



Confined Space Entry



Change record

Date	Reason
September 2020	First LTP edition



Developed by: Health, Safety, Environment Curriculum Development and Evaluation Group

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Confined Space Entry

Unit 1

Confined Space Entry

HSECD & EG

September 2020



Module 1

Identify confined space entry

Enabling objectives

On completion of Module 1, you will be able to:

- Describe the Stop Work Authority program.
- Define and identify a confined space entry.

Terminal objective

You will be able to summarize the confined space entry process based on the information in General Instructions 2.100, 2.709 and the Construction Safety Manual.

Introduction

Saudi Aramco conducts many work tasks and activities that require entry into Confined Spaces.

Confined Space Entry (CSE) has many hazards that must be controlled.

Workers must know and follow confined space entry procedures before work starts.

Training on Confined Space Entry is among the most important safety training you will receive.



Instructional staff



Your safety instructor is your guide through this training course and will help you get the knowledge you need to understand the course material and to prepare you for the on-line test.

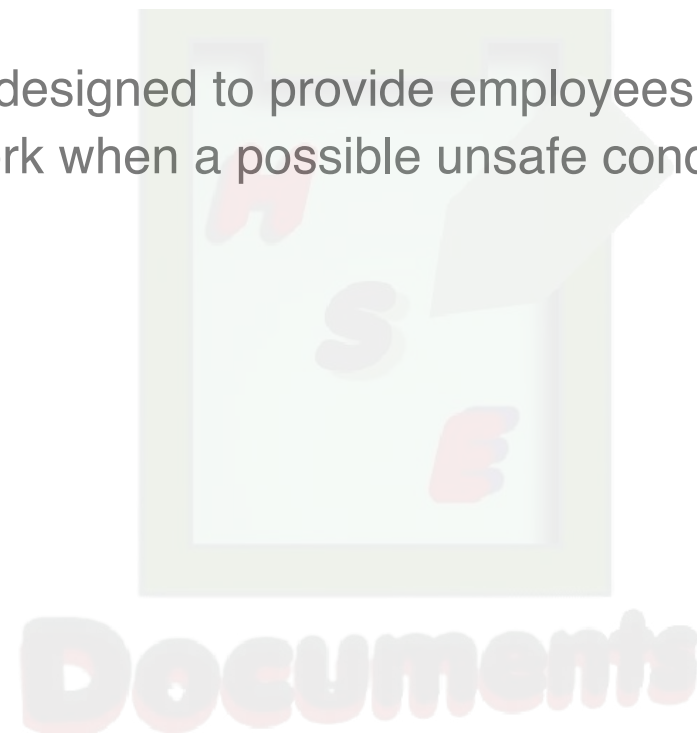
The instructor will present the course material to you, explain and illustrate the information, and answer your questions.

If you do not understand the information, or if you are not sure how to perform an activity, then please ask for more information.

Stop Work Authority (SWA)

Before we start the Confined Space Entry (CSE) course, you must be fully aware of the Saudi Aramco Stop Work Authority (SWA).

The Stop Work Authority is a program designed to provide employees and contract workers with the responsibility and obligation to stop work when a possible unsafe condition or behavior may result in an incident.



Stop Work Authority

All personnel have the authority to stop any unsafe work.

If you observe any unsafe work that has the potential to injure personnel, damage equipment, or harm the environment, you are empowered to stop work and report your concerns to a supervisor.

Basic Safety Rules

Stop Unsafe Work

1. Immediately STOP any unsafe work that has the potential to injure personnel, damage equipment, or harm the environment.

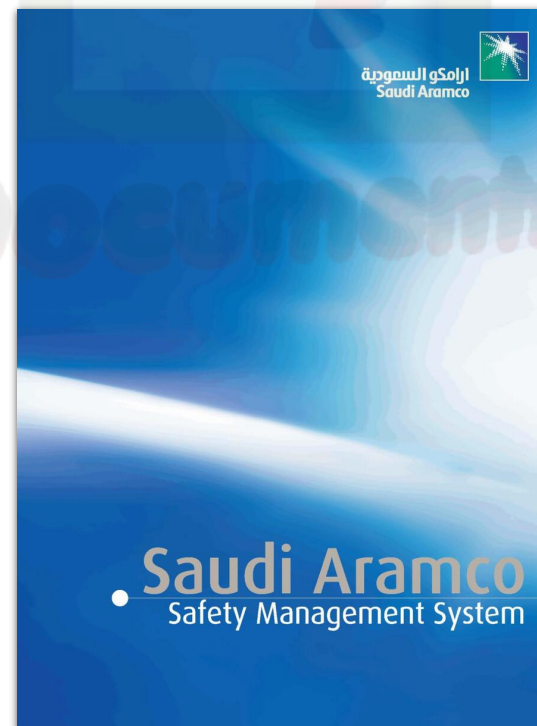
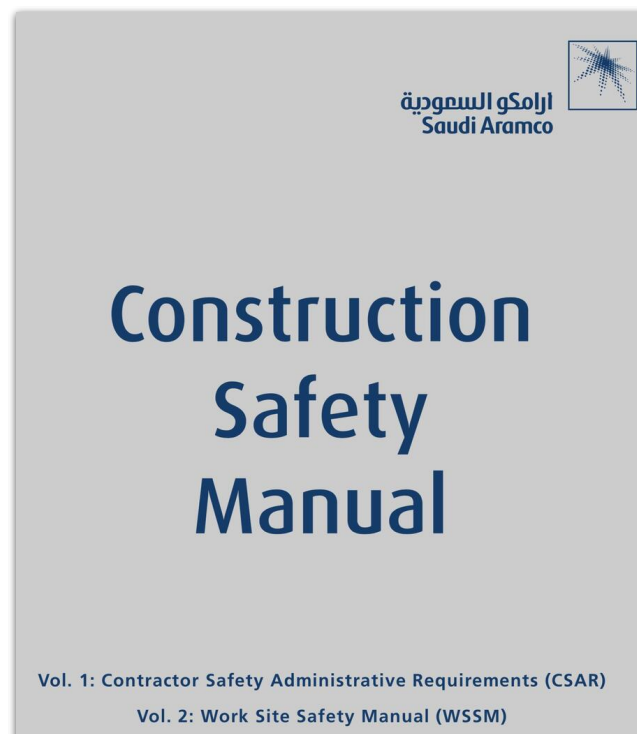
Report Incidents

2. Immediately report all work related injuries/illnesses, no matter how minor, to your supervisor.
3. Immediately report all fires, spills, or releases, no matter how small, to your supervisor.
4. Immediately report any unsafe condition, unsafe act, near miss incident, or vehicle collision to your supervisor.

SWA references

These publications outline the expectations for all personnel to stop work in the event that an unsafe act or situation is observed.

- Construction Safety Manual, Chapter I-4, Work Permit System and Stop Work Authority.
- SMS Manual, Element 6, Safe Operations.
- Safety Handbook Rules 1 and 4.



SWA 5 step process



1. STOP unsafe work.

You are authorized to stop work immediately when coworkers, equipment or the environment are at risk.



2. Notify affected personnel and supervision.

Don't try to correct everything yourself. Notify your supervisor and any other organizations, as required.



3. Investigate the cause for intervention and correct the hazard.

After a stop work action is in place, the proponent organization and those involved should:

- Discuss the situation and come to an agreement on the harmful behavior or condition and a corrective plan.
- If needed, have an external subject matter expert evaluate the situation and confirm whether it is safe to proceed.

If the SWA concern is valid:

- Suspend work until a resolution is in place.
- Verify that all safety issues have been properly resolved.
- Modify work practices or procedures when necessary.

SWA 5 step process



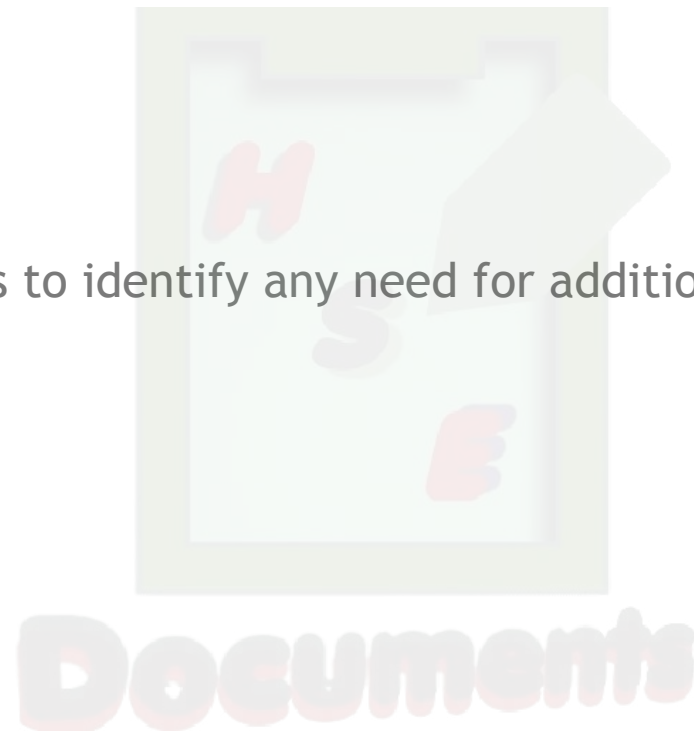
4. Communicate findings and resume work.

Notify all affected personnel about corrective actions to prevent similar issues from occurring.



5. Follow-up.

Promptly review all stop cases to identify any need for additional investigation or follow-up.



SWA Signs

Stop work signage, shall be mounted in clearly visible locations at worksites as per CSM 4.11.4 to remind everyone of their SWA responsibilities.



Define and identify confined space entry

In Module 1 you will learn about the following:

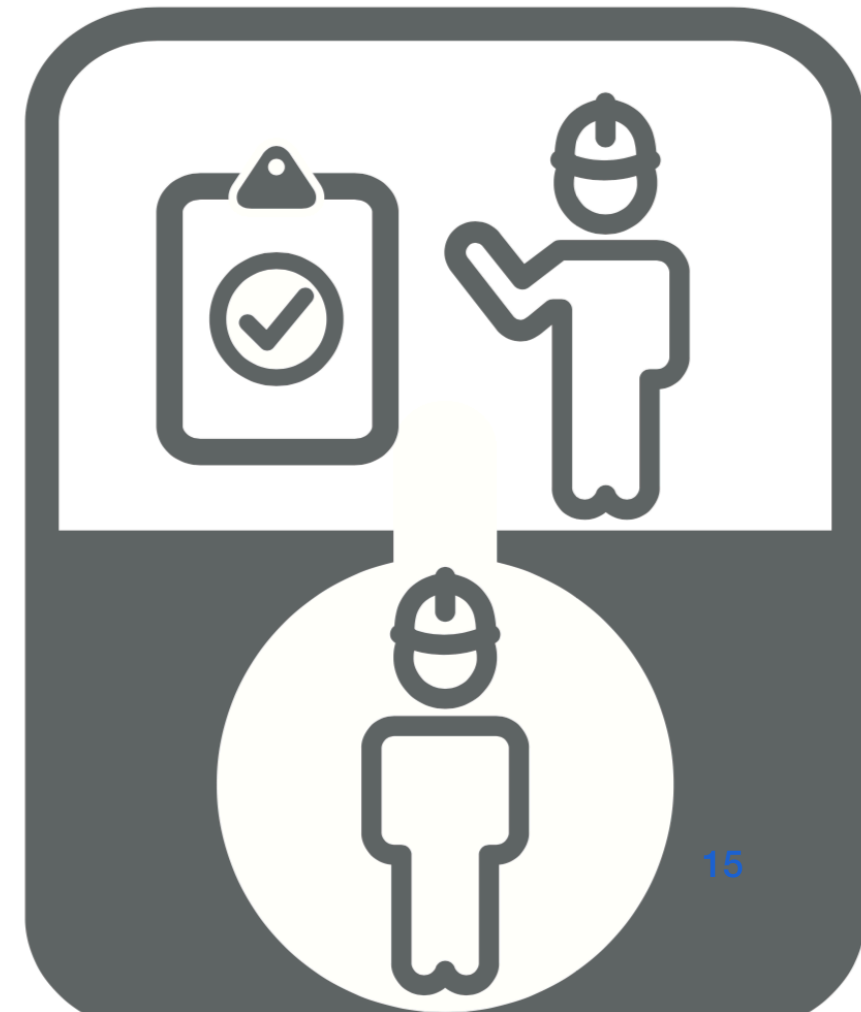
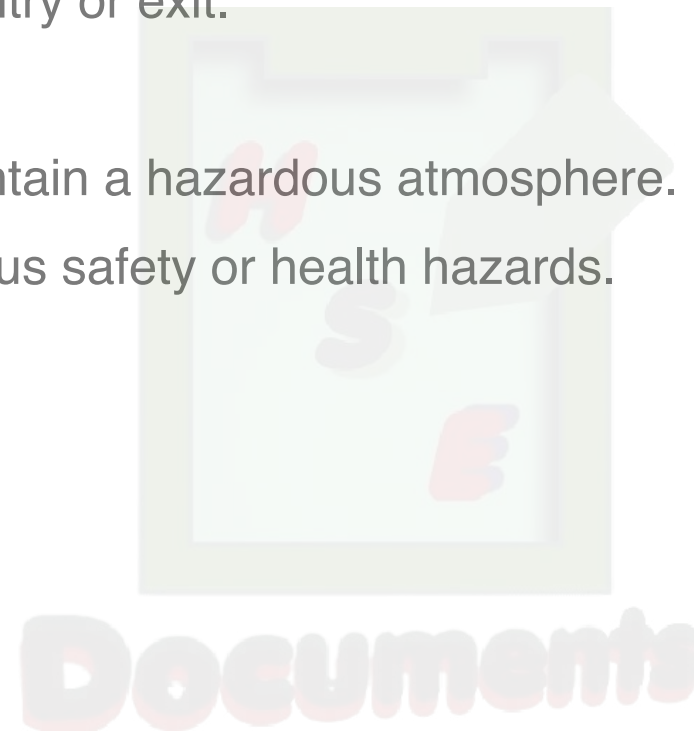
- What is a confined space.
- What is confined space entry.
- Examples of confined spaces.



What is a confined space

A confined space is any space or structure:

- Large enough to allow workers to enter and perform work.
- Has limited or restricted means of entry or exit.
- Not designed for human occupancy.
- Contains or has the possibility to contain a hazardous atmosphere.
- Contains any other recognized serious safety or health hazards.



What is confined space entry

A Confined Space Entry (CSE) is when anyone puts **any part of their body** through the opening of the **space**.

Entry also includes **all periods of time when the confined space is occupied**.

For example, putting your head into a tank opening or manhole is an entry.

When work tasks require you to enter into a confined space, you must follow CSE procedures and **a confined space entry permit must be issued before work can begin**.

CONFINED SPACE ENTRY PERMIT
Saudi Aramco 9873-4 (12/15) Front No. D
Complete this form in English and write clearly. Use ink pen, not pencil.

