SAPREF Business Management System	HSSE Procedure Level 2
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Confined Space Entry (CSE) Procedure

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1. Purpose, scope and target group

1.1 Purpose

In conjunction with HSSE.WI.0006: Inert Gas CSE, the main purpose of this document is to provide the practices & checks for controlling the associated fire, health, safety and environmental hazards to prevent any injuries during CSE.

1.2 Scope

This document (together with HSSE.WI.0006: Inert Gas CSE) guides compliance to legislation, particularly the OHS Act 85 of 1993 and the Shell HSSE SP Control Framework Manual in the BMS (HSSE.EX.0025) on CSE. In differences the more stringent approach is adopted.

This document defines CSE, identifies hazards and controls, competencies, rescue plans, as well as roles and responsibilities. It includes all CSE work in any areas of work activity under SAPREF management control, including Island View sites.

1.3 Target Group

All SAPREF Staff and contractors involved with the performance of work on behalf of or on any areas of work activity under SAPREF management control, including Island View sites, viz.

- OPS Clearance Issuers e.g. MSFP's, TL's
- Operations GSI's
- GMR 2(1), GMR 2(7)(a)
- 16(2)'s
- Contractor Supervisor / Foreman in charge of the work (Permit Holder)
- Emergency Services
- Clearance Receivers
- CSE Standby
- Person/s inside the confined space
- Safety Advisors / HSE Practitioner
- As well as those in acting capacities

2. Definition and Examples of Confined Space

OHS Act, General Safety Regulations defines a confined space as an enclosed, restricted, or limited space in which, because of its construction, location or contents, or any work activity carried on therein, a hazardous substance may accumulate or an oxygen-deficient/enriched atmosphere may occur, and includes any chamber, tunnel, pipe, pit, sewer, container, tank, top of floating roof tank, culvert,cargo hold, vessel, column skirt, furnace & boiler, stack, drain, sewage pit, road/rail tanker, excavation (e.g. trench, well), valve, pump, sump, or similar construction, equipment / machinery or objects / spaces in which a dangerous liquid or dangerous concentration of gas, vapour, dust or fumes may be present.

A CSE means not only complete body entry, but also inserting a head into man-way openings, hatches, pipe ends etc.

The Control Framework and requirements apply also to spaces in the immediate vicinity of any confined space as intended by the OHS Act which states that "the provisions of this regulation shall mutatis mutandis also apply, in so far as they can be so applied, to any work which is performed in any place or space on the outside of and bordering on or in the immediate vicinity of, any confined space, and in which place or space, owing to its proximity to the confined space, any hazardous article, oxygen-deficient atmosphere or dangerous concentration of gas, vapour, dust or fumes may occur or be present".

Partially enclosed areas such as pits, bunds, excavations and tank roofs are considered to be confined spaces when they are deep enough for the breathing zone to be inside the pit AND the natural ventilation is insufficient to prevent possible build up of hazardous vapours. When the width (narrowest side) of such an area is less than six times the depth ventilation will be insufficient**.**

3. Control Framework, Standards and Requirements

Refer to section 11.2 External References for a list of the guiding standards for CSE management at SAPREF, noting that in differences the most stringent approach is adopted.

CSE is considered to be a **"HSE Critical Activity"** and the following control framework and requirements **shall** be adhered to:

- Alternatives for CSE shall be considered and documented.
- Every CSE shall be authorized and controlled by the SAPREF PTW system HSSE.PR.0069
- Only persons who have received SAPREF Confined Space Entry training and are certified competent to enter a confined space by the Emergency Services Section are authorised to enter.
- A job specific Risk Assessment with controls and recovery measures shall be conducted for every CSE and it shall demonstrate that all reasonable practicable steps have been taken to eliminate asphyxiant, flammable, toxic and other hazards as identified in Section 7 : Confined Space Entry Hazards
- The Risk Assessment shall be signed and approved by the relevant Permit Issuers, Permit Receivers, GSI, GMR 2(1) and 16(2) in accordance with the requirements set by the Risk Level of that particular activity.
- CSE General Controls, Entry Criteria and Specific Controls as specified in Section 8 : Controls Applicable to all Confined Space Entries and Section 9 : Entry Conditions, Limits and Specific Controls shall be adhered to.
- The CSE criteria for oxygen, toxic and flammable levels and for Breathing Apparatus as set out in Section 9: Entry Conditions, Limits and Specific Controls of this document are mandatory
- A rescue plan shall be prepared and implemented for every CSE as per the CSE Certificate.

Appendix 1: Confined Space Entry Process Flow shows the process flow for ensuring compliance to the Control Framework.

3.2 OCCUPATIONAL HEALTH AND SAFETY ACT 85 OF 1993- Work in confined spaces

(1) An employer or a user of machinery shall take steps to ensure that a confined space is entered by an employee or other person only **after the air therein has been tested and evaluated by a person who is competent to pronounce on the safety thereof,** and who has certified in writing that the confined space is safe and will remain safe while any person is in the confined space, taking into account the nature and duration of the work to be performed therein. **Level 1 CSE**

(2) Where the provisions of subregulation (1) cannot be complied with the employer *[sic]* or user of machinery, as the case may be, shall take steps to ensure that any confined space in which there exists or is likely to exist a hazardous gas, vapour, dust or fumes, or which has or is likely to have, an oxygen content of less than 20 per cent by volume, is entered by an employee or other person only when –

(a) subject to the provisions of subregulation (3), the confined space is purged and ventilated to provide a safe atmosphere therein and measures necessary to maintain a safe atmosphere therein have been taken; and **Level 1 CSE**

(b) the confined space has been isolated from all pipes, ducts and other communicating openings by means of effective blanking other than the shutting or locking of a valve or a cock, or, if this is not practicable, only when all valves and cocks which are a potential source of danger have been locked and securely fastened by means of chains and padlocks.

(3) (3) Where the provisions of sub regulation (2) (a) cannot be complied with, the employer or user of machinery shall take steps to ensure that the confined space in question is entered only when the employee or person entering **is using breathing apparatus** of a type approved by the chief inspector and, further, that - **– Level 2 and 3 CSE**

(a) the provisions of sub regulation (2) (b) are complied with;

(b) any employee or person entering the confined space is using a safety harness or other similar equipment, to which a rope is securely attached which reaches beyond the access to the confined space, and the free end of which is **attended to by a person referred to in paragraph (c);**

(c) at least **one other person trained in resuscitation** is and remains in attendance immediately outside the entrance of the confined space in order to assist or remove any person or persons from the confined space (Not to physically enter the CSE), if necessary; and

(d) **effective apparatus for breathing and resuscitation** of a type approved by the chief inspector is **available immediately outside the confined space.**

(4) An employer or user of machinery shall take steps to ensure that all persons vacate a confined space on completion of any work therein.

(5) Where the hazardous gas, vapour, dust or fumes contemplated in subregulation (2) are of an explosive or flammable nature, an employer or user of machinery shall further take steps to ensure that such a confined space is entered only if-

(a) the concentration of the gas, vapour, dust or fumes does not exceed 25 per cent of the lower explosive limit of the gas, vapour, dust or fumes concerned where the work to be performed is of such a nature that it does not create a source of ignition; or

(b) such concentration does not exceed 10 per cent of the lower explosive limit of the gas, vapour, dust or fumes where other work is performed.

(6) The provisions of this regulation shall *mutatis mutandis* also apply, in so far as they can be so applied, to any work which is performed in any place or space on the outside of and bordering on or in the immediate vicinity of, any confined space, and in which place or space, owing to its proximity to the confined space, any hazardous article, oxygen-deficient atmosphere or dangerous concentration of gas, vapour, dust or fumes may occur or be present.

4. Monitoring and Auditing

The Operations Supervisor shall monitor work under permit control on a daily basis, including spot checks of worksites, permits and supporting documents and rescue arrangements.

Independent inspections shall be carried-out by Safety Advisors or experienced personnel.

The HSSE Department shall annually review the effectiveness of the CSE procedures taking into account changes in legislation and Shell Control Framework Manual, as well as learning from incidents and new best practices.

5. Responsibilities and Competence

Key persons involved in CSE activities are (refer to Appendix 5):

- **Operations supervisor** (Permit Issuer, TL, MSFP): responsible for making sure that the confined space is safe for entry, and that the supervisor in charge of the work and the standby person are fully familiar with the hazards, controls and recovery measures; also making sure that the considerations for the Rescue Plan are adhered to as per the CSE Certificate.
- **Supervisor in charge of the work** (Permit Receiver): responsible for making sure that the workers are fully familiar with the hazards, controls and recovery measures and comply with the controls specified on the permit, and to make sure that means of rescuing persons from the confined space in case of an emergency are provided for.
- **Safety Watcher**: responsible for maintaining communications between all parties and raising the alarm in case of an emergency inside the confined space (refer Section 8.19 : Standby on Standby requirements). Gas test register to be updated;
- **Persons inside** the confined space: responsible for using all the tools and PPE supplied and complying with the specified controls and carrying out only the work scope specified and authorised in the PTW for which the risk assessment was done.
- **Emergency Services :** To be involved in the development of the Rescue plan and to standby for inert gas CSE

6. Entry Types

Any CSE is inherently a dangerous activity. Based on risk profile the following categories of entry are identified in ascending order of risk. All attempts should be made to keep the CSE risk category ALARP.

1. **No Entry:** Every effort should be made to **avoid/eliminate the need for entry**: identify alternative means to inspect, clean etc. This should be considered during the design of equipment. If CSE is unavoidable the reasons for this should be logged before preparing to enter the CSE and the control framework and requirements **shall** be adhered to: Refer flow chart in **Appendix 1.**

2. If CSE is unavoidable then take steps to **establish and maintain a safe environment/atmosphere** (taking into account the nature of the work to be performed) where it is possible **to <u>enter without the use of Compressed Air Breathing Apparatus (LEVEL 1 CSE)</u>**.

