where a lanyard and harness have been subjected to a free fall and therefore been shock loaded, these items must be destroyed.

24.13.2 Maintenance

All body harnesses and lifelines shall be returned after use to the Safety Equipment Store. They will be stored in clean polypropylene or canvas bags. Lines will be coiled or plaited to ensure they do not become tangled. The harness will be checked to ensure it has not been contaminated in oil, etc, which could result in the webbing material losing its strength.

All webbing will be checked on a regular basis for wear and tear, stitching failing, fraying, etc. A harness in a poor condition should be replaced.

Maintenance of Personal Safety Equipment
As a reminder for personal safety equipment to function correctly and not to fail putting the wearer at risk, they must be kept clean and well maintained. Defective items must be replaced and never used.

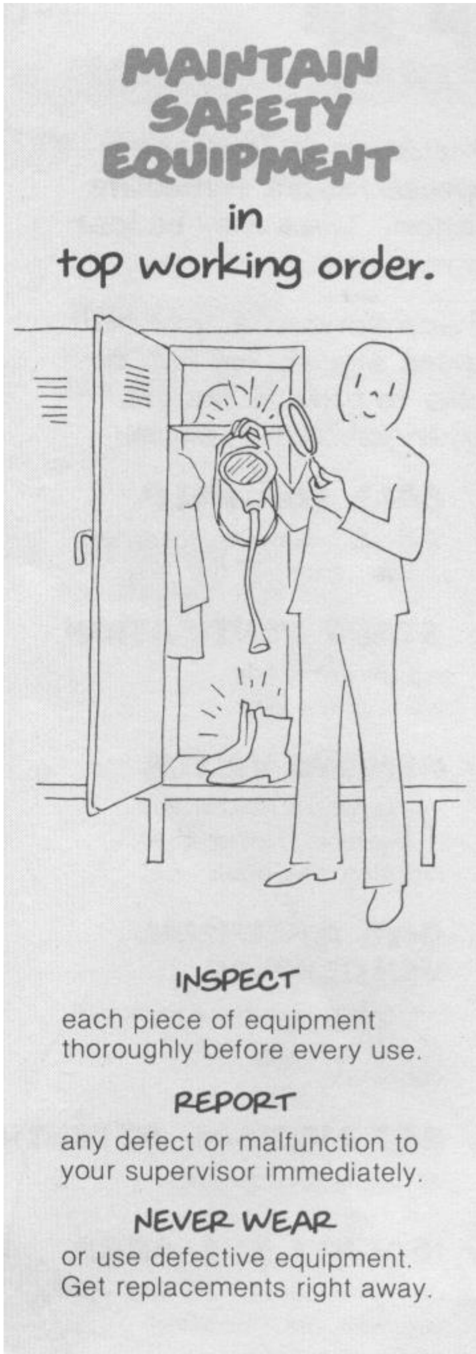


Figure 23.3: Maintenance of Protective Equipment

Dominica Geothermal Development Company Limited

Powering a New Generation...

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-032: Safety-in-Design

(to be developed)

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Contents

26. Office Safety

26.1 Introduction

The purpose of this section is to ensure employee safety whilst working in an office environment by provision of information and procedure for safe working.

26.2 Office Hazards

The office is like any other work environment in that it may present potential health and safety hazards. Most of these, however, may be minimised or eliminated by designing jobs and workplaces properly, and by taking into account differences among tasks and individuals.

26.3 Housekeeping

Good housekeeping is an important element of accident prevention in offices. Poor housekeeping can lead to fires, injuries to personnel, or unhealthy working conditions.

- Employees are responsible for keeping their individual work areas clean and orderly. Pick up items such as pencils or paper clips and wipe up any spilled liquids.
- Do not hurry when walking between desks as this could result in bruises and falls.
- Keep electrical cords, computer cables and other tripping hazards out of aisles and open floor areas.
- Exposed element radiant heaters should not be used in offices. They can easily ignite paper, clothing, plastic, etc nearby.
- Use multi-socket extension boards rather than adapters.
- File drawers, desk drawers and table drawers should be kept closed when not in use. Never open more than one drawer at a time because the filing cabinet may fall forward.
- Try to distribute the weight evenly in file cabinets. It is preferable to load the lower drawers first.
- All aisles, stairways, passageways, means of egress and entrances shall be kept free from obstructions at all times.

- Do not place supplies on top of lockers, boxes or other moveable containers at a height where they are not visible from the floor.
- When stacking materials for storage, make sure the base is firm and level. Cross tie each layer. Keep stacks level and not too high. Keep aisles clear and with adequate space to work.
- When storing materials overhead, provide adequate toeboards to prevent objects from rolling over the edge.
- Never use chairs, desks, or other office furniture as a makeshift ladder. Use a stepladder or a step-stool. Do not overreach and lose your balance
- Tools, equipment, machinery and work areas are to be maintained in a clean and safe manner. Defects and unsafe conditions should be reported and actioned immediately. Only qualified electricians may install, repair and maintain electrical appliances.
- Return tools and equipment to their proper places when not in use.
- Keep the blades of paper cutters closed when not in use.

26.4 Computer Use

26.4.1 Display Screen

- The top of the display screen should be at, or just slightly below, eye level. This allows the eyes to view the screen at a comfortable level, without having to tilt the head or move the back muscles.
- The monitor should be positioned at a distance in front, or slightly to one side, of the operator.
- Adjustable monitor arms which can easily be altered are useful where a computer has multiple users.
- Control glare at the source whenever possible.
- VDUs should be parallel to direct sources of light such as windows and overhead lights. Use window treatments to reduce glare, if necessary.
- If glare sources cannot be removed, seek appropriate screen treatments such as glare filters.
- Keep the screen clean.

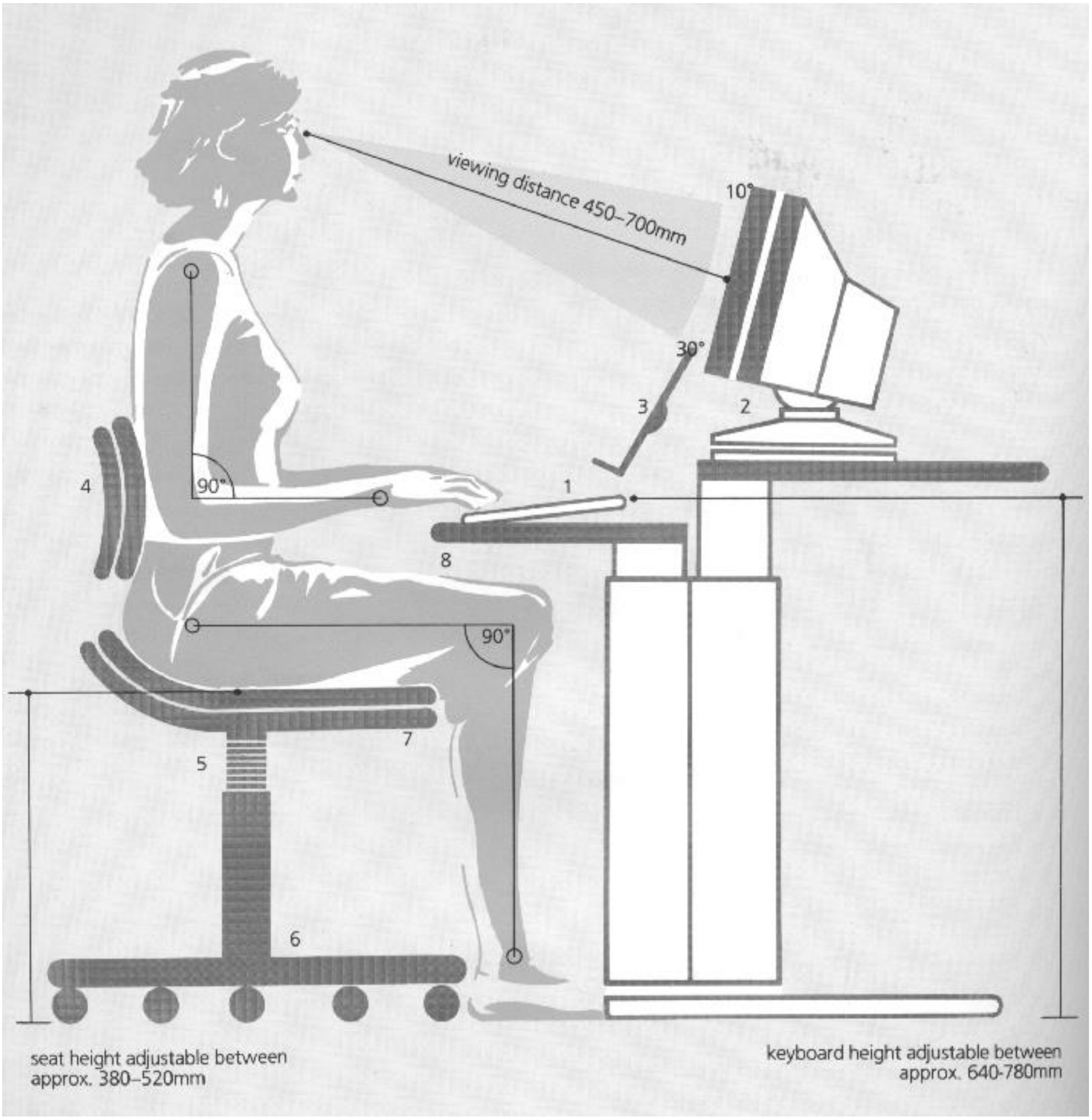


Figure 26.1: VDU Workstation Set-up

26.4.2 Chair

Everyone should adjust their chairs to suit themselves.

Chairs should provide:

- adjustable height, comfortable lumbar support
- waterfall front (rounded front edge on the seat pan)
- stability (five legs preferable) and freedom of movement (wheels)
- fabric that breathes
- comfortable seat pan that fits and swivels.

A chair should be the right size for the person using it.

The chair is usually the most important piece of furniture that affects user comfort in the office. The chair should be adjusted for comfort, making sure the back is supported and that the seat pan is at a height so that the thighs are horizontal and the feet are flat on the floor, or a foot rest. An ergonomically sound chair requires four degrees of freedom - seat pan tilt, backrest angle, seat height and backrest height. Operators can then alter the chair adjustments according to their body and the task. Chairs should be easy to adjust so that changes will be made by the user to suit different tasks. We are all different, and what is comfortable to one person may not be to another. Employees should be able to trial chairs to find one that suits them.

26.4.3 Working Height

The work surface height should fit the task.

-
- Surface height should be such that the work can be performed in such a manner as to keep arms low and close to the body in relation to the task.
- Working height is too high: the shoulders or the upper arms have to be lifted to compensate, which may lead to painful symptoms and cramps at the level of the neck and shoulders.
- Working height is too low: the back must be excessively bowed, which may cause backache.
- Work should be done at about elbow height, whether sitting or standing.
- Adjustable work stations should be provided so that individuals may change the stations to meet their needs.

- Non-adjustable VDU workstations are not suitable for continuous work.
- Fingers on the keyboard should be in a straight line with the forearm rather than bent to the side.
- Wrist rests may also be a help and are built into most keyboard holders. (For some people alternative keyboard and mouse designs may need to be considered.)

26.4.4 Work Space

The work surface should be of sufficient size to accommodate the computer and all associated materials. There should be adequate space beneath this surface for the operator's feet and legs. The mouse should be placed next to the keyboard. It should not be necessary to stretch or reach out to it. Use of the mouse should involve the arm rather than just the wrist.

26.4.5 Work/Rest Schedules

When working at a computer for a long period of time micro pauses should be taken every 5-10 minutes. The arms should be removed from the keyboard and allowed to hang loose at the sides. Also, a short break (5-10 minutes) away from the computer should be taken every hour when involved in continuous work at the computer.

26.4.6 Hand/Shoulder Stretches

Something to do while taking pauses from work on the computer.

Hands: Make a fist and then span or spread the fingers as far as possible.

Shoulder Stretches: Shrug the shoulders and then relax them. Roll the shoulders forward and backward. Gently shake the shoulders. Pinch the shoulder blades together. Reach over the head and stretch, while stretching do side bends.

Forearm: Place palms together with fingers pointing towards the ceiling. Keeping palms together, slowly lower hands until you feel the stretch.

Wrist: Hold arms straight out in front of body, bend arms up and down

Neck: Tuck in the chin. Tilt the head towards each shoulder. Turn the head from side to side, look over the shoulder. Keep head aligned, do not stick the head out.

Upper Back/Shoulders: Sit straight up, place hands behind the head, move elbows backwards to pinch the shoulder blades together. Stretch the arms behind the back.

Upper Arms/Upper Back: Interlace the fingers with palms facing away from the body, straighten arms and lift them towards the ceiling.

Back Stretches: While sitting, bend forward in the chair and if able touch hands to the floor. Grasp leg at shin, slowly pull leg up to chest. Repeat with the other leg. (If there is knee pain, place hands behind thighs and pull slowly. While standing, place hands on hips and bend backwards.

26.4.7 Other

Additional measures that will aid in reducing discomfort while working at the computer include:

- changing position, standing up or stretching whenever starting to feel tired
- using a soft touch on the keyboard and keeping shoulders, hands and fingers relaxed
- using a document holder, positioned at about the same plane and distance as the display screen which minimises eye, neck and shoulder strain by positioning the document close to the monitor
- resting the eyes by occasionally looking off into the distance.

A foot rest should be used where the feet cannot be placed firmly on the floor.

Figure 26.1 provides a diagrammatic representation of assessing work involving computers.

26.5 Occupational Overuse Syndrome

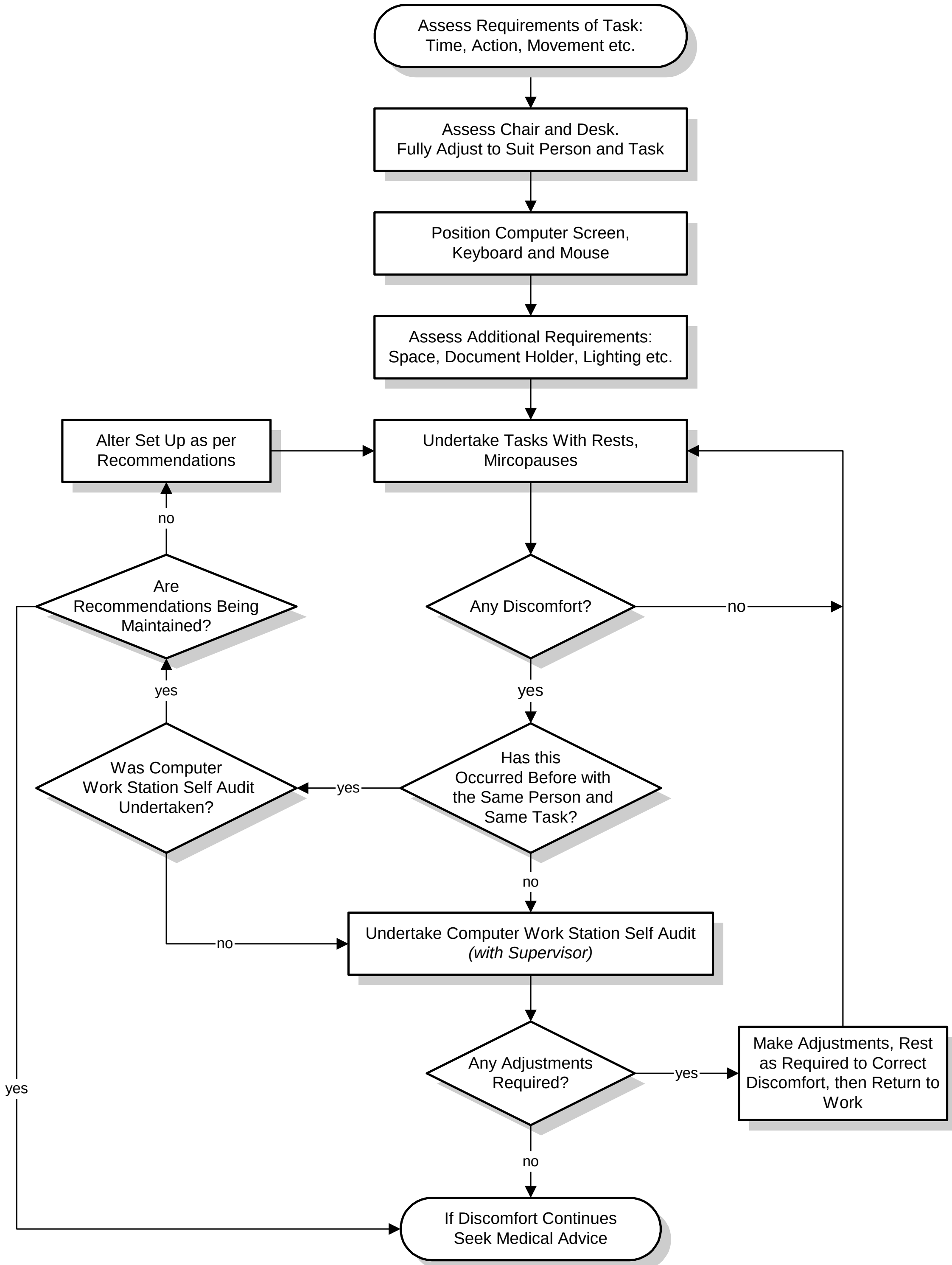
Occupational overuse syndrome (OOS), or repetitive stress/strain injuries (RSI) describe a wide range of conditions which can occur in a variety of work situations, some within the office environment. They are among the fastest growing workplace injuries. They can result any time there is a mismatch between the physical requirements of the job and the physical capacity of the body.

Within the office environment they are usually associated with the use of computers.

26.5.1 Features of OOS

- There are two main types - localised and diffuse.
- It is characterised by discomfort or persistent pain in muscles, tendons or other soft tissues.
- There may or may not be physical signs.
- It develops over time.

Figure 26.2: Assessment of Tasks Involving Computer Use



Certain common characteristics have been identified and associated with increased risk of musculoskeletal problems. These include:

- design of workstation
- nature of the task
- repetitiveness of the job
- degree of postural constraint
- work pace
- work/rest schedules
- personal attributes of individual workers.

The key to comfort is in maintaining the body in a relaxed, natural position. Follow the recommendations given in this section. The ideal work position is to have the arms hanging relaxed from the shoulders. If a keyboard is used, arms should be bent at right angles at the elbow, with hands held in a straight line with forearms and elbows close to the body. The head should be in line with the body and slightly forward.

It is important with this sort of injury that an early diagnosis is made. If anyone has any discomfort while working, they should tell their supervisor and undertake the Computer Workstation Self-Audit Checklist (Form 26.1) presented at the end of this section. If you are unsure of positioning have someone else look at you in your workstation, others can often pick areas where your body is under stress that are not obvious to you.

26.6 Lifting

Be very careful when lifting heavy objects such as large boxes of paper, printers and computers. Face the object being lifted, pull it close to the body, keep the back vertical and lift in a slow steady motion using the leg muscles.

When seated do not reach to the rear to lift objects. Turn the chair to face the item and get out of the chair.

26.7 Lighting

Different tasks require different levels of lighting. Areas in which intricate work is performed, for example, require greater illumination than warehouses. Lighting needs vary from time to time (e.g. seasonal variation) and from person to person as well. Lighting standards are available for different types of tasks and provide a guide to the minimum light requirements.

Table 26.1 provides guidelines for lighting requirements.

Table 26.1: Recommended Values of Illumination for Offices

Tasks	Lux
Difficult seeing tasks: auditing, accounting, machine operating, transcribing, draughting, designing	750
Ordinary seeing tasks: general correspondence, general office work	500
Entrance hall	150
Corridors	100
Stairways, toilets and washrooms	150
Visual Display Units-Hard copy	500
Conference rooms	750
Print rooms	300

Task lamps are very effective to supplement the general lighting in an office for those who require or prefer additional lighting. Since task lamps are controlled by the individual they can accommodate personal preferences.

Some staff may experience discomfort from the ‘flicker’ of fluorescent lamps. This may be overcome by the use of incandescent lamps, LED lamps or improved natural lighting.

26.8 Noise

26.8.1 Effects of Noise

Noise can be defined very simply as unwanted sound. Whether a sound is classified as noise or not depends mostly on personal preferences. For noise levels in offices, the most common effects are interference with speech communication, annoyance and distraction from mental activities.

26.8.2 Reducing Noise

Many unexpected noises cannot be controlled, as when someone accidentally drops something. For many of the annoying sounds in the office environment, the measures listed below are useful for reducing the level of noise or its effects.

- Select the quietest equipment, if possible, especially if it is to be in an open plan type office. Where there is a choice between two or more products, sound levels should be included as a consideration for purchase and use.
- Provide proper maintenance of equipment, such as lubrication and tightening of loose parts that can cause noise.
- Isolate loud equipment from other personnel, if possible, or locate in areas where effects will be less detrimental.
- Enclosing equipment in sound proof boxes may also be an option, but care must be taken to ensure that the operation is not compromised, for example there should still be adequate air flow to prevent equipment overheating etc.
- Rubber pads to insulate vibrating equipment can also help reduce the noise.

26.9 Ventilation

26.9.1 Indoor Air Quality

Indoor air quality is an increasingly important issue in the work environment. It is estimated that most people spend as much as 90% of their time indoors. Over the past several decades, exposure to indoor air pollutants is believed to have increased due to a variety of factors, including:

- the construction of more tightly sealed buildings
- reduced ventilation rates (to save energy)
- use of synthetic building materials and furnishings

- use of chemically formulated personal care products and household cleaners.

The study of indoor air quality and pollutant levels within office environments is a complex problem. It is made complex by some of the factors listed below.

- Office building floor plans change frequently to accommodate increasingly more employees and reorganisations.
- Office buildings frequently undergo building renovations such as installation of new carpet, modular office partitions and free-standing offices and painting.
- Many of the health symptoms appearing are vague and common both to the office and home environment.
- In general, very little data on pollutant levels within office environments is available.
- Guidelines or standards for permissible personal exposure limits to pollutants within office buildings are very limited.

26.9.2 Sources of Indoor Air Quality Problems

Indoor air quality problems can result from the following:

- insufficient and/or poorly distributed air
- airborne chemical agents from indoors and/or outdoors sources
- biological agents/products
- psycho/social issues
- physical discomfort.

Some typical indoor air contaminants are:

- volatile organic compounds (VOCs) such as hydrocarbon solvent vapours
- organic dusts and fibrous particles
- ozone
- formaldehyde
- bacterial and mould spores.

Typical Outdoor Air Contaminants are:

- carbon monoxide

- oxides of nitrogen (NOx), sulphur oxides (SOx) and VOCs
- odours
- products of combustion
- exhaust air from adjacent industries.

Indoor air pollutants can cause long term or immediate health effects. Long term health effects are associated with indoor air pollutants such as radon, asbestos and environmental tobacco smoke. Immediate health effects, which may appear after a single, high dose exposure or repeated exposures, include irritation of the eyes, nose and throat, headaches, dizziness and fatigue. These immediate effects are usually short term and treatable.

26.9.3 Sick Building Syndrome

In contrast to immediate or long term effects, there are situations in which a building's occupants experience symptoms that do not fit the pattern of any particular illness and are difficult to trace to a specific source. This phenomenon, referred to by some as 'Sick Building Syndrome', is often temporary, but some buildings have long term problems. Frequently, problems result when a building is operated or maintained in a manner that is inconsistent with its original design or prescribed operating procedures.

Some indicators of 'sick building syndrome' are listed below.

- Building occupants complain of symptoms associated with acute discomfort, e.g. headache; eye, nose or throat irritation; dry cough; dry or itchy skin; dizziness and nausea; difficulty in concentrating; fatigue and sensitivity to odours.
- The cause of the symptoms is unknown
- Most of the complainants report relief soon after leaving the building.

Contributing factors may include inadequate ventilation, chemical and biological contamination from indoor or outdoor sources, and other non-pollutant stressors such as temperature, humidity, lighting, ergonomic problems or job-related psycho-social issues.