SECTION 1 – WORK DESCRIPTION
Month _____ Day _____ Year _____ Duration _____
A. Identify plant/facility area: _____
B. Exact work location: _____
C. Work to be done: _____
D. Equipment to be used at the site: _____

SECTION 2 – HAZARD IDENTIFICATION & CONTROL
A. Identify and attach any supplementary forms required to perform/control the work:
Confined space entry log (mandatory) ☐ CSE Plan (mandatory) ☐ Job Safety Analysis ☐
Gas test records ☐ Isolation plan ☐ Blind list ☐ Critical Lift Plan ☐ Excavation Checklist ☐
Hydrotest procedures ☐ Other: _____
B. Energy Types:
Hydrocarbon/gas/steam/chemicals ☐ Mechanical ☐ Electrical ☐ Hydraulic/pneumatic ☐
Potential energy (spring loaded, gravity) ☐ Automated extinguishing systems ☐ Other: _____
C. Isolation Method(s):
Locked switch/breaker ☐ Mechanical block ☐ Blinding ☐ Disconnect ☐
Positive isolation (blind or disconnect) shall be used for all piping connections to the confined space.
D. Potential Exposures:
High noise level ☐ Hydrogen Sulfide (H₂S) ☐ Flammable liquids/gases ☐ Hazardous/toxic materials ☐
Radioactive materials ☐ Temperature ☐ High pressure ☐ Other: _____
E. Protective Equipment:
Personal H₂S monitor ☐ FRC ☐ ARC rated PPE ☐ Goggles/face shield ☐ Chemical sub/boilers ☐
Fall protection ☐ Bar/caps/warning signs ☐ Mechanical ventilation/blower ☐
Respiratory protection ☐ (Explain further in Additional Safety Precautions below)
F. Confined Space Entry Supervisor (CSES) ☐ Badge No. _____
G. Confined Space Entry Standby Man ☐ Badge No. _____
H. List any Additional Safety Precautions: _____

IN AN EMERGENCY: ☐ SEE ATTACHED

SECTION 3 – GAS TESTING/MONITORING Gas testing frequency: _____
Periodic monitoring required: Yes ☐ No ☐ If yes, attach a supplemental form.
Additional gas tests required prior to entry, after break/interruption of work, if site conditions change, and at periodic intervals (as required). Record below or use a supplemental form.
ONLY CERTIFIED GAS TESTERS PERFORM GAS TESTS

	LEL (%)	H ₂ S (ppm)	O ₂ (%)	CO (ppm)	Others	Badge No.	Signature
Initial							
Renewed							
Additional							
Additional							

SECTION 4 – PERMIT AUTHORIZATION & CLOSURE
Additional approvals per GI 2.100 or local instructions:
Signature _____ Position _____ Org _____ Badge No. _____
Signature _____ Position _____ Org _____ Badge No. _____
Receiver Org: _____ Issuer Org: _____
PERMIT: _____ Badge No. _____ Cert. No. _____ Signature _____ Badge No. _____ Cert. No. _____ Signature _____
This permit is renewed: Date: _____ Time: _____ Courtesy/signified of permit renewal ☐
This permit is closed: Date: _____ Time: _____
I HAVE INSPECTED THE WORK SITE AND CONFIRM THAT IT HAS BEEN RETURNED TO A SAFE CONDITION:
Closed _____

HAZARD ANALYSIS CHECKLIST
Any "N" (NO) answers below shall initiate a "STOP" point where the Issuer and Receiver are to analyze the hazard(s) and develop methods to adequately control the hazard(s) and list the additional precautions on the permit.

	Y	N	N/A
Is the correct type of permit(s) issued for the work?	☐	☐	☐
Have the Job Safety Analysis (JSA) and other applicable supplementary forms been communicated to the work crew?	☐	☐	☐
Are weather conditions (e.g., wind speed, rain, fog, heat, lightning) acceptable to perform the work?	☐	☐	☐
Are slip and trip hazards controlled?	☐	☐	☐
Does the work crew have the correct tool/equipment for the job? Are they in good condition?	☐	☐	☐
Do personnel have the proper certifications to perform the activity and/or operate the equipment?	☐	☐	☐
Is the equipment's inspection sticker valid?	☐	☐	☐
Have all requirements for working at heights (i.e., fall protection) been applied?	☐	☐	☐
Is the scaffold tag completed correctly, signed, and with a valid inspection date?	☐	☐	☐
Has the potential for contact with sharp objects, rotating equipment, hot/cold surfaces, or live electricity been eliminated?	☐	☐	☐
Is the system/equipment properly isolated and locked out? Did all workers apply their personal lock?	☐	☐	☐
Has the system/equipment been depressurized, drained, and/or purged before opening it?	☐	☐	☐
Has the potential for releasing flammable liquids and gases been controlled?	☐	☐	☐
Are all ignition sources eliminated or controlled?	☐	☐	☐
Does the fire watch have firefighting equipment readily available and know how to use the equipment?	☐	☐	☐
Has the potential for exposure to high noise levels, H ₂ S, hydrocarbons, asbestos, hazardous chemicals, or radioactive materials been controlled?	☐	☐	☐
Is the correct personal protective equipment (PPE) available for use by personnel?	☐	☐	☐
If the work may impact others nearby, or vice versa, have the work crews discussed their activities with each other (i.e., simultaneous operations [SMOPS])?	☐	☐	☐
Is there an emergency contingency plan in place to respond to the work being performed?	☐	☐	☐
Does the work crew know what to do in the event of an emergency, such as evacuation routes, location of emergency equipment, and where assembly areas are located?	☐	☐	☐

Signatures:
Issuer or Designated Representative _____
Receiver _____

Examples of confined spaces

- Columns, Vessels.
- Storage Tanks.
- Pipelines.
- Valve boxes.
- Manholes.
- Ventilation ducts.
- Boilers, steam generators.
- Heat exchangers.
- Sewers, sumps, pits.
- Barge compartments.
- Excavations (at least 4 ft deep).



Confined spaces

Certain confined spaces may be designed for very limited entry. Examples include:

- Manholes.
- Sewer systems.
- Cargo holds.
- Barge compartments.
- Shafts and tunnels.

A confined space may not necessarily be enclosed on all sides and may have open tops.

Examples include:

- Vats.
- Storage towers.
- Floating roofs of large tanks.
- Trenches, excavations, pits, culverts and sumps.



Confined spaces

A space may become a confined space due to the work or due to a change in the conditions inside.

For example, spray painting in an enclosed room can create a hazardous atmosphere.

Also, asbestos work in an enclosed room and sealed with plastic drapes can create a hazardous atmosphere.

Unventilated or poorly ventilated spaces, storage areas and voids may be Oxygen deficient or may develop a hazardous atmosphere.

Even a new tank can become a confined space during the late stages of assembly on location.



Review questions



Summary

In Module 1 you were introduced to the Saudi Aramco Stop Work Authority and the definition and identification of confined space entry.

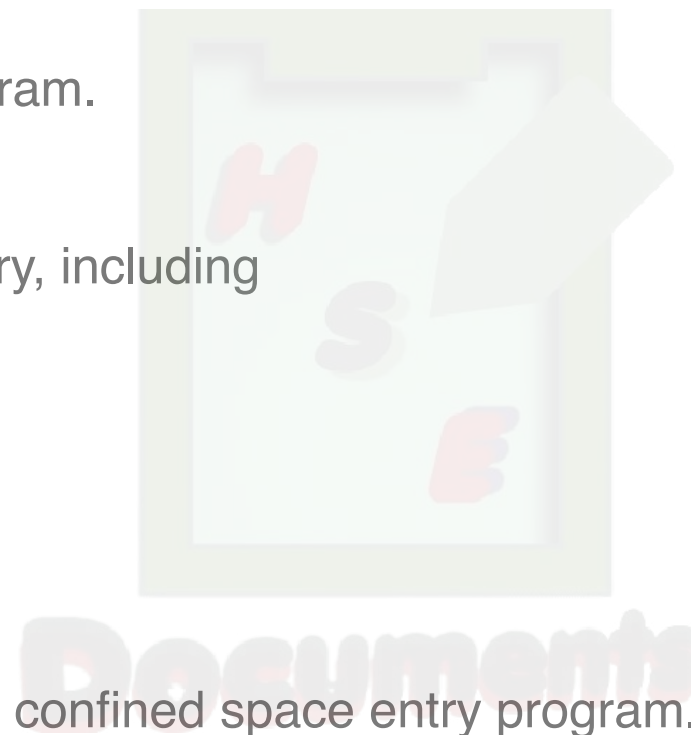
You should now be able to:

Describe the Stop Work Authority program.

Define and identify confined space entry, including

- What is a confined space.
- What is confined space entry.
- Examples of confined spaces.

Your instructor will now start Module 2, confined space entry program.



Module 2

Confined space entry program

Enabling objectives

On completion of Module 2, you will be able to:

- State the requirements of the confined space entry program.



Introduction

Confined Space Entry (CSE) has many hazards that must be eliminated or controlled.

The CSE program, the permit system and the responsibilities of individuals are an essential part of ensuring that entry into hazardous spaces can be undertaken safely.



Confined space entry program

In Module 2 you will learn about the following:

- Confined space entry program.
- Confined space entry permit.
- Roles and responsibilities.

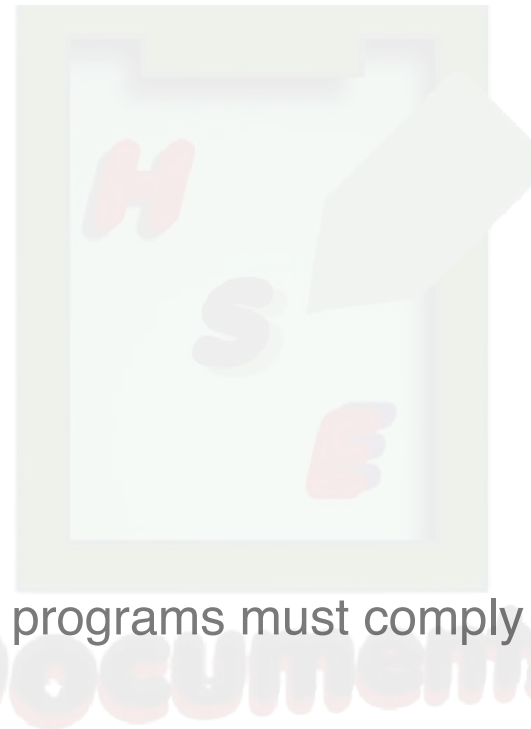


CSE program

Your organization and all contractors for grassroots projects must develop and implement a CSE program, which must include but not be limited to the following:

- Proponent department's local program.
- Identify confined spaces.
- Identify hazards of confined spaces.
- Developing confined space entry plans.
- Training requirements & qualifications.
- Rescue procedures.

Proponent departments and contractor CSE programs must comply with all Saudi Aramco requirements.



CONFINED SPACE ENTRY PERMIT

Saudi Aramco 9873-4 (12/15) Front No. D

Complete this form in English and write clearly. Use ink pen, not pencil.

أرامكو السعودية
saudi aramco

SECTION 1 – WORK DESCRIPTION

Month _____ Day _____ Year _____ Duration _____

A. Identify plant/facility area: _____

B. Exact work location: _____

C. Work to be done: _____

D. Equipment to be used at the site: _____

SECTION 2 – HAZARD IDENTIFICATION & CONTROL

A. Identify and attach any supplementary forms required to perform/control the work:

Confined space entry log (mandatory) ☐ CSE Plan (mandatory) ☐ Job Safety Analysis ☐
Gas test records ☐ Isolation plan ☐ Blind list ☐ Critical Lift Plan ☐ Excavation Checklist ☐
Hydrotest procedure(s) ☐ Other: _____

B. Energy Types:

Hydrocarbon/gas/steam/chemicals ☐ Mechanical ☐ Electrical ☐ Hydraulic/pneumatic ☐
Potential energy (spring loaded, gravity) ☐ Automated extinguishing systems ☐ Other: _____

C. Isolation Method(s):

Locked switch/breaker ☐ Mechanical block ☐ Blinding ☐ Disconnect ☐
Positive isolation (blind or disconnect) shall be used for all piping connections to the confined space.

D. Potential Exposures:

High noise level ☐ Hydrogen Sulfide (H₂S) ☐ Flammable liquids/gases ☐ Hazardous/toxic materials ☐
Radioactive materials ☐ Temperature ☐ High pressure ☐ Other: _____

E. Protective Equipment:

Personal H₂S monitor ☐ FRC ☐ ARC rated PPE ☐ Goggles/face shield ☐ Chemical suit/overalls ☐
Fall protection ☐ Barricades/warning signs ☐ Mechanical ventilation/blower ☐
Respiratory protection ☐ (Explain further in Additional Safety Precautions below)

F. Confined Space Entry Supervisor (CSES) ☐ Badge No. _____

G. Confined Space Entry Standby Man ☐ Badge No. _____

H. List any Additional Safety Precautions: _____

IN AN EMERGENCY:

☐ SEE ATTACHED

SECTION 3 – GAS TESTING/MONITORING

Gas testing frequency: _____

Periodic monitoring required: Yes ☐ No ☐ If yes, attach a supplemental form.

Additional gas tests required prior to entry, after break/interruption of work, if site conditions change, and at periodic intervals (as required). Record below or use a supplemental form.

ONLY CERTIFIED GAS TESTERS PERFORM GAS TESTS

	LEL (%)	H ₂ S (ppm)	O ₂ (%)	CO (ppm)	Others	Badge No.	Signature
Initial							
Renewed							
Additional							
Additional							

SECTION 4 – PERMIT AUTHORIZATION & CLOSURE

Additional approvals per GI 2.100 or local instructions:

Signature _____ Position _____ Org _____ Badge No _____

Signature _____ Position _____ Org _____ Badge No _____

PERMIT	Receiver Org:	Badge No.	Cert. No.	Signature	Issuer Org:	Badge No.	Cert. No.	Signature
Open								

This permit is renewed Date: _____ Time: _____ Counter(s) notified of permit renewal ☐

Renewed _____

This permit is closed Date: _____ Time: _____

I HAVE INSPECTED THE WORK SITE AND CONFIRM THAT IT HAS BEEN RETURNED TO A SAFE CONDITION.

Closed								
--------	--	--	--	--	--	--	--	--

HAZARD ANALYSIS CHECKLIST

Any 'N' (NO) answers below shall initiate a "STOP" point where the Issuer and Receiver are to analyze the hazard(s) and develop methods to adequately control the hazard(s) and list the additional precautions on the permit.