3. If it's not possible to establish and maintain a safe environment/atmosphere for entry without the use of Compressed Air Breathing Apparatus then take steps to establish conditions within and around the confined space that would allow for **<u>Exceptional CSE with Supplied Air BA (LEVEL 2 CSE)</u>**..

4. **<u>Entry into Inert Gas Confined Spaces (LEVEL 3 CSE)</u>** is mainly applied in the removal of catalyst and is an inherently hazardous activity requiring highly specialised skills and experienced contractors to execute.

The precautions for each level of risk are discussed in detail in the remainder of this document.
Normal Entry – Confined Space Entry atmosphere is normal – CSE Standby to be in the possession of a valid Level I First Aid Certificate

Compressed Air Breathing Apparatus Entry - Confined Space Entry atmosphere contains some form of contaminant - CSE Safety Watcher to be in the possession of a valid Level III First Aid Certificate and a Resuscitation
Kit

Inert Entry - Confined Space Entry atmosphere contains an Inert Gas e.g. Nitrogen (N2) - CSE Safety Watcher to be in the possession of a valid Level III First Aid Certificate and a Intermediate Life Support (ILS) Paramedic to be on standby. Process to be monitored via cameras.

Excavations are regarded as Confined Spaces and are defined by SAPREF as follows:

There are 3 categories of Excavation work with different controls:

Category 1

1. Excavation <400mm deep: Is regarded as Low Risk and NOT CSE. PtW paperwork = Method Statement and Clearance Certificate

Category 2

2. (a) Excavations >400mm deep, but <1.2m: PtW paperwork = Method Statement, Risk Assessment, Safety Certificate counter signed by Civil and Electrical Sections, Gas Test once a day and wearing of 4x Gas Monitor.
   (b) The Foreman must carry a radio with the relevant panel person channel and must have a close watch on the excavation activities.
   (c) The requirements like Safe Access and Shoring must be adhered to.

Should the 4x Gas Monitor be activated, the job stops and the full CSE requirements immediately apply.

Category 3

3. Excavation >1.2m deep: PtW paperwork = As per number 2 above and CSE Certificate including Rescue Plan.

As normal, for each category above, LMRA must be done before the job starts.

7. Confined Space Entry Hazards

The following hazards have been identified for CSE.

7.1 Oxygen Deficiency

Atmospheres with less than 20% vol. oxygen are oxygen-deficient and can result in asphyxiation. Oxygen concentrations below 10%, can lead to unconsciousness and death. Inhaling an atmosphere with no oxygen results in instant death.

Oxygen deficiency can result from:

- Displacement of air from low points by heavier gasses;
- Purging (e.g. nitrogen);
- Burning and welding which consumes oxygen;
- Depletion of oxygen by workers if air ventilation is inadequate;
- Biological processes e.g. sewers, pits and storage tanks;
- In closed vessels rust formation can lead to oxygen depletion, especially new or shot blasted carbon steel;
- Air displacement during pipe freezing with liquid nitrogen.

Actions to be taken:

- CSE without Compressed Air Breathing Apparatus shall only be permitted if the oxygen levels are maintained between 20-21.5 % vol and conditions conforms to the requirements set in Section 9: Entry Conditions, Limits and Specific Controls, Section 9.1: General CSE Conditions and Limits , Section 9.2: Testing and Monitoring and Section 9.3: Normal CSE without Breathing Apparatus
- If the oxygen levels cannot be maintained above 20% vol, but is stable enough to ensure it remains above 16 % vol. then entry shall be allowed only by exception (refer to Section 9.4: Exceptional CSE with Supplied Air Breathing Apparatus for requirements for Exceptional CSE with Supplied Air BA).
- Atmospheres containing less than 16 % vol oxygen shall be treated as toxic atmospheres that are immediately Dangerous to Life and Health (IDLH) and CSE shall not be allowed, except under inert gas entry conditions as described in Section 10: Inert Gas Confined Space Entry for Catalyst Handling and detailed in HSSE.WI.0006: Inert Gas CSE.

7.2 Oxygen Enrichment

Atmospheres with more than 21.5 % vol. oxygen are oxygen enriched and significantly increase flammability of clothing, grease and other combustible materials.

Oxygen enrichment can result from:

- Leaks from oxygen containing equipment such as gas cylinders, valves, hoses and welding torches; the most common oxygen containing equipment is that used in gas cutting operations;

- Deliberate addition of oxygen to increase the level of an oxygen deficient atmosphere;
- Inadvertent use of oxygen instead of air for ventilation or breathing air.

Actions to be taken:

- Investigate (per gas test frequency) any increase in the oxygen level above normal, assess the risks and take measures.
- Handle cylinders, gas hoses, valves and welding torches with care and inspect daily for damage.
- Gas cylinders shall not be taken into confined spaces.
- Remove all cutting and welding equipment from confined spaces during breaks (as far as reasonably practicable) and at the end of the working day.

7.3 Fire and Explosion

Fires and explosions can result from accumulations of flammable vapours, fumes or dust in the presence of a source of ignition. Mixtures of flammable vapours and air will only ignite if the hydro–carbon to air ratio is between the Lower Explosive Limit (LEL) and the Upper Explosive Limit (UEL).

Flammable vapours or fumes typically result from:

- Material stored in vessel/tank;
- Sludge or other deposits disturbed during cleaning;
- Material left under scale, even after cleaning or trapped between over-plating;
- Material leaking through the tank floors; from behind vessel linings (rubber, lead, brick, refractory etc.) or from vessel fittings such as tank floating roof pontoons and legs, instrument connections or pipes; leaking from flanges or vents;
- Vapour entering the confined space from nearby process plant;
- Flammable materials used in the cleaning, painting, inspection (dye penetration) or in adhesives;
- Vapour or fumes that build up in sewers, manholes, contaminated ground or excavations;
- Contaminated firewater/process water used to wash the confined space.

Actions to be taken:

- Remove as far as possible all ignition sources incl. open flames, sparks, electrical equipment, hot pipes, exhausts, pyrophoric materials, tools and situations that can cause thermal reactions (e.g. alloy tools striking against rusted iron) and substances that can cause combustion due to chemical reaction;
- Eliminate all flammable vapours (LEL < 1%) before allowing any person to enter a CSE. If this cannot be achieved then special measures have to be taken to eliminate possible ignition sources.
- CSE **shall not** be allowed into spaces where the flammable concentration > 10% LEL.

7.4 Toxic Hazards

Toxic substances can be solids, liquids or gases. They can cause harm by inhalation, ingestion or skin contact.

Toxic hazards in confined spaces can result from the same sources as the flammable hazards, viz:

- Contamination of personal protective equipment;
- Carbon monoxide and nitrogen dioxide e.g. from exhausts of combustion engines;
- Acute toxic gases such as hydrogen sulphide, hydrogen fluoride, ammonia and chlorine;
- Hazardous liquids such as benzene, polycyclic aromatics, lead/anti-knock compounds, hydrazine and biocides;
- Narcotic gases such as butane, pentane, hexane, gasoline and gas condensate;
- Catalyst dusts, such as nickel, platinum, and molybdenum.

Actions to be taken:

- Assess the toxicity of intermediates and products through the Material Safety Data Sheets (MSDS) (refer HSSE.RG.0013).
- At 50% of the Occupational Exposure Limit (OEL) implement specific measures for controlling exposure to the toxic substance during CSE work.
- CSE where the concentration of toxic vapour, fume or dust are between the OEL and the IDLH (Immediate Danger to Life and Health) value **shall** be allowed only by exception when it is not practical to ventilate the confined space or otherwise remove the hazard to reduce the toxic concentration. In this case it **shall** only be allowed when the source, nature and concentration of the toxic hazard is understood and exposure is adequately controlled by other means.
- Entry into confined spaces containing a concentration of toxic vapour, fume or dust above the IDLH value **shall** not be allowed, except under inert gas entry conditions (refer to Section 10: Inert Gas Confined Space Entry for Catalyst Handling).
- Consult the Occupational Hygienist in the HSSE Department for SDS and OEL data.

7.5 Corrosive Hazards

Corrosive substances are harmful by skin or eye contact, by ingestion or by inhalation of a corrosive mist or vapour. They can destroy the tissue and may leave permanent injury or scars, even on organs remote from the point of contact.

Common corrosive substances in the oil and petrochemicals industry are sodium hydroxide, sulphuric acid and hydrofluoric acid.

7.6 Physical Hazards

Typical physical agents that are hazardous in confined spaces include:

- Excessive noise levels from tools or machinery;
- Heat stress, resulting from inadequate cooling of vessel or from ambient heating in hot climates. It can be made worse by the PPE being worn. (Refer to Section 8.16 Heat Stress Controls for more details).
- Electric shock from hand lamps and other electrical tools;
- Radioactive sources e.g. certain types of level instrumentation.

7.7 Unsafe Conditions

Typical causes of unsafe conditions in confined spaces include:

- Falling from heights;
- Structural failure e.g. floating roof may not support worker's weight;
- Falling tools and materials;
- Restricted working space and obstructions;
- Interaction and incompatible work in same space;
- Slippery floor surfaces and tripping hazards;
- Access and escape openings that are too small;
- Poor visibility due to misty or dusty conditions;
- Moving parts e.g. mixers/fans that are not adequately isolated or locked;
- Free flowing solids that can lead to engulfment e.g. catalyst;
- Flow of liquids into drains, excavations etc.;
- Improper shoring of excavations.
- Release of H2S and hydrocarbon gasses when inventory are agitated or disturbed e.g. during HP jetting of sludge, removing of internals, residue catalyst or cleaning activities.