26.9.4 Odours

Often odours are associated with chemical contaminants from inside or outside the office space, or from the building fabric. This is particularly noticeable following building renovation or installation of new carpet. Outgassing from such things as paints, adhesives, sealants, office furniture, carpeting and vinyl wall coverings is a source of a variety of potentially irritant compounds. The detection of the odour can often make individuals feel genuinely unwell although levels are well below 'safe' levels.

26.9.5 Reducing Pollutant Levels Indoors

In the absence of complete scientific understanding of indoor air pollution, prudent public policy dictates that reasonable efforts be undertaken to reduce people's exposure.

Steps which may help prevent or reduce problems are listed below.

1. Ensuring Maintenance of HVAC System

Provision of adequate fresh air, especially in the winter, routine cleaning and replacement of air filters and cleaners. Continued operation in a manner consistent with design.

2. Record Keeping

Document HVAC problems, maintenance and inspection. Document complaints concerning air quality and steps taken to remedy (these will build up a useful long term picture)

3. Pollution Control

Control at source is most effective. Identify any pollution sources, remove them and implement special ventilation. (Have restrictions on smoking).

4. Occupant Activities

Eliminate practices which may restrict air movement such as furniture placement blocking vents.

5. Building Maintenance Activities

Increase ventilation rates during periods of increased pollution such as painting, renovations, installation of new furnishings.

If problems, do become apparent then an investigation should be instigated. The goal of a building investigation is to identify and solve indoor air quality complaints in a way that prevents them from reoccurring and which avoids the creation of other problems. The procedure should be characterised as a cycle of information gathering, hypothesis formation and hypothesis testing.

26.10 Chemical Hazards

Chemical hazards can still exist outside of the laboratory.

26.10.1 Office Machinery Chemicals

Printing inks, toners, etc. used in photocopiers, printers, faxes, etc are potentially dangerous. Usually with modern machinery they are designed for easy changing and with no need to get hands dirty, but they don't always work according to the plan.

- Obtain MSDSs for products with chemical components and ensure staff using them are aware of hazards.
- Office chemicals should be used only in areas with adequate ventilation to remove any fumes.
- Minimise storage of materials that would add fuel to a burning fire.

If products leak:

- secure them inside a suitable outer container for disposal or return to the suppliers
- ensure the outside container is labelled with the product or chemical name, the problem and who the product is being returned to
- wash immediately any accidental leaks or spills of chemicals onto hands, feet
- find the name of the chemicals involved and read the MSDS's for further information.

If there is any irritation, burning etc. seek medical attention and inform of the products involved.

26.10.2 Cleaning Compounds

Often office cleaners are unknown, appearing at night when the rest of the staff are absent. Their tools of the trade are usually kept on the premises and may be accessible for others to use when a need arises. Commercial cleaning chemicals are often purchased in a concentrated form and require dilution. In the concentrated form they should not be used without appropriate protective clothing. No one should use any chemical unless sure of its suitability and how to use it. Any cleaning materials, including dilutions should be the responsibility of the cleaner to maintain correctly labelled and stored.

26.10.3 Receiving/Moving Chemicals

When involved in the receipt or dispatch of chemicals and/or samples be aware of the consequences of mishandling. When transporting chemicals between rooms or buildings, secondary containers, such as bottle carriers, should be used. In the event that a container is dropped, bumped or otherwise breaks, the contents would be contained in the bottle carrier, avoiding a spill. Be aware of the emergency plans for spillage of materials, and where emergency equipment, eye wash stations, etc. are located.

26.11 Office Safety Audit Checklist

On a three monthly basis an audit of the DGDC offices should be undertaken to establish the level of compliance with the safe work practices as stated in this section. An audit checklist (Form 26.2) that can be used to undertake the audit is presented at the end of this section.

Form 26.1: Computer Workstation
Audit Checklist

Building ________________________ Room __________ Supervisor _______________________ Date _________

Audit Performed by ______________________________

	Y	N	NA	COMMENTS
A. Body Position				
1. Head is directly over shoulders				
2. Shoulders are relaxed				
3. Elbows are at 90^{o} angle resting comfortably at side				
4. Wrists are straight, floating over wrist rest				
5. Knees are at 90^{o} angle or greater				
6. Feet flat on floor or supported by footrest				
B. Workstation				
1. Work surface area is adequate for computer and materials				
2. Keyboard and mouse are directly in front of the operator				
3. Keyboard and mouse are at comfortable height				
4. Monitor is placed arm's length away from operator, either directly in front or slightly to one side of operator				

	Y	N	NA	COMMENTS
5. Top of monitor screen is slightly below eye level				
6. Chair has adjustable height and seat back				
7. Seat back is adjusted to support lumbar region of back				
8. Document holders are used to position documents close to monitors				
C. Glare Reduction				
1. Screen contrast and brightness are adjusted				
2. Screen is positioned away from or at right angles to windows				
3. Screen is tilted down slightly to reduce glare from overhead lighting				
4. Lamps and other lighting are positioned to minimize glare				
5. Window coverings are adjusted to reduce glare from outside light				

Form 26.2: Office Safety Audit Checklist

Building________________________ Room _________ Supervisor_________________ Date ___________

Audit Performed by ____________________________

	Y	N	NA	COMMENTS
A. Walking Surfaces				
1. Aisles established and clear				
2. No tripping hazards present				
3. Floor even (no holes or cracks)				
4. Carpets and rugs secure				
5. Floors kept dry - not slippery				
6. Entrance mats available (wet weather)				
7. Outside walkways, stairs, and parking areas in good repair				
B. Workstation				
1. Wall shelves designed for intended load				
2. Shelves not overloaded				
3. Heavy storage cabinets, bookcases and file cabinets				

	Y	N	NA	COMMENTS
secured from tipping				
4. File drawers closed when not in use (only one open at a time to prevent tipping)				

C. Electrical Hazards				
1. All extension cords are 3-wire type and in good condition - no splices or broken insulation				
2. Limit extension cords to ten feet in length				
3. Only one extension cord used - not plugged into other extension cords				
4. Equipment power cords in good condition - no splices or broken insulation				
5. Plugs in good condition - no exposed wires				
6. Wall outlet and junction box covers in place				
7. Electric circuit panels clear (at least 0.75m open area)				
8. Circuits not overloaded - all multiple outlet strips equipped with overload protection				
9. No wires or extension cords under carpets or rugs, through doorways, or place in other traffic areas				

	Y	N	NA	COMMENTS
D. Stairways, Ramps, Corridors, Storage Areas				
1. Adequate lighting in place (including emergency lighting)				
2. Ramps have non-slip surface				
3. Stair treads in good condition				
4. Stairways clear - not used for storage				
5. Handrails installed - in good condition				
6. Guardrails installed (where needed)				
7. Corridors kept clear of equipment and supplies				
8. No storage within 0.45m of sprinkler heads (0.6m of ceiling where no sprinkler system exists)				
9. Ladders provided for high storage areas				
E Office Equipment				
1. Chairs in good condition and adjustable (when appropriate)				
2. Paper cutter equipped with guard - blade spring functioning				
3. Step stools available for use, where needed				

	Y	N	NA	COMMENTS
F. Fire Prevention, Emergency Exists, Housekeeping				
1. Fire Extinguishers have current inspection tags				
2. Fire doors not blocked open				
3. Exits not obstructed and kept unlocked during normal business hours or special events				
4. Exits properly marked, exit signs illuminated				
5. Good housekeeping practised - excess paper, computer cartons and trash removed				
6. Office has current emergency action plan - occupants trained upon initial hire and as necessary thereafter				
7. Electric Space heaters only as approved by Facilities Engineering				
G. Classrooms, Places of Assembly				
1. Desks are in good condition				
2. Chairs are in good condition				
3. Occupancy limits are posted				

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Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-034: Workshop Practices
Revision 0

Contents

27. Workshop Practices

27.1 Introduction

This section is written to cover safe practices within workshops and does not include work done outside the workshop. The intention is to ensure that all workshop personnel follow safe work procedures and are working in a safe environment. It should be read in conjunction with the section on tool safety (Section 18: Safety with Hand Tools and Portable Equipment).

27.2 Training

Machines and equipment shall be operated only by personnel specifically trained and qualified to do so.

All printed rules and operating instructions supplied by the manufacturer shall be followed.

Anyone noticing personnel using dangerous equipment, or using unsafe methods, shall correct the situation immediately.

27.3 Supervisor Responsibility

Supervisors are responsible for enforcing rules and regulations. They shall ensure that safe working conditions are maintained and shall immediately rectify any unsafe conditions affecting personnel and facilities under their supervision. Supervisors must ensure that personnel working under their supervision are aware of the applicable workshop safety procedures, building regulations and the requirements of this section.

27.4 Employee Responsibility

Each employee, as a condition of their employment, is responsible for following all safety rules, regulations and practices. All employees are expected and encouraged to ask questions to remove any doubt about the safe way to perform any job. All employees must know and comply with safety rules and regulations governing required protection and conduct in the areas in which they work.

27.5 Lighting

Lighting design should ensure a uniform distribution of light over the work area to help reduce visual fatigue and provide for the health and safety of all persons in the working area. It is important that there is sufficient lighting under both daytime and night conditions. In the general workplace, lighting values of 450 lux - 500 lux are adequate. Higher lighting values of no less than 600 lux are needed where detailed work, dangerous processes or machinery are used. Localised lighting may be needed to meet this requirement.

Artificial lights should be shaded so as to control glare and reflect available light to the area where it is required. Care should be taken to avoid stroboscopic effects from flickering fluorescent tubes shining on revolving shafts, wheels or reciprocating parts.

27.6 General Shop Safety

Prior to using equipment, personnel should inspect it visually for defects.

All necessary precautions must be taken so that tools and materials are not, by reason of location or use, a hazard to others.

All guards must be in place before a machine is started.

No employee may make alterations or perform major repairs on any equipment unless specifically authorised by his/her supervisor.

No makeshift tools or short-cut methods may be used unless authorised by the Area Supervisor.

If working where there is potential for exposure to flammable or explosive hazards, then personnel shall not wear metal cleats or other spark-producing devices on their footwear.

Only approved containers or devices may be used for transporting material or equipment.

Oily rags form a particular fire hazard. There is to be a designated safe area for the temporary storage of oil soak rags. They are to be regularly and properly disposed of.

Aisles and walkways should be marked and used at all times. Short cuts through roped off or working areas, across ditches or over rough ground are prohibited. Walking or working under work stands or under suspended loads is also prohibited.

Desk drawers, cabinet doors and locker doors must be kept closed when not in use.

Makeshift devices must not be used in the place of ladders for climbing. Both hands should be used when ascending and descending ladders. When ascending or descending stairs, employees shall walk one step at a time using the hand rail. Personnel shall walk carefully and alertly at all times. Running is not permitted except to avoid dangers.

Horseplay is not permitted.

27.7 Housekeeping

(Refer also to Section 41: Housekeeping)

The work area must be kept in a clean and tidy state, free of piles of rubbish or any other trip hazards at all times. Exits, aisles and access ways shall be kept clear at all times. Any oil spillages should be cleaned up immediately and the area 'sponged' or 'mopped' with sand or a proprietary absorber material or absorbing sack. If immediate clean-up of spilled liquid or solid materials is not possible then the area must be barricaded to prevent accidents.

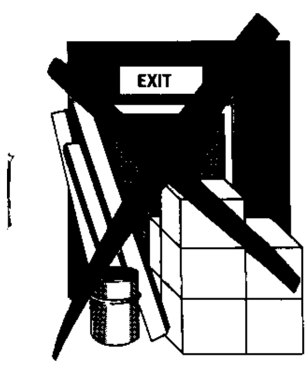

Figure 27.1: Blocked Entrances

All tools and excess materials shall be removed and properly stored or disposed of after a job has been completed.

27.8 Safety

Do not work if you are ill, or taking prescription medication (unless authorised by a medic), as your condition may cause an accident and injury to yourself or others.

Employees shall not attempt to lift heavy or bulky objects that are beyond their capability. They should size up the load and get help if required. The back should be kept vertical and knees bent while lifting with leg muscles, keeping the load close to the body. (Refer also to Section 23: Lifting Equipment and Lifting.)

Sharp objects must not be carried in pockets or clothing.

Barrier cream suitable for the task must be made available and should be used prior to starting work. Employees must wash thoroughly before eating or smoking. Employees shall not use any solvent for the purpose of cleaning hands or arms but rather a proprietary hand cleaner.

27.9 Safety Equipment

Protective gear, such as hand protection, foot protection, eye protection, head protection, ear protection and respirators is necessary in areas and operations where specified. (Refer to Section 31: Personal Safety Equipment.)

In specific areas or operations where it is not practicable to eliminate hazards of head injury, head protection is required.

Safety goggles shall be worn when grinding, drilling, riveting, turning, milling or when performing any operation in which airborne objects are being discharged (ie. in an eye danger area). Ear protection must be worn when performing noisy operations such as grinding.

Industrial overalls (made from flame resistant fabrics such as cotton) and appropriate eye protection shall be worn when engaged in welding and cutting operations. Gloves or gauntlets for arc welding shall be worn, as protection against shock, burns and radiation burns. Refer to Section 28: Hot Work.

Occupational Health & Safety Manual
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DGDC-OHS-035: Food Handling
Revision 0

Contents

28. Food Handling

28.1 Introduction

The purpose of this procedure is to outline good practices in the storage, preparation and serving of food. Good food hygiene practices are important because of the risks of disease, especially through bacterial contamination. Good practices also maintain food of a better nutritious quality and taste.

28.2 Physical Conditions/Controls

The operation of a safe food premise depends primarily on the actions of the people that work there. However, the design and maintenance of the premises play an important role in facilitating the food handling operation.

Food premises should:

- be clean and maintained in good repair.
- be designed and constructed to permit good hygiene practices.
- have surfaces which are suitable for the environment, able to withstand heat and moisture and be easily cleaned.
- have an adequate supply of potable (drinking) water.
- have suitable controls in place to protect against pests.
- have adequate natural and/or artificial lighting.
- have sufficient natural and/or mechanical ventilation.
- have adequate hand washing facilities.
- have adequate facilities for washing food and equipment.
- have adequate facilities for the storage and removal of food.

28.3 Food Handling

28.3.1 Introduction

Safe steps in food handling, cooking and storage are essential to avoid foodborne illness or other contamination. There are critical points during the preparation of food where things can go wrong.

28.3.2 Safe Receipt of Goods

- Ensure deliveries are made when staff are present to receive goods. (Never leave perishable goods outside.)
- Don't buy food that is past 'sell-by' or expiry dates.
- Ensure that perishable food is delivered to you at a suitable temperature from refrigerated transport.

28.3.3 Safe Storage of Foods

Keep it Safe: Refrigerate.

- Check the temperatures of refrigerators and freezers. To slow bacterial growth, the refrigerator should be at 4°C and the freezer at -18°C.
- Goods received should be placed in correct storage as soon as possible.
- Separate storage is required for meat and vegetables.
- Place securely wrapped packages of meat or fish in the meat drawer or coolest part of the refrigerator.
- Cook or freeze fresh poultry, fish, ground meats and variety meats within two days, and beef, veal, lamb and pork within three to five days.

28.3.4 Safe Food Preparation

- Wash hands before and after handling raw meat and poultry.
- Sanitise cutting boards with a proprietary sanitiser frequently. Keep separate boards for use with raw meats, cooked meats and vegetables.
- Prevent cross-contamination. Keep raw meat, poultry, fish and their juices away from other food. After cutting raw meats wash hands, cutting board, knife and counter top with hot, soapy water.
- Marinate meat and poultry in covered containers in the refrigerator, not on the bench.

28.3.5 Thaw Food Safely

- Refrigerator: allows slow, safe thawing. Make sure that the thawing juices do not drip on other foods. Store at the bottom of the refrigerator.
- Cold Water: allows faster thawing. Water should be running with sufficient velocity to remove loose food particles.
- Microwave: Cook meat and poultry immediately after microwave thawing.

28.3.6 Safe Cooking

Cook ground meats and pork to 71°C internal meat temperature; whole poultry to 82°C in the thigh; beef, lamb, roasts and chops to 63°C.

28.3.7 Serving Food Safely

- Never leave food out for over two hours or 1 hour if temperature is above 32°C.
- Keep hot food hot and cold food cold!
- Ensure that there are enough utensils for self-service and that contamination from diners is prevented

28.3.8 Handling Leftovers Safely

- Divide foods into shallow containers for rapid cooling. Put food directly in the freezer or refrigerator.
- Use cooked left overs within two days.

A summary of the critical control points in relation to food handling are presented in Figure 28.1.

28.4 Microwave Food Safety

28.4.1 Defrosting

- Remove store, or suppliers wraps prior to defrosting.
- Cook meat immediately after microwave thawing.

28.4.2 Utensil safety

- Use only dishes that remain cool, such as glass, or ceramic cookware.
- Don't use plastics that are not marked as microwave safe.

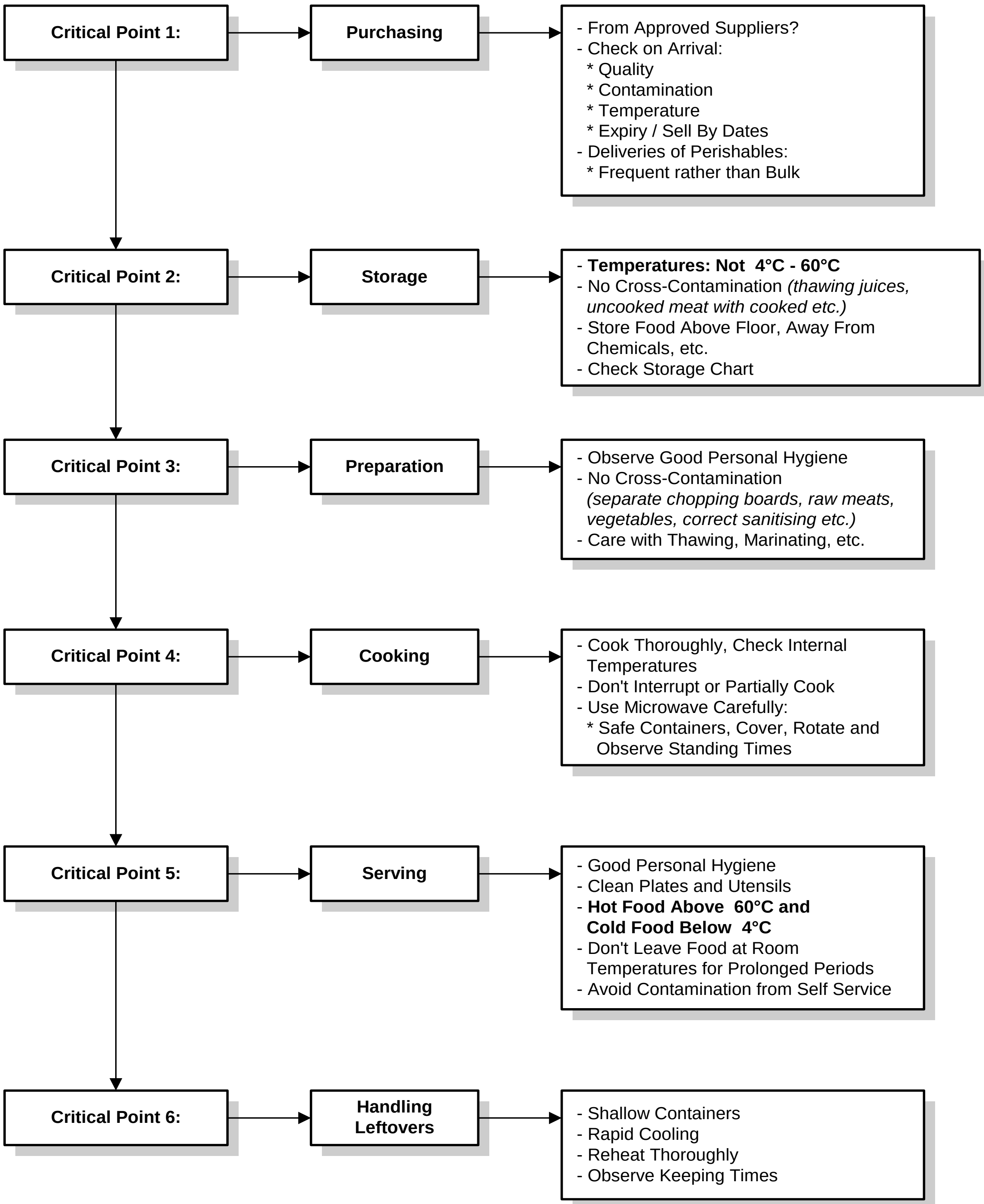
28.4.3 Reheating Foods

- Heat leftovers and precooked food to at least 74°C.
- Cover foods to hold in moisture.

28.4.4 Cooking

- Debone large pieces of meat.
- Arrange items uniformly.
- Cook large pieces of meat on medium for longer times.
- Stir or rotate foods during cooking times.
- A thermometer or probe can be used to confirm cooking temperatures.
- Observe standing times.

Figure 28.1: Food Hygiene: Critical Control Points



28.5 Cold Storage Times

The length of times that specific food items can be held at either refrigerated or frozen temperatures is specified in Table 28.1.

Table 28.1: Cold Storage Times

Product		Refrigerator	Freezer
Eggs			
Fresh in shell		3 weeks	Don't freeze
Hard cooked		1 week	Don't freeze well
Mayonnaise, Commercial			
Refrigerate after opening		2 months	Don't freeze
Deli & Vacuum-Packed Products			
Store-prepared (or homemade) egg, chicken, tuna, ham, macaroni salads		3 to 5 days	Don't freeze well
Pre-stuffed pork & lamb chops, chicken breasts stuffed w/dressing		1 day	Don't freeze well
Commercial brand vacuum-packed dinners w/USDA seal, unopened		2 weeks	Don't freeze well
Raw Hamburger, Ground & Stew Meat			
Hamburger & stew meats		1 to 2 days	3 to 4 months
Ground turkey, veal, pork, lamb & mixtures of them		1 to 2 days	3 to 4 months
Ham, Corned Beef			
Corned beef in pouch with pickling juices		5 to 7 days	Drained, 1 month
Ham, fully cooked, whole		7 days	1 to 2 months
Ham, fully cooked, slices		3 to 4 days	1 to 2 months
Hot Dogs & Lunch Meats			(in freezer wrap)
Hot dogs	opened package	1 week	1 to 2 months
	unopened package	2 weeks	1 to 2 months
Lunch meats	opened package	3 to 5 days	1 to 2 months
	unopened package	2 weeks	1 to 2 months

Product	Refrigerator	Freezer
Soups & Stews		
Vegetable or meat-added	3 to 4 days	2 to 3 months
Bacon & Sausage		
Bacon	7 days	1 month
Sausage, raw from pork, beef, chicken or turkey	1 to 2 days	1 to 2 months
Smoked breakfast links, patties	7 days	1 to 2 months
Fresh Meat (Beef, Veal, Lamb & Pork)		
Steaks	3 to 5 days	6 to 12 months
Chops	3 to 5 days	4 to 6 months
Roasts	3 to 5 days	4 to 12 months
Variety Meats (tongue, kidneys, liver, heart, chitterlings)	1 to 2 days	3 to 4 months
Meat Leftovers		
Cooked meat and meat dishes	3 to 4 days	2 to 3 months
Gravy and meat broth	1 to 2 days	2 to 3 months
Fresh Poultry		
Chicken or turkey, whole	1 to 2 days	1 year
Chicken or turkey, parts	1 to 2 days	9 months
Cooked Poultry, Leftover		
Pieces, plain	3 to 4 days	4 months
Pieces covered with broth, gravy	1 to 2 days	6 months
Chicken nuggets, patties	1 to 2 days	1 to 3 months

28.6 Food Hygiene Rules

28.6.1 Personal Hygiene for Food Handlers

Anyone who works in a food handling area must maintain a high standard of hygiene, both of themselves and the work they undertake.

- Never smoke in food handling areas
- Routinely wash hands when handling food.
- Report any illness, including infected wounds and skin infections.

28.6.2 Training and Supervision

Food handlers must receive adequate instruction and supervision in the handling of food and utensils.

28.6.3 Bacteria that Cause Foodborne Illnesses

Bacteria surround us. Careful control of the food that we eat prevents bacteria contaminating food and multiplying to reach critical concentrations which are able to infect us. The 'Danger Zone' is between 4°C and 60°C. To keep food out of this zone, keep cold food cold and hot food hot!