	Y	N	N/A
Is the correct type of permit(s) issued for the work?	☐	☐	☐
Have the Job Safety Analysis (JSA) and other applicable supplementary forms been communicated to the work crew?	☐	☐	☐
Are weather conditions (e.g., wind speed, rain, fog, heat, lightning) acceptable to perform the work?	☐	☐	☐
Are slip and trip hazards controlled?	☐	☐	☐
Does the work crew have the correct tools/equipment for the job? Are they in good condition?	☐	☐	☐
Do personnel have the proper certifications to perform the activity and/or operate the equipment?	☐	☐	☐
Is the equipment's inspection sticker valid?	☐	☐	☐
Have all requirements for working at heights (i.e., fall protection) been applied?	☐	☐	☐
Is the scaffold tag completed correctly, signed, and with a valid inspection date?	☐	☐	☐
Has the potential for contact with sharp objects, rotating equipment, hot/cold surfaces, or live electricity been eliminated?	☐	☐	☐
Is the system/equipment properly isolated and locked out? Did all workers apply their personal locks?	☐	☐	☐
Has the system/equipment been depressurized, drained, and/or purged before opening it?	☐	☐	☐
Has the potential for releasing flammable liquids and gases been controlled?	☐	☐	☐
Are all ignition sources eliminated or controlled?	☐	☐	☐
Does the fire watch have firefighting equipment readily available and know how to use the equipment?	☐	☐	☐
Has the potential for exposure to high noise levels, H ₂ S, hydrocarbons, asbestos, hazardous chemicals, or radioactive materials been controlled?	☐	☐	☐
Is the correct personal protective equipment (PPE) available for use by personnel?	☐	☐	☐
If the work may impact others nearby, or vice versa, have the work crews discussed their activities with each other (i.e., simultaneous operations (SIMOPS))?	☐	☐	☐
Is there an emergency contingency plan in place to respond to the work being performed?	☐	☐	☐
Does the work crew know what to do in the event of an emergency, such as evacuation routes, location of emergency equipment, and where assembly areas are located?	☐	☐	☐
Signatures:			

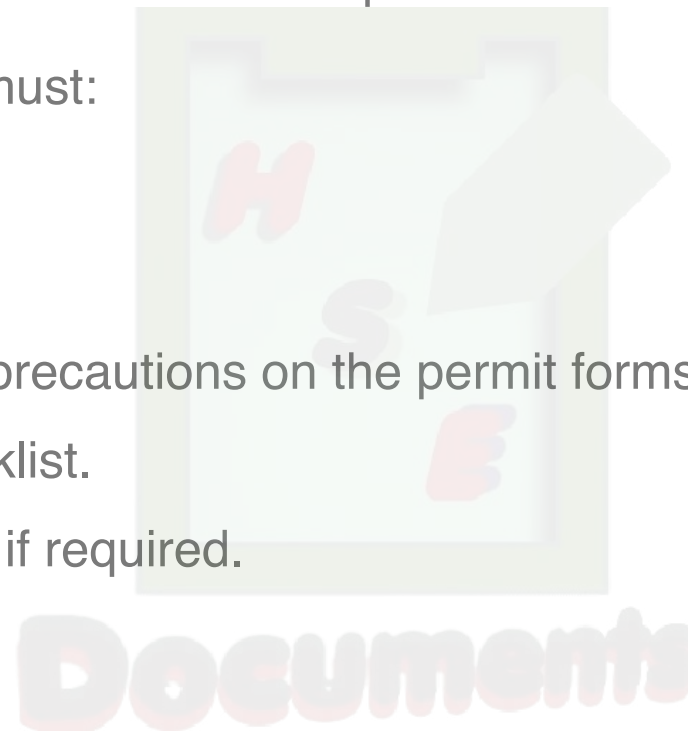
Issuer and Receiver roles

Work permit issuers and receivers must make sure that all work task hazards are identified and either controlled or eliminated.

Hazard control requirements are recorded on the work permit and become a condition for starting work.

If you are the work permit issuer, you must:

- Identify which permits are required.
- Conduct a joint site inspection.
- Identify and document hazards and precautions on the permit forms.
- Complete the Hazard Analysis Checklist.
- Attach additional forms to the permit if required.



Management roles

Proponent management must develop and implement a CSE program that complies with all Saudi Aramco requirements.

Management responsibilities include:

- Develop a CSE program.
- Develop and review CSE plans.
- Identify training and qualifications.
- Mandate training.
- Restrict confined space entry to trained personnel.
- Designate Confined Space Entry Supervisors (CSES).
- Provide equipment required for safe confined space entry.
- Conduct drills and emergency scenarios.



Confined space entry supervisor

The Confined Space Entry Supervisor (CSES) is a work permit issuer or someone who has been assigned by an issuer and directs all aspects of the confined space entry.

Responsibilities include:

- Decides if conditions are acceptable for entry.
- Authorizes entry.
- Supervises entry operations.
- Stops entry if required.
- Generally the work permit issuer.
- Reviews entry plan.
- Communicates plan with entrants and standby men.
- Implementation of permits and plans.



Confined space entry supervisor

- Training of entrants and standby men.
- Designates trained standby men.
- Generally issues CSE permits.
- Provides manpower and coordinate activities of multiple crews.
- Checks isolation, purging and gas test results.
- Monitors confined space activity.
- Ensures logs are completed.
- Ensures PPE is provided and used.
- Provides communications equipment.
- Provides immediate response equipment.
- Emergency rescue capabilities.
- STOPS confined space entry, when necessary.



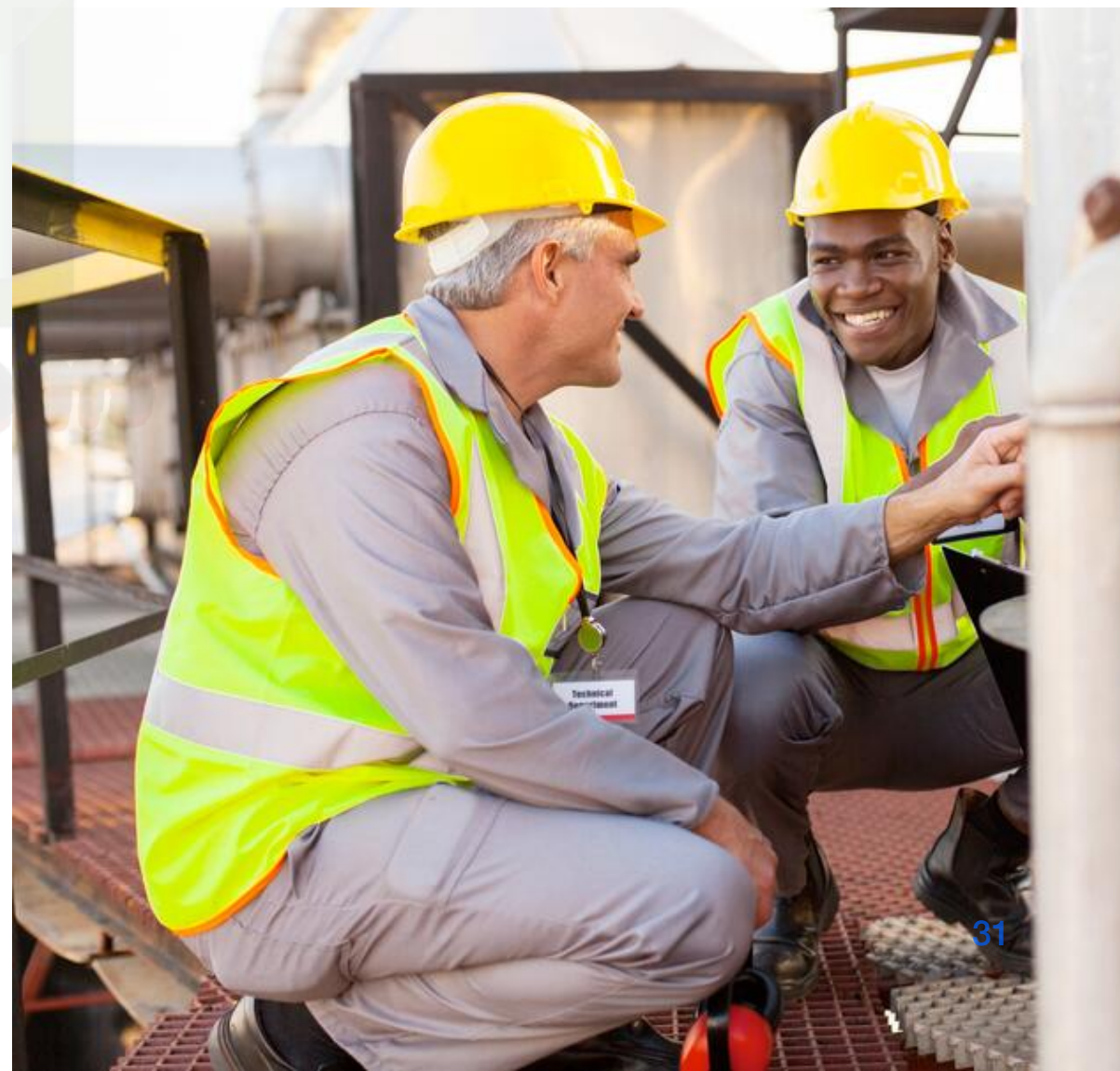
Standby man

A standby man is the worker who is responsible for monitoring the internal and external activities associated with work in and around a confined space.

He is generally stationed at entry points to the confined space near to where the work is taking place. This worker acts as the 'eyes' and 'ears' of the entrants in the confined space.

Standby man responsibilities include:

- Reviews the entry plan and permits.
- Understands possible hazards.
- Maintains entry log.
- Monitors activities inside and outside the confined space.
- Maintains two-way communication.
- Notifies personnel in the event of an emergency.



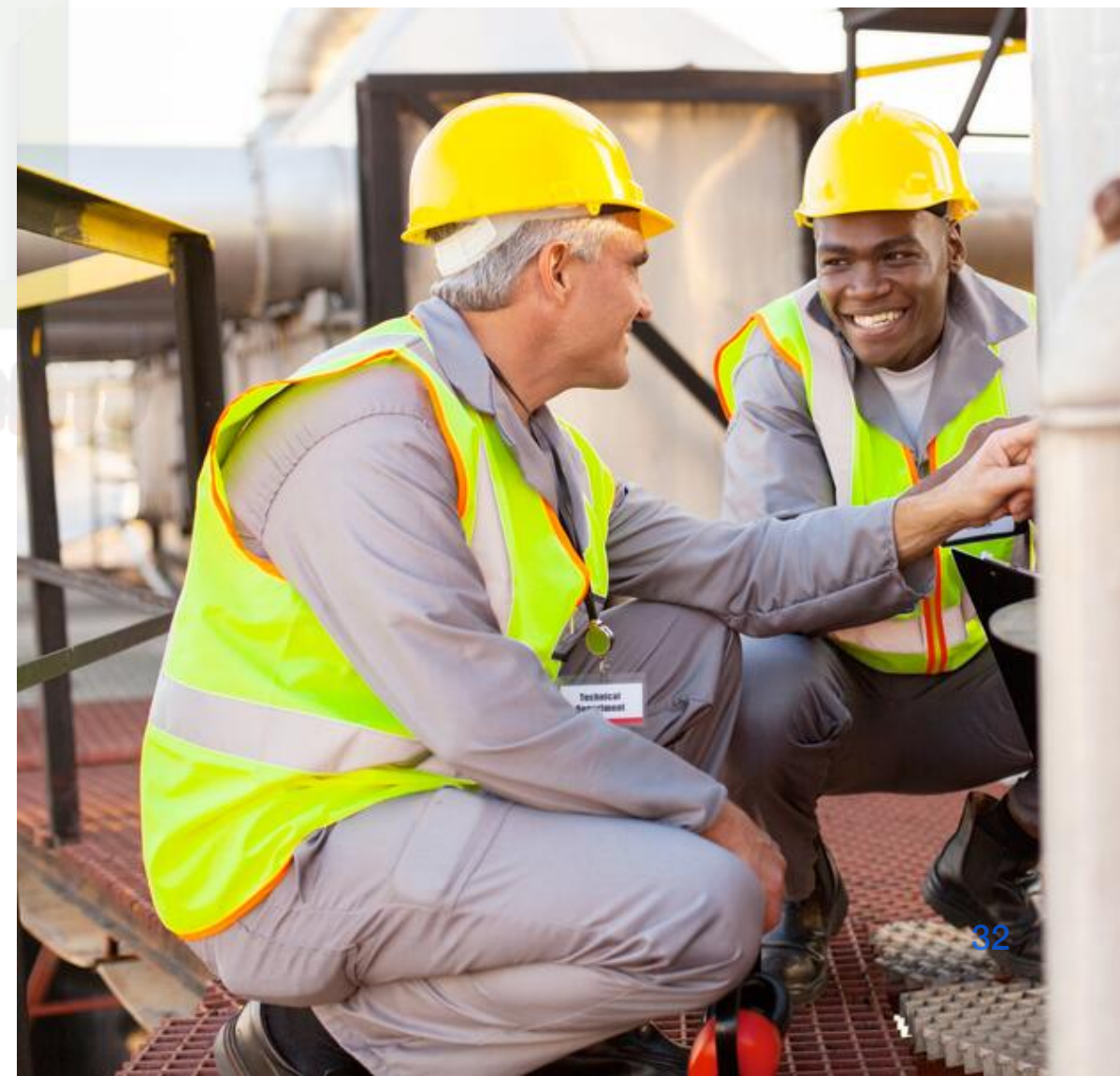
Standby man

- Does not leave the 'entry point'.
- Never enters the confined space.
- Primary responsibility, no other duties.

Note: in some specific cases the standby man may also be assigned as a fire watch for the confined space activity.

Orders entrants to evacuate when:

- An unsafe condition develops.
- An entrant displays unusual behavior effects from hazard exposure.
- The standby man has leave the area and no relief is provided, the entrants must evacuate the space.



Entrant

A Confined Space Entrant is anyone who is trained to enter a confined space to perform work.

This includes entering for light tasks such as visual inspection or taking measurements.

An Entrants responsibilities include:

- Reviewing all permits.
- Reviews the entry plan.
- Checks work and site preparation.
- Understands potential hazards in the confined space.
- Trained on use of PPE.

Never enters until:

- Safety requirements are in place.
- Clearly understands the work assignment.



Entrant

Maintains communication with standby man.

Alerts the Standby man and other entrants to exit when:

- Order to evacuate is given.
- Warning signs or symptoms of exposure start to develop.
- Emergency alarm is activated.

An Entrant has perhaps the most hazardous task on a CSE job.

The Entrant must enter the confined space, so must be fully prepared for the job.

They must know and follow all safety requirements for the job and know how to communicate with standby personnel.



Summary

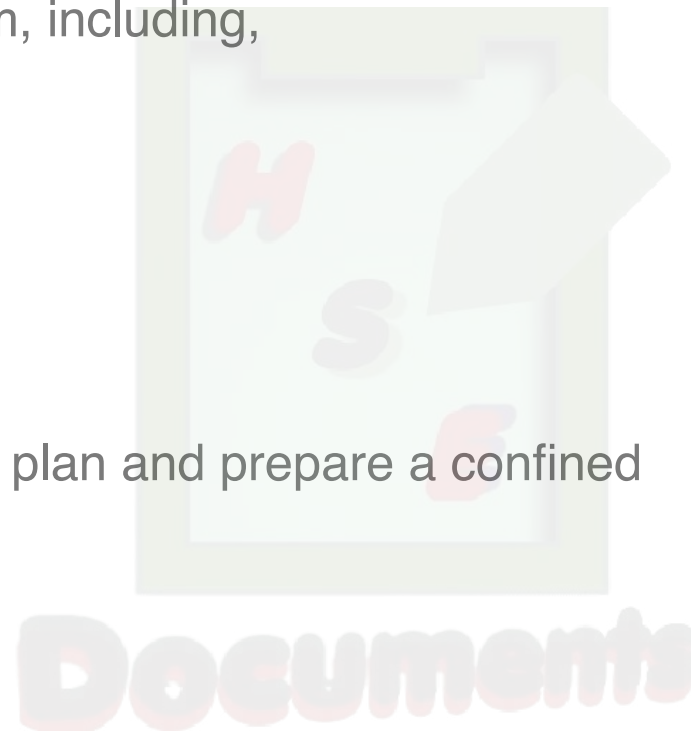
In Module 2 you were introduced to the confined space entry program.