7.8 Psychological Issues

Working in confined spaces can cause claustrophobia and anxiety to people who are predisposed to the condition; hence the selection of personnel to enter confined spaces should take account of the arduous nature of the work and the mental and physical requirements.

Action to be taken:

- Entering confined spaces shall only be allowed if a person has proof of training and certification through SAPREF Emergency Services.

7.9 Heat Stress

Heat stress is often neglected as a hazard of CSE. Refer to Section 8.16: Heat Stress Controls for control measures.

8. Controls Applicable to all Confined Space Entries

8.1 Risk Assessment

CSE is **NOT ALLOWED** without a Risk Assessment. The Risk Level will determine the attendee list and signature requirements. For Exceptional CSE with Compressed Air Breathing Apparatus the Risk Assessment shall be-co-signed by a 16(2) appointee, Area Engineer and GSI.
The following information shall be prepared and be available beforehand as input into the Risk Assessment:

- The work method statement
- Any Safe Working Procedures
- An Assessment of the ability to adhere to the CSE controls stipulated in Section 8: Controls Applicable to All Confined Space Entries and Section 9: Entry Conditions, Limits and Specific Controls

The Risk Assessment shall be used to identify and assess:

- All the hazards associated with each specific CSE (refer Section 7: Confined Space Entry Hazards);
- Appropriate precautionary measures to be taken;
- The contingency plans to be put in place;
- Changing conditions in the environment and work processes;
- Specific actions that should be used in the Rescue Plan

8.2 Permit to Work (Refer to Permit to Work HSSE.PR.0069)

All CSE work **shall** be controlled by means of SAPREF's Permit to Work system.
A Confined Space Entry Certificate, Clearance Certificate, Risk Assessment and Rescue Plan for complex rescues are pre-requisites for any CSE. Refer to Section 3: Control Framework, Standards and Requirements.

The Risk Assessment should be used as the basis for pre-job and daily work team briefing and displayed with the work permits outside the confined space.

The following documentation should accompany the Confined Space Entry Certificate:

- Completed and signed Risk Assessment
- Confined Space Entry Register (refer to Appendix 3: Confined Space Entry Register);
- Confined Space Entry Gas Test Register (refer to Appendix 4: Confined Space Entry Gas Test Register);
- Marked up EFD indicating the isolation points;
- Spade/isolation list;

8.3 Process Isolation

Confined spaces shall be positively isolated from potential hazards by inserting blinds or by disconnecting and blanking all lines connected to the space.

The isolation flange shall be as close as possible to the vessel or tank. Blinds and blank flanges shall be sufficiently strong to withstand the maximum internal pressure that might be exerted against them.

The following methods of isolation shall not be used for CSE:

- A closed valve, even when sealed and made inoperative;
- Inserting a sewer plug, an inflatable balloon or a stopper in a line;
- Freezing of a fluid in a line.

Exceptions to the general requirement for positive isolation are allowed in the following situations:

- Double block valve and drain arrangements (to confirm the valve isolation is effective) may be used for low hazard fluids such as water or air;
- Sewer plugs or air bags may be used in very low-pressure water service, e.g. for isolating drain pits or interceptor pits from the connecting pipes or channels.

Both these exceptional situations require detailed Risk Assessments before accepting the lower standard of isolation, as well as a means of verifying the effectiveness of isolation throughout the entry period.

A signed off Spade/Isolation List and marked up EFD must be attached to the Risk Assesses Method Statement (RAMS) and CSE Certificate and included in the work pack.

8.4 Electrical / Hydraulic / Mechanical Isolation

Electrically driven equipment in confined spaces shall be isolated, and the isolating switches locked and tagged to prevent inadvertent use or movement as per the Electrical LOTO procedure..

Hydraulically or pneumatically driven equipment shall be depressurised and the hydraulic or pneumatic lines shall be positively isolated outside the confined space.

Moving parts inside confined spaces, e.g. air cooler fans or vessel stirrers, shall be isolated from drives by removing mechanical linkages and locking the moving part in position with mechanical stops.

SAPREF Responsible Electrician and Mechanical Supervisor to countersign Clearance Certificate after ensuring that the various drives are positively “isolated/de-energised” and adequately “locked” to prevent inadvertent use or movement as intended above.

8.5 Clearance of Process Materials

Process materials in a confined space need to be removed before entry is allowed. This is often referred to as gas freeing, and is achieved by a combination of draining, venting, displacing or flushing with water or heavy hydrocarbon, purging with steam or inert gas, chemical cleaning and finally ventilation with air.

8.6 Ventilation

Confined spaces shall be ventilated with air:

a) Initially to remove the purge gases;
b) Throughout the entry period to replace oxygen, to remove vapour or fumes produced and to remove vapour generated from residues, scale, pyrophoric reactions etc.

Natural ventilation does not depend on mechanical devices that can fail or can provide an ignition source, whilst forced ventilation through fans or air eductors is independent of wind speed and direction, and is therefore more predictable and often more effective, and is the preferred method at SAPREF.

Whichever method is chosen, man-ways and vents shall be selected and eductors and fans shall be located so as to reinforce the natural movement of gases, i.e.:

- Hot gases and air tend to rise;
- Hydrocarbon vapours are generally heavier than air, and tend to fall.

Ventilation shall be arranged so that it changes the air in all parts of the confined space, including low spots and dead ends where heavy gases and vapours can collect.

To prevent contamination of the air used for ventilation the following precautions shall be taken:

- Closely monitor surrounding process plant to identify leaking liquids or vapours, especially confined spaces below ground level, drains and excavations. Many contaminants are heavier than air;
- Stop any work in the surrounding area that could cause contamination of the ventilation air;
- Do not locate diesel engines upwind of any ventilation air inlet, man-way or compressor air inlet;
- Move residues and waste materials well away to prevent contamination of the ventilation air.

Forced exhaust ventilation is needed to extract fumes or dust resulting from welding, gas burning and other work if the general ventilation is inadequate.

Oxygen **shall** not be used to ventilate a confined space, as this could lead to oxygen enrichment.

Take special care to prevent coupling of pneumatic tools up to nitrogen supplies as this could pose a hidden hazard (should it leak) and oppose our efforts to ventilate the area.

8.7 Control of Ignition Sources

The recommended approach is to eliminate ignition sources by means such as:

- Use intrinsically safe electrical equipment where available, e.g. gas testing equipment & radios;
- Use approved electrical equipment that has been regularly tested and inspected;
- Earth any equipment that can become charged with static electricity, e.g. ventilation eductors and hoses, spray painting guns, and ensure that vessels are earthed;
- Select PPE that does not become charged;
- Remove pyrophoric scale or keep it wetted until it can be removed;
- Locate diesel engines and other internal combustion engines well away from the confined space;
- Prevent mechanical sparks, e.g. from falling tools.

When ignition sources cannot be totally eliminated they should be strictly controlled and included into the Risk Assessment and identified in the CSE Certificate.

8.8 Control of Radiation Sources

If radiation sources are used in certain types of level instruments, they shall be de-energised and removed or shielded.

The Authorised Radiation Protection Officer (ARPO) or stand in (Acting Radiation Protection Officer) to counter sign the CSE Certificate and RAMS after ensuring the above.

8.9 Lighting and Electrical Equipment and Tools

Lighting and electrical equipment used in confined spaces should be intrinsically safe and an approved type that has been regularly tested and inspected before use. If a confined space is gas freed (LEL=0), other standard electrical equipment and 220V lighting maybe used inside and must be fitted with an Earth Leakage Current Device or other approved means of protecting users against electric shock.

8.10 Internal Combustion Engines and Gas Cylinders

Do not use petrol-fuelled engines in confined spaces due to the increased risk of a flammable atmosphere and ignition by the engine ignition system.

Diesel driven engines to be located outside the confined space at a safe location where exhaust fumes cannot contaminate the atmosphere inside the confined space, either directly or through forced ventilation or breathing air systems. In the exceptional situations where diesel engines have to be used in the confined space, e.g. diggers in excavations or dumper trucks in large storage tanks, sufficient ventilation should be applied to prevent the build-up of harmful fumes. The atmosphere should be continually monitored. Engines should be refueled outside the confined space.

Eliminate the need for gas supplies into confined spaces as far as possible, e.g. by not using gas operated lights or gas welding and by designing out the need for inert gas welding in confined spaces.

Keep gas cylinders supplying gas for oxy-propane/oxy-acetylene cutting or burning outside the confined space, and inspect the hoses and equipment carefully before use.

Close gas supplies during work breaks and remove the hoses and equipment to an open area at the end of each day.

8.10.1 Conditions to comply to in order to use diesel machinery in confined spaces, i.e. Tank maintenance work.

In the exceptional situations where diesel engines have to be used in the confined space, the following conditions have to be complied to in order to execute the activity safely:

- The tank, including internals of all Pontoons, must be free of all hydrocarbons
- The complete Centre Deck must be cut out and dropped on the floor for removal.
- The tank must have sufficient ventilation and a suitable access door, i.e.4x4 meter cut out as a door way.

- Continuous machine idling whilst in tank is not permissible to prevent Carbon Monoxide build up.
- Have an escape plan as part of the CSE work execution.
- Gas testing to be carried out (LEL and O2) by MSFP.
- Stationary Gas tester (Yellow Man) must be used for continous gas monitoring in the tank.
- Each person inside the confined space must wear a 4 in 1 gas monitor.
- Operations to ensure system is isolated and LOTO locked
- Operations to ensure all tank valves are chain locked shut in a closed position, as per marked up EFD and isolation list, as per LOTO lock system
- Ensure all relevant paper work is in place and signed- marked up EFD and isolation list, RAMS and clearance certificate to carry out the task.