28.6.4 In case of Suspected Foodborne Illness:

- Preserve the suspected evidence. Tests for bacteria could help in treatment of the victim, and help in the determination of the source.
- Seek treatment. Often there is nothing that can be done, but this needs to be confirmed.
- Anyone suspected of foodborne illness should not be working in any food preparation or serving roles.

Common food poisoning bacteria, their sources, transmission and symptoms are presented in Table 28.2.

28.7 Inspection

Regular inspections of food handling areas at the sites should be undertaken by the food supervisor in conjunction with the site health and safety officer. A minimum frequency of once every month should be attained. Table 28.3 Food Hygiene Inspection Checklist presents checklists that should be used to conduct the inspection.

Table 28.2: Summary of Some Common Food Poisoning Organisms, Their Symptoms and Methods of Transmittal

Bacteria	Source	Transmission	Symptoms
Campylobacter jejuni	Intestinal tracts of animals and birds, raw milk, untreated water, and sewage sludge.	Contaminated water, raw milk, and raw or undercooked meat, poultry, or shellfish.	Fever, headache and muscle pain followed by diarrhoea (sometimes bloody), abdominal pain and nausea that appear two to five days after eating; may last 7 to 10 days.
Clostridium botulinum	Widely distributed in nature; in soil, water, on plants, and intestinal tracts of animals and fish. Grows only in little or no oxygen.	Bacteria produce a toxin that causes illness. Improperly canned foods, garlic in oil, vacuum packaged and tightly wrapped food.	Toxin affects the nervous system. Symptoms usually appear in 18 to 36 hours, but can sometimes appear as few as four hours or as many as eight days after eating; double vision, droopy eyelids, trouble speaking and swallowing, and difficulty breathing. Fatal in 3 to 10 days if not treated.
Clostridium perfringens	Soil, dust, sewage, and intestinal tracts of animals and humans. Grows only in little or no oxygen.	Called "the cafeteria germ" because many outbreaks result from food left for long periods in steam tables or at room temperature. Bacteria destroyed by cooking, but may survive.	Diarrhoea and stomach pains may appear 8 to 24 hours after eating; usually last about one day, but less severe symptoms may persist for one to two weeks.

Bacteria	Source	Transmission	Symptoms
***Escherichia coli* O157:H7**	Intestinal tracts of some mammals, raw milk, unchlorinated water; one of several strains of *E. coli* that can cause human illness.	Contaminated water, raw milk, raw or rare ground beef, unpasteurised apple juice or cider, uncooked fruits and vegetables; person-to-person.	Diarrhoea or bloody diarrhoea, abdominal cramps, nausea, and malaise; can begin two to five days after food is eaten, lasting about eight days. Some, especially the very young, have developed Hemolytic Uremic Syndrome (HUS) that causes acute kidney failure. A similar illness, thrombotic thrombocytopenic purpura (TTP), may occur in older adults.
Salmonella (over 1600 types)	Intestinal tract and faeces of animals; *Salmonella enteritidis* in raw shell eggs.	Raw or undercooked eggs, poultry, and meat; raw milk and dairy products; seafood.	Stomach pain, diarrhoea, nausea, chills, fever, and headache usually appear 6 to 48 hours after eating; may last one to two days.
Streptococcus A	Noses, throats, pus, sputum, blood and stool of humans.	People to food from poor hygiene, ill food handlers or improper food handling. Outbreaks from raw milk, ice cream, eggs, lobster, salads, custard, and pudding allowed to stand at room temperature for several hours between preparation and eating.	Sore throat, painful swallowing, tonsillitis, high fever, headache, nausea, vomiting, malaise; occurs 1 to three days after eating, lasting a few days to about a week.
Listeria monocytogenes	Intestinal tracts of humans and animals, milk, soil, leaf vegetables, and processed foods; can grow slowly at refrigerator temperatures.	Soft cheese, raw milk, improperly processed ice cream, raw leafy vegetables, meat, and poultry. Illness caused by bacteria which do not produce toxin.	Fever, chills, headache, backache, sometimes abdominal pain and diarrhoea; 12 hours to three weeks; may later develop more serious illness (meningitis or spontaneous abortion in pregnant women); sometimes just fatigue.

Bacteria	Source	Transmission	Symptoms
Shigella	Human intestinal tract; rarely found in other animals.	Person-to-person by faecal-oral route; faecal contamination of food and water. Most outbreaks result from food, especially salads, prepared and handled by workers using poor personal hygiene.	Disease referred to as “shigellosis” or bacillary dysentery. Diarrhoea containing blood and mucus, fever, abdominal cramps, chills, and vomiting; 12 to 50 hours from ingestion of bacteria; can last a few days to two weeks. Sometimes, no symptoms seen.
Staphylococcus aureas	On humans (skin, infected cuts, pimples, noses, and throats).	People to food through improper food handling. Multiply rapidly at room temperature to produce a toxin that causes illness.	Severe nausea, abdominal cramps, vomiting, and diarrhoea occur one to six hours after eating; recovery within two to three days - longer if severe dehydration occurs.

Table 28.3 Food Hygiene Inspection Checklist

Food	Yes	No	Comments
• Purchased from approved sources.			
• Inspected and found to be free from contamination, adulteration and spoilage.			
• Unpackaged foods which have been served and returned from the dining area are discarded.			
• All foods are stored at least 150mm off the floor.			
• Restrooms not used for storage of food, equipment or supplies.			
• Food, and other food related products and protected from dirt, unnecessary handling, leakage and other forms of contamination.			
• All food storage containers have tight fitting lids and are well labelled.			
• Foods are dispensed in the self-serve area in an approved manner, minimising contamination and ensuring appropriate temperatures.			

Temperature Control	Yes	No	Comments
• Potentially hazardous foods are maintained below 4°C and above 60°C at all times.			
• A thermometer is provided as an integral part of the refrigerators and freezers or is readily available to check temperatures.			
• An accurate metal probe thermometer, suitable for measuring food temperatures is			

readily available and being used to check food temperatures daily.			
• Food products thawed by approved methods (see sub-section 3.5).			
• Frozen food maintained in a frozen state.			
• Thawed food items not refrozen.			

Personnel	**Yes**	**No**	**Comments**
• All employees handling food or utensils have obtained their Food Workers Certification.			
• Employees wash their hands with soap and warm water for the following reasons: a) before starting work b) immediately after using the rest room c) any time needed to prevent food contamination.			
• Employees handling food or utensils have no open sores.			
• Tongs or other implements are used for serving food products.			
• Hair of employees is properly confined.			
• Employees do not smoke or use tobacco inside the facility.			
• Clothing and personal effects are stored away from food products.			

Water and Sewage	**Yes**	**No**	**Comments**
• All sinks are fully operable with hot and cold water.			
• All sinks drain properly. Floor drains and floor sinks are in good working order.			
• Plumbing is in good repair.			

Equipment	Yes	No	Comments
• All equipment is clean and well maintained, including filters etc.			
• Inoperable equipment has been repaired or replaced			

Utensils	Yes	No	Comments
• Multiservice utensils are being washed by one of the following means a) handwashing in three compartment sink b) chemical sanitising c) dishwasher with rinse water reaching 82°C for three seconds.			
• Testing materials to adequately test sanitising methods are available.			
• Damaged utensils are repaired or replaced.			
• Utensils are properly protected during storage.			

Floors/Walls/Ceilings	Yes	No	Comments
• Floors are clean, well maintained and in good repair.			
• Walls, ceilings and windows are clean, well maintained and in good repair.			

Toilet/Dressing Room/Handwashing Sinks	Yes	No	Comments
• Toilet facilities are clean and in good working order.			
• Self-closing doors in toilet and dressing rooms are working properly.			
• Single serve soap and towel dispensers above all hand wash sinks are operable and full.			

• Toilet tissue dispensers are full.			
• Legible handwashing signs are properly posted.			
• Ventilation is provided and is in proper working order.			

Light and Ventilation	**Yes**	**No**	**Comments**
• Adequate lighting and ventilation is provided throughout the facility.			
• Outside doors and screen doors are self-closing and closures are in working order.			
• Air curtains are operating properly.			

Refuse	**Yes**	**No**	**Comments**
• Rubbish containers are lined with disposable plastic bags.			
• Outside refuse bin lids are closed.			
• Outside premises and refuse areas are clean and well maintained.			
• No signs of vermin infestation.			

Operation	**Yes**	**No**	**Comments**
• Hazardous substances (chemicals, cleaning supplies) are properly labelled and stored away from food products.			
• Cleaning equipment and soiled linens are properly stored.			
• Returned, damaged and unlabelled foods are properly stored.			

• Facility has a current Permit to operate.			

The following conditions are of particular concern and if unable to be immediately remedied the premises should be closed.

- Overflowing sewage (inside or outside)
- No potable water
- No hot water
- No electricity
- Severe rodent or insect infestation
- Actual or potential threat to public health and safety (foods out of temperature, sickness among several staff members)

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-036: Fire Prevention and Fire Fighting Equipment
Revision 0

Contents

29. Fire Prevention and Fire Fighting Equipment

29.1 Introduction

This section describes procedures and practices in regard to preventing fire and minimising its impact.

29.2 Principles

Prevent fires by the use of good work practices and maintaining good housekeeping throughout the sites operated and owned by DGDC.

In the event of a fire, the aim of DGDC firefighting effort shall be to:

- firstly, prevent loss of life or injury in the event of fire
- secondly, minimise the effects of fire on business operations
- thirdly, minimise property damage in the event of fire.

29.3 Fire Records

All fires are to be reported to the site superintendent and the health and safety committee regardless of size. The causes and effects of each fire are to be reviewed by the safety committee with the aim of implementing methods and practices that would prevent a similar fire occurring or to minimise the effects.

29.4 Fire Hazards

29.4.1 Fire Hazards

Fire hazards include:

- fires in buildings, (furniture and rubbish)
- electrical fittings
- electrical plant
- electrical switchgear
- vehicles
- fuel storage

- flammable stores (prints etc.)
- flammable gas storages (welding gases, hydrogen)
- sulphur outcropping
- smoking
- hot work
- electrical faults
- mechanical friction.

29.4.2 Related Hazards

- CO2 extinguishing systems

29.5 Preventing Fire

Appropriate precautions should be taken during hot work or other work that produces heat, sparks or flames. These would normally involve ensuring a fire extinguisher of a type and size appropriate to the hazard is immediately available. Staff on fire watch trained in the use of extinguishers may be appropriate depending on the risk and consequence of fire in any particular situation. (Refer to Section 13: Work Control.)

Rubbish should normally be placed in designated, purpose designed areas. It is not to be allowed to accumulate adjacent to buildings, fuel stores, in porches or under building overhangs.

Exit corridors and stairs in buildings must be clear and free of rubbish and other flammable material or objects that block or restrict the egress from the building.

Smoking is prohibited within all hazardous areas or within 6m of any flammable stores or other potential fuel source.

Additional precautions must be taken when automatic systems are rendered inoperative (see Section 8.2).

29.6 Location and Type of Fire Fighting Appliances

Manual firefighting equipment should be located around the facility. The equipment should be appropriate for likely hazards and distributed to provide coverage for the whole facility.

Equipment must be suitable for the class of fire as described in Table 29.1 below:

Table 29.1: Classification of Fires

Class	Characteristics	Extinguishing Agent
A	Wood, Paper, Textiles Plastic Cardboard	Water Multipurpose Dry-Chemical Foam Light Water (AFFF)
B	Flammable Liquids, Gases and Greases	Multipurpose Dry-Chemical Foam Light Water (AFFF) Dry-Chemical CO_2
C	Energized Electrical Equipment	Multipurpose Dry-Chemical Dry-Chemical CO_2

NB: Where dry chemical powder is used, it should be borne in mind that it could damage intricate equipment and could prove difficult to clean up.

Locations of manual firefighting equipment should be shown on plans of buildings and sites. The plans should be displayed prominently near the main entrance of buildings and in Volume II of the Safety Manual.

A separate register of firefighting appliances is to be held. This is to form the basis of the planned maintenance programme.

Fire-fighting equipment should be appropriate for the hazard, e.g. CO_2 extinguishers for electrical fires.

Manual firefighting equipment will be identified by type with signage as shown in Figure 29.1.

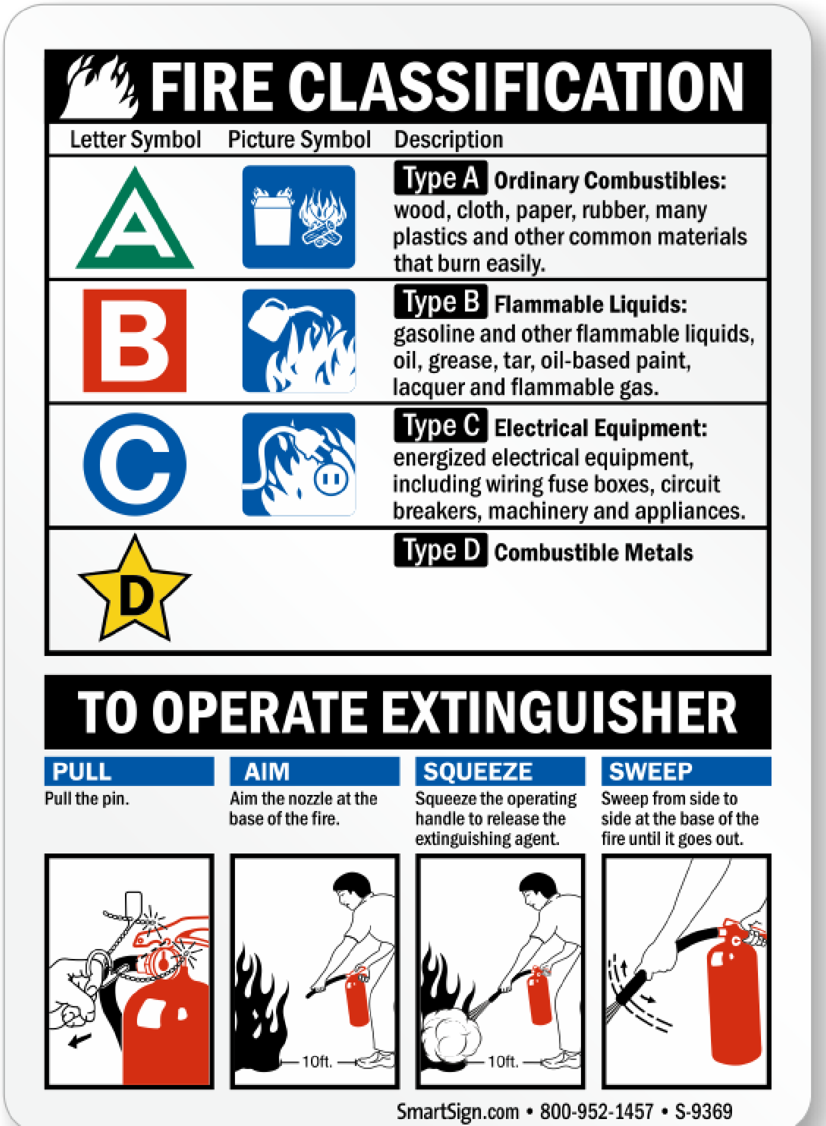


Figure 29.1 Fire Extinguisher Signage

29.7 Location of Alarms and Detection Systems

Locations of automatic suppression systems, detectors and sounders should be shown on plans of buildings and sites. The plans should be displayed in the appropriate control rooms and areas and in Volume 3: Site Specific Safety, and will be used in maintaining and surveying equipment.

29.8 Alarm and Suppression Systems

29.8.1 General

Buildings and sites will be equipped with both alarm systems and suppression systems. Staff must be aware of the hazards associated with suppression systems (e.g. CO2) and be aware of the appropriate actions to be taken upon system activation.

Staff must be notified if a system is to be deactivated and appropriate precautions must be taken in order to minimise risk to life and property while systems are inoperable and to ensure the systems function correctly after recommissioning.

29.8.2 Inoperative Suppression and Detection Systems

29.8.2.1 General

Automatic detection and suppression systems may be rendered inoperative from time to time to effect maintenance, repairs or alterations. The following procedures and precautions are to be taken.

Such work is to be given the highest priority and is to be completed without delay.

29.8.2.2 Notification

Before an automatic detection or suppression is rendered inoperative, notification shall be given to the appropriate plant manager. All work is to be carried out under the normal work permit system. If an emergency compels immediate action to render the system inoperative, such notification shall be given as soon as possible thereafter.

The work control precautions are to include a requirement to display a warning notice in the plant control room. Permit applicants are to ensure that plant operators are fully aware of the status of the work.

The status report is to include:

i) reason for rendering system inoperative
ii) date and times system will be off
iii) details of extension or alteration work
iv) whether the work will involve cutting or welding and, if so, the precautions that will be taken.

Staff using a facility without normal detection or suppression systems in operation must be notified.

29.8.2.3 Authorisation

Except in emergency, the system shall not be rendered inoperative until the Master Work Permit has been authorised.

29.8.2.4 Hot Work

Cutting, welding or grinding, or other activities involving hot work should normally not be carried out whilst a sprinkler system or drencher in the area of the work is out of action. If it cannot be avoided, then at least normal hot work precautions should be taken.

These precautions will typically include (see Section 28: Hot Work for full precautions):

- having fire hose reels or water type extinguishers on hand
- removing or covering combustibles in the immediate vicinity of the work
- posting a watchman during the actual hot work
- re-checking the area one hour after completion of the hot work
- hot work shall not be carried out without first obtaining the approval of the Plant Manager. Such approval, given on a hot work permit if granted, may specify precautions to be taken by personnel to minimise the risk of ignition while the installation is inoperative.

29.8.3 Sprinklers and Drenchers

29.8.3.1 Sectional Valves

Where provided, sectional valves should be used if practicable to keep to a minimum the area in which a sprinkler installation is inoperative.

Great care shall be used to ensure that the system is reverted to the correct line-up after completion of work.

29.8.3.2 Blanking Pieces

Blank pieces ('blind flanges') inserted between the flanges of a pipe joint may be used to isolate temporarily sections of a sprinkler installation. Their location is to be clearly marked to prevent their being inadvertently left in place after work completion. The work permit is to include a specific check that they have been removed.

Typically, they are to:

- be fitted with a handle that project at least 300mm from the flange
- be painted with fluorescent paint
- be stamped and painted with an identification number
- be drilled and be marked with a tag-out tag that is clearly visible.

Where screwed plugs or end caps are used for temporary isolation, a tag shall be attached so as to be clearly visible.

The work permit is to include a specific record of the number of blanks being used.

Discs in union joints to effect temporary isolation should not be used.

29.8.4 Water Supplies

In the event of all the water supplies of a sprinkler or drenching system becoming inoperative for a long period, a temporary supply from another source should be arranged if practicable.

29.9 Training

Staff and contractors must be trained to a suitable standard in the following areas:

- evacuation procedures
- use of manual fire-fighting equipment
- use of breathing apparatus
- rescue of personnel from fires
- maintenance of fire-fighting equipment.

29.10 Regular Testing, Inspections and Maintenance

29.10.1 General

All fire safety equipment (automatic suppression systems, manual and automatic alarms, fire hydrants and manual fire-fighting equipment) must be inspected, tested and maintained on a regular basis to ensure that all equipment operates effectively. All such maintenance is safety related and is to be designated 'starred maintenance'.

The timing of maintenance will depend upon:

- the reliability of the equipment
- whether the system is fail-safe in operation (e.g. an alarm circuit if broken will activate an alarm)
- type of equipment
- environment
- susceptibility to interference or misuse.

Maintenance and inspection records will be held and updated by the appropriate maintenance department with faults in fire equipment reported to the Plant Manager and safety manager. The maintenance plan is to be checked against the appliance register. In addition to the normal maintenance records all bare appliances are to have a signed and dated label attached to indicate last inspection. Completion of 'starred maintenance' is reported to the site safety committee.

The requirements in this section are for guidance only and inspection, maintenance and testing should not be limited to these requirements. Systems will be subject to procedures listed in the relevant Regulations and Codes.

General inspection requirements are detailed in the checklist at the end of this section.

29.10.2 Testing Guidelines

Following are guidelines for the testing of fire equipment. More specific requirements are listed in NFPA10: 1962/63.

29.10.2.1 Manual Fire-Fighting Equipment

- Test external fire hydrant flow and pressure.
- Test internal fire hydrant pressure.

- Check operation of manual water pumps.
- Don breathing apparatus sets and check air flow, seals, straps, and low pressure alarm. Re-fill after test.
- Run out fire hose reels and check hoses for damage.
- Visually inspect condition of extinguishers for corrosion or damage.
- Test or check pressure on extinguishers fitted with pressure gauges or test devices.
- Weigh extinguishers and recharge if necessary.
- Check seals and anti-tamper devices on extinguishers.

Manual fire extinguishers must be recharged at intervals not exceeding those in Table 29.3.

Table 29.3: Periodic recharging intervals

Type of extinguisher	**Recharge interval - years**
Water	
Gas cartridge type	5
Stored pressure type	5
Foam	
Premix liquid type	5
Sealed liquid container type	5
Wet Chemical	1
Dry Powder	
Gas cartridge type	5
Stored pressure type	5
Carbon Dioxide (CO_2)	No set interval but recharge immediately after use or after successful pressure test

29.10.2.2 Fire-Fighting Water Supplies

This includes supplies for sprinklers or drenchers.

More specific requirements are contained in NFPA 22, 26 and 1231. Check valves are in correct position.

Check open reservoirs and clear out debris that may clog inlets.

- Diesel engine driven pumps shall be exercised under load for a period of at least 15 minutes and shall be checked for correct start, run and stop functions and for battery, fuel, oil and water levels at regular intervals.
- Electric motor driven fire supply pumps which do not have the power supply to them continuously monitored by an audible alarm device, shall be exercised under load for a period of at least five minutes and shall be checked for correct start, run and stop functions at regular intervals.
- The control valves and the area immediately around them in the valve house, shall be checked for free access and if necessary, cleared. If free access cannot be achieved, the situation shall be reported to the plant manager and noted in the report.
- The installation pressure and the water supply, and where applicable gas pressurisation systems, (no flow) pressures shall be checked for adequacy and recorded. In the event that supply pressures are less than the static reference pressures, a flow test shall be undertaken to confirm design flows will be achieved.
- Diesel engine driven pumps shall be checked for battery acid density, battery age, external cleanness, belt tightness, filter state, and correct spare parts inventory.
- Any static water supply shall be checked and the level recorded. If the level is less than required, the plant manager shall be notified and the report annotated to that effect.
- System line up correct (note supply valves should normally be locked open.)

29.10.2.3 Alarm Systems

More specific requirements are found in NFPA 72A, 72C, 72D, 72M and 72B.

Monthly

- Sounders and sirens must be activated and operation and sound levels confirmed.
- General conditions and float voltage of battery power supplies must be checked.
- Signals to a remote receiving centre signal must be checked.

Annual

- Test defect warning systems by disconnecting battery connection to detector head or manual call point.

- Test operation of all manual call points and automatic detector heads on a rotation basis.
- Test operation of each zone from most remote device.
- Examine system for general condition.
- Check system for earthing resistance. This may be carried out with the system disconnected.

29.10.2.4 Suppression Systems

Water Based Systems (Sprinklers and Drenchers)
The following are general requirements only. More specific requirements are found in NFPA 13A.

- Checks on evacuation alarms (sounders and sirens) should be carried out as per Section 10.2.3.
- Checks on water supplies and pumps are as per Section 10.2.2.
- Check position of control valves.
- Check access is clear around valve house and report to the plant manager otherwise.
- Check static installation and supply pressure. If these are less than the reference static pressure, a flow test is required.
- Check installation pressure at most hydraulically remote drain valve.

29.10.2.5 Gas Flood Systems

These systems must be maintained according to the relevant standard (NFPA 12) and the manufacturer's instructions.