You should now be able to:

State the confined space entry program, including,

- Confined space entry program.
- Confined space entry permit.
- Roles and responsibilities.

Your instructor will now start Module 3, plan and prepare a confined space entry.



Module 3

Plan & prepare a confined space entry

Enabling objectives

On completion of Module 3, you will be able to:

- Define the requirements to plan and prepare a confined space entry.



Introduction

Confined Space work needs thorough planning and preparation to ensure that all hazards can be identified and suitable control measures are in place before entry is permitted.

Plan and prepare a Confined Space for entry

In Module 3 you will learn about the following:

- Confined space entry plan.
- Confined space preparation.
- Confined space isolation and LOTO.



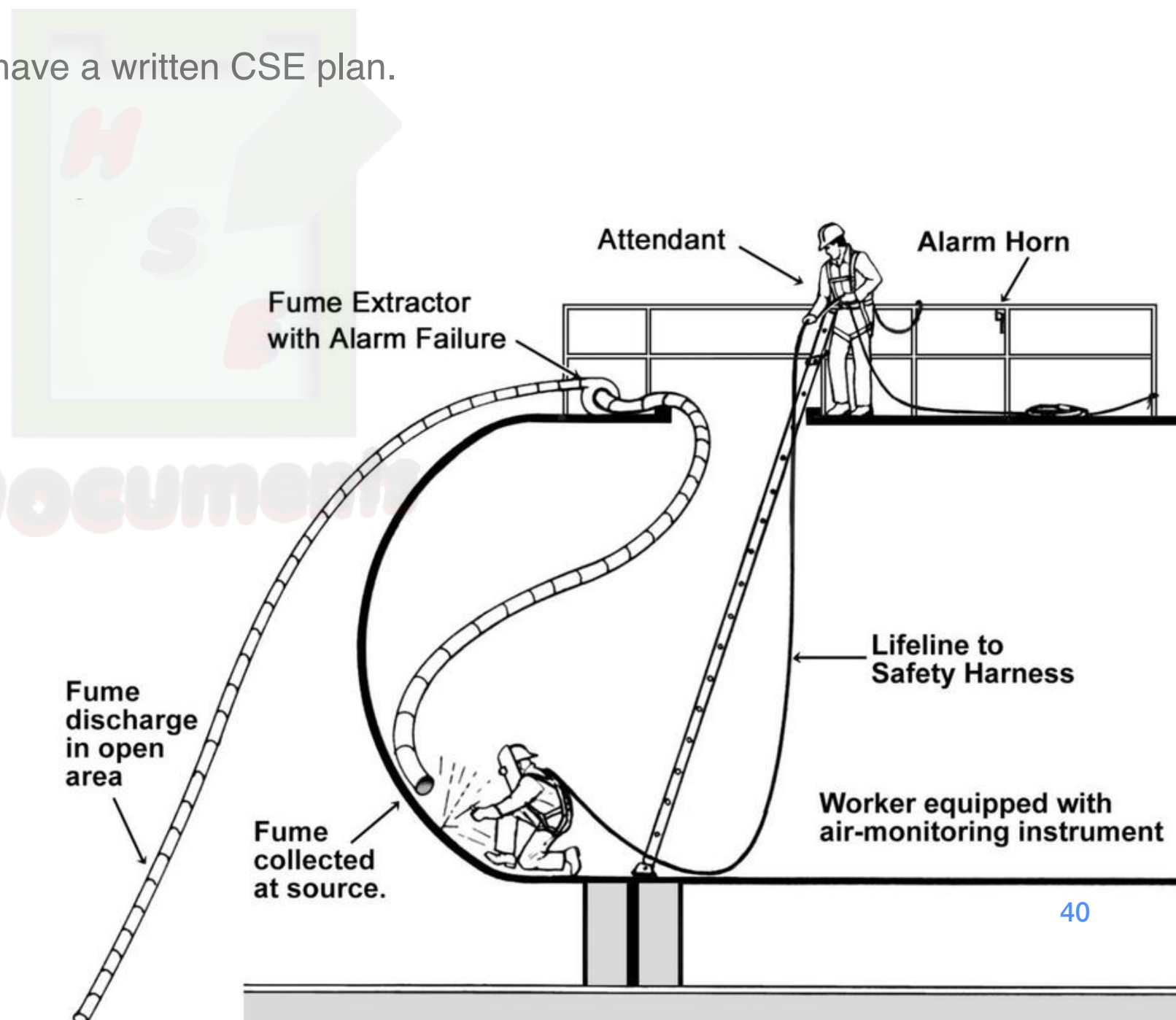
CSE plan

Proponent management CSE plans assess existing and possible hazards and control measures for each specific confined space.

Besides a work permit, each CSE job must have a written CSE plan.

This plan must:

- Review the scope of work.
- Perform a hazard evaluation of space and its surrounding area.
- Unique to a specific confined space.
- Prepared in advance.
- Use 'what if' scenarios for emergency procedures.



CSE plan

There is no standard template that can be applied for all CSE jobs. The specific work site and job details will dictate the items to be included in the specific plan.

The minimum requirements for a confined space entry plan are listed in the Construction Safety Manual and may include the following item:

- Scope of work.
- Hazard identification and evaluation.
- Types and frequency of gas testing.
- Training requirements for all personal involved in the entry.
- Locate and identify method of each isolation point.
- Procedures for cleaning, purging or ventilating.
- Entry and exit requirements (such as, equipment, air movers communication, PPE)
- Pedestrian and vehicle barriers.
- Emergency response procedures and contacts.
- Retrieval/rescue equipment in place.



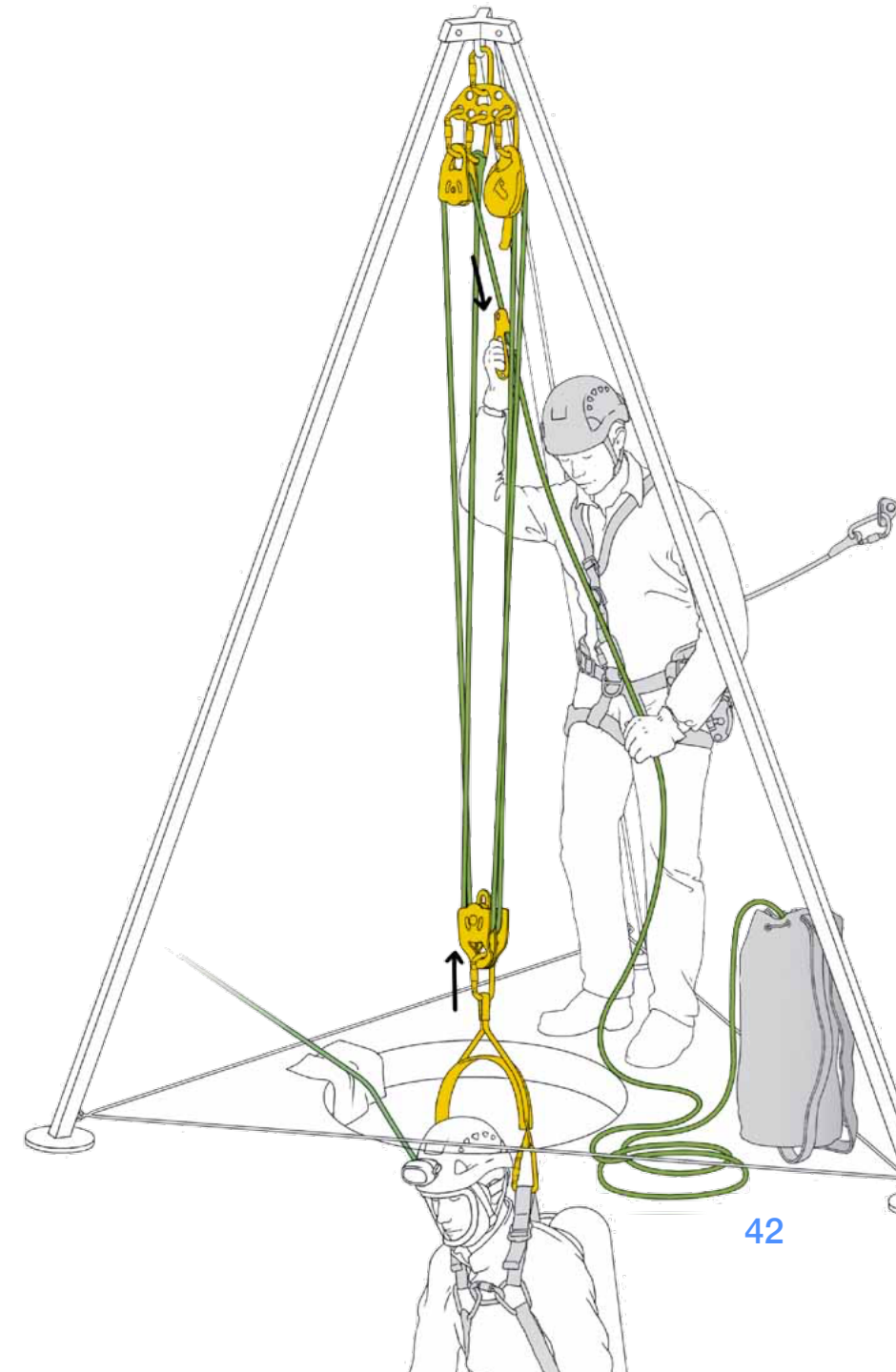
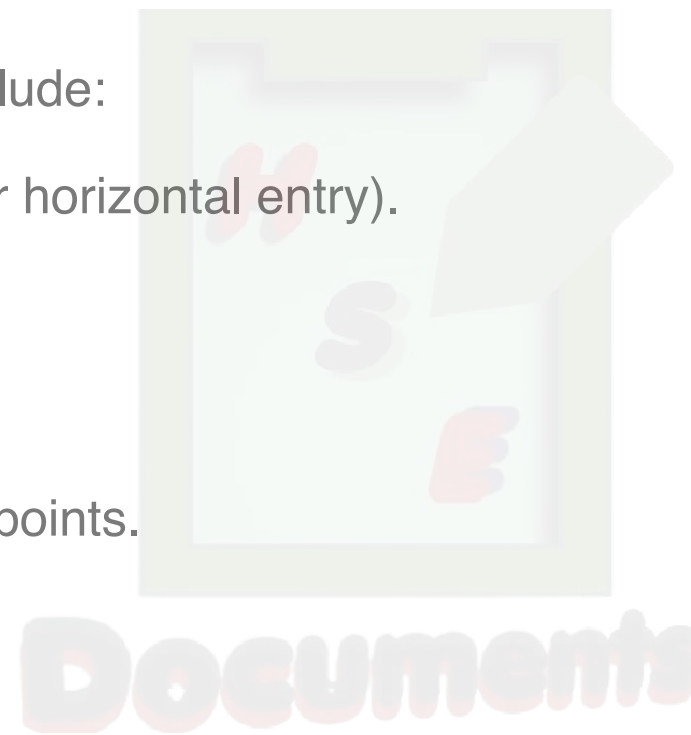
CSE rescue plan

The level of detail in the CSE rescue plan varies and is dependent on several factors.

The level of detail should be decided by the proponent management and the rescue service that completes the rescue plan.

Some common rescue plan factors include:

- Configuration of the space (vertical or horizontal entry).
- Immediate surroundings.
- Location of the space.
- Position/dimensions of the entry/exit points.
- Hazards in the space.
- PPE requirements.
- Number of authorized entrants.
- Experience of the rescue team.
- Available rescue equipment.



CSE plan development

To assist and support proponent management with the development of their CSE plans, LPD have created a 'Best Practice' document. This can be used as a checklist that can guide management to develop their own plans and what they must contain.

This best practice document can be found on the LPD Intranet site.

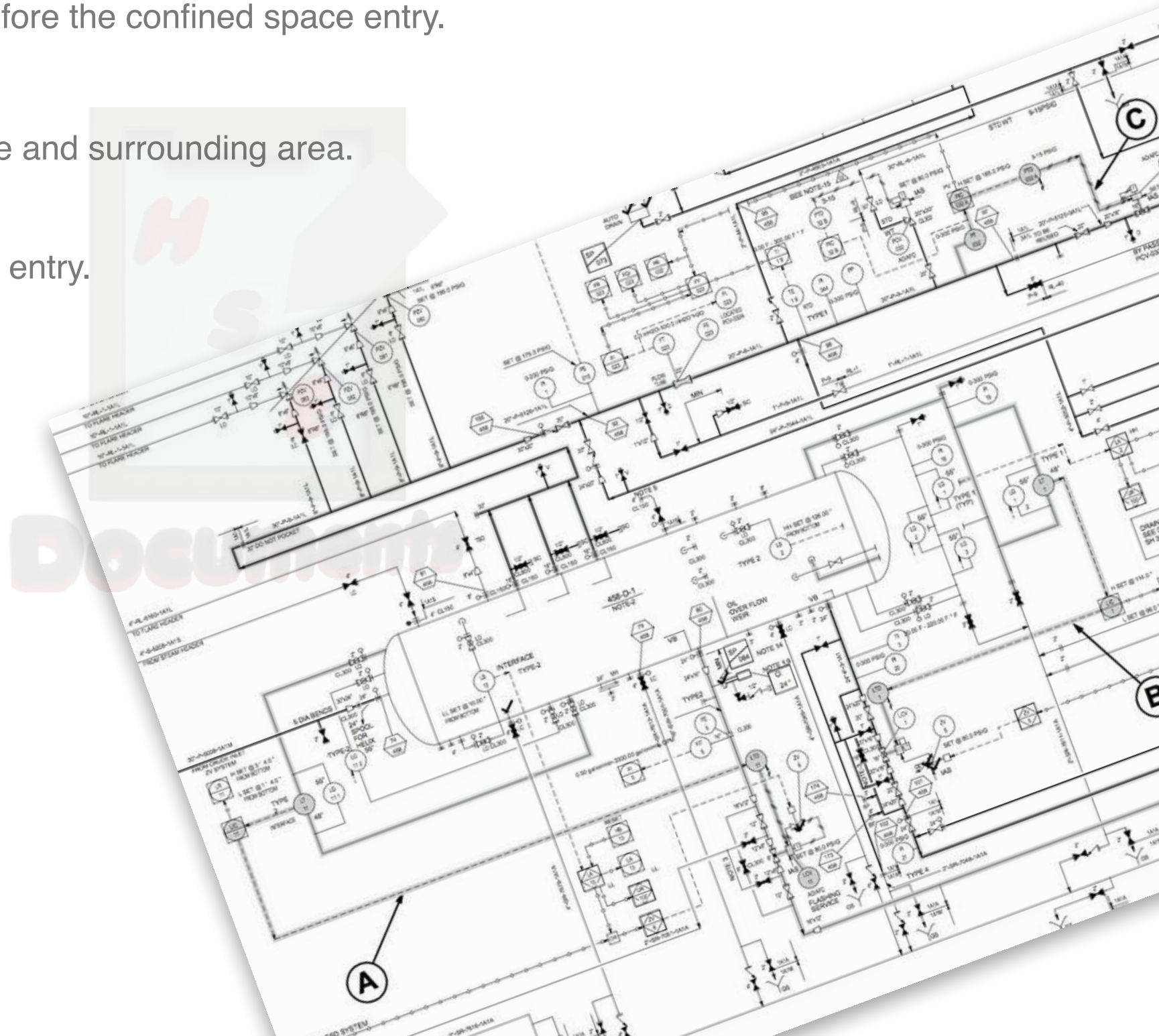
CONFINED SPACE ENTRY PLAN BEST PRACTICE			
PROTECTION OF SURROUNDING AREAS	☐ Edge Protection tape	☐ Caution Hard barricade	MEANS OF COMMUNICATION WITH ENTRANTS
	☐ Warning lights	☐ Warning Signs	
PREVENTION OF UNAUTHORIZED ENTRY	☐ Posting a Sign (Do Not Enter) ☐ Closing the entry point ☐ Standby man ☐ Sealing the entry point by warning tape ☐ Other:		
EMERGENCY RESPONSE AND RESCUE	☐ Local FrPD has been formally notified about this activity ☐ Workers shall wear harness and Life-line at all-time ☐ Rescue equipment must be in place before work starts ☐ Personnel trained for confined space rescue are available on site ☐ Portable Air Horn		