8.11 Personal Protective Equipment (PPE)

PPE that are suitable for entry into atmospheres containing toxic vapours, fumes and dusts and into oxygen deficient atmospheres are described in Section 9: Entry Conditions, Limits and Specific Controls

Protective suits, boots and gloves may be needed when there is a risk of contact with toxic or corrosive chemicals. When specifying the use of PPE consideration should be given to the risk of increasing heat stress, and the need for appropriate work patterns. Refer also to the HSSE.RG.0029 SAPREF PPE Specification Register.

8.12 Rescue plan

A rescue plan is mandatory for any CSE (refer to HSSE.WI.0097 Rescue plan) and should take account of legal requirements and shall be checked against the job specific hazards including those identified in the Risk Assessment.

Key considerations for the rescue plan:

- The relevant authorised person required to sign off the Rescue Plan will depend on the Rescue Complexity which can be classified as either Low, Medium or High. For Low Rescue Complexity sign off is required by the Zone AGSI , Medium Rescue Complexity by Fire Officer and High Rescue Complexity by Fire Chief.
- Emergency Services, Shift Manager and clinic to be alerted daily of Level 3 Confined Space Entry.
- Identify access and escape routes (min 600 mm aperture).
- How will access be gained for rescue of persons inside.
- Specify potential physical obstacles.
- Stipulate special PPE that persons inside the Confined Space need to wear to facilitate rescue – consider in what condition people might be working / found.
- Emergency Services to stipulate rescue equipment required immediately outside the entry point before CSE.

8.13 Access and Escape

Unauthorised or accidental entry into confined spaces must be prevented. Provide barricades and warning notices **("NO Entry"** signs) at the access points when work is temporarily suspended.

Safe Access and Emergency escape routes must be provided and included in the Rescue Plan.

Sufficient man way covers and internal fittings should be removed from tanks, vessels or columns to enable:

- Equipment and persons to be moved into and out of the space;
- Space for the intended work;
- The standby to keep persons under observation;
- Persons to escape in an emergency.

A single point of entry into a confined space requires additional precautions, e.g. an extraction fan mounted to the man-way must be easily removable for emergency exit. The implications of single entry points must be considered in both the Risk Assessment and the Rescue Plan.

Precautions must be specified and taken to prevent any Hazardous Gases/Substances from entering the Confined Space via the Access ways, e.g. Planned or Unplanned Toxic Gas release.

When the Risk Assessment indicates the possibility of toxic gases building up in the space for any reason whatsoever, including as a result of changes during the work, persons entering the confined space should be using Breathing apparatus i.e. the CSE entry is treated as an Exceptional CSE with supplied air BA.

A box-up permit is required to ensure everyone is out of the space before the man way is boxed-up.

8.14 Rope / Chain Ladders

Climbing a rope ladder requires more skill than climbing a rigid ladder, as the ladder is unstable and tends to swing causing a fright to the user when ascending or descending.

Chain or Rope Ladders are prohibited unless all other means of accessing the work area have been considered and are not possible.

The use of Chain or Rope ladders may be required during vertical climbs/access e.g., in confined spaces, whilst working with power tools (e.g. jack hammer in a riser pipe), using hand tools for work in a vertical shaft.

If a Chain or Rope ladder is used, then:

- An Inertia Reel Fall Arrestor must be used with it and the users must be trained and/or experienced in their use. SAPREF Emergency department shall be engaged to guide with the positioning or installation of the Fall Arrestor. The supervisor/foreman must ensure that the Fall Arrestor equipment is inspected by a competent person.
- It is the Supervisor's responsibility to ensure that all employees using rope ladders are trained and records / register of such training must be made available on request.
- Only a full body harness with dorsal or shoulder pickups will keep the body upright in case of a fall.
- Chain or Rope ladder must be inspected and secured properly by the supervisor/foreman before being used. When installing a Rope Ladder, consideration should be given to the strength of the anchorages or anchor points.

8.15 Fitness to Work

All people entering confined spaces must be medically fit, adequately trained (including Confined Space training) and competent to perform the job using the relevant equipment and PPE.

The fitness of persons who will enter a confined space, and of the rescue team, should be considered as part of the Risk Assessment, especially in case of difficult access, heavy manual work, and high temperatures or where breathing apparatus and chemical suits have to be used.

The factors that can impact on fitness to work are described in Section 7.8 : Psychological Issues and Section 8.16 : Heat Stress Controls.

8.16 Heat Stress Controls

The Environmental Regulations for Work Places (OHSact) specifies that workers required to perform hard manual labour in conditions where the WBGT > 30°C must be certified fit to work in such an environment by a registered medical practitioner (refer HSSE.PR.0058)

Refer to PROD.TR.0001: Authorised Gas Tester for instructions on use of the heat stress meter.

In general, the likelihood of heat stress increases when:

- The temperature and/or humidity in a confined space are high;
- When the work done is abnormally strenuous or
- When impervious protective clothing is used which prevents the ability to control body temperature by perspiration

In cases of potential Heat Stress, the following work/rest schedule applies:

WBGT INDEX (°C)	WORK/REST RATIO PER HOUR
<30	No special rest period needed
30.1 to 30.6	45 mins work then 15 mins rest
30.7 to 31.4	30 mins work then 30 mins rest
31.5 to 32.2	15 mins work then 45 mins rest

If the WBGT index exceeds 30°C the following measures need to be implemented in conjunction with the specified work/rest regiment:

- Fluid Replacement– cool drinking water must be provided at the job site, with a minimum consumption of 600 ml every hr;
- Awareness training for workers on the hazards of heat stress, recognition of predisposing factors, danger signs and symptoms;
- Provide cool areas for workers to recover during rest periods;
- Limit the number of workers present in confined spaces;
- Ensure workers are closely supervised and take additional WBGT readings if conditions deteriorate during the day;
- Workers must be medically screened prior to entry to determine their fitness to work in heat stress conditions.

The following additional controls should be considered:

a) Engineering Controls

- General ventilation – dilutes hot air with cool air. Only works if air outside is cooler than inside;
- Air cooling – blowing in cool dry air;
- Convection fans –as long as the air temperature is less than the worker's skin temperature. NB: If the dry bulb temperature is higher than 35°C, the hot air passing over the skin can actually make the worker hotter. Increases in air speed have no effect on the body temperature of workers wearing vapor-barrier clothing.

b) Administrative controls

- Hot jobs should be scheduled for cooler parts of the day and cooler seasons of the year;
- Reduce the physical demands of work;
- Use shifts e.g. early morning, cool part of the day, or night work.

c) Worker Monitoring

The Safety Watcher should observe/monitor every worker who works in extraordinary conditions that increase the risk of heat stress. These conditions include:

- Wearing semi-permeable or impermeable clothing when temperature exceeds 21°C (sweat don't evaporate);
- Strenuous work at extreme metabolic loads (greater than 500 kcal/hr. e.g. shovelling dry sand).

d) PPE

- Ice-vests, water-cooled garments, air supplied suits.

NB: the weight of Compressed Air Breathing Apparatus increases stress on a worker, and this stress contributes to overall heat stress. Chemical protective clothing such as totally encapsulating chemical protection suits will also add to the heat stress problem.

8.17 Boxing-Up Precautions

a) A Box-Up Permit is required before any equipment is taken back into service.
b) The Responsible Production member shall inspect the inside of the Confined Space to satisfy himself or herself that no person or undesired equipment or material is inside.
c) The Responsible Production member shall remain present until at least two bolts on the cover have been tightened and sign the Box-up Permit.
d) The Clearance Issuer shall ensure that all the relevant signatures appear on the box-up permit prior to issuing a Clearance Certificate to box up.

8.18 Hot Work Precautions

[Refer ASSET.WI.0228: Installation/Maintenance of Oxygen/Acetylene Equipment]
[Refer ASSET.WI.0218 Containment of Sparks and Slag]

The following Precautions must be adhered to for Hot Work in Confined Spaces:

a) The Explosimeter must read Zero;
b) The Area Engineer must satisfy him/herself that adequate ventilation will be provided to remove any harmful substances that may or can be caused by the Hot Work;
c) The user must ensure the Oxy-Acetylene equipment conforms to SAPREF Fire Prevention requirements;
d) The torch to be lit outside the Confined Space to ensure the equipment is working correctly. Once the user is satisfied, the flame must be extinguished prior to entry;
e) The user must ensure the Oxy-Acetylene valves on the torch are properly and securely closed after the flame has been extinguished;
f) An unlit torch may only be left unattended by the user provided the gas supply lines are isolated at the cylinders/bottles.

Cathodic protection must be disconnected and the equipment well earthed 24 hours prior to entry.

8.19 Safety Watcher

There **shall** always be one or more Safety Watchers outside the confined space with proper mode of communication between the entrant and the control centre and/or emergency response team.

a) The Risk Assessment and Rescue plan shall identify the number and level (competence) of Safety Watchers needed for the different phases of the work and it should detail their responsibilities.

b) An adequate and effective means of communication shall be established before persons enter the space:
   - Between the persons inside a confined space;
   - Between the persons inside a confined space and the Safety Watchers outside;
   - Between the Safety Watcher and the control room and/or emergency response team.

   Communication can be by speech, tugs on a rope, telephone or radio (intrinsically safe when flammable conditions could exist). It is important that communication is easy and effective; therefore, it should be practiced.