29.11 Passive Protection

- The integrity of fire rated walls and floors that subdivide buildings, separate isolated risks or exit ways must be maintained at all times.
- Penetrations in separations must be stopped with proprietary products tested in recognised fire test facilities.
- Doors in penetrations must be fire resistant and fitted with closers. Automatic closing doors and hold-open devices must be tested on a regular basis.
- Fire safety issues and systems may need to be modified to allow for future changes in plant layout and operation.

- Exit ways must be clearly labelled with exit signs. Suitable signage is shown in Figure 29.2.

Figure 29.2 Exit way signs

Checklist for Fire Safety Systems

Manual Fire Fighting Equipment

Fire Extinguishers	**Yes**	**No**
Are they in place?	☐	☐
Are the anti-tamper devices and seals in place?	☐	☐
Are they in good physical conditions? Check for mechanical damage and corrosion.	☐	☐
Has the extinguisher been charged?	☐	☐
Is the maintenance label up to date?	☐	☐

Fire Hose Reels

Are all the components in place?	☐	☐
Are they in good physical condition? Check for mechanical damage and corrosion. Run out hose and check for damage.	☐	☐
Run water through hose (outdoor reels only)	☐	☐

Hydrants and Water Supplies	**Yes**	**No**
Has pressure been checked?	☐	☐
Has flow been checked (outdoor hydrants only)?	☐	☐
Has operation of pumps been checked?	☐	☐
Has water supply tank and reservoir levels been checked?	☐	☐
Alarm Systems and Sprinkler		
Check for mechanical damage and corrosion	☐	☐
Have monthly checks according to Sections 28.10.2, 28.10.3, NFPA 72 and NFPA 13A been carried out?	☐	☐
Have annual checks according to Sections 28.10.2, 28.10.3, NFPA 82 and NFPA 13A been carried out?	☐	☐

Dominica Geothermal Development Company Limited

Powering a New Generation...

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-037: First Aid and Medical
Revision 0

Contents

30. First Aid and Medical

30.1 Introduction

This section looks at the requirements for provision of first aid facilities and associated equipment. It examines the medical surveillance provided for all staff and particularly those involved in the Medical Surveillance Programme by virtue of the potentially hazardous nature of the tasks they perform.

30.2 Paramedic Station

- Paramedic stations are located at specific points at the site. The location of the facilities will be identified on a site plan.
- There should, where possible, be a wash hand basin in the vicinity.
- In buildings where a sick room is provided, a first aid box should be available at that location.
- The paramedic station area should always be maintained in a tidy and clean condition. Always clean up after using any items from the station.
- Employees should ensure they obtain first aid treatment for all injuries, no matter how small.
- Each major work location should maintain at least one first aid box.

The number of first aid boxes for a site is related to the number of persons working at the site, and the number of separate buildings and work areas. Each distinct work area shall have a first aid box e.g. workshops, control room, office area. First aid boxes will be located at key points throughout the plant (water pumping station, well heads) or at key road junctions.

Each company vehicle will have a fully equipped first aid box.

Work teams will also carry a first aid box with them, e.g. grass cutting gang, etc.

30.3 First Aid Boxes

- First aid equipment should be stored in a suitable cabinet of wood or metal with a tightly closing lid or door.

- The box should be clearly marked 'First Aid' and will be green in colour. The location of first aid boxes will be shown on a site layout plan.
- If the box is locked there must be several keys and the names and locations of key holders shown on the outside of the box.
- Nothing other than standard first aid equipment should be kept in the box.

Table 30.1: Minimum Scale of First Aid Requisitions gives a guideline of the basic requirements that should be provided in first aid boxes, dependent on the number of personnel at the site.

- The first aid box should be customised to suit its location and the type of injuries that may be expected.
- Every first aid box will have a list indicating the contents of the box and the first aid person responsible for that box. This person should be contacted to obtain any supplies. (alternatively a first aid box will have a register and this is to be completed when items are taken from the box.)
- It is the responsibility of the first aid person to periodically check (once a month) their first aid station and replenish supplies.
- The first aid box shall contain a first aid manual.

Some non-prescription medications like analgesics, pain relievers, antacids, cold and hay-fever remedies will also be available at the paramedic station. These are designed to keep people on the job and allow them to work more safely and efficiently than if they were in discomfort. Most of these medications are unit-dosed with directions and cautions in self-dispensing boxes to reduce or eliminate any liabilities associated with dispensing from a bottle. The paramedic will advise on dose rates, etc.

Two developments that have influenced the contents of first aid kits in recent years are increased concerns about infectious and contagious diseases such as HIV, hepatitis and tuberculosis, and a heightened awareness of lost-time injuries. As diseases become more prevalent, many people, even those trained in CPR, are reluctant to give first aid to strangers. For that reason, first aid kits now contain latex gloves, antimicrobial solutions, wipes and sprays to protect against pathogens, and one-way valve airway masks.

Table 30.1: Minimum Scale of First Aid Requisitions

	Number of Employees						
	Up to 5	**6-25**	**26-50**	**51-75**	**76-100**	**101-250**	**Over 250**
30g cotton wool	2	3	4	5	6	7	8
225g cotton wool		1	1	1	1	1	1
25mm bandages, open wove	2	3	4	5	6	8	12
50mm bandages, open wove	1	2	3	4	6	8	12
Triangular bandages	2	2	2	4	4	6	6
Sterile dressings - large	2	2	6	9	12	18	24
Sterile dressings - small	2	3	12	18	24	36	36
Adhesive wound dressings (assorted)	6	6	18	30	48	72	96
Solution of 3% cetrimide and 0.3% chlorhexidine	100ml	200ml	400ml	400ml	400ml	2 x 400ml	2 x 400ml
Scissors	small	small	small	small	125mm	125mm	125mm
Safety pins	1 card	1 card	1 card	1 card	1 card	2 cards	2 cards
Fine-pointed tweezers or splinter forceps	1	1	1	1	1	1	1
Filter papers (to be used for the removal of particles from eyes)	1 pkt	1 pkt	1 pkt	1 pkt	1 pkt	2 pkts	2 pkts
Forceps, non-toothed			1	1	1	2	4
Antiseptic cream (tube)	1 small	1 small	1 small	1 small	1 small	1 large	1 large
Clinical thermometer						1	1

	Number of Employees						
	Up to 5	**6-25**	**26-50**	**51-75**	**76-100**	**101-250**	**Over 250**
First aid manual (Red Cross or St. John)	1	1	1	1	1	1	1
Accident register forms and pencil	1 pad	1 pad	1 pad	1 pad	1 pad	1 pad	1 pad
Kidney bowl 125mm					1	2	2
Splints (leg)						1	1
Steriliser							1
Dressing drum (if Paramedic employed)							1
Receptacle for soiled dressings				1	1	1	1
Where wet work is carried on in a Workplace: Waterproof adhesive plaster (reels)	1	1	1	1	1	1	2
Disposable gloves (large multi fitting)	2prs	4prs	4prs	8prs	8prs	12pr	12pr
Antimicrobial Wipes	1	2	3	4	6	8	12
One-way valve air-way mask	1	2	2	3	3	4	4

30.4 First Aiders

Management must ensure that a sufficient number of personnel throughout the organisation are trained in first aid. Employees should be encouraged to volunteer for training in first aid techniques.

- First aid courses will be arranged and paid for by the organisation.
- Time will be given to attend courses.
- First aiders will hold an appropriate first aid certificate valid for a three-year period.
- First aid certificates will be issued by a recognised training body, e.g. Red Cross, etc.
- The ratio of trained first aiders to staff should be 1 to every 25 employees.
- Trained first aiders will be easily identifiable at the site wearing a green chevron with the words 'First Aider' fixed to cloth above the breast pocket.
- Each area or group of workers has an assigned first aider.
- First aiders are to be contacted when any accidents or near-misses occur.
- It is the responsibility of the Health and Safety Officer to ensure that a register of first aiders is maintained and that training and refresher courses are undertaken to ensure that qualifications are kept current.

Duties of first aiders include:

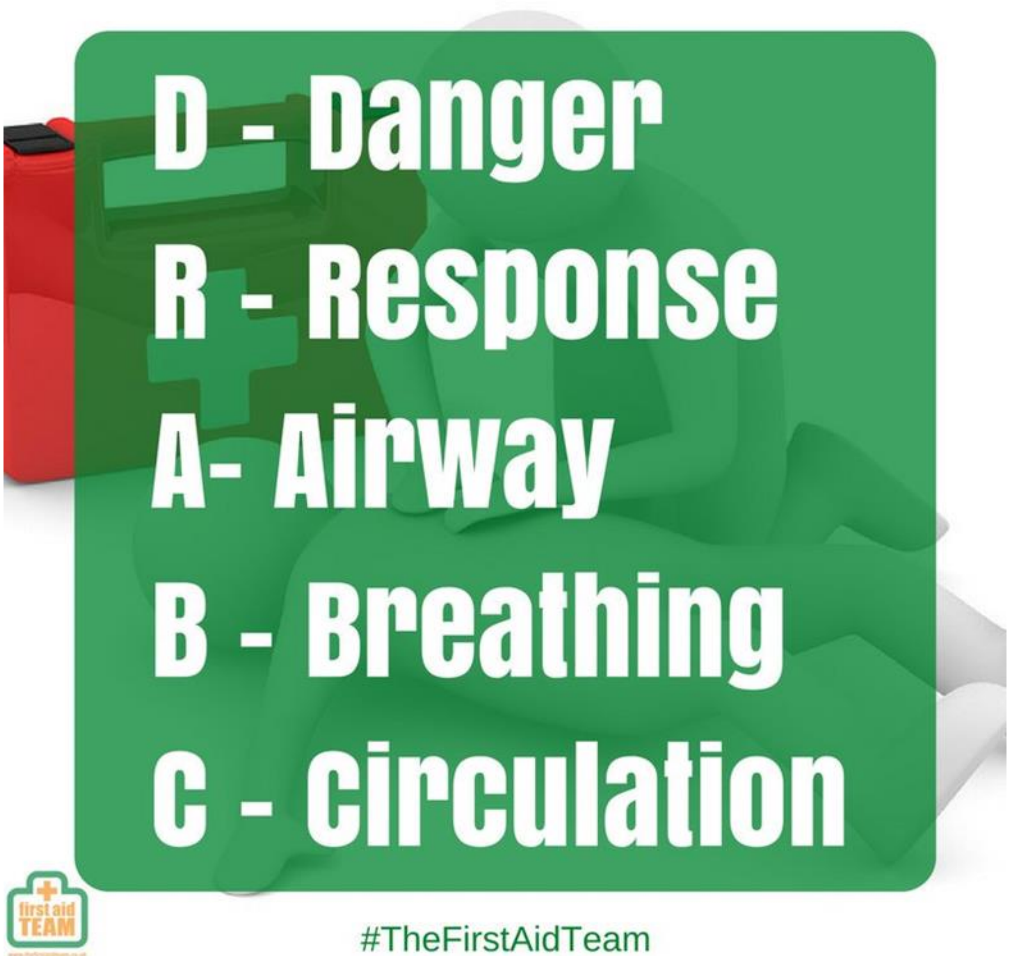
- maintenance of the first aid boxes and stations
- attendance at any accidents or near-misses in their area or as required
- checking the accident register is completed when an accident or near-miss occurs and actioning according to the prescribed procedure
- vigilance for any unsafe conditions or hazards in their area and reporting these to supervisors
- ensuring that they have a deputy who will carry out first aid duties when they are away or on leave.

30.5 Emergency Preparedness

When an emergency occurs:

- Report the nature and location of the emergency to the appropriate control (fire, police, health and safety, or medical (paramedics)). Give name, phone number, location and estimation of hazard (number of people, if unconscious, trapped, burned, chemical, electrical, etc.).
- Contact group first aider.
- Notify others in the area and supervisor.
- Wait for response personnel or send someone else.
- Leave communication lines open, do not make other phone calls unless emergency related.

Do what is necessary to protect life while waiting for assistance. KEEP CALM. First aid personnel and/or paramedics should be available immediately. If not, the following general comments are made.



- Check for danger. You can't help anyone if you get injured too. Have a look around to see what could have happened. If all clear proceed.
- Safeguard injured personnel. Do not remove unless in further danger. Keep them warm. Unnecessary movement can severely complicate neck injuries or fractures.
- Remove contamination, if possible. If chemicals are spilled on someone get them to the shower or eyewash immediately. Remove any clothing contaminated with chemicals with care to avoid further contamination of skin or eyes. Find out what chemicals are involved.
- CPR and Resuscitation If an injured person is not breathing, provide mouth to mouth resuscitation. The following procedure is recommended: Place the person face up, clear the mouth of any obstruction, and loosen tight clothing. Lift the neck and tilt the head back, so the chin is pointed upward. Insert your thumb in the mouth, grasp the lower jaw and lift it forcibly upward and forward. Pinch the nose and blow vigorously through the mouth to make the chest expand. Repeat every four to five seconds. If the victim's chest does not expand recheck the mouth for any obstruction, tilt the head back and resume blowing into the mouth. CPR is not to be undertaken unless training has been given.
- Control bleeding by elevating the injury above the heart, if possible. If blood is spurting place a sterile pad on the wound and apply firm pressure. Wrap the injured person to avoid shock. Tourniquets should be applied only by persons trained in first aid.
- Do not touch a person in contact with a live electrical circuit. Disconnect the power first or the rescuer may become seriously injured.

Refer to First Aid Manual with first aid box for more specific first aid treatment measures.

30.6 Emergency Showers and Eye Washes

Eyewash and shower stations should be available to all employees whose faces or bodies may come into contact with hazardous material.

- Emergency flushing/irrigating equipment should be located within 30 metres (or 10 seconds travel time) of the hazard.
- Emergency irrigating equipment should be identified by a highly visible sign.

- Emergency/irrigating equipment should be connected to a source of potable water.
- A minimum area of 0.9 metres in diameter should remain free of obstruction immediately below the flushing/irrigating equipment.
- The flushing/irrigating equipment valves should be designed to allow constant water flow without the use of the operator's hand. The valve should remain open until it is intentionally closed.
- Safety showers and eyewashes should be activated weekly to flush lines and to verify proper operation.
- Emergency showers should deliver a minimum of 75 litres (20 gallons) per minute for 15 minutes.
- Emergency eyewash stations should deliver a minimum of 1.5 litres (0.4 gallons) per minute for 15 minutes.
- Emergency drench hoses should deliver a minimum of 11.4 litres (3 gallons) per minute for 15 minutes.
- All employees who may be potentially exposed to splashes of hazardous substances shall be trained in the proper use of flushing/irrigating equipment.

30.7 Medical Surveillance

30.7.1 Medical Surveillance

(See Figure 30.1: Medical Surveillance Process)

- Employees engaged in potentially dangerous occupations and those working with certain hazardous substances will be enrolled in the Medical Surveillance Programme.
- The programme will be operated under the surveillance of a registered medical practitioner trained in the requisite testing or medical examinations for the substances in question.
- The requirements for the programme will be derived from numerous sources including OSHA, NIOSH and other approved guidelines and standards.
- The employer is responsible for the costs of the Medical Surveillance Programme.
- Medical surveillance information will not be used for employment purposes such as hiring and firing.

Where the employee is undergoing medical surveillance the medical practitioner shall ensure, as soon as practicable, that:

- the employee is notified of results, together with an explanation of the results
- the employee is notified of the outcome and of the need for remedial action
- medical records obtained during the medical surveillance are confidential
- medical records are made available to the employee or to his representative, with written permission from that person
- the informed written consent of the employee shall be obtained before the medical records which identify that person are provided to a third party not covered by professional confidentiality.

30.7.2 Inoculations

As part of pre-employment assessment it will be determined whether a person has the required inoculations to work safely at the site. This could include whooping cough, tuberculosis, measles, diphtheria, polio, tetanus, hepatitis B.

30.7.3 Hearing Conservation

Prolonged exposure to excessively loud noise can cause noise-induced deafness. The purpose of having a hearing conservation programme is to prevent deafness by controlling the noise hazard by the systematic and total approach involving all of the company.

The hearing conservation programme (HCP) targets those most at risk, that is, those workers who are exposed to an average noise level of 85dBA or more for eight hours per day or 40 hours per week or to impactive noise which is above the limits specified in Section 22: Noise and Vibration. In addition, if the average noise level is 90dBA or more, engineering noise control measures should be implemented.

Where employees are to be placed in a job requiring participation in the HCP the following will be undertaken:

- baseline audiogram and medical history to determine pre-existing medical pathology of the ear
- work history taken to determine past noise exposures and also non-work exposures

- annual examination to include annual history of work exposures, use of personal protective equipment and other work-related or non-work-related exposures to noise
- provision of hearing protectors and instructions in their care and use
- health education on the importance and necessity of using hearing protectors
- a final audiometric examination of all employees in the HCP before termination of employment.

Audiograms must follow 14 hours of no known exposure to sound levels in excess of 80dBA. This interval should be sufficient to allow recovery from noise induced temporary threshold shift.

Personnel suffering acute diseases of the ear should not be placed in hazardous noise areas until the condition has abated.

In association with the annual medical examination and audiometric testing it may be determined that further clinical audiological evaluation or ontological examination is necessary. This may be the case if it is suspected that medical pathology of the ear is caused or aggravated by the wearing of hearing protectors or if further general concerns are held by paramedics. The cost of this will be covered by the company.

30.8 Pre-Employment Checks

A comprehensive and confidential medical examination is required of all new employees and temporary employees hired for three months or more. Medical examinations may be offered periodically during employment and at the time of termination or retirement.

Women who are, or plan to become pregnant should consult the medical service facility about their work environment.

30.9 Paramedics

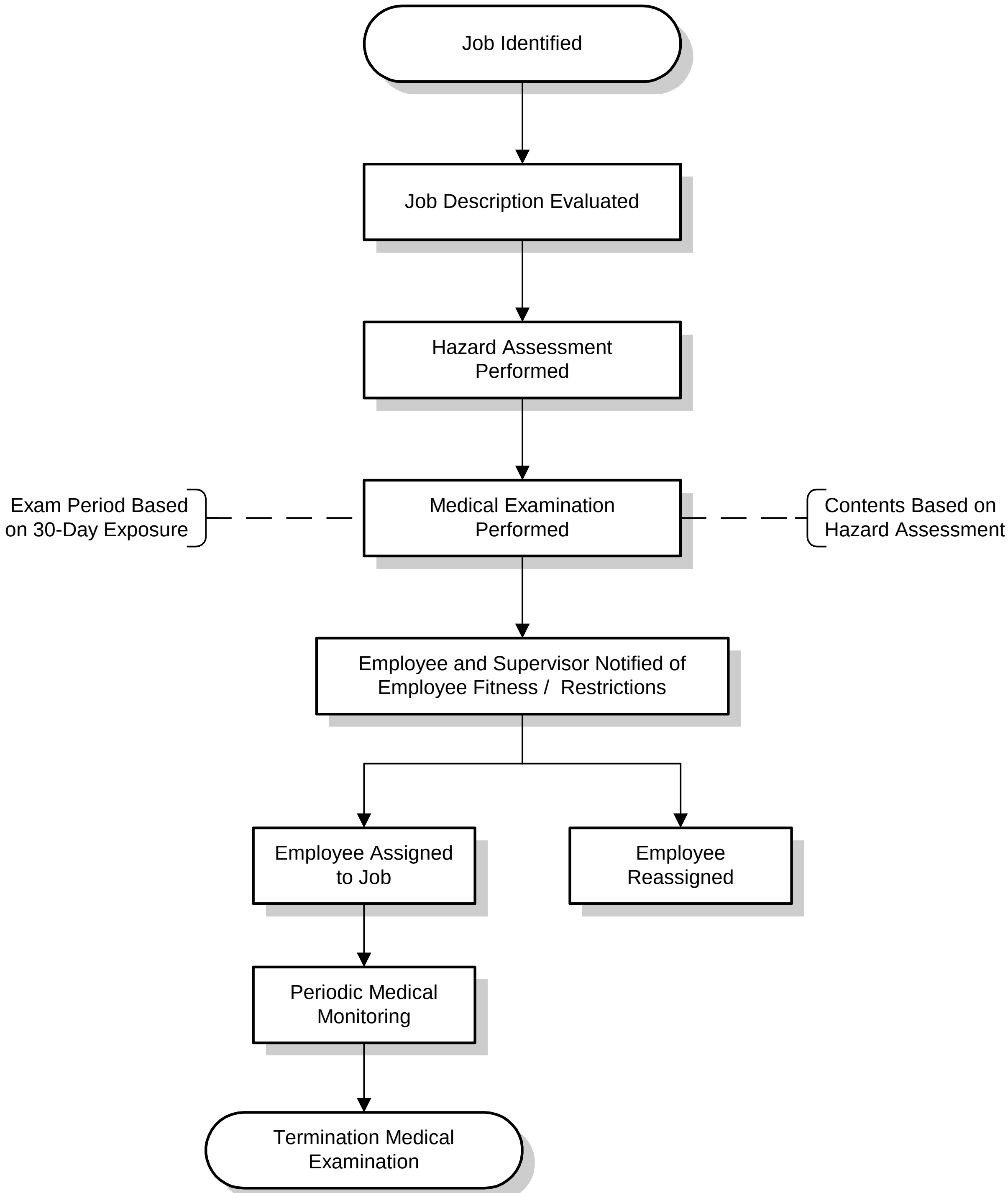
Professional medical services will be available via the public health care system. DGDC will maintain a register and site signage at first aid locations for contact details of the paramedic services. They are available to treat injuries and minor illnesses and to advise employees of medical conditions that should be discussed with or treated by an outside personal physician. Supervisors shall require their employees to report as soon as possible all illnesses and injuries that occur at work so that medical evaluation and treatment may be provided promptly and effectively. On returning to work after a work-related illness or injury resulting in lost time, employees should provide an evaluation certificate of their condition from their personal physician confirming their ability to resume normal duties. For non-occupational health problems requiring an absence of three or more consecutive work days the medical service facility should be contacted and an explanation from a personal physician may be required.

30.10 Training

A scaled system of training in first aid will be provided.

- As part of the new employee or contractor induction course personnel will be made aware of the location of first aid boxes, how to identify and summon first aiders and paramedics, and the emergency procedures to follow.
- Basic first aid training course for staff. How to deal with cuts, abrasions, burns etc. until a trained first aider arrives. How to administer immediate first aid to the injured person.
- CPR training to first aiders and supervisory staff.
- First aid certificate training for first aiders.
- Health awareness courses by paramedic.

Figure 30.1 Medical Surveillance Process



Dominica Geothermal Development Company Limited
Powering a New Generation...

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-038: Emergency Procedures
Revision 0

Contents

31. Emergency Procedures

31.1 Introduction

DGDC has taken practicable steps to develop procedures to deal with emergencies which may arise at or near their facilities. This section details the procedures for a range of emergency scenarios that could affect the facility.

All staff at the facility shall be trained in the use and process of the emergency procedures.

All contractors and visitors to the facility will be advised of the site's emergency procedures and the locality of Safe Briefing Areas (assembly points), with particular emphasis of the evacuation procedure which will be followed in the event of a fire, explosion, major H2S release, earthquake, major plant failure, bomb threat, etc.

31.2 Emergency Response Team

31.2.1 Response Team

For DGDC sites which are isolated from quick response municipal emergency services (fire, ambulance, etc), an on-site Emergency Response Team will be set-up. The Emergency Response Team will consist of DGDC personnel who in addition to their normal duties have received specialist training in:

- firefighting equipment and techniques
- emergency rescue techniques (abseiling, man-winching etc)
- self-contained breathing apparatus use

Emergency medical response will be provided by the site's Paramedics and trained First-Aiders.

A core number of Emergency Response Team personnel will be present at the site for each shift. The expanded team will be drawn in by mobile communication devices worn by the Emergency Response Team members.

The team will provide the following services:

- limited firefighting to enable personnel to safely evacuate buildings and to put out small scrub type fires;
- fire rescues of personnel trapped in building;
- rescues of injured personnel trapped in the forest or at site (wells, cellars, H2S releases etc).

An Emergency Response Team Co-ordinator will be appointed and an Emergency Response Team Leader will be appointed for each site shift.

The Emergency Response Team Co-ordinator will be responsible for the following items:

- arranging specialist training of new team members;
- arranging refresher training of team members;
- managing and the maintaining of the emergency response equipment;
- organising and running training sessions;
- co-ordinating the team in an emergency situation.