CONFINED SPACE ENTRY PLAN BEST PRACTICE			
FACILITY:	CSEP WILL NOT EXCEED 30 DAYS		
EQUIPMENT:	START DATE:	END DATE:	
DIVISION:	ENTITY EXECUTING THE JOB		
UNIT:	NUMBER OF EMPLOYEES		
SCOPE OF THE WORK			
ISOLATION METHOD	☐ Locked switch/breaker Disconnect	☐ Blinding	☐
ELIMINATING ATMOSPHERIC HAZARDS BY:	☐ Purging ☐ Cleaning ☐ Flushing ☐ Steaming-out ☐ Natural Ventilation ☐ Mechanical Ventilation ☐ N2/CO2 inerting	ATMOSPHERIC GAS TESTING TYPES AND FREQUENCY	☐ O2 ☐ CO ☐ H2S ☐ LEL ☐ Other: ☐ Frequency:
TYPES OF EQUIPMENT REQUIRED FOR CONFINED SPACE ENTRY:	☐ Self-contained breathing apparatus ☐ Air movers ☐ Rescue equipment ☐ Lighting equipment ☐ Communication equipment ☐ Fire extinguisher	REQUIRED TYPES OF PPE (IN ADDITION TO Hard Hat; Clear Safety Glasses and Safety Shoes) ☐ Personal H2S Monitor Detector ☐ FRC ☐ Goggles/face shield ☐ Chemical suit/coverall ☐ Gloves (Specify): ☐ Respiratory Protection (Specify): ☐ Other:	
ACCESS AND EGRESS	☐ Ladder required ☐ External scaffold required ☐ Internal scaffold required ☐ Fall Protection required ☐ Platform modification required ☐ Other:		

Pre entry preparation

The CSE supervisor must review and communicate the plan to entrants and standby men. The plan must be available for review by all personnel before the confined space entry.

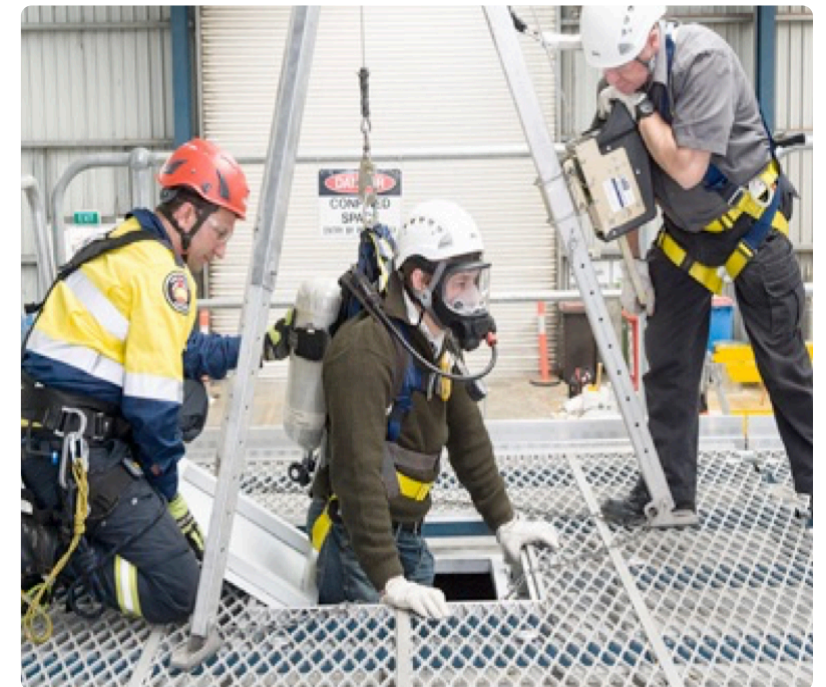
- Review plan with the work crew.
- Perform a hazard evaluation of space and surrounding area.
- Implement control measures.
- Rescue plan must be in place before entry.



CSE preparation

Ensure the required permits are issued, then prepare the job site:

- Isolate work site using signs, barricades.
- Check entry/exit points and entry equipment.
- Communication equipment.
- Initial response and equipment.



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CSE preparation

Entry points must be kept clear for easy access and egress, especially for emergency vehicles and personnel, when entrants are in the space.

- No obstruction at entry points.
- Post warning signs and permits.
- Isolate and ventilate.
- Gas test per CSE plan.
- Issue proper PPE.
- Use CSE checklist.



When the job is not active and there are no entrants inside the space, entry and exit points must be blocked and labeled as a confined space and as warning to 'keep out'.

Confined space warning signs and barriers must be posted outside the confined space—in both Arabic and English.



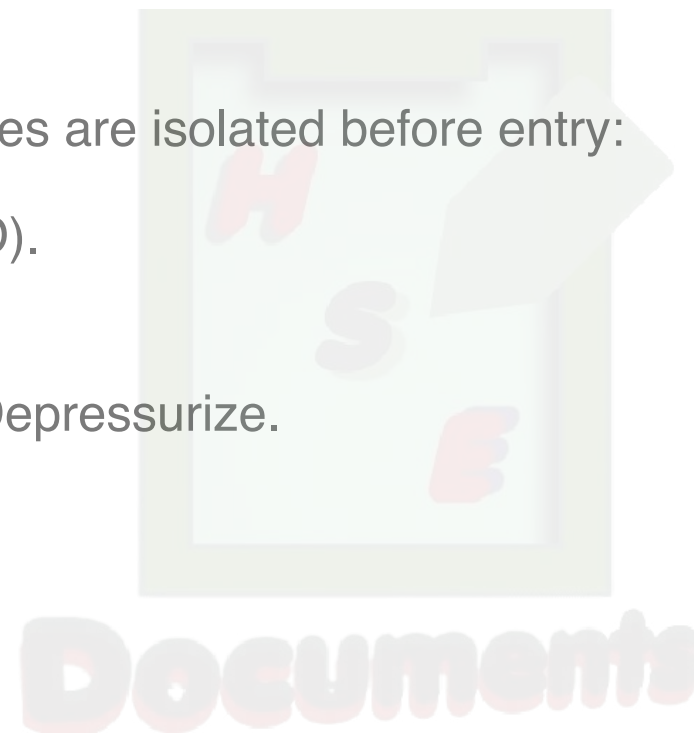
Isolation and LOTO

For CSE isolation and LOTO, G.I. 6.012 (Isolation, Lockout and Use of Hold Tags), must be implemented.

G.I. 2.100 (Work Permit System) may also apply to equipment inside of or adjacent to the space.

Ensure that the following energy sources are isolated before entry:

- Electrical, Lock Out - Tag Out (LOTO).
- Mechanical: LOTO.
- Hydraulic and pneumatic systems: Depressurize.



Isolation and LOTO

Residual products and hazardous materials must be **drained**, **cleaned** or **purged** by steam cleaning or power washing.

Flammable or other hazardous fluids can be **purged** using an **inert gas** such as **Nitrogen**.

Usually, equipment is **shut down** and **isolated** first, then **depressurized** or **de-energized**.

Then the equipment must be **cleaned** or **purged**.

- Drain: Hazardous materials.
- Clean: Water wash or steaming.
- Purge: Nitrogen or other inert gas



Review questions



Module 4

Hazards & controls

Enabling objectives

On completion of Module 4, you will be able to:

- Identify work hazards and control measures.



Introduction

Confined Space Entry has both internal and external hazards that must be recognized and controlled.

Confined space workers must know how to communicate with the standby man and to ensure that they carry out the correct actions during any emergency.



Work hazards and controls

In Module 4 you will learn about the following:

- Confined space entry hazards.
- Confined space entry controls.
- Communication methods.
- Emergency response.
- Confined space restoration.



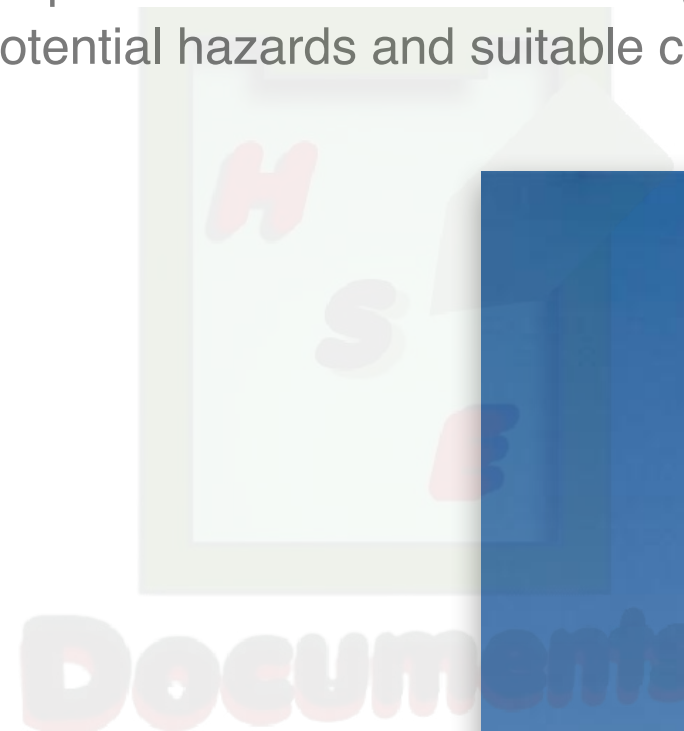
CSE hazards

Industrial hazards outside of a confined space can be also present inside the space and are often more severe (e.g. loud noises, grinding).

Whenever possible, entry into confined spaces should be avoided or greatly limited. All workers involved in a CSE must be trained on existing and potential hazards and suitable control measures.

Common hazards include:

- Engulfment.
- Temperature extremes.
- Electrical.
- Mechanical.
- Noise.
- Slips, trips and falls.
- Poor lighting.
- Atmospheric.
- Configuration of confined spaces.
- External activities (heavy equipment, exhaust fumes).



CSE hazards

All confined spaces must be gas tested for Flammable, Toxic (H_2S , CO) gases, as well as adequate Oxygen levels.

Oxygen deficient atmosphere can occur due to:

- Oxygen consumption.
- Oxygen displacement.

Gas testing applies especially when hydrocarbon process equipment must be entered for cleaning or service.

Use ventilation to bring in and circulate fresh air in to make spaces safe.

SCBA/SABA may often be required.



CSE hazards

Toxic atmospheres may result from hydrocarbon residuals such as Hydrogen Sulfide or Benzene, commonly found in Saudi Aramco facilities.

Toxic atmospheres can also be caused by:

- Decomposing organic material from a tank or sewer releases.
- Welding or brazing with metals capable of producing toxic fumes.
- Cleaning products used to prepare the confined space for entry.

Poisonous Carbon Monoxide (CO) may build up in a confined space.

In welding operations, incomplete combustion may occur and CO can form as a byproduct.

Exhaust emissions from internal combustion engines also produce CO.

Do not place internal combustion engines inside confined spaces or where their exhaust gases could enter the space. Always place this equipment downwind.

CSE hazards

Entry into a confined space where **NORM** (**N**aturally **O**ccurring **R**adioactive **M**aterial) is known or suspected must be controlled by:

- Mechanically ventilating for at least 4 hours prior to entry.
- Personnel and equipment exiting the space must submit to a NORM contamination survey.
- NORM contaminated personnel or equipment must be segregated and decontaminated.

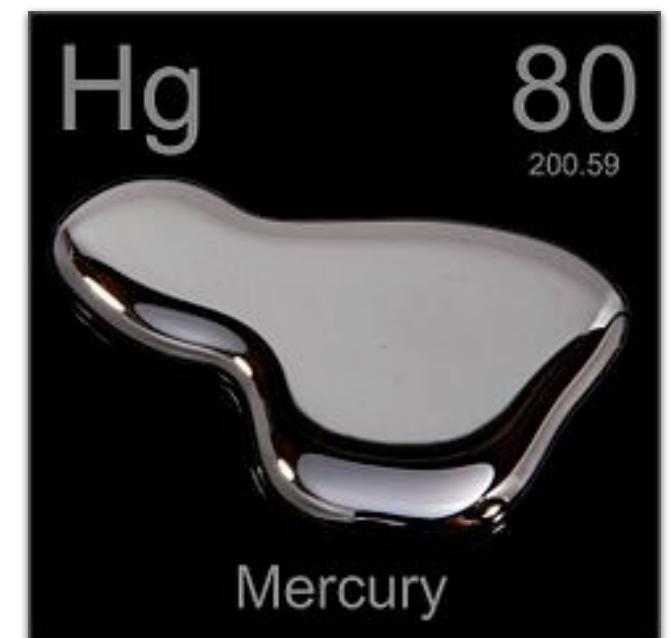


Mercury (Hg) is an extremely heavy, odorless, silver colored liquid that when evaporated during steaming, becomes an invisible, odorless, toxic vapor.

Inhalation is the main route into your body.

Mercury is found in **crude refining vessels**.

Breathing in Mercury vapor can cause vomiting, abdominal pain, weakness, confusion, shortness of breath, bronchitis, pneumonia, and kidney damage.



CSE external hazards

Even though a confined space's internal atmosphere may be within acceptable limits, diesel or petrol fumes nearby can move into the space by wind or fans.

These fumes may contain Carbon Monoxide (CO).

Other Toxic or Flammable hazards can enter the space if hydrocarbon or hazardous substance lines are opened near the entry point. This includes product sampling activities.

Examples of external hazardous activities can include:

- Combustion engines.
- Equipment opening/line break other line opening activity.
- Hydrocarbon sampling.
- Loading/unloading operations.
- Overhead crane lifts.



CSE controls

Hazards within a space often increase in number and severity. Hazards that may be generated by work should be identified, evaluated and **controlled** during the preparation of the CSE plan and work permits.

Flammable atmospheres in a confined space are very hazardous.