I. Minimum requirements for ANY Safety Watcher

The Safety Watcher shall:

a) Know and understand the potential hazards and the associated symptoms, including heat stress (section 8.16 : Heat Stress Controls).
b) Be aware of and understand the risks identified in the Risk Assessment session;
c) Maintain contact with the persons inside the confined space. Visual contact is preferred;
d) Know the communication mechanism and maintain contact with the control room and/or emergency response team;
e) Be able to communicate in the agreed working language;
f) Monitor activities inside/outside the confined space, and order an evacuation if entrants show signs of being affected, or should conditions outside the space pose a threat;
g) Have the confidence to stop the work, order evacuation and raise alarm in emergencies;
h) Raise the alarm by alerting the rescue team in case of any emergency in the confined space;
i) Barricade an area around the confined space/entry point and keep unauthorised persons out;
j) Ensure that barricades and warning signs are in place during breaks and at the end of the day;
k) Remain in attendance outside the confined space until relieved by another Safety Watcher;
l) Be physically able to assist workers in times of difficulty and assist in any rescue;
m) Not attempt a rescue that involves entry
n) Be aware of the escape/exit routes;
o) Maintain a register of entry and exit to/from the confined space.
p) Ensure rescue equipment is in place as per plan.

II. Additional requirement for Safety Watcher for Non- Compressed Air Breathing Apparatus entry

The Safety Watcher shall:

a) Meet all the criteria as set out in **I.** above
b) Additional requirements to be identified from the job specific Risk Assessment and Rescue plan e.g. under potential heat stress conditions consider a first-aider that is able to perform mouth to mouth resuscitation.

III. Additional requirement for Safety Watcher for Exceptional CSE with Compressed Air Breathing Apparatus

The Safety Watcher shall:

a) Meet all the criteria as set out in **I.** above
b) Ensure that the air supply from outside the confined space is sustained and safeguarded against contamination. The responsibility for the refinery breathing air system remains with OMUTDE. (It may be necessary to allocate a separate person to control the air supply);
c) Standby with a portable Breathing Apparatus (BA) set;
d) Be trained in resuscitation and use of apparatus and **remain in attendance immediately outside** the entrance of the confined space in order to assist or remove any persons from the confined space (refer **I.(m)** above), if necessary; AND
e) Ensure effective apparatus for breathing and resuscitation of a type approved by the Chief Inspector (DOL) is available immediately outside the confined space.

IV. Further requirement for standby for Inert Gas Entry

Refer to Section 10 : Inert Gas Confined Space Entry for Catalyst Handling for full details.

The Safety Watcher:

a) Shall meet all the criteria as set out in **I.** and **III.** above;
b) The Specialised Safety Standby Shall be trained in Intermediate life saving skills/ Intermediate life support (refer HSSE.PR.7004).
c) Should wear a full inert gas suit and breathing apparatus set on positive pressure mode, ready to respond to an emergency. Consideration should be given to alternative means of emergency response instead of physical entry e.g. harness and pulley.

9. Entry Conditions, Limits and Specific Controls

This section is mandatory and sets out the criteria to determine whether entry is allowed as well as the associated testing and monitoring requirements. It then describes the controls specific to the particular entry conditions.

The controls that are common to all confined spaces are detailed in Section 8 : Controls Applicable to All Confined Space Entries and HSSE.PR.0069 Permit To Work Procedure.

Controls specific to Inert Entry for Catalyst Handling are detailed in Section 10 : Inert Gas Confined Space Entry for Catalyst Handling

9.1 General CSE Conditions and Limits

Entry into a Confined Space is only permitted subject to the following conditions:

	Normal entry **Without** breathing apparatus	**Exceptional** entry **With** breathing apparatus
Oxygen - % vol.	20 to 21.5	16 to 20
Toxic Vapours - ppm	< 50% OEL	50 % OEL to IDLH
Flammables - % LEL	Not detectable (< 1)	< 10 For hotwork - not detectable

OEL = Occupational Exposure Limit
LEL = Lower Explosive Limit
IDLH = Immediately Dangerous to Life and Health

Entry shall not be allowed into any confined spaces outside these limits;

- **Where oxygen is less than 16% vol.**
- **Where toxics are above IDLH limit**
- **Where flammables (explosimeter readings) are above 10% LEL,**

except for:

a) Entry by specialist rescuers using BA with back-up air supplies, specialist standbys and communication systems;
b) Inert gas entry by specialist catalyst handling contractors, as described in Section 10 : Inert Gas Confined Space Entry for Catalyst Handling.

Notes:

1) The toxic IDLH criteria should not be applied for work in open areas with breathing apparatus.
2) If any one of oxygen, toxics or flammables does not meet the Normal criterion, supplied air breathing apparatus shall be worn.

9.2 Testing and Monitoring

A competent person [i.e. who has been adequately trained and appointed in writing as a Competent Person by SAPREF, typically AGT] must test the atmosphere both in and around the confined space before any entry to determine if the entry criteria are met and will remain safe for the duration of the work to be carried out. He/she to wear the appropriate PPE until the test results confirm that the hazard is controlled.

Wet Bulb Globe Test (WBGT) to be done: 1) Minimum frequency is prior to entry and during breaks (Mandatory).

2) Above minimum frequency as advised daily by Health and Safety Specialist or Clinic.

In addition to the criteria set in Section 9.1 : Entry Criteria, the potential for Heat Stress, i.e. WBGT index to be measured using approved monitor (Section 8.16 : Heat Stress Controls).

The atmosphere in the confined space should be tested : 1) Minimum frequency is prior to entry and during breaks (Mandatory). 2) Above minimum frequency (as determined by the GSI). Tests required should be signed for on the Clearance Certificate and results recorded on the Gas Test Register (refer Appendix 4: Confined Space Entry Gas Test Register) and kept at the work site.

The RAMS/CSE Certificate should specify additional tests and any changes to the aforementioned test frequency.

Testing equipment should be:

- Specific to the gases that have to be tested and sensitive at the OEL;
- Of an approved type, e.g. intrinsically safe;
- Designed to give a visual and audible alarm, when being applied for monitoring as opposed to one-off testing;
- Correctly maintained and calibrated;
- Checked that it is functioning correctly, at the start of each day.

The gas tests shall be representative of conditions in the entire space. Particular attention should be paid to the direction of flow of ventilation air and to locations where toxic or flammable gases may accumulate, e.g. in sumps.

The preferred method is for gas tests to be carried out from outside the confined space, using sample probes attached to the testing equipment. The time lag when drawing a sample through a probe should be allowed for. If it becomes necessary to enter the confined space to obtain a representative sample, entry of the competent person, shall only be allowed when all the controls specified on the entry permit, apart from the gas test, are implemented and effective.

Entry to clean a tank or vessel can disturb scale or sludge and result in a locally high concentration of flammable material, even if the confined space was gas free before entry and forced ventilation is applied. This situation is acceptable providing the excursion is limited to an area immediately surrounding the point of disturbance and the bulk of confined space is controlled within the allowable limit. Consider Breathing apparatus for instances where there is a possibility of disturbing scale or sludge to release vapours.

In the rare situations where forced ventilation is being applied to control the concentration of a flammable, toxic or asphyxiant hazard, continuous monitoring for the hazardous gas is essential.

Any work carried out in a confined space will require the person to wear a 4 Gas Monitor. At least one person in a team shall wear a 4 Gas Monitor unless the team is working in different locations or elevations

in the confined space, in which case, at least one person in every group of workers shall wear a 4 Gas Monitor (Refer Section 5.1 from General HSSE Specification HSSE.PR.0004 GENERAL HSSE SPECIFICATIONS).

For hot work in CSE: 1x 4X monitor/hot work team. Safety watcher to carry/measure at the entrance of CSE using 4 in 1 gas Monitor (4X monitor) or 5 in 1 gas monitor (5X monitor).

9.3 Normal CSE Without Breathing Apparatus

In addition to the general controls as outlined in Section 8 : Controls Applicable to All Confined Space Entries & Section 9.1 : Entry Criteria and Section 9.2 : Testing and Monitoring, the following specific controls apply;

a) Carry out more frequent tests if the presence of Toxic Gases in the table below has been identified,

b) Ventilation should be sufficient to ensure that the confined space is kept free of toxic vapours, fumes or dusts in excess of the OEL, and is maintained at atmospheric oxygen content (20 to 21.5 % vol.). Precautions should be in place to ensure that no Hazardous Substances can enter the Confined Space while work is in progress. Activities (e.g. sampling, depressurising) upstream of a confined space have to be taken into consideration.

c) If measurements show that the levels of toxic vapours or dusts are above 50% of OEL, breathing apparatus will be required. Air purifying respirators (canister masks and cartridge masks) may be used in confined spaces where the oxygen content is between 20 and 21.5 % and the level of toxics is below OEL x Protection Factor and below the IDLH value. Note that the practical Protection Factor of air purifying respirators can be several times lower than the often-quoted Nominal Protection Factor (NPF). It is recommended to apply the values of 10 for half facemask and 50 for full-face mask. Guidelines are given in the table below.

	HAZARD	LIMIT - 50% of OEL	IDLH Value	TEST METHOD	Competent Persons	Half-face Mask	Full-face mask
1	Hydrocarbons (containing Benzene)	0.25 ppm	500 ppm	Drager Petroleum Benzene Tubes	AGT, OH	0.25 - 2.4ppm	<12.5ppm
2	Hydrocarbons (containing Hexane, Toluene or Xylene)	10 ppm	500 ppm	Drager Petroleum Hydrocarbon Tubes	AGT, OH	10 - 100ppm	<500ppm
3	Other Hydrocarbons (Mixtures)	150 ppm	500 ppm	Drager Petroleum Hydrocarbon Tubes	AGT, OH	150 - 500ppm	<500ppm
4	H_2S	5 ppm	100 ppm	SCT	AGT, OH	5 - 50ppm	<100ppm
5	CO	12,5 ppm	1 200 ppm	SCT	AGT, OH	12.5 - 125ppm	<625ppm
6	CO_2	2500 ppm	40 000 ppm	SCT	AGT, OH	2500 - 25000 ppm	<40 000 ppm
7	SO2	1 ppm	100 ppm	SCT	AGT, OH	1 - 10ppm	<50ppm

8	HCl	5 ppm (STEL C)	50 ppm	SCT	AGT, OH	5 - 50ppm	<250ppm
9	Furfural	1ppm	100 ppm	Adsorbent Tube with external analysis	OH	1 - 10ppm	< 50ppm
10	Tetra Ethyl Lead	0.50 mgPb/m3	40 mg/m3	SABS 1164-1990 (A.A.) / Octel Test Method	AIA, OH	0.5 - 5mg/m3	<25 mg/m3

SCT - Siebetic Colorimetric Tube
OH –Occupational Hygienist
AIA – Approved Inspection Authority

i. If any of the limits above are exceeded, the SAPREF's Occupational Hygienist must be consulted for guidance on the additional controls required including the use of Breathing Apparatus

ii. If more than one of the gases in no. 4 to 7 is present, the Occupational Hygienist must be consulted for advice on "additive" effect, i.e. affecting the target organ. The sum of the percentages of the OEL may not exceed 100%, e.g.