The Emergency Response Shift Team Leader will be responsible for managing/controlling the team in the event of an emergency situation for which the team is activated. Control will be passed over to the Emergency Response Team Co-ordinator when they arrive at the scene.

31.2.2 Emergency Response Vehicle

For sites where municipal emergency services have a response time of more than 30 minutes, an Emergency Response Vehicle will be provided. This vehicle typically should, as a minimum, be equipped with the following:

- Four by four-wheel drive capability
- Fire pumps - unless the site has a secure slate head on water mains
- Fire hoses (suction and delivery)
- Ladders
- Fire extinguishers
- Stand pipes, nozzles etc
- Lightweight fire suits

- Self-contained breathing apparatus
- Rescue harnesses and ropes
- Man lifting gear (tripod and winch)
- Cutting equipment (power)
- Tool kit (axes, shovels, picks etc)
- First aid and resuscitation equipment
- Trauma kits (splints, braces, etc)
- Rescue stretches
- Chemical resistant suits

The Emergency Response Team shall be trained in the use of the equipment on the vehicle and on the vehicle's use.

31.3 Evacuations

31.3.1 General Responsibilities

Evacuation provisions are applicable to fires and all other occurrences for which evacuation of staff from buildings to Safe Briefing Areas (assembly points) is appropriate, such as major plant failure, major H2S releases, etc.

All building emergency exits are labelled with the green sign EXIT.

All personnel should familiarise themselves with the locations of ALL emergency exits from their work area and the location of their nearest Safe Briefing Area (assembly point).

All Safe Briefing Areas are sign posted 'Safe Briefing Areas' and are allocated a distinct letter for identification purposes. (These tie up with marked areas on site layout maps.)

Always assemble at the designated Safe Briefing Area closest to your point of work.

31.3.2 Evacuation Procedures

In the event of a fire, major plant failure, explosion, bomb threat or the need to evacuate the plant, the actions listed below should be followed.

- On the continuous sound of the alarm siren (bells), STOP all activities and vacate the building or area without delay, by the nearest exit.

- Plant Operators to initiate appropriate Emergency Operating Procedures (EOP), and where possible, confirm plant is in safe state prior to vacating buildings.
- Move quickly, but do not run.
- Do not return to a work area to collect belongings.
- Keep left in corridors and stairs.
- Do not overtake others along the route.
- Assemble in the designated Safe Debriefing Area.
- At Safe Debriefing Area report to the responsible Warden.
- Do not enter the building or work area under any circumstances until the all clear is given.

All new staff, as part of their induction into the company, shall be given instructions on the evacuation procedures for the site.

All visitors and contractors are to be advised of the site's Evacuation Procedure and the location of Safe Debriefing Areas when they are admitted to the site.

31.3.3 Specific Responsibilities

Duties of Warden (Fire)

- Study and become familiar with evacuation procedure.
- Turn off power and gas supplies.
- Check department including toilets, showers, offices, etc to ensure that all personnel are evacuated from their area/department. DO NOT try to account for individuals, just clear all personnel from the department or area.
- Ensure all doors are closed but not locked to partitioned areas, strong rooms, and main doors. Ensure emergency lighting is operational where applicable.
- Advise Control Centre whereabouts of fire, or threat in your area.
- Check all personnel from your area are at the Safe Briefing Area (assembly point).
- Mark Evacuation Control Board at Control Centre that the area of responsibility is clear.

Duties of Control Officer

- Report to designated control centre area.
- Await wardens to report.
- Review Evacuation Control Board status.
- Direct personnel accordingly.

- On all clear, issue instructions to return to work.

31.3.4 Safe Briefing Areas (Assembly Points)

Designated Safe Briefing Areas are marked on site layout maps, and are displayed on noticeboards throughout the site next to the Evacuation Procedure.

For some sites, wind socks are placed throughout the site. Observe the wind direction (sock direction) during the evacuation. Personnel should assemble at the safe upwind Briefing Areas.

All Clear
Instructions to return to work will be given by the Control Officer.

Control Centre

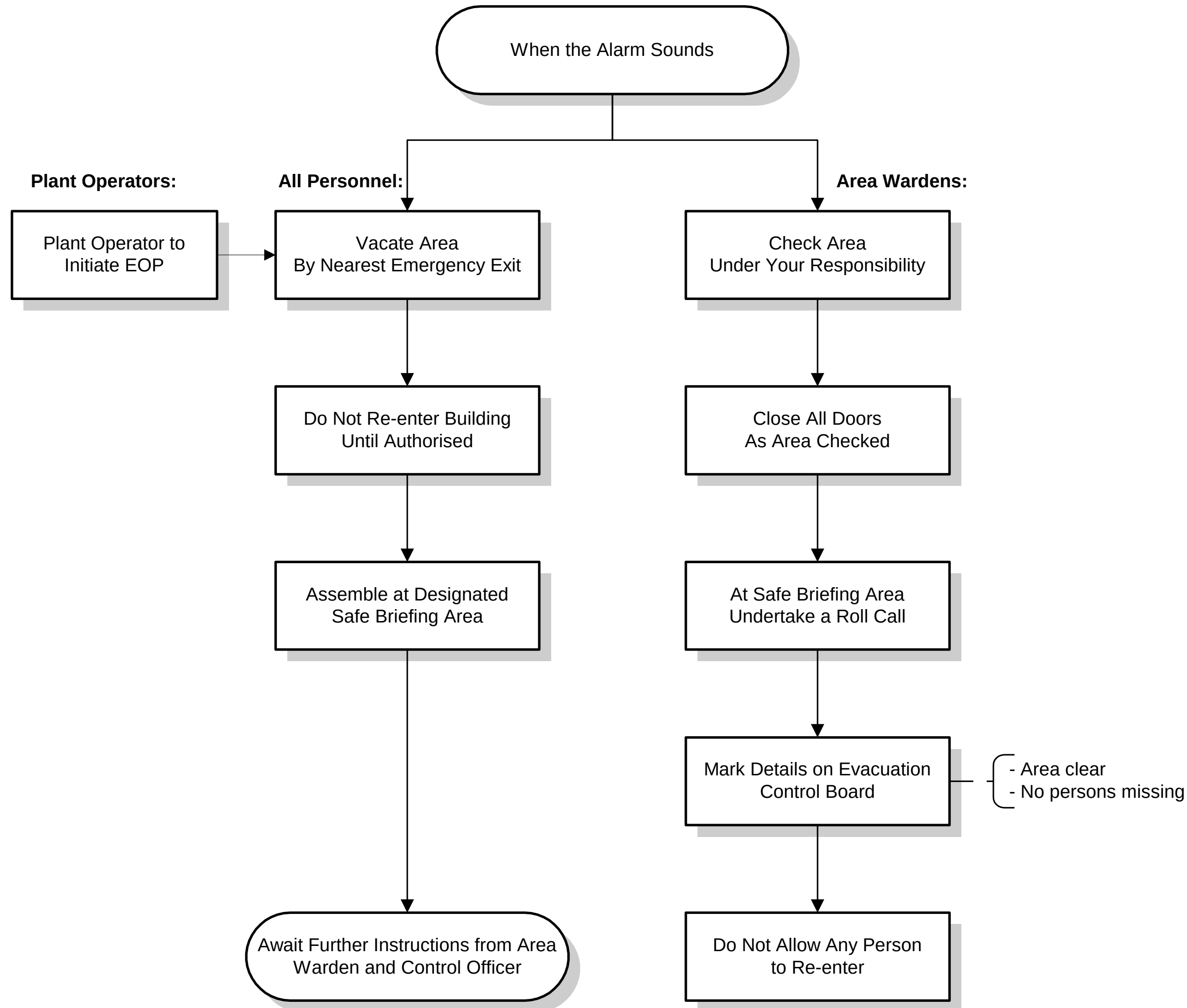
- The most senior staff member of the shift will be the Control Officer. All Area Wardens will report to the Control Officer.
- The Evacuation Control Board will be held at the Control Centre.

A flow diagram showing the Evacuation Procedure is presented in Figure 31.1. This flow diagram will be placed on noticeboards throughout the site next to the site plan showing designated Safe Briefing Areas.

Regular drills (once every six months) are held to ensure that staff are familiar with the Evacuation Procedures.

Figure 31.1 : Evacuation Procedures

In the Event of a Fire or the Need to Evacuate the Plant the Following Actions Should Be Taken:



31.4 Fire Procedures

If you discover a fire, immediately carry out the actions listed below.

- Activate the nearest manual alarm (break glass and operate the switch).
- Ring Site Security and give relevant details.
- Site Security to alert Fire Service Site/Emergency Response Team (as appropriate to site).

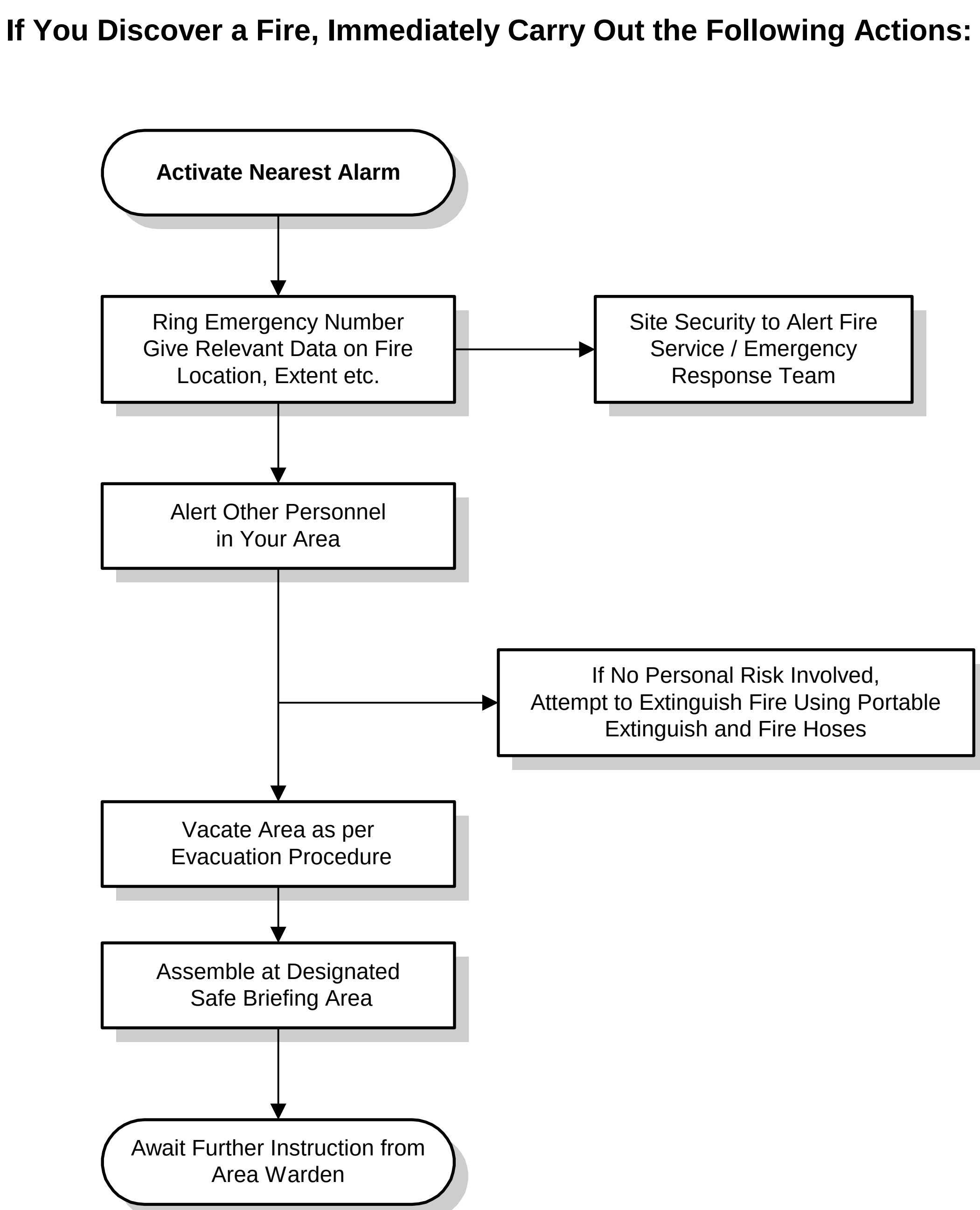
- Alert other personnel in your area and remove any injured person(s) from immediate danger.
- If no personal risk is involved, an attempt should be made to extinguish the fire using nearest fire extinguisher or hoses.

Note: In the case of electrical fires, hoses should not be used, use dry powder or CO2 extinguishers instead.

- If in doubt, evacuate the premises and leave firefighting to the experts.
- Evacuate building following the Evacuation Procedure.
- Go to your Designated Safe Briefing Area.
- Follow instructions from Area Warden.

Figure 31.2 presents the Fire Procedure as an action flow diagram.

Figure 31.2: Fire Procedure



31.5 Natural Hazards

31.5.1 Earthquake Procedure

When an earthquake starts:

- Stay calm and take cover under a desk;
- Brace yourself in a doorway (hold onto the door to prevent personal injury from the door slamming);
- Crouch behind a solid structure, eg wall;
- If under furniture which moves, move with it;
- Stay away from glass doors and windows, tall shelves, light fittings, or objects that might topple;
- If travelling in a lift, stop and get out at the next floor;
- Do not leave the building or try to leave the immediate area;
- If outdoors, take cover in a doorway or other safe place away from falling debris and electrical hazards.

After an earthquake:

- Stay calm, stay together. Account for everyone in the work area and immediate vicinity.
- Area Wardens take control and co-ordinate actions in areas of responsibility and:
    - assess all persons for injury
    - check for hazards, fire, gas or chemical leaks
    - move people away from windows and outside walls
    - leave doors to rooms open, pull curtains across broken windows
    - turn off and unplug all unnecessary electrical equipment.
- Do not evacuate unless the building has sustained major structural damage.
- Put signs up identifying dangerous areas.
- Do not use lifts - put signs in the lift lobby.
- Conserve water.
- Do not use the toilets. Make other arrangements that do not involve relying on the sewerage system.
- If communications system has failed, try to pass notes to rescue personnel.

Listen carefully to any announcements over loudhailers.

If an evacuation is necessary:

- proceed carefully, expect to find exit routes blocked or damaged

- never use lifts
- when outside, stay well away from buildings and power lines
- stay together in your work or floor group to assist with record keeping
- if it is safe to do so, go to your Designated Safe Briefing Area.

Remember, that there are almost always aftershocks following a major earthquake - sometimes quite significant. They can go on for weeks or even months. Be prepared for them to happen.

31.5.2 Landslide Procedure

When a landslide starts:

- if outdoors attempt to get out of its path
- if in building, do not attempt to leave until movement has ceased.

After the landslide:

- Stay calm, stay together, account for everyone in the work area/work team.
- Evacuate buildings caught in landslide.
- Raise the alarm by contacting Security.
- Provide details:
  - extent of landslide
  - location
  - buildings, equipment damaged
  - number of persons missing/trapped etc.
- If facilities damaged, initiate Emergency Operating Procedures to make equipment safe and to shut-down affected areas.
- Emergency response team to initiate search and rescue of the affected areas to find/locate missing persons.
- Isolate area affected by landslide to prevent unauthorised persons being trapped in landslide debris etc.
- Notifying Government authorities for assistance in rescue etc.

31.5.3 Geothermal Eruptions

A range of hazardous events can result from geothermal activity, these include:

- explosive eruption/blasts of rock and ash
- pyroclastic flows
- lava flow
- lahars

- volcanic gases (CO_2, SO_2, H_2, H_2S, water vapour)

In most situations, large volcanic activity is usually predictable and contingencies can be put in place to mitigate the effects on areas of population.
In the event of sudden geothermal activity take the actions listed below.

- If you are near a water body stream or base of a valley move to higher ground, as lahars and lava flows tend to flow down valleys (path of least resistance).
- Move indoors to get away from falling rocks and ash.
- Under direction from management evacuate the site.

31.5.4 Flooding

In the event of flooding the precautions listed below should be followed:

- Do not try to cross swollen rivers in vehicles or by foot.
- Stay indoors, move up to higher building levels if flood levels rise.
- If working in a valley with a stream, move up to higher ground, especially during periods of heavy, sudden rain.
- Initiate EOP when key plant items before they are submerged, and could cause shock hazards.
- Maintain communication where possible.
- Listen to the instruction of the responsible warden.

31.5.5 Hurricane Procedure

Definitions
The Office of Disaster Management (ODM) will issue weather announcements when a storm or hurricane is approaching. The following terms are commonly used in such notices:
Bulletin - An announcement issued when a significant weather system is detected in the area.
Advisory - An Advisory is issued at regular intervals when a tropical storm or hurricane is located near Dominica.
Watch - Issued when the storm or hurricane is approaching Dominica and severe weather conditions are possible.
Warning - An announcement issued when it is established that storm or hurricane conditions are expected to affect Dominica within 24 hours.
Tropical Depression - A tropical system with a circulation, and with winds of less than 39 m.p.h.

Tropical Storm - A tropical system with a circulation and with winds of 39 –73 m.p.h.
Hurricane - An intense tropical system with maximum sustained winds greater than 73 m.p.h.

Category 1	74 – 95 m.p.h.
Category 2	96 – 110 m.p.h.
Category 3	111 – 130 m.p.h.
Category 4	131 – 155 m.p.h.
Category 5	above 155 m.p.h.

Eye - The relatively calm area near the centre of a storm of hurricane, around which the strongest winds blow. As the eye passes, light winds rapidly give way to very severe winds from the opposite direction.
Storm Surge - The rise of water above normal sea level, brought on by the strong winds and low pressure at the storm centre.

At the start of the Hurricane Season

- Check the number of tarpaulins, plastic sheets and other waterproof covering which are available, to ensure there is adequate to cover each generating unit (alternator and exciter), switchgear panel and other critical and sensitive electronic / electrical equipment at the power plant. These provide the only means of preventing serious water damage to electrical equipment, in the event of damage to the station building during a hurricane. Ensure that each tarpaulin has sufficient rope affixed to it for fastening around the generator or switchgear panel.
- List and have corrected any defects in the buildings, including but not limited to:- windows, doors, ventilators, roof leaks and structural defects.
- Check that drainage channels are clear, sumps and drains are free of oil and that the compound is free of loose material or objects such as empty oil drums which could pose flying danger in high wind.
- Ensure that the two-way radio equipment is working correctly and that there is an adequate number of portable units available to enable effective communication among staff under emergency conditions.
- Check the contents of the Emergency Medical Kit (Table 31.1) and the Hurricane Locker (Table 31.2) to verify that they are fully stocked. Replace any missing and expired items.
- Test the station's emergency lighting system on the first day of each month. Replace all blown or missing bulbs. Check the state of batteries, as evidenced by the duration of discharge, and replace if necessary.
- Review and update the list of names and telephone numbers of members of the emergency committee.

- Review and update the address, telephone number and next of kin of all employees.

Table 31.1: Contents of Emergency Medical Kit

QUANTITY	DESCRIPTION
3	Rolls 30g cotton wool
1	Roll 225g cotton wool
2	Antimicrobial wipes
24	Gauze pads (assorted)
3	25mm bandages, open wove
2	50mm bandages, open wove
2	Triangular bandages
6	Rolls 1” bandage
2	Sterile dressing - large
3	Sterile dressing - small
1	Box *Elastoplast* or similar
1	adhesive plaster
1	Pair of scissors (small)
1	Fine-pointed tweezers or
1	splinter forceps
1	Packet safety pins
1	Tube antiseptic cream (small)
1	Clinical Thermometer
1	Bottle Eye Lotion (large)
1	Jar petroleum jelly
4prs	Bottle disinfectant
2	Bottle salt tablets
	Disposable gloves (large multi-
	fitting)
	One-way valve air-way mask

Table 31.2: Contents of Hurricane Locker

QUANTITY	DESCRIPTION
2 cases	Bottled drinking water
4 boxes	Crackers
3	Flashlight
1	Set of non-rechargeable
2	batteries – size AA
3	Portable radio
3	Protective hard hat
3	Pairs of working gloves
3	Pairs 'Wellington' boots
1	Raincoat
1	Bucket
1	Carpenter's hammer
2	Crowbar
2	Spade
1	Cutlass
1	16" chainsaw
	bail (630ft) 5/8" rope

<u>During the Watch / Warning Period</u>

When the signal to activate "Hurricane Imminent" procedures in accordance with these instructions has been given by the Emergency Manager, all staff will ensure that the activities outlined below are carried out immediately.

Employees have an obligation to help secure the Company's property e.g. equipment and vehicles used in their work. Once this has been done to the satisfaction of the Emergency Manager, all personnel not designated to special tasks under these instructions, shall be released to return home, with instructions to report back for work as soon as it is safe to do so, without waiting to be called.

The Emergency Manager will determine and communicate with staff the best place for parking of Company vehicles, taking into account the availability of space, security and mobility after the storm.

Everyone who has volunteered for any special emergency duties during the aftermath of the hurricane should take shelter at home and hold him/herself in readiness to report for duty according to his/her assigned shift. If necessary, a roster should be prepared for volunteers.

The Emergency Manager must ensure that staff are allowed sufficient time to get to their homes and secure same before the hurricane strikes.

The following actions must be taken:

- Test communications channels, standby generator and emergency lighting equipment.
- Store adequate drinking water, preferably in gallon containers.
- Fill emergency water tanks.
- Ensure that computers, printers, UPSs, transformers etc. are raised from the floor by at least 300mm. Only if they are turned off must they be covered with plastic sheeting, which must be fastened securely.
- If it is deemed safe to do so, allow the network infrastructure (including the servers, switches and ADSL modems) to remain online for remote access. Otherwise shut down the system, disconnect from the power supply and cover with plastic sheeting.
- One tarpaulin (or plastic sheet) should be positioned close to each generating unit so that it can quickly be placed over the alternator, exciter and vulnerable parts at the time of a complete shutdown.
- Ensure that everything possible is done to secure all aspects of the power station building(s), such as doors, windows, and apertures etc. which are to be tightly closed up. All outside loose and movable objects are to be well secured.

<u>During a Tropical Storm / Hurricane</u>

- The Station Superintendent will keep in constant contact with Domlec System Control so as to determine when it is necessary to take full shutdown measures. Shutdown of the generators must be carried out in accordance with DOMLEC dispatch instructions or as according to DGDC procedures for safe shut down of the Units.
- As soon as each generation unit stops running, its electrical components must be covered with a securely tied down tarpaulin or plastic sheet.
- After the power station has been shut down, staff on duty shall take all steps to ensure their safety. They must ensure that they have free access to the hurricane locker, in the event that they need to use any equipment stored there.
- Remain indoors. Stay away from windows and doors. Find a safe area in the building – an interior room, a closet or bathroom.
- Avoid venturing outside because the strong wind will blow objects around, making it extremely dangerous.

- Listen to local radio for updates on the progress of the storm and information on changes in the weather situation.

After the storm

When the "all clear" has been given by the relevant authority, the company will be in Restoration Mode. The initial action will be for the Emergency Manager to enquire as to the wellbeing of staff who were on duty during the storm. Next, he must identify the extent of damage sustained within his/her area of responsibility and provide a detailed report to the CEO / Project Manager. An overall strategy for restoration will be developed by the Emergency Manager in consultation with other senior staff. This strategy must be approved by the Board of Directors/Executive Chairman.

Thereafter the Emergency Manager must take the following actions:

- Make contact with the ODM or the Disaster Preparedness Coordinator himself and briefly report on DGDC's situation, extent of damage and immediate needs.
- Prepare a detailed report on the extent of damage and requirements for rehabilitation, from the information coming out of the various departments. This report is to be made available to the Board of Directors.
- As part of the damage report, an assessment of the situation at the plant and drill pads/weather station location/work sites stating:
  - Damage to buildings;
  - Damage to equipment – switchgear, cooling towers, pipelines and vehicles;
  - Those generating units capable of immediate generation;
  - Units that can be made available within 24 hours;
  - Units requiring extensive repairs, drying out, etc.;
- Any generation plant item or portion of the system which has been shut down (manually or automatically) during the storm must be considered as decommissioned. It must **not** be re-energised until thoroughly checked by maintenance crews.
- Have staff clean up debris and water and erect temporary covering if necessary, giving priority to critical areas like over the generators and HV switchboards.