To prevent and **control** a flammable atmospheres, do not store inside the space:

- Flammables or combustible materials.
- Compressed gas cylinders.

Control sources of ignition by:

- Following hot work permit rules.
- Equipment shall meet electrical classification for the area.
- Fire protection equipment available.
- Ground air movers to prevent static build-up.

Note: if any hot work is likely to affect the internal atmosphere, then continuous gas monitoring is required.



CSE controls

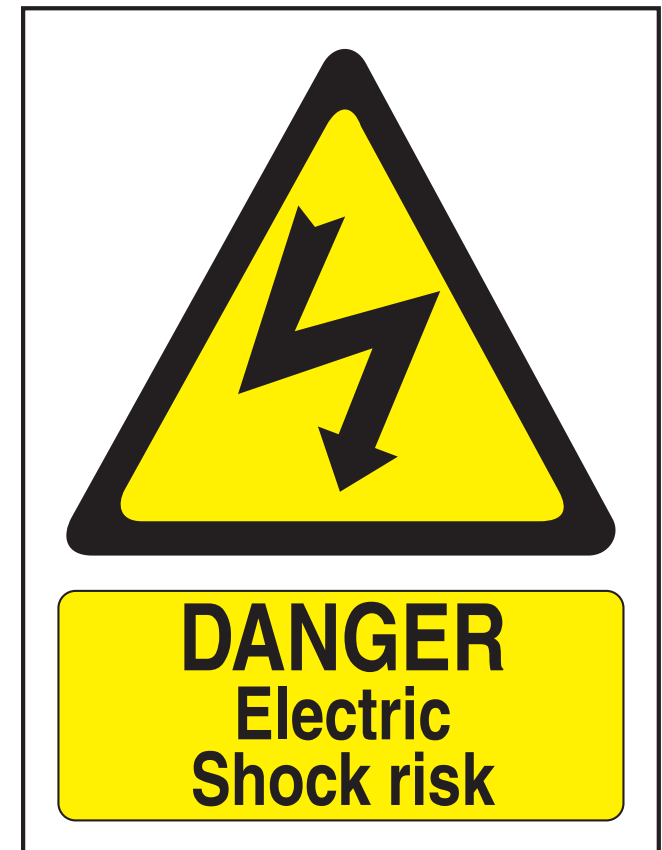
All entrants must be protected from electrical shock. Electrical equipment, including lighting and radios must comply with the electrical classification of the confined space (G.I. 6.008 and SAES-B-068).

Electrical shock controls include:

- Ground fault circuit interrupter (GFCI) on tools and equipment.
- UL listed or FM approved equipment.
- Cord protection.

There must be adequate lighting to safely enter, work and exit a confined space.

The lighting must be on a separate circuit from other electrical equipment and tools in the confined space. This is to prevent potential overload of a circuit and losing lighting inside the space.



All equipment must be grounded, as static electricity can ignite a flammable atmosphere inside the confined space. Air movers can generate static electricity and should be bonded to the vessel or tank.

CSE controls

As part of CSE preparation, the confined space must be cleaned and decontaminated to the maximum extent possible before entry.

Preparation.

- Drain.
- Nitrogen purge.
- Clean.

Isolate.

- Lock Out Tag Out.
- Blind.
- Disconnect.



Nitrogen/inert gases can create an Oxygen deficient atmosphere (less than 20.0%).

Acceptable levels of **Oxygen** in a confined space are between **20.0% and 23.5%**.

CSE controls

Air movers and fans provide positive pressure ventilation and clean air into confined spaces.

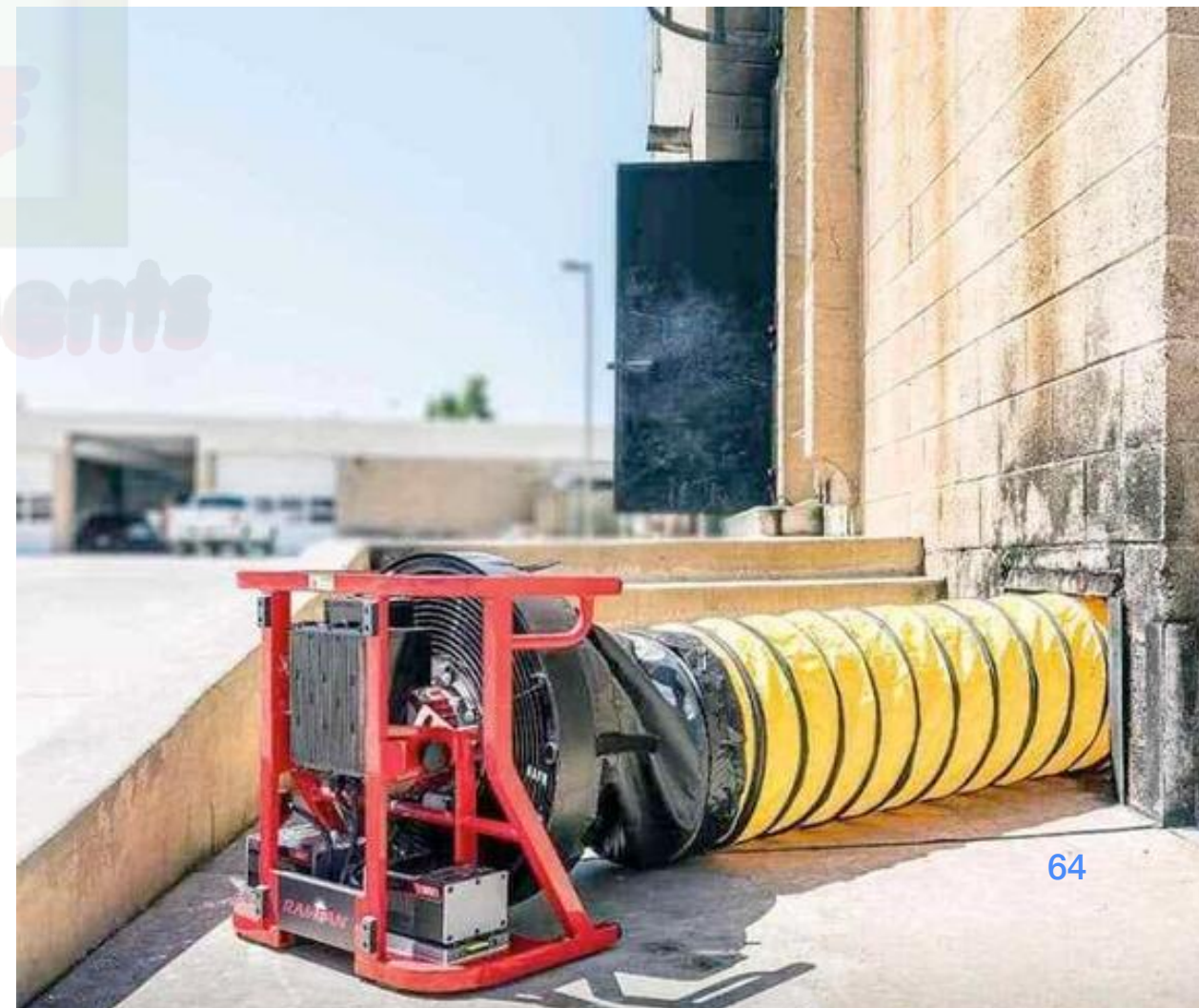
You must use ventilation to improve atmosphere conditions by supplying clean air into a confined space or by exhausting contaminants, such as toxic or flammable gases, out of the space.

Ventilation:

This can be either be a mechanical supply or natural ventilation and can also provide direct cooling to the work areas inside the space.

Position of equipment:

Always place blowers or air movers to minimize the possibility of introducing air contaminants from adjacent equipment or generators.



CSE controls

Grounding:

Ground equipment such as air movers and ventilation systems.

Ventilation must be properly grounded and bonded to vessels or tanks to prevent static electricity.

Exhaust ventilation:

Welding, grit blasting and spray painting etc, can create a need for local exhaust.

Local exhaust is where fumes, vapors or particulates are mechanically drawn out of the confined space.

The negative pressure created in the space can be equalized by openings in the space that allow fresh air to enter or with the use of air movers.



CSE controls

Atmospheric testing must be conducted by certified gas testers using approved gas monitors.

Frequency of testing:

- Before first entry.
- After breaks.
- Conditions change.
- Periodic intervals (e.g. every 2hours).

Examples of gases that need to be monitored:

- Oxygen (O₂).
- Hydrogen Sulfide (H₂S).
- Flammable (LEL).
- Carbon Monoxide (CO).



Note: if any hot work is likely to affect the internal atmosphere, then continuous gas monitoring is required.

CSE controls

Initial gas test:

Always perform initial gas testing before entry with all mechanical **ventilation shut down** at least **15 minutes before testing**.

Initial gas testing data will help to determine ventilation, PPE, respiratory protection and atmospheric monitoring requirements.

Acceptable entry working conditions:

The CSE permit gas test information table indicates the acceptable atmospheric work conditions and any necessary PPE or approvals that are required based on the gas test results of the job site.

GAS TEST INFORMATION TABLE		
Combustible Gases/Vapors	Any reading above 0% LEL	No hot work allowed
	5% LEL – 10% LEL	Breathing apparatus must be used
	10% LEL or above	No work (or confined space entry) allowed
Hydrogen Sulfide (H ₂ S)	10 ppm or above	Breathing apparatus must be used
	10 ppm – 100 ppm	Division Head must sign the permit
	100 ppm or above	No work (or confined space entry) allowed
Oxygen (O ₂)	Less than 20.0%	Breathing apparatus must be used and Division Head must sign the permit
	Above 23.5%	No work allowed
Carbon Monoxide (CO)	35 ppm – 1,000 ppm	Breathing apparatus must be used
	1,000 ppm or above	No confined space entry allowed

CSE controls

Continuous monitoring:

Continuous gas testing shall be used if the atmosphere inside the confined space is subject to change or if work activities involve combustion such as welding or torch cutting. Area gas monitoring devices can monitor the atmosphere for an extended period of time and provide an early warning of escalating gas concentrations in a work area.

Evacuation of the space:

Whenever a hazardous atmosphere is detected, the confined space shall be evacuated of all personnel until corrective actions have been taken and the space has been verified by the CSE supervisor as safe for re-entry.

Always refer to the Gas Testing Information Table on the work permit forms for the confined space entry limits.



CSE controls

Breathing apparatus shall be **continuously worn** if:

- O_2 is less than **20.0%**.
- **Flammable** gases are at/or above **5%** and less than **10% LEL**.
- **CO** is at or above **35 ppm** and less than **1000 ppm**.
- **H₂S** is at or above **10 ppm** and less than **100 ppm**.
- Other toxic gases that are **above** their **TLV/TWA** and **at or below** their **IDLH level**.

Confined space **entry** is **not permitted** if:

- O_2 is above **23.5 %**.
- **Flammable** gases are at or above **10% LEL**.
- **CO** is at or above **1000 ppm**.
- **H₂S** is at or above **100 ppm**.
- Other toxic gases are **above** their **IDLH level**.



CSE PPE

Confined spaces are hazardous work spaces that require PPE for entrants.

In addition to minimizing exposure to a hazard, consideration must be given to ensure PPE allows workers to freely move within the confined space, to operate equipment and exit the space quickly in the event of an emergency.

Below are common examples of PPE required for CSE:

- Self Contained Breathing Apparatus /Supplied Air Breathing Apparatus.
- Air purifying cartridge respirator.
- Coveralls.
- Flame Retardant Clothing (FRC).
- Safety helmet.
- Eye and face protection.
- Hearing protection.
- Safety shoes or boots.
- Gloves.
- Full body harness with lanyard for rescue.



CONFINED SPACE ENTRY PERMIT

Saudi Aramco 9873-4 (12/15) Front No. D

Complete this form in English and write clearly. Use ink pen, not pencil.

أرامكو السعودية
saudi aramco

SECTION 1 – WORK DESCRIPTION

Month _____ Day _____ Year _____ Duration _____

A. Identify plant/facility area: _____
 B. Exact work location: _____
 C. Work to be done: _____
 D. Equipment to be used at the site: _____

SECTION 2 – HAZARD IDENTIFICATION & CONTROL

A. Identify and attach any supplementary forms required to perform/control the work:

Confined space entry log (mandatory) ☐ CSE Plan (mandatory) ☐ Job Safety Analysis ☐
 Gas test records ☐ Isolation plan ☐ Blind list ☐ Critical Lift Plan ☐ Excavation Checklist ☐
 Hydrotest procedure(s) ☐ Other: _____

B. Energy Types:

Hydrocarbon/gas/steam/chemicals ☐ Mechanical ☐ Electrical ☐ Hydraulic/pneumatic ☐
 Potential energy (spring loading, gravity) ☐ Automated extinguishing systems ☐ Other: _____

C. Isolation Method(s):

Locked switch/breaker ☐ Mechanical block ☐ Blinding ☐ Disconnect ☐
 Positive isolation (blind or disconnect) shall be used for all piping connections to the confined space.

D. Potential Exposures:

High noise level ☐ Hydrogen Sulfide (H₂S) ☐ Flammable liquids/gases ☐ Hazardous/toxic materials ☐
 Radioactive materials ☐ Temperature ☐ High pressure ☐ Other: _____

E. Protective Equipment:

Personal H₂S monitor ☐ FRC ☐ ARC rated PPE ☐ Goggles/face shield ☐ Chemical suit/overalls ☐
 Fall protection ☐ Barricades/warning signs ☐ Mechanical ventilation/blower ☐
 Respiratory protection ☐ (Explain further in Additional Safety Precautions below)

F. Confined Space Entry Supervisor (CSES) ☐ Badge No. _____

G. Confined Space Entry Standby Man ☐ Badge No. _____

H. List any Additional Safety Precautions:

IN AN EMERGENCY:

☐ SEE ATTACHED

SECTION 3 – GAS TESTING/MONITORING

Gas testing frequency: _____

Periodic monitoring required: Yes ☐ No ☐ If yes, attach a supplemental form.

Additional gas tests required prior to entry, after breaks/interruption of work, if site conditions change, and at periodic intervals (as required). Record below or use a supplemental form.

ONLY CERTIFIED GAS TESTERS PERFORM GAS TESTS

	LEL (%)	H ₂ S (ppm)	O ₂ (%)	CO (ppm)	Others	Badge No.	Signature
Initial							
Renewed							
Additional							
Additional							

SECTION 4 – PERMIT AUTHORIZATION & CLOSURE

Additional approvals per GI 2.100 or local instructions:

Signature _____ Position _____ Org. _____ Badge No. _____
 Signature _____ Position _____ Org. _____ Badge No. _____

PERMIT	Receiver Org.:	Issuer Org.:
	Badge No.	Badge No.
	Cert. No.	Cert. No.
	Signature	Signature

Open ☐ This permit is renewed ☐ Date: _____ Time: _____ Courtesy/signer(s) notified of permit renewal ☐

Renewed ☐ Date: _____ Time: _____

This permit is closed ☐ Date: _____ Time: _____

I HAVE INSPECTED THE WORK SITE AND CONFIRM THAT IT HAS BEEN RETURNED TO A SAFE CONDITION.