GAS	OEL	Concentration Found	% of OEL value
H2S	10	7	70%
SO2	2	1	50%
			TOTAL 120%

iii. **NB: If the Oxygen content is less than 20% air purifying respirators can not be used – Self Contained Breathing Apparatus must be used. The Occupational Hygienist shall be consulted for advice on the correct canister or cartridge to be used with air purifying respirators.**

d) There **shall** always be a Safety Watcher outside the confined space.

e) The need for harnesses, lifelines, escape breathing apparatus and presence of rescue personnel should be considered when preparing the Rescue Plan.

9.4 Exceptional CSE With Supplied Air Breathing Apparatus

Every effort shall be made to ventilate a confined space, to remove all contaminants and to establish an atmosphere oxygen concentration, so that entry is possible without breathing apparatus.

In exceptional situations where the contaminant cannot be entirely removed and the oxygen content remains below 20%, for example:

- Drains or sewers that cannot be positively isolated, and which may be difficult to ventilate;
- Storage tanks containing scale/sludge which releases flammable vapours when disturbed;
- Trenches where nitrogen is being used to freeze isolate a pipeline;
- Vessels/Reactors/Tanks which can't be fully decontaminated/Gas freed.
- CSE where there is possibility of disturbing internals; releasing toxic gases and vapours

Then the employer or user of machinery shall take steps to ensure that the confined space is entered only when the entrant is using breathing apparatus of a type approved by the Chief Inspector

Any person entering the confined space should be using a safety harness or other similar equipment, to which a rope/life line is securely attached which reaches beyond the access to the confined space, and the free end of which is attended to by the Safety Watcher.

In these situations it is essential that the Risk Assessment identifies the source of contamination and provides for ventilation that will ensure that the atmosphere in the confined space is stable, i.e. oxygen level will not reduce further and will remain above 16% vol. **The potential for the hazard to cause harm has to be understood and controlled.**

Ventilation shall be continued throughout the entry period to maintain the oxygen as close as possible to atmospheric level and the toxic and flammable levels as low as reasonably practicable.

In any event the oxygen, toxics and flammables controls and limits **shall** be maintained throughout the entry period.

Supplied air breathing apparatus should meet the following specification:

- When air is supplied from a breathing air compressor, a bank of cylinders or a breathing air supply main, the supply system should be reliable with sufficient back-up capacity in case of compressor or supply main failure. Persons operating the air supply system should be well trained and competent in their duties and in operating the air system.
- When breathing air is supplied from a compressor or supply main, separator vessels, filters or other equipment may be needed to remove water, oil or particulates from the supplied air. The compressor air intake should be located so that the supplied air is not contaminated by fumes from the diesel exhaust or other sources
- Hoses supplying breathing air to a confined space should be located, suspended or otherwise guarded to avoid accidental damage.
- When self-contained breathing apparatus is used, cylinders should be of sufficient capacity for the duration of the work;
- Air masks should be full face, and should be of the positive pressure demand type;
- Respiratory Protective Devices shall be compliant to the OHS Act and be approved by the National Regulator for compulsory specifications (NRCS) after being homologated to the specified SANS standards.
- Air purifying respirators **shall not** be used.

There **shall** always be one or more Safety Watchers outside the confined space, as established by the Risk Assessment and Rescue Plan.

9.5 Entry into Furnaces or Boilers that may contain Vanadium Pentoxide

For entry into furnaces or boilers where Vanadium Pentoxide might be present, precautions must be taken to prevent exposure, e.g. wetting areas that may have potential for releasing Vanadium Pentoxide dust, and the following Personal Protective Equipment must be worn:

a) A Fresh Air Breathing Mask or where specifically authorised, a Respirator fitted with a Air Purifying Respirator ABEKP , Disposable overall and goggles. The cartridge and a new Disposable Overall should be renewed daily.
b) PVC gloves or where impractical, leather gloves may be worn over thin rubber gloves. Care must be taken not to generate & inhale the dust when handling used PPE.

11. References

11.1 Records

ID No.	Title	Holder	Location	Working Duration	Archive Duration

11.2 External References

Document Reference	Title	Issued by	Revision / Date
	OHS Act 85 of 1993		
	Environmental Regulations for Workplace (ERW 2 (4)) (of OHS Act 85 of 1993)		
HSSE.EX.0025	HSSEms & SP Control Framework Manual		

11.3 Internal References

Doc. ID	Title
SITE.SF.0007	Risk Assessment
HSSE.SF.0053	Confined Space Entry Certificate
HSSE.PM.0004	SAPREF HSSE Regulations
SITE.SI.0001	SAPREF Standing Instructions
HSSE.PR.0069	PERMIT TO WORK
HSSE.WI.0006	Inert Gas CSE
HSSE.SF.0202	Confine Space Entry Register
HSSE.SF.0203	Confined Space Entry Gas Test Register

12. Keywords [back to TOC]

Inert Gas, Confined Space Entry, CSE, Man Ways, Fires, Toxic gases , Nickel Carbonyl , Heat Stress, Catalyst Beds, Inert Gas Supply, Breathing Air, Risk Assessment

13. Definitions and abbreviations [back to TOC] Refer to SITE.RG.0001

Additions to this list must be sent via e-mail to the Bms Administrator.

IDLH - Immediately Dangerous to Life and Health
CSE - Confined Space Entry
OEL - Occupational Exposure Limit
LEL/UEL - Lower/Upper Explosive Limit

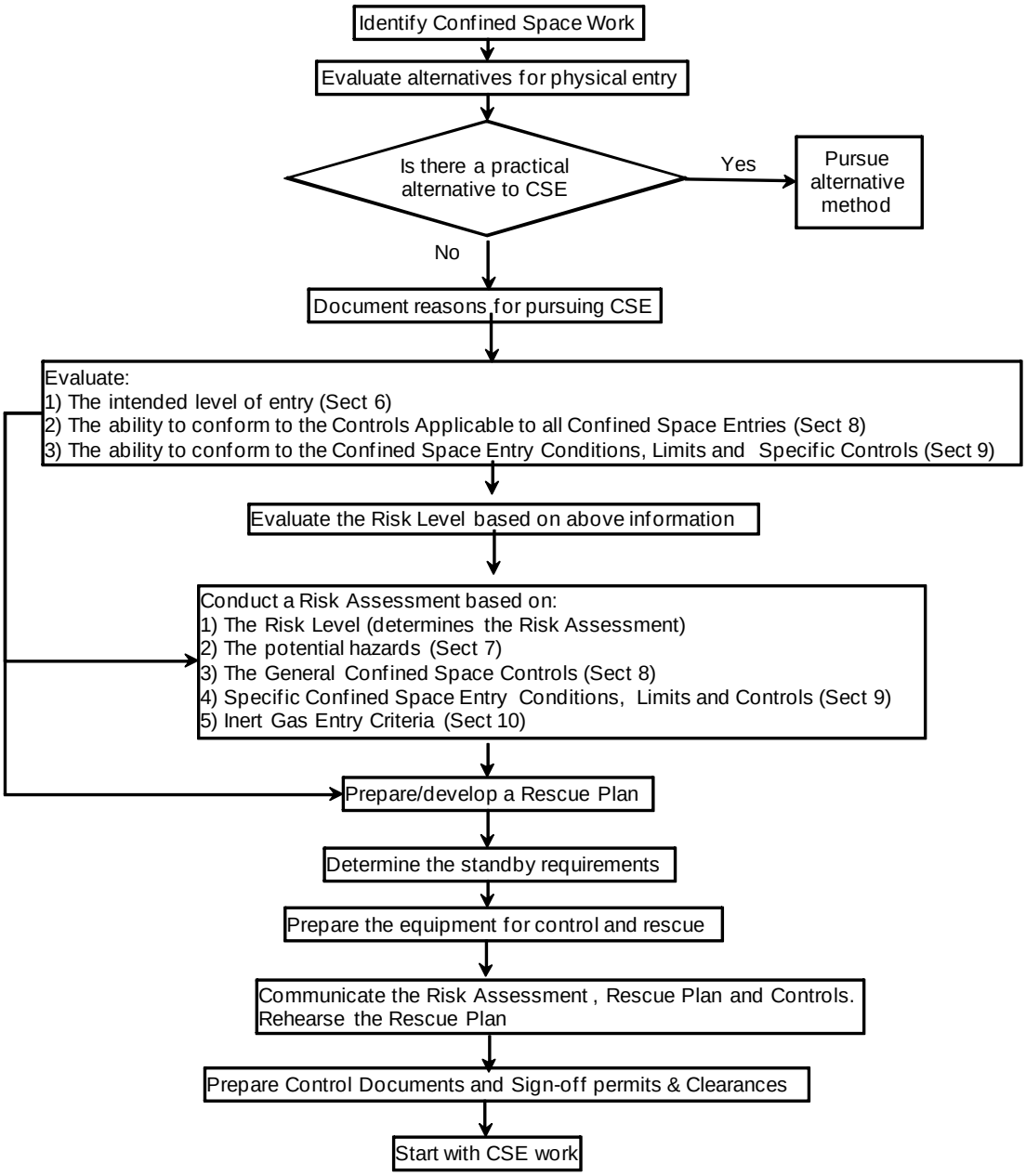
14. Revision list [back to TOC]