Staff will report to the Emergency Manager the details of any damage to their homes or injury to themselves or family.

31.6 Blow Outs/H2S Releases

In the event of a well blow and/or a major H2S release, the steps listed below should be followed.

- All personnel to vacate the area to upwind Safe Briefing Areas. Remember to observe the direction of the wind socks.
- Roll call taken to ensure all persons accounted for.
- Essential staff to don personal protective equipment, including SCBA and attempt to shut-down well.
- If attempts to shut-down well are unsuccessful, consider initiating evacuation of site.

31.7 Explosions

In the event of an explosion at the site:

- initiate evacuation procedure
- all staff to assemble in Safe Briefing Areas
- account for all personnel, visitors, contractors
- if fire, initiate fire procedure
- Control Officer to initiate EOP to minimise plant damage, if able to do so safely
- await further instructions from Control Officer.

31.8 Plant Failures

In the event of a major plant failure:

- initiate evacuation procedure
- account for personnel assembled in Safe Briefing Area
- determine the need for Emergency Response Team to perform a rescue
- if fire, follow the Fire Procedures
- initiate EOP to limit damage to the rest of the plant.

31.9 Chemical/Fuel Spillage

In the event of a chemical/fuel spillage or leak, the priority actions listed below should be taken. (See Figure 31.3.)

1. Ensure personnel are safe

- If personnel are injured and can be removed from the area safely, do so.
- Check Material Safety Data Sheets as to hazards and first aid measures.

2. Stop the flow of leaking material

- Reposition the drum to stop the flow.
- Shut off the source of the leak.
- Equipment filled with the material that is found leaking should be removed from service as soon as possible.

3. Contain the spill

- Bund and protect all open grates, sumps, manholes that discharge into the storm water system.
- If the chemical has entered the drains, advise supervisor and environmental officer immediately.
- Dyke major spills with soil or other material.
- Prevent spilled material entering drains, waterways or on to the ground.
- Where it is not possible to remove equipment from service immediately, some means of collecting the leaking material should be used, such as metal trays, buckets, polyethylene sheeting.

4. Protection of Personnel

- Personnel entering the leak or spill area shall be provided with and use appropriate protective equipment, as set out in the Material Safety Data Sheet (MSDS) for that particular chemical.
- All non-essential personnel shall be kept out of the immediate leak or spill area.

5. Report the Spill

- Report the incident once the spill is contained or get a fellow worker to report the incident to the foreperson or supervisor.

6. Actions of Responsible Person

- The foreperson and/or supervisor is to assess the situation quickly to determine the need for external help.

7. Clean Up

- Minor spills or leaks can be cleaned up using absorbent material, sand, sawdust, or kitty litter. Check MSDS to see what is the correct material.
- All liquid and contaminated material must be collected for disposal.
- Transfer contents of leaking drum to new clean drum.

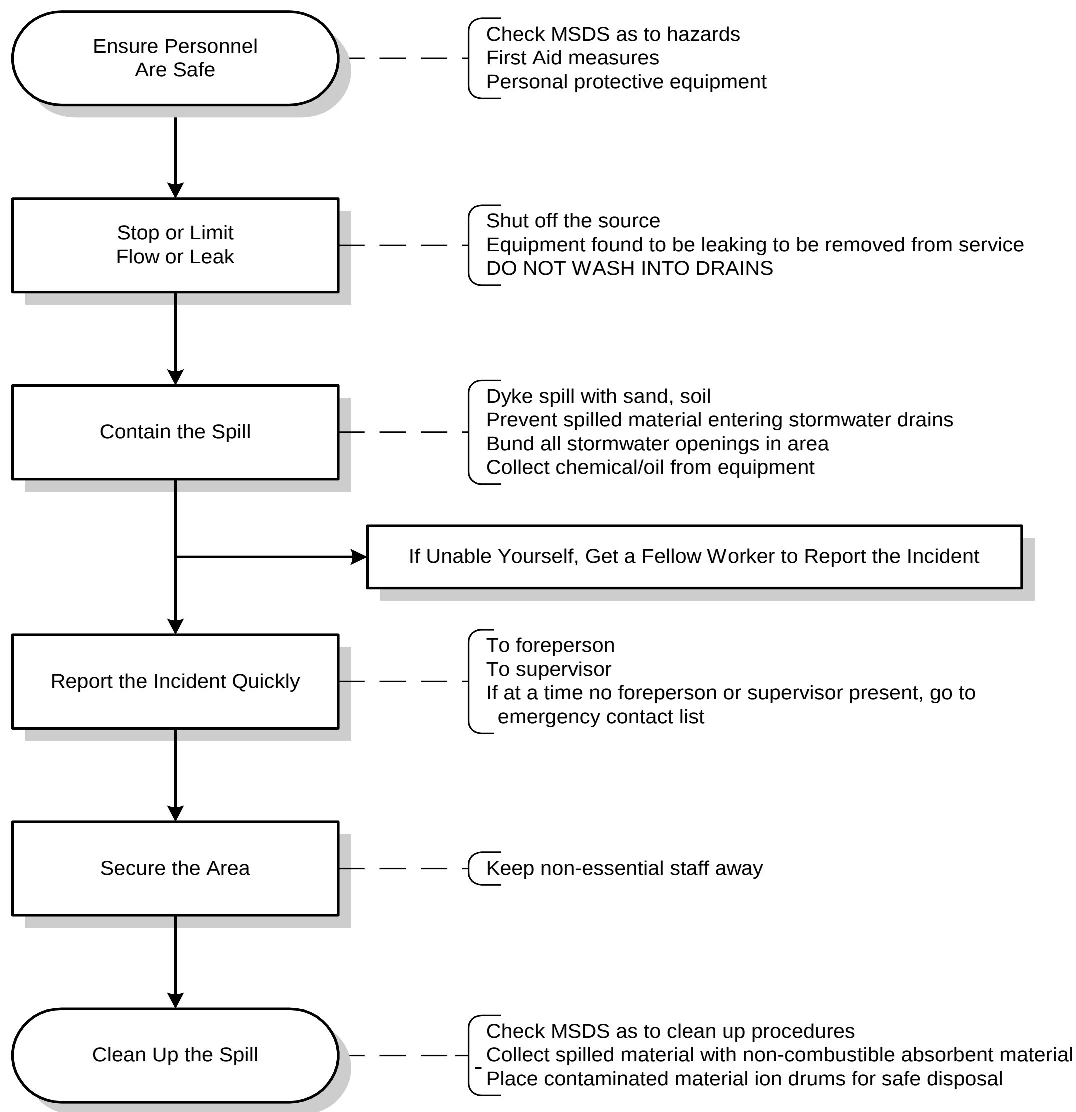
- Ensure collected material is placed in a container which will not leak during transportation off site for disposal.
- Check MSDS that disposal route is appropriate, eg to landfill.

8. Incident/Investigation

- Foreperson/supervisor to prepare a short report on incident.
- Comment on contingency plans: Were they effective in dealing with the situation?
- If any improvements identified, inform the personnel responsible.

Figure 31.3: Chemical/Oil Spillage Emergency Procedure

In the Event of a Chemical Spillage or Leak the Following Steps Should Be Taken:



31.10 Vehicle Accident

In the event of a vehicle accident, the actions listed below should be followed:

- Send for help if anyone is injured.
- Try to prevent other accidents from happening by warning other vehicles of the vehicle accident by placing accident hazard warning signs.

- Administer first aid to injured person(s).
- As soon as possible, record details of the accident.
- Report accident to Site Superintendent as soon as possible.

31.11 Bomb Threat

Treat all bomb threats seriously. Investigation may reveal a hoax, but until certain there is no risk, act with extreme caution.

31.11.1 Telephone threats

- Keep calm. It is not possible to think clearly when panicking.
- If possible, attract attention of another person, and have that person contact the Police.
- Delay the caller. The more the caller talks, the more chance there is of obtaining useful information.
- Try to elicit as much information as possible.
- Note any characteristics of the caller, e.g. sex, accent, speech (fast, soft, well-spoken, etc), background noises (music, street noises, aircraft, etc).
- If caller hesitates for more than a few minutes, ask another question.

When caller hangs up:

- Do not hang up, keep the line open.
- Evacuate premises if there is only a short time until stated explosion time.

Suspicious object found:

- Leave the object alone. DO NOT interfere with it in anyway.
- DO NOT TOUCH JAR, OR MOVE THE OBJECT.
- DO NOT cover it with water, or put water on it.
- Inform the Police.
- Open all doors and windows to minimise the blast damage.
- Have fire extinguisher ready.
- Evacuate the premises.

31.11.2 Evacuation

When directed to leave the building:

- act quickly and quietly

- leave the building via exits as directed
- take personal belongings which are handy in work areas, but do not go to other parts of the building to collect them
- assemble at a Safe Briefing Area.

31.12 Emergency Contact List

A contact list of key DGDC personnel and other organisations to contact in the event of an emergency will be drawn up. The list will include after-hour contact numbers, cell phones numbers etc.

The list will include:

- Senior DGDC Site Personnel
- Paramedics
- DGDC Health and Safety Co-ordinator
- Emergency Services
  - Fire
  - Medical (Hospital)
  - Ambulance
  - Police
- Statutory Government Agencies

A copy of the emergency contact list will be held at the security gatehouse and in the Site Safety Manual.

It will be revised and updated on a six monthly interval to account for changes in personnel, etc.

31.13 Training

All personnel, visitors and contractors will be trained on how to use the emergency plans set out in this section.

Emergency procedures will be included in induction training for all new staff and contractors to the site.

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Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-039: Incident/Accident Reporting
Revision 0

Contents

32. Incident/Accident Reporting

32.1 Introduction

This section sets out the policy and practices for notifying, investigating and reporting on incidents/accidents that occur at DGDC facilities (workplace) in which DGDC personnel, contractor personnel, visitors, the public and DGDC property are involved.

DGDC policy requires all employees, contractors and visitors to report any incidents that occur, including fire, explosion, natural disaster, equipment failure, plant, vehicle or other accident, other incidents or near misses. When an incident is reported, the practices stated in this section shall be followed.

32.2 Definitions

Lost-Time Accident (LTA)
Any incident/accident that results in serious harm to an individual with that person either being hospitalised or not being able to return to normal duties within a period of 24 hours after the incident/accident, or where the incident results in severe damage to equipment.

Serious Harm
i) Any of the following conditions that amount to, or result in, permanent loss of bodily function, or temporary severe loss of bodily function:

- respiratory disease
- noise-induced hearing loss
- neurological disease
- cancer
- dermatological disease
- communicable disease
- musculoskeletal disease
- illness caused by exposure to infected material
- decompression sickness
- poisoning
- vision impairment

- chemical or hot metal burn of the eye
- penetrating wound of eye
- bone fracture
- laceration
- crushing

ii) Amputation of body parts.

iii) Burns requiring referral to a specialist, registered medical practitioner or specialist outpatient clinic.

iv) Loss of consciousness from lack of oxygen.

v) Loss of consciousness, or acute illness requiring treatment by a registered medical practitioner, from absorption, inhalation, or ingestion, of any substance.

vi) Any harm that causes the person harmed to be hospitalised for a period of 24 hours or more commencing within seven (7) days of the harm's occurrence.

Non-Loss Time Accident (NLTA)
Any incident that results in harm to an individual with that person requiring some minor medical treatment, and is of such a nature that the person can resume normal duties within 24 hours of the event, or where the incident results in damage to equipment, etc.

Near Miss
An unplanned occurrence in which there is no injury to personnel, minor damage to equipment or property, and no interruption to production, but which possesses the potential to cause a LTA or NLTA.

Emergency
A state arising from unforeseen circumstances that requires immediate action to limit or contain the situation (such as fire, natural disaster, equipment failure, plant accident, vehicle accident, etc.) that threatens injury to personnel or damage to equipment and property.

Paramedic
A person trained as a paramedic who can administer treatment above first-aid, but less than that of a qualified medical practitioner (doctor).

Property Damage
Damage to equipment, plant or property resulting from an incident/accident. The level of property damage will define it as either a LTA, NLTA or near miss (see definitions above).

32.3 Responsibilities

32.3.1 DGDC Employees

DGDC employees are responsible for reporting any incident (LTA, NLTA, and near misses) that occurs to their immediate supervisor during DGDC operations, if any DGDC or contractor personnel, the public or DGDC equipment or property are involved. (This includes off-site traffic accidents or incidents involving DGDC personnel carrying out work for DGDC away from their normal place of work.)

32.3.2 Supervisors

The DGDC person supervising the activity in which the incident occurs or to whom the incident was reported to is responsible for the actions listed below:

a) Ensuring immediate notification of the incident. Notification is required for any incident or near miss resulting in a potential hazard or risk to personnel even though no personal injury or property damage may have occurred. Notify Site Supervisor of any serious incidents.
b) Starting the initial investigation into the incident by obtaining information, names of witnesses etc. This information should be recorded on the Accident Investigation Form.
c) Under direction of the Health and Safety Committee along with the Site Safety Officer, undertake a detailed investigation into the accident.

32.3.3 Paramedic

Attend to the injured person's needs. Record at a later date the extent of the injuries and the treatment administered. Record accident in the Site Accident Register. Complete MIGAS injury notification form.

32.3.4 Superintendent

Receive notification of serious accidents from supervisors. Through role as chairperson of Health and Safety Committee ensure accident is investigated and recommendations implemented.

32.3.5 Health and Safety Officer

The Site Health and Safety Officer shall record all incidents in the Accident Register and report them to the Site Superintendent.

To undertake an accident investigation with an affected persons immediate Supervisor. The report shall be completed within five (5) days of the incident.

To receive contractor's incident notifications.

32.3.6 Contractors

Contractors are responsible for reporting to the Site Superintendent all incidents, including near misses within one day of the incident, that occur while working at the site. Contractors are responsible for investigating any incident and reporting the incident to the Site Health and Safety Officer. The report shall be completed within five (5) days of the incident.

Procedural Steps in the Event of an Incident (LTA or NLTA)
Procedure in Event of an Incident
In the event of an incident (LTA, NLTA) or near miss, the steps listed below should be followed.

- At the time of the accident, a person should first ensure their own safety, then ensure the safety of others.
- Assess the situation.
- Minimise the risk of further injury by shutting down plant and equipment, turning off the power supply, extinguishing fires (if this is possible without taking undue risks), etc.
- Give appropriate first aid, or get the nearest trained first-aider to administer first-aid.
- Ring for emergency services (Paramedic) or get someone else to; this can be attended to earlier depending on manpower availability.

- Secure the area and do not interfere in any way with the accident scene (unless this is necessary to save life, prevent injury, maintain essential services or to prevent further damage or property loss).
- Should a person receive injury that requires treatment, above that which can be provided by the equipment contained in a first-aid box or by a trained first-aider, the site's Paramedic must be immediately notified.
- Report the accident/incident/near miss to the immediate supervisor/foreperson.

Guidelines for Management who Attend the Incident

- Review the situation.
- Access whether the accident scene has been dealt with appropriately.
- Find out the extent of the injuries sustained.
- Start to prepare documentation on the incident/near miss.
- Make a decision as to the need to report the accident to the relevant authorities.
- Make a list of all staff who witnessed the accident.

32.4 Incident Reporting/Recording

- All incidents, including near misses to personnel, plant and equipment damage, must be reported to the person's immediate supervisor or foreperson.
- The immediate supervisor will ensure the incident (LTA, NLTA or near miss) is recorded in the site's Accident Register (see Form 32.1 at end of this section) and will complete the initial sections of the Incident Investigation Report Form (see Form 32.2 at end of this section).
- The Accident Register is held at each site under the control of the Site Superintendent. The register is divided into four parts:
  i) Lost Time Accidents.
  ii) Non-Lost Time Accidents.
  iii) Near Misses.
  iv) Property Damage

  It records:
  - the date and time of the incident
  - briefly what happened
  - personnel involved
  - extent of injuries to personnel
  - extent of damage to equipment.

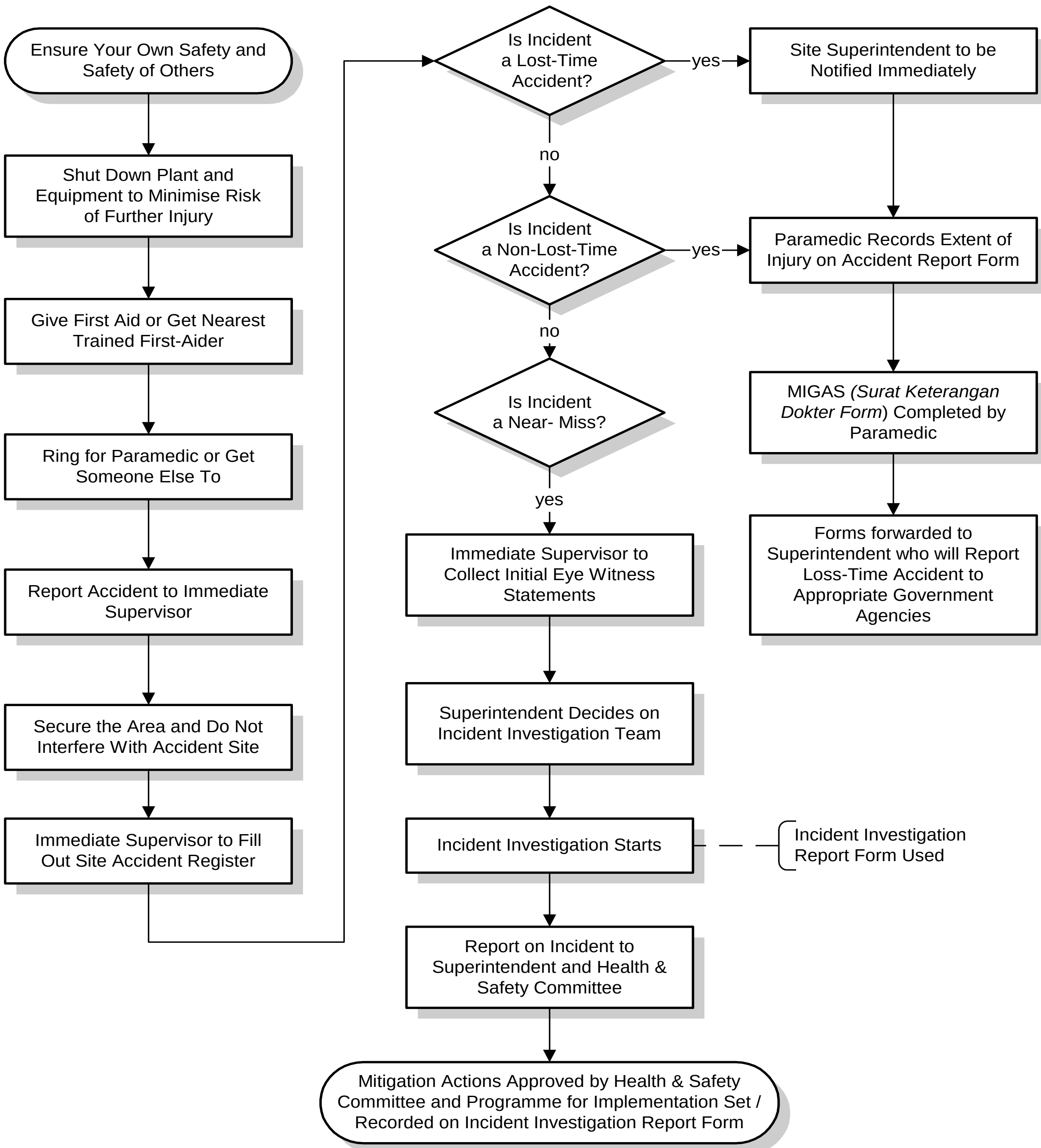
- Once those personnel involved in the incident have received adequate medical treatment, or are recovered sufficiently to be questioned as to the cause(s) of the incident, then initial statements should be recorded by the immediate supervisor.
- Incidents/accidents reportable, or likely to be reportable to the relevant Government agency, must be immediately brought to the attention of the Site Superintendent or deputy.
- The Paramedic shall record all details on the extent of the injuries received on the DGDC Paramedic Accident Injury Report Form (Form 32.3). This completed form shall be forwarded to the Site Superintendent and a copy to the Health and Safety Committee.
- For incidents that are reportable to the relevant Government agency, the scene of the accident shall be secured to allow it to remain in an undisturbed state until further notice, except where it constitutes a further safety hazard, then the supervisor in charge of the area must use their discretion in order to protect personnel and equipment.
- The Site Superintendent will decide on who shall undertake the Incident Investigation. In most instances the Incident Investigation shall be undertaken by the sections or work groups, the immediate supervisor and the site's Health and Safety Officer.
- The investigation shall be recorded on the Incident Investigation Report Form (Form 32.2) including all recommendations including improvements, work practice changes, disciplinary actions, etc.
- The Incident Investigation Report shall be forwarded to the Site Superintendent and to the Health and Safety Committee for their review.
- The report shall be presented to the Health and Safety Committee by the Site Health and Safety Officer.
- Report recommendations shall be reviewed by the committee and a programme to implement the recommendations developed. This programme will specify tasks, responsibilities and a timeframe for implementing the recommendations.
- The outcome of these discussions will be recorded in the minutes of the meeting and on the Incident Investigation Report.
- Progress as to implementing the recommendations will be tracked by the Health and Safety Committee.
- Disciplinary action will be at the sole discretion of the Site Superintendent, in discussion with Corporate Human Resources Manager.

- Within 48-hours the superintendent will send to the relevant Government agency details of the LTA on the appropriate forms. A copy will be sent to DGDC Corporate Health and Safety Coordinator.
- A copy of the completed LTA investigation shall be forwarded to the relevant Government agency and DGDC Health and Safety Co-ordinator.

The steps in the Incident/Accident Reporting are summarised in Figure 32.1

Figure 32.1: Incident / Accident Reporting

In The Event Of An Incident The Following Steps Should Be Followed:



32.5 Contractor Incident Reporting

Contractors working under the jurisdiction of DGDC in addition to their own incident reporting procedure shall:

- report the incident to the Site Superintendent
- ensure the incident is recorded in DGDC Site Accident Register
- complete the Accident Report Form (32.3) if injury has occurred and the Incident Investigation Report Form (32.2).

The completed reports shall be forwarded to the Site Health and Safety Committee.

32.6 Accident Investigation

32.6.1 Accident Investigation Responsibilities

The aim of the investigation is to establish the cause of the incident, not the guilty person, and to determine whether or not the incident was caused by, or arose from, a significant hazard.

For every incident (LTA, NLTA or near miss) reported, an incident investigation shall be undertaken and an Incident Investigation Report completed.

The incident investigation shall be carried out by the immediate supervisor in conjunction with the Site Health and Safety Officer. They shall complete the Incident Investigation Report (Form 32.2).

32.6.2 Points to Consider in the Investigation

Key points to include in the investigation are:

- Date and time of the occurrence
- People, materials, and equipment involved in the incident
- The location of the accident
- The general conditions that prevailed at the time of the incident;
  - the weather
  - road conditions
  - duties being conducted
  - lighting details

- type of safety equipment being used
- practices being followed, e.g. Permits-to-Work.

- Describe how the accident occurred, give minute to minute account of what happened.
- List actions taken and by whom, include all emergency details.
- Describe the severity of the injury and the likelihood of the accident happening again.
- Collect statements from witnesses clearly identifying the person making the statement.
- Establish underlying cause(s) of the accident and whether the accident arose from a 'significant hazard'.
- Analyse and evaluate all non-trivial causes:
  - evaluate if the incident is traceable to an identified hazard
  - determine the critical and specific causes.
- Develop and take control measures that may reduce the risk of recurrence:
  - take temporary actions immediately;
  - take permanent actions as soon as possible;
  - consider alternative controls;
  - document all details through a written report.
- Review findings and recommendations:
  - have the report reviewed;
  - decide who should be notified.
- Follow-up:
  - monitor preventive and/or remedial actions;
  - add any new hazards identified to the Hazard Register.
- List remedial actions to prevent a recurrence of the incident recording all recommendations on the form.
- Take photographs and make sketches whenever practicable.