Closed							
--------	--	--	--	--	--	--	--

HAZARD ANALYSIS CHECKLIST

Any 'N' (NO) answers below shall initiate a "STOP" point where the Issuer and Receiver are to analyze the hazard(s) and develop methods to adequately control the hazard(s) and list the additional precautions on the permit.

	Y	N	N/A
Is the correct type of permit(s) issued for the work?	☐	☐	☐
Have the Job Safety Analysis (JSA) and other applicable supplementary forms been communicated to the work crew?	☐	☐	☐
Are weather conditions (e.g., wind speed, rain, fog, heat, lightning) acceptable to perform the work?	☐	☐	☐
Are slip and trip hazards controlled?	☐	☐	☐
Does the work crew have the correct tools/equipment for the job? Are they in good condition?	☐	☐	☐
Do personnel have the proper certifications to perform the activity and/or operate the equipment?	☐	☐	☐
Is the equipment's inspection sticker valid?	☐	☐	☐
Have all requirements for working at heights (i.e., fall protection) been applied?	☐	☐	☐
Is the scaffold tag completed correctly, signed, and with a valid inspection date?	☐	☐	☐
Has the potential for contact with sharp objects, rotating equipment, hot/cold surfaces, or live electricity been eliminated?	☐	☐	☐
Is the system/equipment properly isolated and locked out? Did all workers apply their personal locks?	☐	☐	☐
Has the system/equipment been depressurized, drained, and/or purged before opening it?	☐	☐	☐
Has the potential for releasing flammable liquids and gases been controlled?	☐	☐	☐
Are all ignition sources eliminated or controlled?	☐	☐	☐
Does the fire watch have firefighting equipment readily available and know how to use the equipment?	☐	☐	☐
Has the potential for exposure to high noise levels, H ₂ S, hydrocarbons, asbestos, hazardous chemicals, or radioactive materials been controlled?	☐	☐	☐
Is the correct personal protective equipment (PPE) available for use by personnel?	☐	☐	☐
If the work may impact others nearby, or vice versa, have the work crews discussed their activities with each other (i.e., simultaneous operations [SMOPS])?	☐	☐	☐
Is there an emergency contingency plan in place to respond to the work being performed?	☐	☐	☐
Does the work crew know what to do in the event of an emergency, such as evacuation routes, location of emergency equipment, and where assembly areas are located?	☐	☐	☐
Signatures:			
Issuer			

CSE communication

Standby men must be provided with a suitable means of maintaining communication with entrants, the CSE supervisor and emergency responders.

Two way radio communication is the preferred method of communication, however in noisy work environments where verbal communication is difficult or in work spaces where visual contact is not possible, you may need to use a different method of communication.

Common examples of confined space communication include:

- Portable radios.
- Face to face or voice relay.
- Hand signals.
- Rope tugs.
- Whistles.
- Air horns.
- Sign boards.
- Hard wired systems.



Stop work

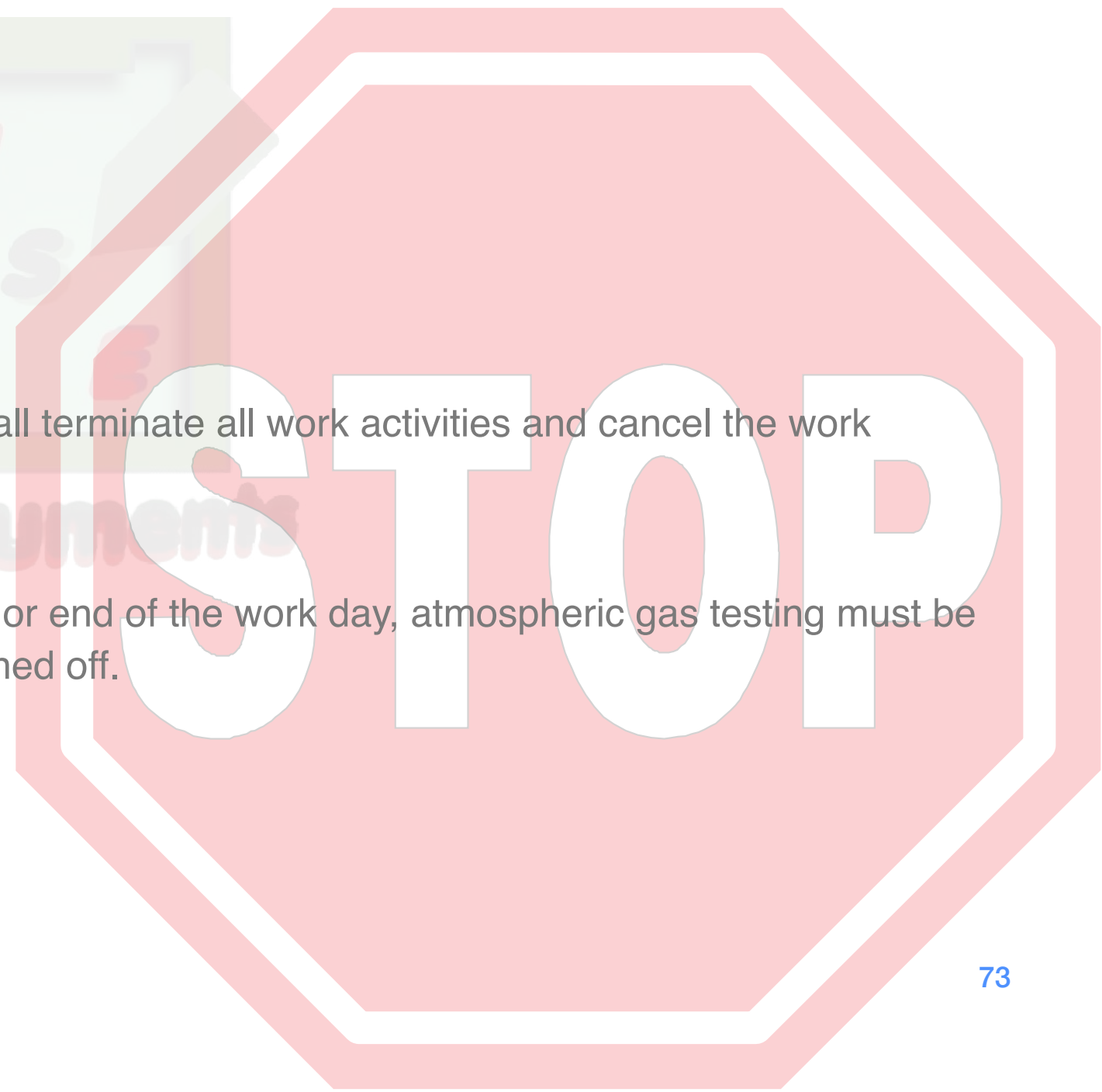
Anytime hazardous conditions develop or a CSE job becomes unsafe the work must be immediately stopped and the entrants ordered out of the space.

Hazardous conditions can include:

- Unsafe atmosphere.
- Safety incident within the space.
- Evacuation or an emergency outside of the space.
- Standby man must leave and no relief is provided.

In the case of an emergency, the CSE supervisor shall terminate all work activities and cancel the work permits.

After longer work stoppages, such as an emergency or end of the work day, atmospheric gas testing must be conducted prior to initial entry with the ventilation turned off.



Emergency response

CSE jobs require preparations for emergency response.

The CSE plan must include a CSE rescue plan for entrants who become unable to exit a confined space under their own power. The plan must provide details on rescue procedures specific to the confined space being entered.

The rescue equipment and rescue workers must be verified by the CSE Supervisor prior to approving the entry.

Be prepare for rescue:

- Rescue team and equipment availability.
- Department and site specific procedures.
- Team awareness and knowledge.
- Training and rescue drills.

Never attempt a rescue unless you are trained and equipped.



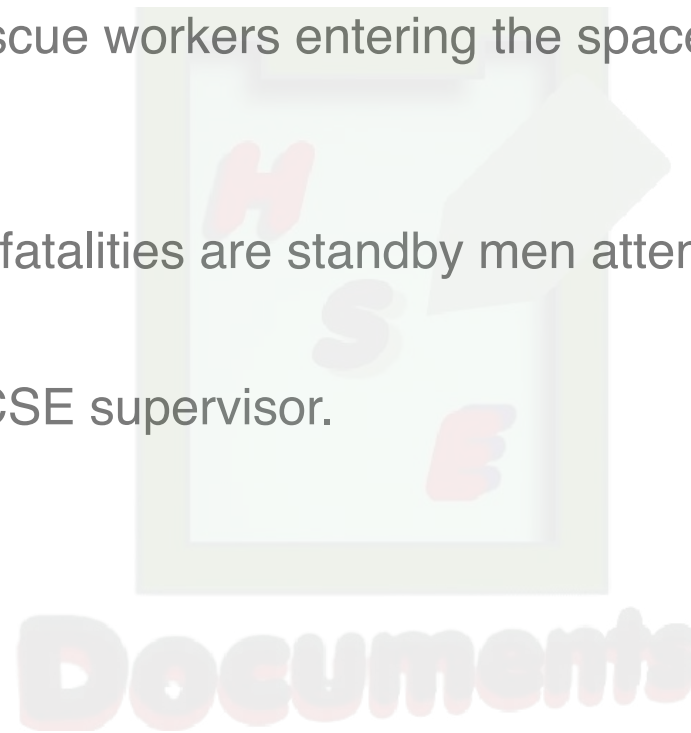
Emergency response

In the event of a confined space rescue, the confined space atmosphere shall be considered to be Immediately Dangerous to Life or Health (IDLH).

Self Contained Breathing Apparatus (SCBA) or Supplied Air Breathing Apparatus (SABA) with an emergency escape cylinder should be used by all rescue workers entering the space.

Standby Man:

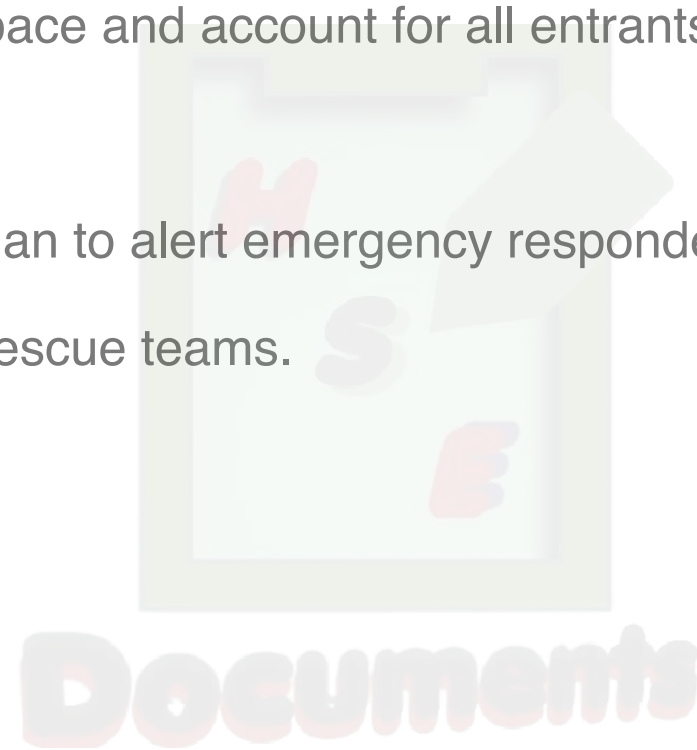
- Do not rescue, 60% of confined space fatalities are standby men attempting to rescue an entrant.
- Notifies the emergency team and the CSE supervisor.



Emergency responsibilities

Standby man: in the event of a CSE emergency the standby man must:

- Order the entrants to evacuate the space.
- Keep count of entrants leaving the space and account for all entrants against the entry log.
- Notify confined space supervisor.
- Follow the CSE emergency rescue plan to alert emergency responders and rescue teams.
- Provide essential information to the rescue teams.



Emergency responsibilities

Confined Space Entry Supervisor: in the event of a CSE emergency the CSE supervisor must:

- Terminate all entry activities.
- Cancel any work permits.
- Once entry is suspended, barricade the entry point and post a 'No Entry' sign.



Emergency rescue types

CSE rescue operations can be classified into three types:

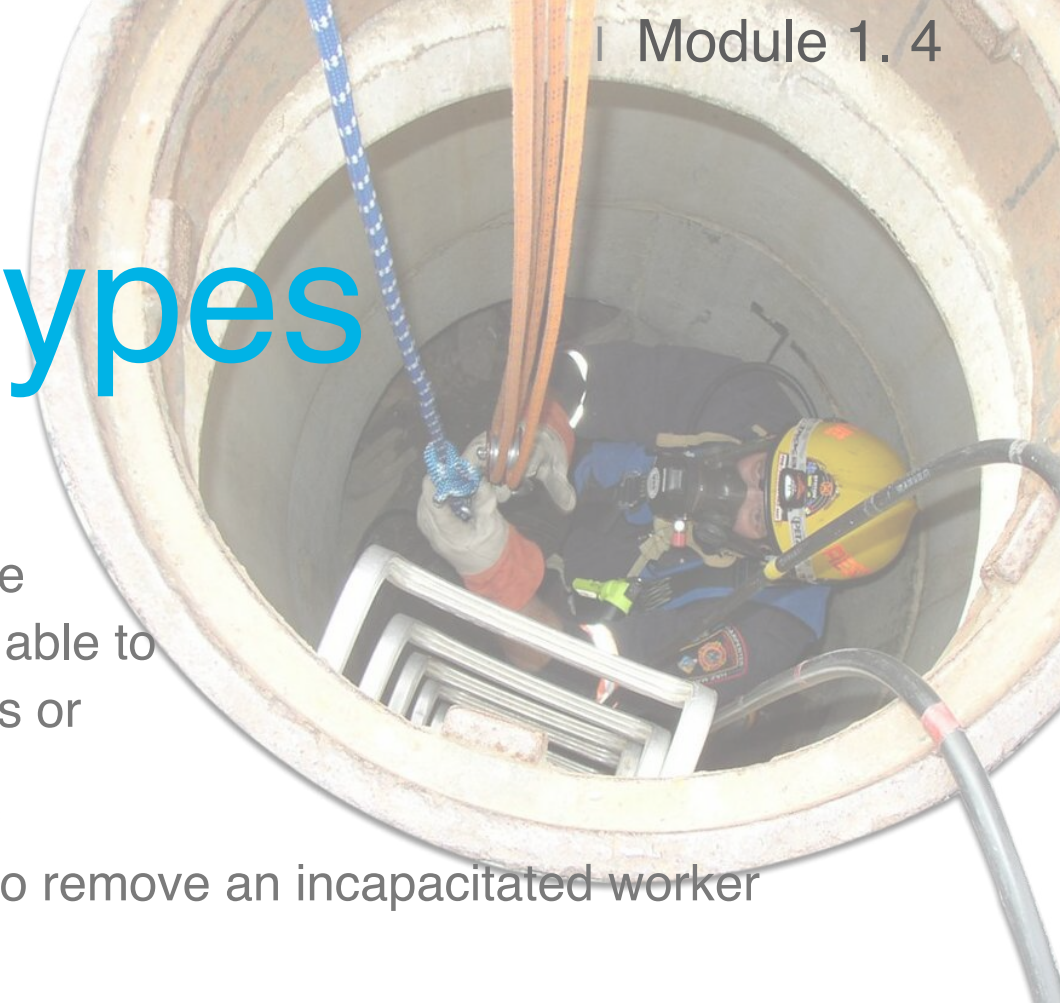
Self rescue: the entrant recognizes an unsafe critical condition or the symptoms of exposure to hazardous materials/gases. The entrant is able to escape from the space on his own with no help from external workers or rescuers.