Revision	Date	Description	Checked by	Approved by
0	11/11/2006	First Issue	D. Moodley, MS4 K. Moodley, MS12 J. Van Belkum, PO M. Francis, MS22	D. Lowe, MS
1	08/01/2009	As per Tactic 62 (PTW) requirements	L. Ndlovu, MS11	S. Zulu, MS1
2	29/08/2012	Update, restructure and separation from the Old "Rules and Regulations" book	P. Nadar	J. van Belkum
3	November 2016		Caliway Lloyd, MS11, S. Zulu, MS1	M. Yokwe, MS
4	May 2017	Added 8.10.1	M. Meyer	M. Yokwe, MS
5	February 2022	1. Aligned OHSACT requirements with SAPREFs terminology on CSE entry types. 2 Removed Inert gas entry requirements because they are covered in a separate BMS document 3 Added BA as a requirement for CSE with possible change in concentrations. And added 2 activities requiring use of BA	L Mngoma, MS12	L. Schabalala, MS
6	November 2023	Minor update – copied over personal monitoring requirements from General HSSE Specification.	L Mngoma, IHS4	M Francis, IHS
7	December 2023	Minor update – on Hot work in CSE. Addes CSE LSR summary -Appendix 7.	L Mngoma, IHS4	M Francis, IHS
8				

15. Appendices

APPENDIX 1: Confined Space Entry Process Flow
APPENDIX 2: Confined Space Entry Register
APPENDIX 3: Confined Space Entry Gas Test Register
APPENDIX 4: Accountability Matrix
APPENDIX 5: Guidelines for Standby Requirements
APPENDIX 6: Confined Space Entry Certificate
APPENDIX 7: CSE Life Saving Rule

APPENDIX 1: Confined Space Entry Process Flow



APPENDIX 2

:

CONFINED SPACE ENTRY REGISTER

No.

AREA:_____ **EQUIPMENT NUMBER:**_____

DATE:

NAME OF ENTRANT	COMPANY/ DEPARTMENT	ACTIVITY	TIME OF ENTRY	SIGN	TIME OF EXIT	SIGN	STANDBY	
							NAME	SIGN

Completed copy to be filed in control room for duration of activites

CONFINED SPACE ENTRY GAS TEST REGISTER

No.

AREA:_____ **EQUIPMENT NUMBER:**_____

		REQUIRED GAS TESTS							OTHER TESTS SPECIFY		AUTHORISED GAS TESTER (AGT)	
DATE	**TIME**	**O2 %**	**L.E.L. %**	**H2S ppm**	**CO ppm**	**CO2 ppm**	**WBGT °C**	**ORGANIC VAPOURS**			**NAME**	**SIGN**

LEGEND: 1. OXYGEN = 02 2. L.E.L = LOWER EXPLOSIVE LIMIT 3. H2S = HYDROGEN SULPHIDE
4. CO = CARBON MONOXIDE 5. CARBON DI OXIDE 6. WBGT = WET BULB GLOBE TEST

AN ORGANIC VAPOUR TEST NEEDS TO BE DONE PRIOR TO 1ST ENTRY ONLY UNLESS ON REQUEST SHOULD THE LEVELS BE CLOSE TO THE THRESHOLD LIMIT.

Completed copy to be filed in control room for duration of activities

APPENDIX 4:

ACCOUNTABILITY MATRIX

NO.	DISCIPLINE	ROLE	FREQUENCY
1.	Person Entering Confined Space	▪ Must be MEDICALLY FIT and competent to perform the job using the relevant equipment, tools, PPE supplied and complying with the specified controls. ▪ Must undergo SAPREF training and be certified competent by the Emergency Services Section, i.e. must be in possession of valid ORANGE CARD. ▪ Be expected to produce valid Orange Card before entering Confined Space. ▪ Sign CSE Register	▪ Annually ▪ Annually ▪ Every entry ▪ Every entry & exit
2.	Authorised gas Tester (AGT)	▪ Must test the atmosphere both in and around the confined space before any entry to determine if the entry criteria are met and will remain safe for the duration of the work to be carried out, refer Appendix 4. He/she to wear the appropriate PPE until the test results confirm that the hazard is controlled.	▪ Prior to entry and after breaks
3.	Operations Supervisor (Clearance Issuer/ Team Leader/ Acting Team Leader/ MSFP)	▪ Signs and approve a job specific Risk Assessment. ▪ Ensures the Safety Certificate has been completed. ▪ Ensures the Work Method Statement and any relevant Procedures have been made available. ▪ Ensures the Rescue Plan is also available. ▪ Must make sure that the confined space is safe for entry, and that the supervisor in charge of the work and the attendant are fully familiar with the hazards, controls and recovery measures; ▪ Must consult with the Occupational Hygienist in deciding the frequency and timing of measurements when heat stress is identified as a potential hazard ▪ To monitor work under permit control to include spot checks of worksites, permits and supporting documents. ▪ A Box-Up Permit is required before any equipment is taken back into service. ▪ Before boxing-up, must inspect the inside of the Confined Space to satisfy himself or herself that no person or undesired equipment or material is inside. ▪ An Operations Representative must remain present until at least two bolts on the cover have been tightened and sign the Box-up Permit. ▪ Shall ensure that all the relevant signatures appear on the box-up permit prior to issuing a Clearance Certificate to box up.	▪ All the time ▪ All the time ▪ All the time ▪ All the time ▪ All the time ▪ During hard manual labour in hot conditions ▪ All the time ▪ All the time ▪ All the time ▪ All the time ▪ All the time

		▪ Notify Fire Chief or his deputy of planned inert gas CSE	▪ All the time
4.	Gas Safety Inspector (GSI)	▪ Sets the frequency of gas testing ▪ Signs and approve the Risk Assessment in accordance with the requirements set by the Risk Level. ▪ Signs and approves of Confined Space Certificate. ▪ Withdraws and re-issues Confined Space Certificate under changing conditions.	▪ All the time ▪ All the time ▪ All the time ▪ All the time
5.	GMR2(1)	▪ Signs and approve the Risk Assessment in accordance with the requirements set by the Risk level. ▪ Signs Safety Certificate to include any additional precautions from engineering point of view. ▪ Must satisfy himself that adequate ventilation will be provided to remove any harmful substances that may or can be caused by Hot Work.	▪ All the time ▪ All the time ▪ All the time
NO.	**DISCIPLINE**	**ROLE**	**FREQUENCY**
6.	GMR2(7)(a)	▪ Signs and approve the Risk Assessment in accordance with the requirements set by the Risk Level.	▪ All the time
7.	Section 16(2)	▪ Signs and approve the Risk Assessment in accordance with the requirements set by the Risk Level. ▪ Signs and approves Confined Space Entry Certificate	▪ All the time ▪ All the time
8.	Contractor Supervisor	▪ Signs the Risk Assessment ▪ Must make sure that the workers comply with the controls specified on the permit, and for providing means of rescuing persons from the confined space in case of an emergency. ▪ To be familiar and discuss the RAMS, CSE Certificate and Rescue Plan with co-workers.	▪ All the time ▪ All the time ▪ All the time ▪ All the time
9.	Clearance Receiver	▪ Must produce a job specific RAMS, LMRA and discuss with the team. ▪ Signs the RAMS ▪ Must ensure all Permit to Work paperwork is in place and this includes but not limited to the following: Confined Space Entry Certificate, Complete and signed RAMS and Clearance Certificate	▪ All the time ▪ All the time
10.	CSE Safety Watcher	▪ The Safety Watcher should NOT attempt to enter the confined space for rescue. ▪ Must be in possession of valid Yellow Card. ▪ Must ensure all Permit to Work paperwork is in place and this includes but not limited to the following: Confined Space Entry Certificate, Complete and signed RAMS, and Clearance Certificate	▪ All the time ▪ All the time ▪ All the time ▪ All the time

		▪ Responsible for maintaining communications (radio) between all parties and raising the alarm in case of an emergency inside the confined space (refer Section 8.19 on Standby requirements)	
11.	Plant Inspector	▪ Inspect Confined Space ▪ Initiate Box-up Permit	▪ If required ▪ All the time
12.	Instrument Technician	▪ All Nuclear Instruments for entry to be locked out – Alkylation Unit ▪ For Hot work activity – the Nuclear source must be completely removed.	▪ All the time ▪ All the time
13.	Safety Advisor	▪ Signs and approve the Risk Assessment in accordance with the requirements set by the Risk level. ▪ To monitor work under permit control on a frequent basis, this must include spot checks of worksites, permits and supporting documents. ▪ Carry out in-depth inspections of Risk Assessment sheets	▪ All the time ▪ Frequently ▪ Quarterly
14.	Safety Manager	▪ To review the effectiveness of the CSE procedures taking into account changes in legislation and Shell guidelines, as well as learning from incidents and new best practices.	▪ Annually ▪ All the time
15.	Technical Auditor	▪ Under the sponsorship of the HSSE department audit the effectiveness of the site controls around CSE.	▪ Two yearly
16.	Emergency Services	▪ Responsible for the development of the Rescue plan ▪ To standby for inert gas CSE ▪ To advise on Emergency response controls and requirements.	▪ All the time ▪ All the time