Remember the main tool of the incident investigation is the interview and it is important to ask the right questions.

For LTAs or significant NTLAs the amount of information that needs to be covered is more than that which can be recorded on the Incident Investigation Report form. All additional details should be recorded on further sheets, in a report format and attached to the Incident Report Form.

32.6.3 Witness Statement

Usually a witness statement is taken, and may be produced in Court or at a legal hearing. Persons involved in, or witnessing an accident, may be asked for a statement.

The statement forms part of the 'evidence', which can be tested by cross-examination in Court. Statements must be both 'relevant', that is have direct relationship with the matter in hand, and 'admissible'. There are certain rules that govern if evidence is admissible. Without going into too much detail, it is important to note that hearsay evidence is generally not admissible. That means that a person cannot report what they did not actually see, because the facts obtained are not their own, but gained through conversation with another person, e.g. John said that he had been bitten by a dog, is hearsay as the author did not see a dog bite John.

A statement should clearly identify who is making the statement, usually by providing the full name, occupation and address, and shall be signed and dated by both the person making the statement and a witness.

32.7 Medical Emergency Procedures

The DGDC Medical Emergency Procedures shall be followed in the event of an unexpected serious illness or injury which needs hospital treatment.

32.8 Death or Serious Injury Notification Procedures

Death is an unexpected event that may occur because of an accident or an illness. When this occurs, the Human Resource Procedures which cover the notification of nearest relatives, the transfer of the body to relatives, etc. will be followed. These procedures are beyond the requirement of this Safety Manual which are to prevent injury and death, and to investigate those incidents which could result in death.

Reference should be made to the Personnel Manual as to relevant procedures for notifying relatives of a death or serious injury.

Form 32.1: DGDC

Incident Register

1. Particulars of Incident

____

____

____

Near Miss ☐ LTA ☐ NLTA ☐ Property Damage ☐

2. Location of Place of Work

____

____

3. Personal Data of Injured Person:

Name: ______________________________________

Residential Address: __________________________

Date of Birth: ____________________ Sex (M/F)__________

4. Occupation or Job Title of Injured Person

____

5. Period of Employment by DGDC of Injured Person:

1st week ☐ 1st month ☐ 1-6 mths ☐ 6 mths ☐

1-5 yrs ☐ over 5 yrs ☐ non-employee ☐

6. Treatment of Injury:

None ☐ First aid only ☐

Doctor but no hospitalisation ☐ Medical treatment ☐

7. Time and Date of Incident

Time ____________________am/pm

Date ______________________________

8. Mechanism of Incident

Fall, trip or slip	☐	Hitting objects with part of body	☐
Sound or pressure	☐	Being hit by moving objects	☐
Body stressing	☐	Heat, radiation or energy	☐
Biological factors	☐	Chemicals or other substances	☐
Mental stress	☐	Near miss	☐

9. Agent of Incident

Machinery or (mainly) fixed plant	☐
Mobile plant or transport	☐
Powered equipment, tool, or appliance	☐
Non-powered hand tool, appliance or equipment	☐
Chemical or chemical product	☐
Material or substance	☐
Environmental exposure (e.g. dust, gas)	☐
Animal, human or biological agency (other than bacteria or virus)	☐

10. Body Part:

Head	☐	Neck	☐	Trunk	☐	Upper Limb	☐
Lower Limb	☐	Multiple locations	☐	Systemic internal organs	☐		

11. Nature of Injury or Disease

Fracture of spine	☐	Puncture wound	☐
Other fracture	☐	Poisoning or toxic effects	☐
Dislocation	☐	Multiple injuries	☐
Sprain or strain	☐	Damage to artificial aid	☐
Head injury	☐	Disease, nervous system	☐
Internal injury of trunk	☐	Disease, musculoskeletal system	☐
Amputation, inc eye	☐	Disease, skin	☐
Open wound	☐	Disease, digestive system	☐
Superficial injury	☐	Disease, infectious or parasitic	☐
Bruising or crushing	☐	Disease, respiratory system	☐
Foreign body	☐	Disease, circulatory system	☐
Burns	☐	Tumour (malignant or benign)	☐
Nerves or spinal cord	☐	Mental disorder	☐

12. Where and How did the Incident Happen?
(If not enough room attach separate sheet(s))

____

____

13. Has an Investigation been Carried Out? Yes/No

Was a Significant Hazard Involved Yes/No

Employer or employer's representative (delete which is not applicable)

Signature and Date: ____

Name and Position: ____

Form 32.2: DGDC

Incident Investigation Report

DGDC SITE	DEPARTMENT		
EXACT LOCATION	DATE OF OCCURRENCE	TIME AM PM	DATE REPORTED

LOST-TIME ACCIDENT		NON-LOST-TIME ACCIDENT		NEAR MISS INCIDENT	
INJURED'S NAME		**INJURED'S NAME**		**PERSON REPORTING INCIDENT**	
OCCUPATION	PART OF BODY AFFECTED	OCCUPATION	PART OF BODY AFFECTED	OCCUPATION	COST (IF APPLICABLE) $
NATURE OF INJURY/ILLNESS		NATURE OF INJURY/ILLNESS		NATURE OF INCIDENT	
OBJECT/EQUIPMENT/SUBSTANCE/INFLICTING INJURY/ILLNESS		OBJECT/EQUIPMENT/SUBSTANCE/INFLICTING INJURY/ILLNESS		OBJECT/EQUIPMENT/SUBSTANCE/RELATED	
PERSON WITH MOST CONTROL OF ITEM 11		PERSON WITH MOST CONTROL OF ITEM 17		PERSON WITH MOST CONTROL OF ITEM	

DESCRIBE CLEARLY HOW THE INCIDENT OCCURRED (Continue on other sheets of paper as required)

WHAT ACTS, FAILURES TO ACT AND/OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS INCIDENT?

WHAT ARE THE BASIC OR FUNDAMENTAL REASONS FOR THE EXISTENCE OF THESE ACTS AND/OR CONDITIONS?

EVALUATION: SEVERITY POTENTIAL **MAJOR** **SERIOUS** **MINOR**	PROBABLE RECURRENCE RATE **FREQUENCE** **OCCASIONAL** **RARE**

WHAT ACTION HAS BEEN, OR WILL BE, TAKEN TO PREVENT RECURRENCE? NUMBER ALL ITEMS IN SEQUENCE (Attach Additional Pages as Required)

CIRCLE NUMBER AND GIVE DATE OF INTERMEDIATE ACTION. CROSS OUT NUMBER (AND GIVE DATE) WHEN COMPLETED

INTERMEDIATE 1 ___________ 2 ___________ 3 ___________ 4 ____________ 5 ___________ 6 ___________ 7 ____________ 8 ______________

COMPLETED 1 ____________ 2 ______________ 3 _____________ 4 _______________ 5 ______________ 6 ______________ 7 ______________ 8 ______________

INVESTIGATED BY	DATE	REVIEWED BY	DATE

Form 32.3

To: DGDC
Attn:
From:
Subject: Medical Accident Report
Copy: Al. Safety Department

Ref No.

Paramedic Accident Injury Report

Name of Injured: ______________________________

Date of Birth ______________________________

Company/Position: ______________________________

Date of Accident ______________________________

Time of Accident: ______________________________

Location of Accident: ______________________________

Type of Injury: ______________________________

Cause of Injury: ______________________________

____

Treatment: ______________________________

____

____

____

Recommendation:

1. Return to Work Yes/No
2. No of Rest Days _______
3. Further Treatment Yes/No

Report by: ______________________________

Dominica Geothermal Development Company Limited
Powering a New Generation...

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-040: Monitoring of Safety Systems
Revision 0

Contents

33. Management Review

33.1 Introduction

The purpose of this section is to establish methods and standards for the assessing the health and safety performance of DGDC facilities.

DGDC safety performance can be monitored during the year, via a number of means. These include:

- occupational hygiene monitoring of worker's exposures to various hazards
- noise monitoring and effectiveness of hearing conservation programmes
- the number of incidents/accidents reported
- the number of new hazards identified and assessed, or reviewed
- results of staff medical surveillance
- the number of Safety Alert notifications
- the results of regular inspections of safe work practices
- evaluating whether targets are being met within specified time frames
- external and internal safety audits of the facility or targeted areas and/or work practices.

A performance monitoring plan will need to be established at each facility in relation to the level and type of significant hazards present. The Health and Safety Committee shall approve the plan and the Site Superintendent will implement the plan.

33.2 Safety Auditing

An inspection and auditing programme will be established at each facility. The audits will be at regular intervals to ensure the ongoing effectiveness of the site's Safety System. The audit programme shall be approved by the Site's Health and Safety Committee.

The audits are required to ensure:

- the safe work practices are understood and being implemented
- the resources are adequate and personnel are suitably trained for delegated tasks

- hazards are being identified and control measures implemented
- the documented work control systems are being undertaken
- corrective actions for accident investigation, changes to equipment, plant and operating process are being implemented within the specified time.

Safety audits and checklists are provided in the sections detailing safe work practices. These checklists should be used in the first instance to assess compliance with the requirements of the safe work practices.

A full site Safety Audit checklist which can be used to audit the safety management performance at the site is presented at the end of this section. This questionnaire reviews elements relevant to managing safety of the facilities. Safety Management System Audits should be performed on an annual basis until the Safety Management System is performing well and then that audit frequency can be extended to once every two years.

Objectives, targets and performance measures should be audited; to establish which targets are being achieved within time frames and that tasks in the Safety Management Plan have been implemented.

33.3 Audit Reports

A summary report will be produced for each audit undertaken. This report will summarise the audit, the work area or safe work practice audited, number of defects found and recommendations for corrective actions. The report will be submitted to the Health and Safety Officer and to the Health and Safety Committee. The controls implemented as a result of the audit shall be recorded in the minutes of the Safety Committee's meetings.

All audit reports will be held by the Health and Safety Officer in their role as secretary to the Health and Safety Committee.

33.4 Procedures

The General Manager has overall responsibility for ensuring the safety system and performance is audited. At each facility the Health and Safety Officer under the jurisdiction of the Site Superintendent has direct responsibility for planning and managing the safety audit procedures. Such planning may vary depending on the nature and significance of site hazards and the frequency of non-conformance detected within the system. The greater the level of non-conformance the more rigorous the auditing plan.

Audits will be carried out by personnel trained in the safety audit procedures and familiar with the safe practices to be audited.

Monitoring of health and safety management system shall be carried out annually for the first five years of operation and every two years thereafter. Safe work practices should be audited every six months or if there is a change at the site to equipment, plant or standard operating procedures. A sample of completed Permit to Works shall be audited every three months for compliance with the specified safe work practices.

Full site Safety Management System Audits should be performed by personnel from other DGDC sites with the Lead Auditor being the Environmental and Safety Coordinator.

Table 33.1 details the audits required, together with a summary of the method that must be used - normally in the form of a checklist.

Table 33.1 Safety Audit Frequency

Health and Safety Management System Assessment. • For the assessment of the effectiveness of current measures to manage health and safety. • To be done by an independent health and safety expert (possibly from another DGDC site)	Use Audit Checklist Form 33.1 to identify any deficiencies or gaps in current health and safety system. Annually
Site Safety Assessment • To be carried out by site supervisors	Use Audit Checklist Form 33.2 on a six monthly basis
Assessment of Permit to Work System. • To be carried out by Shift Supervisors	Audits to be undertaken every three months. Audit completed Permit to Work and Permit Log for completeness and against DGDC requirements.
Review of in-force Permits. • Undertaken by night shift operators as directed by Shift Supervisor.	A sample each day.
Assessment of Accident records • To be completed by the health and safety officer.	Every three months.
Assessment of Hazardous Substances handling and storage. • To be done by the Health and Safety Officer	Every three months.
Review of safety performance in achieving objectives and targets. • Health and Safety Committee	Ongoing, formal every three months.
Noise Assessment • To be done by person qualified and experienced in noise exposure assessment	Preliminary noise assessment during commissioning and when noise hazard areas are identified or there are changes to equipment or plant.

Compliance with Safe Work Practices • Supervisors, forepersons and Health and Safety Officer.	Ongoing, formally once every three months.

These audits shall be recorded and copies held with the health and safety officer.

For each deficiency detected during the audit an Improvement Request will be raised and submitted to the Health and Safety Committee for implementing corrective actions. A copy of an Improvement Request is presented at the end of this section as Form 33.3

33.5 Corrective Actions

All Improvement Requests, Safety Alert Cards, and complaints will be forwarded to the Health and Safety Committee to review and recommend corrective actions. For each instance the recommended corrective actions will be in the Committee's Meeting Minutes and tasks allocated to specific line managers, etc to implement the corrective action.

The person with ultimate responsibility for implementing corrective action is the Site Superintendent (Chairperson of the Health and Safety Committee).

Corrective actions could include one of the following:

training of individuals or contractors
disciplinary action of individuals or contractors
adjustment of hazard controls
adjustment of safe work practices
modifying safety system
instigating new safe work practices.

33.6 Training

DGDC shall ensure that employees are trained in auditing or assessment as appropriate.

Auditors must be given full training covering:

- health and safety issues relevant to the process that they are auditing
- auditing techniques
- recommendations of remedies/control measures
- implementation of controls.

33.7 Safety Management Audit Questionnaires

Examples of two audit questionnaires (Form 33.1 and Form 33.2) which can be amended to develop a site specific safety Management Audit Questionnaire are presented on the following pages.

Form 33.1 : Safety Management System
Audit Questionnaire

		Yes/No	Comments
MANAGEMENT COMMITMENT			
A.	**Policy Statement**		
1.	Is there a written health and safety policy?		
2.	Is the policy suitably displayed at each work site?		
3.	Is the policy signed by the senior manager on site? Dated?		
4.	Are off-site operations adequately covered?		
B.	**Policy Objectives & Targets**		
1.	Are annual H&S objectives and targets set by management?		
2.	Are the objectives measurable?		
3.	Are the health and safety objectives reviewed annually?		
C.	**Management Responsibilities**		
1.	Are health & safety responsibilities clearly defined in every manager's job description?		
2.	Are all managers aware of the current legislation and codes of practice applicable to their industry?		
3.	Are H&S responsibilities part of the performance evaluation process?		

		Yes/No	Comments
D.	**Employee Responsibilities**		
1.	Are employees aware of their responsibilities and rights under the legislation?		
2.	Are employees aware of the mechanisms in place for reporting accidents?		
3.	Are employees aware of the mechanisms in place for identifying and reporting hazards?		
E.	**Authorities and Authorisation**		
1.	Do people have the authority required to carry out their H&S responsibilities?		
2.	Does anyone have the authority to waive adherence to established H&S requirements?		
3.	If standard H&S procedures are not followed, is there any formal system or required documentation?		
4.	Are authorisations sometimes given without an understanding of what is involved?		
F.	**Conflicts of Interest**		
1.	Do you see any conflicts of interest between H&S issues and economic issues, production goals, job performance goals?		

		Yes/No	Comments
2.	Do people responsible for H&S issues also have other conflicting responsibilities?		

G.	**Procedures**		
1.	Is there a set of written health and safety procedures?		
2.	Do written procedures cover all areas of health and safety?		
3.	Do written procedures constitute a controlled document?		
4.	Are written procedures individually authorised and dated?		
5.	Are written procedures freely available to all employees?		
6.	Are there written SOPs including health & safety provisions?		
HEALTH AND SAFETY ADMINISTRATION			
H.	**Programme Co-ordination**		
1.	Has one person been designated as health and safety co-ordinator?		
2.	Does the health and safety co-ordinator report to senior site manager?		
I.	**Health and Safety Representation**		
1.	Is there a health and safety committee		

		Yes/No	Comments
2.	Are there individual health and safety representatives?		
3.	Is there a written procedure clearly setting out their functions?		
4.	Do people with health and safety responsibilities have an appropriate level of authority to take corrective action?		
5.	Are minutes of health and safety committee meeting circulated to all staff?		
J.	**Planned General Inspections**		
1.	Is there a written procedure for carrying out planned inspections?		
2.	Are planned inspections carried out regularly?		
3.	Are planned inspections carried out against a standard check sheet ?		
4.	Are the results of each inspection made available to employees?		
5.	Are all substandard conditions/practices observed during the inspections reported and writing?		
K.	**Health and Safety Rules**		
1.	Is there a written set of health and safety rules?		
2.	Does each employee have a copy of these rules?		

		Yes/No	Comments
3.	Are rules discussed with employees?		
4.	Are relevant rules displayed around the work site?		
5.	Are these rules included in the procedures manual?		
6.	Are the health and safety rules consistently enforced?		
7.	Are these rules made available to contractors?		
HAZARD IDENTIFICATION, ASSESSMENT AND CONTROL			
L.	**Identification**		
1.	Is there a written procedure for systematic hazard identification?		
2.	Have all existing hazards been systematically identified? - by process - by material - by task - by area		
3.	Is there a method for the systematic identification of potential hazards?		
4.	Are hazard reporting forms available for all staff to use?		
M.	**Assessment**		
1.	Is there a written procedure for hazard assessment?		

		Yes/No	Comments
2.	Have all hazards been assessed and significant hazards determined?		
3.	Have hazard assessments been documented?		
N.	**Control**		
1.	Is there a written procedure for hazard control?		
2.	Have all significant hazards been eliminated where practicable?		
3.	Have all significant hazards been isolated where elimination not practicable?		
4.	Have all significant hazards been minimised where elimination and isolation not practicable?		
5.	Are “other” hazards controlled?		
6.	Are hazard reports periodical reviewed?		
INFORMATION TRAINING & SUPERVISION			
O.	**Information**		
1.	Are employees provided with adequate information on the significant hazards to which they are exposed, or may create?		
2.	Are employees provided with adequate information on control measures in place for significant hazards?		

		Yes/No	Comments
3.	Have specific information needs been identified?		
4.	Are there written procedures on the supply and storage of information?		
5.	Is there a specific person with the responsibility of managing the provision of information?		
6.	Have all employees received adequate information?		
7.	Do all employees appear to understand the information supplied?		
8.	Is information given to visitors, contractors before they enter the site?		
P.	**Training**		
1.	Are all new employees put through a health and safety induction programme?		
2.	Are there written procedure for training employees in health & safety?		
3.	Are training needs identified and analysed for each employee?		
4.	Are appropriate records kept on all employee training?		
5.	Are all employees appropriately trained before working alone?		

		Yes/No	Comments
6.	Have all tasks been analysed to identify hazards and associated training needs?		
7.	Is training content and language able to be understood by employees?		
8.	Is ongoing work performance monitored to ensure correct performance?		
9.	Is training in hazard identification and management provided?		
10.	Do contractors receive training in the safety procedures before going on-site?		
Q. Supervision			
1.	Are untrained/unskilled workers adequately supervised?		
2.	Is supervision carried out by someone with appropriate level of skill and knowledge?		
3.	Are there written procedures indicating the level of supervision required?		
ACCIDENT REPORTING AND INVESTIGATION			
R. Accident Reporting			
1.	Are there written procedures for accident reporting and investigation?		
2.	Have all employees been trained in accident reporting?		

		Yes/No	Comments
3.	Is a register of accidents kept?		
4.	Are all lost time accidents recorded?		
5.	Are all accidents resulting in non-serious harm recorded?		
6.	Are all 'near-miss' incidents recorded?		
7.	Is notification as soon as possible, required for serious accidents?		
8.	Do staff follow accident reporting requirements?		
S.	**Accident Investigation**		
1.	Are all accidents and incidents investigated and causes identified?		
2.	Are there procedures that ensure recommendations are acted upon?		
3.	Are all accident reports seen by senior management?		
4.	Have personnel carrying out accident investigation been trained?		
5.	Is data in registers periodically analysed to show trends?		
6.	Are all accidents costed?		
T.	**First Aid**		
1.	Are there written procedures on first aid?		
2.	Are first aid facilities and equipment adequate?		

		Yes/No	Comments
3.	Is there always a qualified first aider on site?		
U.	**Emergency Procedures**		
1.	Are there written emergency procedures and plans?		
2.	Are they up to date?		
3.	Are major procedures prominently displayed?		
4.	Have all likely causes of emergency been identified?		
5.	Is there an emergency co-ordinator?		
6.	Have all employees been trained in emergency procedures?		
7.	Does the emergency plan clearly state the areas of responsibility and the procedures to be followed?		
8.	Is there a system for accounting for all persons on site?		
9.	Has there been an emergency drill in the past 12 months?		
10.	Are drills evaluated with respect to performance?		
11.	Are the emergency procedures reviewed at least annually		
12.	Are regular checks made on fire escape routes?		
13.	Are sufficient numbers of staff trained in first aid and CPR?		

		Yes/No	Comments
14.	Are emergency telephone numbers prominently posted?		
V.	**Contractors and Subcontractors**		
1.	Are there written procedures for the management of contractors and sub-contractors?		
2.	Are health and safety performance requirements written into contracts?		
3.	Do the criteria for contractor and sub-contractor selection include past health and safety performance?		
4.	Are contractors and subcontractors required to submit plans on how they will manage health and safety?		
5.	Is there a planned induction for contractors and subcontractors?		
6.	Are there systems in place to monitor the H&S performance of contractors and sub-contractors?		
7.	Are disciplinary provisions available in the contract?		
8.	Have situations where this relationship applies been identified?		
9.	Is H&S considered in equipment purchase and/or hire?		
GENERAL			
W.	**Personal Protective Equipment**		
1.	Is there a written procedure on the provision, use, and maintenance of		

		Yes/No	Comments
	PPE and RPFs (including emergency PPE)?		
2.	Is the correct PPE available to all employees?		
3.	Have employees been trained in the use of their PPE?		
4.	Are employees assessed for their suitability to wear PPE?		
X.	**Health Controls**		
1.	Are there written procedures on the monitoring of employee health?		
2.	Are the procedures appropriate to the hazards encountered?		
3.	Is worker health monitored?		
4.	Are all personal monitoring results made available to employees?		
5.	Are pre-employment medical checks given to potential employees?		
Y.	**Monitoring**		
1.	Are there written procedures for safety (noise, occupational hygiene, etc) monitoring?		
2.	Are the procedures appropriate to the hazards encountered?		
3.	Are all monitoring results made available to employees?		
4.	Are results understood and acted upon by the responsible person?		

		Yes/No	Comments
Z.	**Resources**		
1.	Is there a register of all relevant health and safety legislation, guidelines, codes of practice, and standards?		
2.	Is there a procedure for obtaining and reviewing new legislation, codes, and standards etc.?		
AA.	**Purchasing Controls**		
1.	Are there written procedures for equipment purchasing that include health and safety provisions?		
2.	Are there written procedures for materials purchasing that include health and safety provisions?		
3.	Is there an inventory of hazardous substances held on site?		
4.	Are MSDSs required for prior to the delivery of any hazardous substance to the site?		
AB.	**Equipment Maintenance**		
1.	Are there written procedures for equipment maintenance?		
2.	Do these procedures require the physical disabling of equipment prior to maintenance?		
3.	Is there a preventative maintenance programme?		