Appendix 5: Guidelines for Standby Requirements

Potential Risk/ Hazard	Criteria/ measure	Highest Potential Consequence	Prevention	Standby requirement	Sections in procedure
Oxygen deficiency	O_2 = 16% - 20%	Asphyxiation and death	Exceptional entry with BA set	Standby with BA. Trained in resuscitation. Resuscitation apparatus available immediately outside confined space	7.1 8.19 (III)
	O_2 < 16%	Immediately dangerous to life (death)	Treat as inert entry	Advanced life saving skills, basic life support or paramedic. Resuscitation apparatus available immediately outside confined space	7.1 8.19 (IV) 10
Oxygen enrichment	O_2 > 21.5%	Increased flammability risks - LTI, Disability	Care for O_2 equipment. O_2 containing bottles/ cylinders remain outside CS. Remove cutting & welding equipment during breaks and at end of day	Basic standby training Fire training	7.2 8.19 (I)&(II)
Fire and Explosion	LEL > 10%	Death	CSE only with LEL < 10%. For Hotwork LEL must not be detectable	Basic standby training Fire training	7.3 8.19 (I) & (II)
Toxic Hazards	> 50% OEL < IDLH	Health risks	Entry only by exception after consultation with Occupational Hygienist	Basic standby training Training as specified by the Fire Chief/ Occupational Hygienist	7.4 8.19 (I) & (II)
	> IDLH	Death	Treat as inert entry	Advanced life saving skills, basic life support or paramedic. Resuscitation apparatus available immediately outside confined space Training as specified by the Occupational Hygienist.	7.4 8.19 (IV) 10
Corrosive Hazards	Acids	Damage to tissue (LTI or Disability)	Neutralize acids before entry	Basic standby training Training as specified by the Fire Chief /Occupational Hygienist	7.5 8.19 (I) & (II)

				(For HF - refer to specific training and requirements)	
Physical Hazards	Heat stress, electric shock	Death	Ventilation. Follow WBGT work/rest guidelines Adequate water intake.	Standby with BA. Trained in resuscitation. Resuscitation apparatus available immediately outside confined space	7.6 8.19 (III) 8.16
Potential Risk/ Hazard	**Criteria/ measure**	**Highest Potential Consequence**	**Prevention**	**Standby requirement**	**Sections in procedure**
Unsafe Conditions	Several (refer 7.7)	Range from First aid to fatality	Identify in SWP and Risk Assessment	As required by Risk Assessment and Rescue plan	7.7 8.19
Psychological issues	Claustrophobia & anxiety	MTC	Medical certificate Acclimatise	Basic standby training	7.8 8.19 (I) & (II)

Notes:

- The above is merely a guideline. The actual situational requirement must be determined after a Risk Assessment session and development of a Rescue Plan
- The ability to adhere to the General and Specific Controls as specified in Section 8 & Section 9 of the procedure must be taken into account when determining the standby requirement.

Appendix 6 : Confined Space Entry Certificate

Confined Space Entry Certificate

No: _____ *Sec 8.1*

Valid for Area:	**Documentation to be attached:** - Marked up EFD showing isolation and spading and associated spade list - SAPREF's RAP for entry Specific activities inside the confined space (e.g. hotwork) require its own Permitry and RAPs A Clearance Certificate must be obtained from the Clearance Issuer before entry
Equipment No:	
Product (specify) in vessel/equipment before CSE:	
Sec 6 **Type of entry:** Without BA set ☐ Exceptional with BA set ☐ Inert Gas Entry ☐	
Sec 9.1 **Alternatives to CSE considered/Reason for CSE**	
Sec 3 **Date Validity** From: To:	

1. Entry Criteria and Specific Controls

Sec 8.5 To gas free the equipment it must be:	YES	NO
Sec 8.6 • Water Washed		
Sec 9.5 • Chemically Washed		
• Steamed-out		
• Specify other		
Ventilation requirements:	**Natural**	**Forced**
1. Remove purge gasses (record what the purge gas was :.....)		
2. Maintain oxygen content and/or remove fumes produced by work activity or equipment content e.g. sludge/coke		

The equipment must be tested for the following hazardous substances/environment and the levels must conform to the requirements stipulated in Chapter 5 of the SAPREF Rules & Regulations to allow entry and results signed off on the gas test register. *Sec 9.2*

Sec 7.1 **Test**	YES	NO
Sec 7.4 • Lower Explosive Limit (L.E.L)		
• Carbon Monoxide (CO)		
• Oxygen (O_2)		
• Hydrogen Sulphides (H2S)		
• Organic Vapour (before first entry)		

Wet Bulb Globe Test (WBGT) to be done 1) Minimum frequency is prior to entry and during breaks (Mandatory)
2) Above minimum frequency as advised daily by the OH or Clinic

Gas tests to be done 1) Minimum frequency is prior to entry and during breaks (Mandatory)
2) Above minimum frequency every ..... hrs (as determined by the GSI)

2. General Precautions *Sec 8.15* *Sec 8.16*

- All entrees must sign the Confined Space Entry Register (controlled by the standby).
- "No Entry Without a CLEARANCE" sign must be placed at all entry points
- Supplied breathing air apparatus must meet specification (HSSE.PR.0006: CSE Section 2.6.4)
- Any special breathing air set-up requires an approved Method Statement, SWP or RAP
- Heat stress prevention to be in place. Follow WBGT index (HSSE.PR.0006: CSE Sect 2.5.14)
- All entrees to be Confined Space trained (valid Blue or Orange card)
- Adequate lighting to be provided *Sec 8.9*

3. Prevent contamination of the confined space air *Sec 8.10*

- Internal Combustion Engines not allowed inside the space
- No Gas cylinders to be taken into Confined space (excluding BA set)
- Diesel engines placed not to introduce fumes
- Ensure adjacent processes are stable and do not impact on CSE e.g. gas leaks
- No draining, sampling or venting of hydrocarbons/chemicals is permitted within 15 metres of confined space (during entry)
- Move residue/waste well away to prevent contamination of internal air/ventilation *Sec 8.7*
- **Ignition sources should be controlled via a Fire Permit** *Sec 8.18*
- **Ensure the correct driving force is used for pneumatic tools** *Sec 7.3*
  - For normal & BA set entry, use air driven tools.
  - For Inert entry, use Nitrogen driven tools

4. Specific PPE to be stipulated below; consider e.g. static generation, heat stress etc *Sec 8.11* *Sec 8.16*

5. Isolate confined spaces from other systems (Chapter 3 Rules & Regs) *Sec 8.3*

	YES	N/A
• The equipment to be fully spaded from other systems at all the equipment nozzles and recorded and signed off		
• Isolate drives on moving parts (mechanical linkages)		
• Isolate Electrical systems		
• Isolate Hydraulic/pneumatic systems		
• Isolate Instruments		
Sec 8.8 • Radiation sources must be:		
a. De-energised		
b. Removed		
c. Shielded		

6. In cases of potential Heat Stress, the following work/rest schedule applies: *Sec 8.16*

WBGT INDEX (°C)	WORK/REST RATIO PER HOUR
<30	No special rest period needed
30.1 to 30.6	45 mins work then 15 mins rest
30.7 to 31.4	30 mins work then 30 mins rest
31.5 to 32.2	15 mins work then 45 mins rest

NOTE: For BA Set entry, effective Breathing and Resuscitation apparatus must be available immediately outside a Confined Space.

7. Considerations for the Rescue Plan: These to be included in the RAP *Sec 8.12* *Sec 8.13*

- Fire Department, Shift Manager and Clinic to be alerted daily of confined space entry.
- Identify access and escape routes (min 600mm aperture):
- How will access be gained for rescue of persons inside:
- Specify potential physical obstacles:
- Stipulate **special PPE** that persons inside the confined space need to wear to facilitate rescue (consider in what condition people might be working/found):
- Fire Dept to stipulate rescue equipment required immediately outside the entry point:

8. Standby Requirements: **Shall** be considered in the RAP and Rescue Plan *Sec 8.19*

- Standby must be aware of requirements in HSSE.PR.0006: CSE, Section 2.5.12)
- There **shall** always be a standby outside the confined space and ensure that the communication with workers inside the confined space is established and maintained as well as communication with the Control Room/ Fire Department.
- The standby must ensure that the entry register is kept up to date and ensure that all entrants have valid Confined Space Entry training
- Stipulate the standby position during the entry, and own level of PPE:
- Stipulate means of communication with persons inside the confined space:
- Stipulate means of communication with Control room/Fire Department:

Tick level/qualification required below (refer HSSE.PR.7004)

	Minimum Qualification/ Level:	**Typical application** (confirm through RAP)
	Basic First Aider / Level 1	non-BA entry with low risk of Heat Stress
	Advanced First Aider/ Level 3	BA entry, and / or risk of Heat Stress
	Paramedic (Basic Ambulance Assistance)	Inert entry

9. COMMENTS: Add precautions from the RAP session not covered above:

10. We the undersigned allow entry into the above-mentioned equipment provided that the above precautions have been fulfilled and a Clearance Certificate has been obtained.

Designation	Name	Signature	Ref.	Date
GMR 2(1) (Area Engineer)				
~~Gas Safety Inspector (Day Assistant)~~				
Rescue Plan Sign off: Low Rescue Complexity (DA) as defined in HSSE.PR.0006 Medium Rescue Complexity (Fire officer) High Rescue Complexity (Fire Chief)				
Sec 16(2) Production Unit Manager				

Appendix 7: CSE as an Life Saving Rule

Obtain authorisation before entering a confined space

- I confirm energy sources are isolated
- I confirm the atmosphere has been tested and is monitored
- I check and use my breathing apparatus when required
- I confirm there is an attendant standing by
- I confirm a rescue plan is in place
- I obtain authorisation to enter