		Yes/No	Comments
4.	Are all items of 'critical' equipment systematically inspected on a regular basis?		
5.	Are daily checks made before mobile equipment is used?		
AC.	**Communication**		
1.	Are there effective channels of communication between all levels of the organisation?		
AD	**Permits-to-Work**		
1.	Are permit-to-work systems used?		
2.	Do they include: • Entry permits • Confined space • Hot work • Stick work • Working at heights • Hazardous areas • Lockouts		
3.	Are there other systems covered by Permit-to-work (list)		
4.	Is there a register of permits issued, and who authorises them?		
5.	Are completed permits returned and retained?		
AE	**Documentation Available**		
1.	Health and Safety Policy		
2.	Health & Safety Manual/Guidelines		

		Yes/No	Comments
3.	Emergency Plan		
4.	Staff Handbook		
5.	Staff Induction Programme		
6.	Staff Contract		
7.	Material Safety Data Sheets		
8.	Accident Records		
9.	Hazard Records/Register		
10.	Insurance Claims		
11.	H&S Committee Minutes		
12.	Contractor Appointment Documents		
13.	Statutory Notices/Regulatory Authority Correspondence		
14.	Tenancy Agreements		
15.	Past Health & Safety Reports		
16.	Other		
AF	**Personnel Available**		
1.	Health and Safety Officer/ Coordinator		
2.	Health and Safety Committee		
3.	Staff Representative (Union)		
4.	Training Officer/ Coordinator		
5.	Facilities Maintenance Manager		
6.	Occupational Health Nurse		
7.	First Aider		
8.	General Practitioner		

		Yes/No	Comments
9.	Chief Executive/ General Manager		
10.	Other		
AG	**Other Comments**		

Form 33.2
Site Safety Audit

■ **ACTIVE MANAGEMENT COMMITMENT**

■ **POLICY STATEMENT**

1. Is there a written health and safety policy? YES ☐ NO ☐

2. Is the policy suitably displayed at each work site? YES ☐ NO ☐

3. Is the policy signed by the senior manager on site? YES ☐ NO ☐

4. Is the statement dated? YES ☐ NO ☐

■ **POLICY OBJECTIVES**

5. Are the health and safety objectives set/reviewed annually? YES ☐ NO ☐

6. Are the objectives measurable? YES ☐ NO ☐

■ **MANAGEMENT RESPONSIBILITIES**

7. Are health & safety responsibilities clearly defined in every manager's job description? YES ☐ NO ☐

8. Are all managers aware of the current legislation and codes of practice applicable to their industry? YES ☐ NO ☐

■ **EMPLOYEE RESPONSIBILITIES**

9. Are employees aware of their responsibilities? YES ☐ NO ☐

10. Are employees aware of the mechanisms in place for reporting accidents? YES ☐ NO ☐

■ **PROCEDURES**

11. Is there a set of written health and safety procedures? YES ☐ NO ☐

12. Do written procedures cover all areas of health and safety? YES ☐ NO ☐

13. Do written procedures constitute a controlled document? YES ☐ NO ☐

14. Are written procedures individually authorised and dated YES ☐ NO ☐

15. Are written procedures freely available to all employees? YES ☐ NO ☐

16. Are there written SOPs including health & safety provisions? YES ☐ NO ☐

■ **HEALTH AND SAFETY ADMINISTRATION**

■ **PROGRAMME CO-ORDINATION**

1. Has one person been designated as health and safety co-ordinator? YES ☐ NO ☐

2. Does the health and safety co-ordinator report to senior site manager? YES ☐ NO ☐

■ **HEALTH AND SAFETY REPRESENTATION**

3. Is there a health and safety committee? YES ☐ NO ☐

4. Are there individual health and safety representatives? YES ☐ NO ☐

5. Is there a written procedure clearly setting out their functions? YES ☐ NO ☐

6. Do people with health and safety responsibilities have an appropriate level of authority to take corrective action? YES ☐ NO ☐

7. Are minutes of health and safety committee meeting circulated to all staff? YES ☐ NO ☐

■ **PLANNED GENERAL INSPECTIONS**

8. Is there a written procedure for carrying out planned inspections? YES ☐ NO ☐

9. Are planned inspections carried out regularly? YES ☐ NO ☐

10. Are planned inspections carried out against a standard check sheet? YES ☐ NO ☐

11. Are the results of each inspection made available to employees? YES ☐ NO ☐

■ **HEALTH AND SAFETY RULES**

12. Is there a written set of health and safety rules? YES ☐ NO ☐

13. Does each employee have a copy of these rules? YES ☐ NO ☐

14. Are rules discussed with employees? YES ☐ NO ☐

15. Are relevant rules displayed around the worksite? YES ☐ NO ☐

16. Are these rules included in the procedures manual? YES ☐ NO ☐

17. Are the health and safety rules consistently enforced? YES ☐ NO ☐

■ **HAZARD IDENTIFICATION, ASSESSMENT & CONTROL**

■ **IDENTIFICATION**

1. Is there a written procedure for systematic hazard identification? YES ☐ NO ☐

2. Have all existing hazards been systematically identified? YES ☐ NO ☐

   -by process YES ☐ NO ☐

   -by material YES ☐ NO ☐

   -by task YES ☐ NO ☐

   -by location YES ☐ NO ☐

3. Is there a method for the systematic identification of potential hazards? YES ☐ NO ☐

4. Were all employees given the opportunity to be fully involved? YES ☐ NO ☐

5. Were employees trained in hazard identification? YES ☐ NO ☐

6. Was specialist advice obtained to assist with hazard identification? YES ☐ NO ☐

■ **ASSESSMENT**

7. Is there a written procedure for hazard assessment? YES ☐ NO ☐

8. Have all hazards been assessed and significant hazards determined? YES ☐ NO ☐

■ **CONTROL**

9. Is there a written procedure for hazard control? YES ☐ NO ☐

10. Have all significant hazards been eliminated where practicable? YES ☐ NO ☐

11. Have all significant hazards been isolated where elimination not practicable? YES ☐ NO ☐

12. Have all significant hazards been minimised where elimination and isolation not practicable? YES ☐ NO ☐

■ **INFORMATION TRAINING & SUPERVISION**

■ **INFORMATION**

1. Are employees provided with adequate information on the significant hazards to which they are exposed, or may create? YES ☐ NO ☐

2. Have specific information needs been identified? YES ☐ NO ☐

3. Are there written procedures on the supply and storage of information? YES ☐ NO ☐

4. Is there a specific person with the responsibility of managing the provision of information? YES ☐ NO ☐

5. Have all employees received adequate information? YES ☐ NO ☐

6. Do all employees appear to understand the information supplied? YES ☐ NO ☐

■ **TRAINING**

7. Are there written health and safety procedures for the induction of new employees? YES ☐ NO ☐

8. Are all new employees put through a health and safety induction programme? YES ☐ NO ☐

9. Are there written procedure for training employees in health & safety? YES ☐ NO ☐

10. Are training needs identified and analysed for each employee? YES ☐ NO ☐

11. Are appropriate records kept on all employee training? YES ☐ NO ☐

12. Are all employees appropriately trained before working alone? YES ☐ NO ☐

13. Have all tasks been analysed to identify hazards and associated training needs? YES ☐ NO ☐

14. Is training content and language able to be understood by employees? YES ☐ NO ☐

15. Is ongoing work performance monitored to ensure correct performance? YES ☐ NO ☐

■ **SUPERVISION**

16. Are untrained/unskilled workers adequately supervised? YES ☐ NO ☐

17. Is supervision carried out by someone with appropriate level of skill and knowledge? YES ☐ NO ☐

18. Are there written procedures indicating the level of supervision required? YES ☐ NO ☐

■ **ACCIDENT REPORTING & INVESTIGATION**

■ **ACCIDENT REPORTING**

1. Are there written procedures for accident reporting and investigation? YES ☐ NO ☐

2. Have all employees been trained in accident reporting? YES ☐ NO ☐

3. Is a register of accidents kept? YES ☐ NO ☐

4. Is the register in the prescribed form? YES ☐ NO ☐

5. Are all serious harm accidents recorded? YES ☐ NO ☐

6. Are all accidents resulting in non-serious harm recorded? YES ☐ NO ☐

7. Are all 'near miss' incidents recorded? YES ☐ NO ☐

8. Have all cases of serious harm been reported to OSH? YES ☐ NO ☐

9. Was notification a.s.a.p, with formal notice within 7 days? YES ☐ NO ☐

■ **ACCIDENT INVESTIGATION**

10. Are accidents and incidents investigated and causes identified? YES ☐ NO ☐

11. Are there procedures that ensure recommendations are acted upon? YES ☐ NO ☐

12. Are all accident reports seen by senior management? YES ☐ NO ☐

13. Have personnel carrying out accident investigation been trained? YES ☐ NO ☐

14. Is data in registers periodically analysed to show trends? YES ☐ NO ☐

15. Are all accidents costed? YES ☐ NO ☐

■ **FIRST AID**

16. Are there written procedures on first aid? YES ☐ NO ☐

17. Are first aid facilities and equipment adequate? YES ☐ NO ☐

18. Is there always a qualified first aider on site? YES ☐ NO ☐

■ **EMERGENCY PROCEDURES**

1. Are there written emergency procedures and plans? YES ☐ NO ☐

2. Are major procedures prominently displayed? YES ☐ NO ☐

3. Have all likely causes of emergency been identified? YES ☐ NO ☐

4. Is there an emergency co-ordinator? YES ☐ NO ☐

5. Are employees involved in developing emergency procedures? YES ☐ NO ☐

6. Have all employees been trained in emergency procedures? YES ☐ NO ☐

7. Does the emergency plan clearly state the areas of responsibility and the procedures to be followed? YES ☐ NO ☐

8. Is there a system for accounting for all persons on site? YES ☐ NO ☐

9. Has there been an emergency drill in the past 12 months? YES ☐ NO ☐

10. Are the emergency procedures reviewed at least annually? YES ☐ NO ☐

11. Are sufficient numbers of staff trained in first aid and CPR? YES ☐ NO ☐

12. Are emergency telephone numbers prominently posted? YES ☐ NO ☐

■ **PRINCIPALS, CONTRACTORS, AND SUB-CONTRACTORS**

1. Does the employer understand the term 'principal', and its associated duties? YES ☐ NO ☐

2. Are there written procedures for the management of contractors and sub-contractors? YES ☐ NO ☐

3. Are health and safety performance requirements written into contracts? YES ☐ NO ☐

4. Does criteria for contractor and sub-contractor selection include past health and safety performance? YES ☐ NO ☐

5. Are contractors and sub-contractors required to submit plans on how they will manage health and safety? YES ☐ NO ☐

6. Is there a planned induction for contractors and sub-contractors? YES ☐ NO ☐

7. There are systems in place to monitor the performance of contractors and sub-contractors? YES ☐ NO ☐

8. Have situations where this relationship applies been identified? YES ☐ NO ☐

■ **GENERAL**

■ **PERSONAL PROTECTIVE EQUIPMENT**

1. Is there a written procedure on the provision, use, and maintenance of PPE (including emergency PPE)? YES ☐ NO ☐

2. Is the correct PPE available to all employees? YES ☐ NO ☐

3. Have employees been trained in the use of their PPE? YES ☐ NO ☐

4. Are employees assessed for their suitability to wear PPE? YES ☐ NO ☐

■ **HEALTH CONTROLS**

4. Are there written procedures on the monitoring of employee health? YES ☐ NO ☐

5. Are the procedures appropriate to the hazards encountered? YES ☐ NO ☐

6. Is worker health monitored? YES ☐ NO ☐

7. Are all personal monitoring results made available to employees? YES ☐ NO ☐

8. Are results understood and acted upon by the responsible person? YES ☐ NO ☐

9. Are pre-employment medical checks given to potential employees? YES ☐ NO ☐

■ **MONITORING**

10. Are there written procedures for occupational hygiene monitoring? YES ☐ NO ☐

11. Are the procedures appropriate to the hazards encountered? YES ☐ NO ☐

12. Are all monitoring results made available to employees? YES ☐ NO ☐

13. Are results understood and acted upon by the responsible person? YES ☐ NO ☐

■ **RESOURCES**

14. Is there a register of all relevant health and safety legislation, guidelines, codes of practice, and standards? YES ☐ NO ☐

15. Is there a procedure for obtaining and reviewing new legislation, codes, and standards etc. YES ☐ NO ☐

■ **PURCHASING CONTROLS**

16. Are there written procedures for equipment purchasing that include health and safety provisions? YES ☐ NO ☐

17. Are there written procedures for materials purchasing that include health and safety provisions? YES ☐ NO ☐

18. Is there an inventory of hazardous substances held on site? YES ☐ NO ☐

19. Are MSDSs required for prior to the delivery of any hazardous substance to the site? YES ☐ NO ☐

■ **EQUIPMENT MAINTENANCE**

20. Are there written procedures for equipment maintenance YES ☐ NO ☐

21. Do these procedures require the physical disabling of equipment prior to maintenance? YES ☐ NO ☐

22. Is there a preventative maintenance programme YES ☐ NO ☐

23. Are all items of 'critical' equipment systematically inspected on a regular basis? YES ☐ NO ☐

24. Are daily checks made before mobile equipment is used YES ☐ NO ☐

■ **COMMUNICATION**

25 Are there effective channels of communication between all levels of the organisation? YES ☐ NO ☐

Form 33.3: Improvement Request (IR)

Initiator(s)

IR Ref: ________________

IR Date: ________________

Part A: **By Initiator**		
Is IR the result of an Audit?	Yes	No
Is IR the result of an Incident/Accident Investigation?	Yes	No
Is IR the result of a Safety Audit Card notification?	Yes	No
Is IR the result of a complaint	Yes	No
Is IR the result of a Hazard Assessment	Yes	No
Describe the Safe Work Practices/Permit-to-Work Audited		
Department/Section Name Audited etc.		
Reason for Improvement Request: Non-Conformance ☐ Complaint ☐ Recommendation ☐ Describe:		
Part B: **By Health and Safety Committee** Target Date for Completion: ____________________		
Describe Corrective Action:		

Date Corrective Action Completed: Signed: ____________________

Occupational Health & Safety Manual
Volume 2: Safe Work Practices

DGDC-OHS-041: Housekeeping
Revision 0

Contents

34. Housekeeping

34.1 Introduction

Good housekeeping practices are important in the ongoing safety of DGDC operations. This section details the measures that should be taken by DGDC staff, contractors and contracted personnel to minimise the potential for accidents caused by poor housekeeping.

34.2 Background

Housekeeping is basically measures taken to keep the workplace tidy, uncluttered and clean. Hazards associated with poor housekeeping are generally seen as minor e.g., slips and trips. These are also the most frequent accidents that occur in the workplace.

An example is an employee tripping over some uplifted carpet. This accident could potentially cause effects ranging from minor bruising to sprained muscles and broken bones. The severity could be greatly magnified if, for instance, the uplifted carpet was partly up a stairwell. Thus a seemingly minor hazard can result in life-long injury and/or many small injuries.

The significance of hazards present due to poor housekeeping are often greatly magnified in an emergency.

Good housekeeping can significantly reduce the number and severity of these accidents.

34.3 Responsibilities

- Housekeeping shall primarily be the responsibility of individuals. Every person when working at the site shall endeavour to minimise hazards by cleaning and tidying their workplace as appropriate.
- Line supervisors shall inform employees if risks due to poor housekeeping are present in their work area.
- DGDC will strive to minimise hazards by setting up and maintaining practical work stations designed to enable ease of operation.
- DGDC shall provide sufficient equipment to enable effective cleaning.

34.4 Hazards Due to Poor Housekeeping

Good housekeeping is a vital factor in preventing accidents. The great majority of work accidents are caused during the handling of goods or materials, and by people falling, being hit by falling objects or striking against objects in the workplace.

Some of the accidents commonly caused by bad housekeeping are:

- tripping over loose objects on floors, stairs and platforms
- articles dropping off shelves or from above
- slipping on greasy, west or dirty surfaces (floors, scaffolding planks, walkways, etc.)
- striking against projecting, poorly shored, or misplaced material
- tearing the hand or other parts of the body on protruding nails, wire, sheet, strapping on bales or boxes, etc.
- labels falling off hazardous substance drums and not being replaced, bungs lids not securely fastened resulting in chemical splashes.

Typically examples of workplace hazard created by poor housekeeping include:

- excessive material, waste or chips in the immediate working area
- congested aisles
- tools left on machines or overhanging
- waste containers overflowing
- lockers and workrooms in disorder
- bungs, lids left off containers containing hazardous substances
- acids/alkalis held in open containers
- broken glass left on floors etc.
- electric leads or airlines across aisles, etc.
- inadequate lighting due to blown bulbs/tubes not being replaced
- dirty light fittings, windows and skylights.

34.5 Basic Good Housekeeping

The sub-sections below outline the basics of good housekeeping practices that will be observed at DGDC facilities.

34.5.1 Keeping Aisles Clear

Aisle space should be reserved for the movement of personnel, products and materials. It should be kept clean and clear and should never be used for "bottleneck" or "overflow" storage. This also applies to passageways and emergency exits.

Blind corners should be eliminated or be adequately protected by warning signs.

Aisle boundary markings should be drawn to show clearly the space which has been reserved for traffic; they should be sufficiently wide (say a minimum of 30 mm) and of a colour to make them clearly visible.

34.5.2 Improving Storage Facilities

Tidiness and order are essential in overcoming storage problems, whether in the storerooms or in the yard. Good storage utilises air space instead of floor space, and the ready availability of stores saves many time-wasting delays.

It is important to prevent stores and scraps accumulating on the floor and around machines.

Never keep more stores and materials than necessary near machines and provide proper facilities (such as bins, shelves, boxes, racks, etc.) in which to store them.

34.5.3 Keeping Floors Clean

Floor conditions are responsible for many work accidents. When floors are given the right treatment they are much easier to keep clean and sanitary. Spilt oil and other liquids should be cleaned up at once. Chips, shavings, dust, and similar wastes should never be allowed to accumulate. They should be removed frequently, or better still, be suitably trapped before they reach the floor.

34.5.4 Disposing of Scrap and Preventing Spillages

It is a common practice to let the floor catch all the waste and then spend time and energy cleaning it up. Suitable and conveniently located containers will be provided for scrap and waste disposal. Employees will use them.

Oily floors are a common accident and fire hazard will be mitigated by splash guards and drip pans being installed wherever oil spills or drips may occur. Oil and grease will be kept off the floor of work of work areas.

34.5.5 Getting Rid of Dust and Dirt

In some jobs, dust, dirt, chips, etc. are unavoidable. If they cannot be collected as part of the process (e.g. by enclosure and exhaust methods) suitable cleaning methods must be devised. Vacuum cleaners are suitable for removing light dust and dirt. Industrial models have special fittings for cleaning walls, ceilings, ledges, machinery, and other hard-to-reach places where dust and dirt may accumulate. If light dust is removed by sweeping, floors should be dampened first rather than swept dry.

34.5.6 Keeping Tools Tidy

Tool housekeeping is very important, whether in the tool room, on the rack, out in the yard, or on the bench. Suitable fixtures for tools are required to provide orderly arrangement, both in the tool room and near the work bench, and a regular system of inspecting, cleaning, and repairing is an essential part of any programme.

34.5.7 Maintaining the Light Fittings

Attention to light fittings should be an integral part of any good housekeeping programme. Dirty lamps and shades, and lamps whose output has deteriorated with use, deprive employees of essential light. It has been found that lighting efficiency may be improved by 20 to 30 percent simply by cleaning the lamps and reflectors.

34.5.8 Cleaning the Windows

Cleaning the windows is a cheap and easy way to better conditions. Clean windows let in light; dirty ones keep it out. Insufficient light causes eye strain and leads to accidents because employees are unable to see properly. Ensure that windows are not blocked by stacked materials, equipment or articles on the ledges.

34.5.9 Maintain a High Standard in Meal Rooms, Rest Rooms

No housekeeping programme should ignore the facilities provided for meals, rest and sanitation, where cleanliness is essential for walls, floors, and fixtures.

Soap and towels should be renewed regularly and wash basins properly cleaned.

34.5.10 Don't Neglect the First Aid Gear

First aid facilities and equipment should be kept under spotlessly clean conditions and fully stocked so that they are always ready in the event of accidents or illness.

34.5.11 Inspect Fire-Control Equipment

It is essential to ensure that all fire-fighting equipment such as extinguishers and fire-hoses is regularly inspected and kept in god working order. Fire-protection facilities - fire doors and exits, automatic alarms, etc. - should be in good working order. Doors and exits should always be kept clear of obstructions.

34.5.12 Attending Regularly to Maintenance

Perhaps the most important element of good housekeeping is the attention paid to maintenance of buildings and equipment. If something gets broken or damaged it should be replaced or fixed as quickly as possible (e.g. defective ladders, broken handrails, steps, etc). Apart from the possibility of causing accidents, an installation can take on a very neglected appearance if broken windows, damaged doors, defective plumbing, leaking futters, broken floor surfaces and the like are allowed to remain in that condition.

A good maintenance programme will make provision for the inspection, lubrication, upkeep and repair of tools, equipment, machines and processes.

34.5.13 Assigning Responsibility for Cleaning

Where practicable, the cleaning of the workplace should be the responsibility of special cleaning staff and not an additional job for employees engaged in production.

Where this is not possible adequate time during working hours should be allowed for cleaning up to be done. Responsibility will be clearly assigned as to who is to do the cleaning and what area is to be cleaned. If this is not done, out-of-the-way places, such as shelves, yards, small buildings, sheds, cellars, basements, and boiler rooms are overlooked until they get into a deplorable state.

34.6 Actions

Housekeeping is an ongoing process, and employees and contractors must see tidying and cleaning up after them as part of their job. In addition, employees shall thoroughly clean and tidy their work area at the end of each working week.

As part of this programme work area supervisors will be responsible for undertaking a housekeeping inspection of the work area. All details noted shall be recorded, and corrective measures introduced.

On a monthly basis the senior supervisor and/or site Health and Safety Officer will audit the work area assess the level of housekeeping being achieved.

A checklist (Form 34.1) that will be used in both audits, is presented at the end of this section.

34.7 Training

New employees will receive training in the importance of effective housekeeping as part of their induction training before they begin work. This training will be repeated every three years.

Form 34.1: Housekeeping Audit Checklist

Check the items that apply to your particular work area:

1.	**Floors**	**Comments**
	Even surface - no holes.	
	Loose boards nailed down.	
	Dropped objects picked up.	
	Oil and grease spots wiped up.	
	Stock and material out of way.	
	Sawdust, shavings, etc. swept up.	
	Special attention to areas around machines.	
	Floor openings covered when not in use.	
2.	**Aisles**	**Comments**
	Wide enough for goods traffic.	
	Marked with white lines if possible.	
	Clear of cases, material and rubbish.	
	Clear of trolleys, hand trucks, etc.	
	Clear of electrical leads, etc.	

3.	**Work Benches**	**Comments**
	Clear of rubbish.	
	Tools not in use kept in place.	
	No damaged tools.	
4.	**Ladders and Steps**	
	Stored in proper place.	
	No broken or missing rungs, etc.	
	Rubber safety feet where possible.	
5.	**Rubbish**	**Comments**
	Bins located at suitable points around plant.	
	Bins emptied regularly.	
	Oily rags and combustible refuse in covered metal containers.	
6.	**Yards**	**Comments**
	Clean and free of rubbish.	
	Even surface - no holes.	
7.	**First Aid**	**Comments**
	Cabinets and contents clean and orderly.	
	No replacement materials needed.	

8.	**Machines**	**Comments**
	Clean.	
	Guards in place.	
	Drip pans to prevent oil on floor.	
9.	**Storage**	**Comments**
	Adequate and convenient racks and bins.	
	Materials stored in racks and bins wherever possible.	
	Shelves free of dust and rubbish.	
	Stacks stable with good foundations.	
	Stack layers cross-tied where possible.	
	Floor around stacks and racks free from rubbish.	
	Required materials taken from top of stacks - not pulled out from below.	
	Bottles correctly labelled and caps properly fitted.	
	Drums with bungs properly filled.	
10.	**Light Fittings and Walls**	**Comments**
	Shades clean and in good order.	
	No bulbs needing replacement.	
	Walls clean and bright as possible.	

Item		Comments
11.	**Windows**	**Comments**
	Clean, admitting of daylight.	
	No broken panes.	
	Ledges free of dust, tins, etc.	
12.	**Stairs and Landings**	**Comments**
	No worn or broken treads.	
	Handrails in good repair.	
	Landings clear of crates and other obstructions.	
13.	**Electricity**	**Comments**
	Gear not in use properly stored.	
	No broken plugs, sockets or switches.	
	No frayed or defective leads.	
	Portable power tools in good condition.	
	Isolating transformers available.	
14.	**Fire**	**Comments**
	Extinguishers in place and recently serviced.	
	Adequate notices giving directions to fire exits.	
	Exit doors easily opened from inside.	
	Exits clear of obstructions.	

15. **Staff Amenities**	**Comments**
Washroom clean.	
Toilet clean.	
Lockers clean.	
Newspapers, lunch papers, etc. in rubbish bins.	
Meal rooms clean and tidy.	