Non-entry retrieval: non-entry rescue/retrieval involves attempting to remove an incapacitated worker without having anyone else enter the confined space.

Entry/internal rescue: this is the last resort option. This involves more personnel entering an area that has already incapacitated one or more workers, and places the rescuers at considerable risk.

Entry rescues must be carefully planned and implemented to avoid creating more victims in need of rescue.

Only trained and certified rescue teams may perform an entry/internal rescue.



Non-entry retrievals

To facilitate 'non-entry' retrievals, **retrieval systems** and methods **must be used** whenever an entrant enters an enclosed confined space that requires a **vertical entry**.

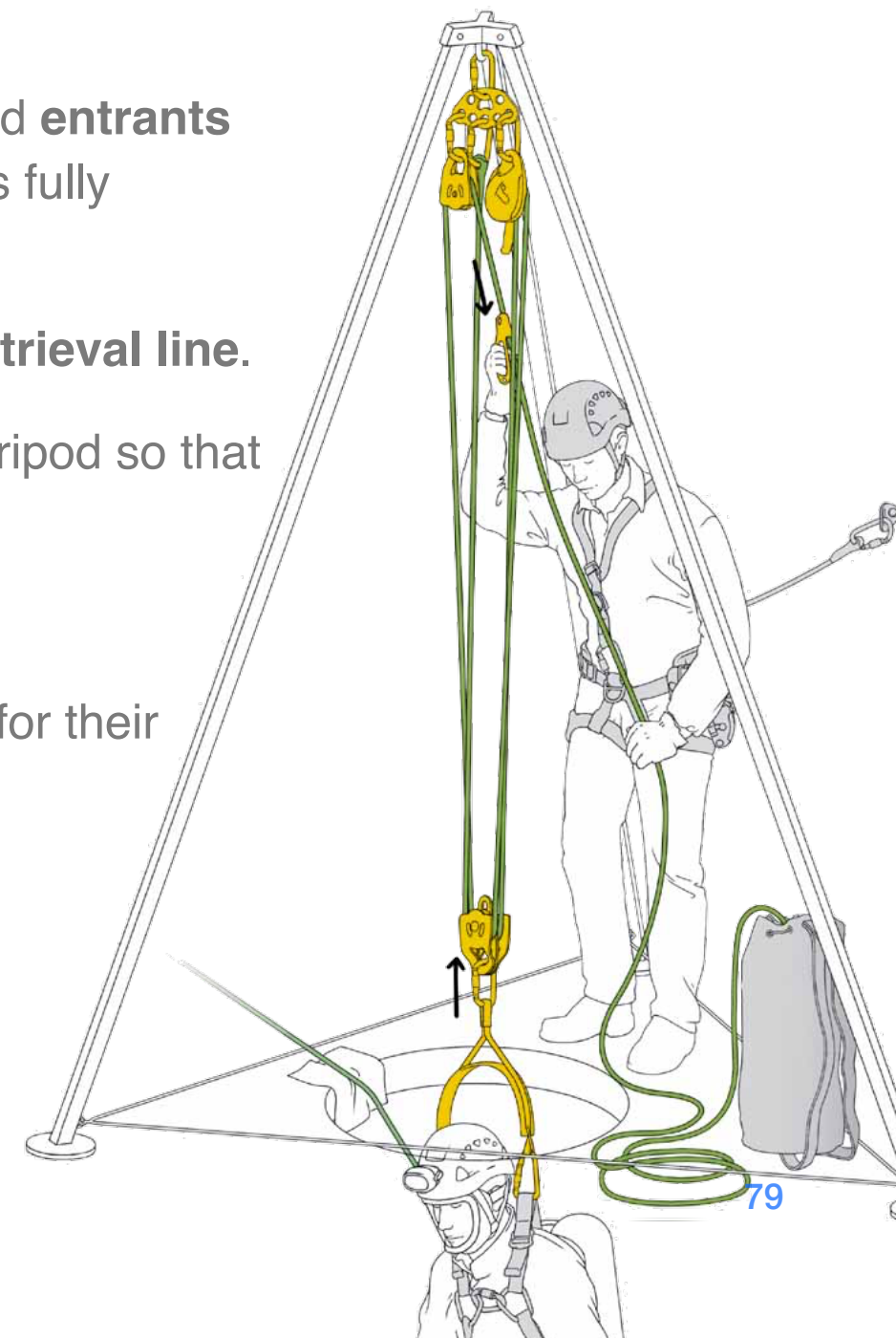
The retrieval system **must be installed and tested before entry**.

If the system stops working then all entry **activities must be stopped** and **entrants must exit** the space until the retrieval system is replaced or repaired and is fully operational.

All entrants **must wear a full body harness** complete with an **attached retrieval line**.

The retrieval line must be attached to a mechanical winch attached to the tripod so that 'non-entry' retrieval can begin, without delay, as soon as help is required.

The standby man and all rescue responders must be trained and qualified for their jobs, including participating in emergency response drills.



Emergency response

Conditions can change and hazards may arise inside of a confined space that may trigger evacuation or self rescue, below are some common examples that may require evacuation or self rescue:

- Entrant recognizes the warning symptoms of exposure to a hazardous material, such as dizziness, blurred vision, difficulty in breathing.
- Continuous gas monitoring indicates a hazardous condition.
- Gas monitor goes into alarm.
- An unsafe condition develops inside or outside the confined space.
- Entrant displays abnormal behavior due to exposure to hazardous materials.
- A change in the work environment, such as the temperature.
- Hot conditions leading to a dangerous increase in workers body temperature.
- Equipment critical to the entrants safety malfunctions or breaks down.



Confined space restoration

When the work has been completed and the confined space is ready to be returned to service, use a pre-prepared operations checklist to restore it.

In addition to the items on the checklist, ensure that:

- All entrants have exited the space.
- All tools and equipment have been removed.
- Close and seal man-ways and flanges.
- All valves back to operation mode.
- Remove isolations and LOTO.
- Handover equipment, use checklist.
- All blinds have been removed using the blind list as required by GI 6.012 (Isolation, Lockout and Use of Hold Tags).



Summary

In Module 4 you were introduced to confined space hazards and controls.

You should now be able to:

Identify work hazards and control measures, including

- Confined space entry hazards.
- Confined space entry controls.
- Communication methods.
- Emergency response.
- Confined space restoration.

Your instructor will now start Module 5, CSE incident case studies.



Module 5

CSE case studies

Enabling objectives

On completion of Module 5, you will be able to:

- Identify the hazards and controls measures for each of the case studies.
- List the primary and immediate causes.



Introduction

Confined Space Entry has many hazards that if ignored can lead to incidents that may result in fatal injuries.

The recognition of hazards and controls, and the identification of the primary causes of CSE incidents, is an important skill that will improve CSE safety.

Learning the lessons from past incidents will reduce future incidents and lead to an increase in CSE safety performance.

Case studies

In Module 5 you will discuss CSE incident case studies.

You will:

- Identify the hazards and what controls measures should have been used to mitigate the identified hazards.
- List the primary and immediate causes of this incident.



Case study 1

Contractor crews were sand blasting and painting a water tower. A worker was spray painting the inside of the riser of the tower.

He was standing on a fixed ladder 40 feet above the riser floor without wearing any fall protection gear.

Apparently he slipped and fell through an opening in the floor of the riser onto a standpipe.

Worker suffered a broken back and injuries to his head.

Worker involved in incident was 24 years old and had more than 3 years of experience doing this type of job.

He was assigned to the project 3 months before the incident.

Identify the hazards and what controls measures should have been used to mitigate the identified hazards.

List the primary and immediate causes of this incident.



Case study 1

Case study 1: hazards and controls.

Example Hazards

- Low oxygen.
- Respiratory hazard associated with grit and scale.
- High LEL.
- Working at elevation.
- Ignition source (i.e. grit blasting).

Example Controls

- Continuous air monitoring for O₂ and LEL.
- Continuous ventilation of space.
- Scaffolding/fall protection.
- Grounding of grit blasting equipment .
- Training.
- PPE.
- Planning.
- Administrative i.e. confined space entry permit, procedures etc.



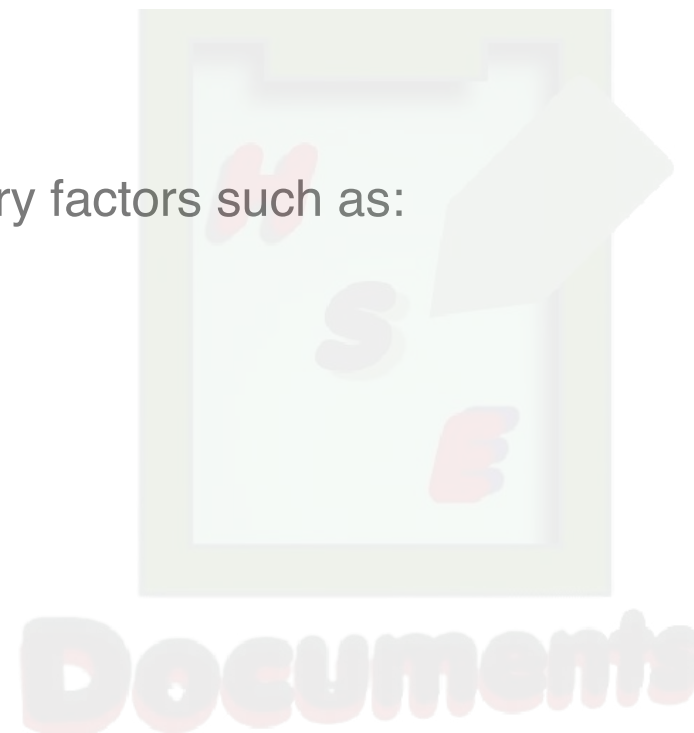
Case study 1

Example Primary/Immediate Causes:

- Falling.
- Lack of fall protection gear.

There may have been other contributory factors such as:

- Atmospheric conditions.
- Fatigue.
- Work surface.
- Exposure to hazardous materials.



The message is to identify all hazards and implement and follow all controls.

Case study 2

A welder entered a steel pipe (24 inch diameter) to grind a bad weld at a valve about 30 feet from the entry point.

The pipe had been purged with nitrogen.

Before he entered, other crew members decided to add Oxygen to the pipe near the bad weld.

He had been grinding intermittently for about five minutes when a fire broke out enveloping his clothing.

A second crew member pulled him 30 feet to the pipe entrance and extinguished the fire.

However, the welder died the next day from his burns.

Identify the hazards and what controls measures should have been used to mitigate the identified hazards.

List the primary and immediate causes of this incident.



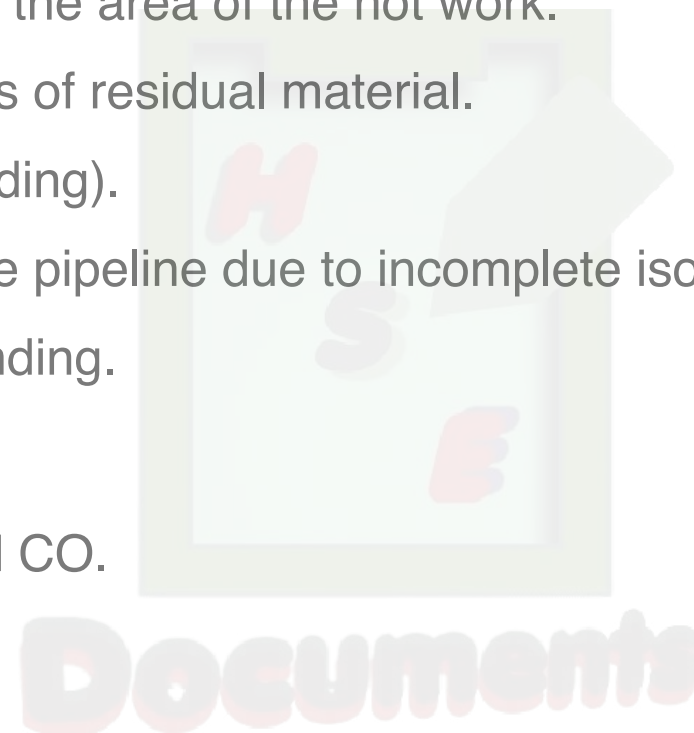
Case study 2

Example Hazards:

- Low oxygen from nitrogen purge.
- High O₂ as they injected oxygen into the area of the hot work.
- Existing toxic and flammable hazards of residual material.
- Ignition source (i.e. grinding and welding).
- Engulfment from product entering the pipeline due to incomplete isolation.
- Noise from tools and activity, i.e. grinding.

Example Controls:

- Continuous air monitoring for O₂ and CO.
- Continuous ventilation of space.
- Grounding of welding leads.
- Training.
- PPE such as, FRC, welding helmet and face shield.
- Planning.
- Administrative i.e. confined space entry permit, procedures etc.



Case study 2

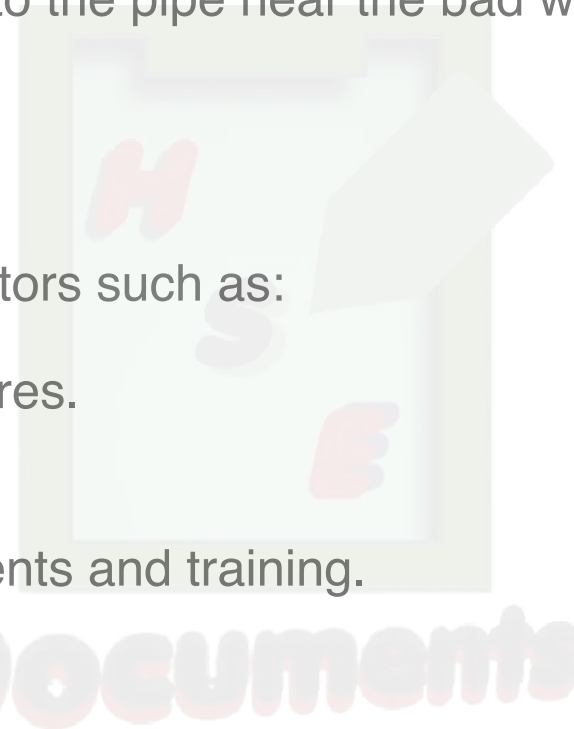
Example Primary/Immediate Causes:

- Elevated Oxygen levels leading to Oxygen enriched environment.
- Fire as a result of the addition of Oxygen to the pipe near the bad weld.
- Lack of correct air monitoring.

There may have been other contributory factors such as:

- Inadequate confined space entry procedures.
- Lack of fire protection equipment.
- Lack of communication/rescue arrangements and training.

The message is to identify all hazards and implement and follow all controls.



Case study 3

A team of 6 employees were assigned to conduct a boring and jacking job inside a 21 feet deep manhole.

An employee with very little experience on this type of a job was lowered approximately 17 feet into the manhole sitting in a looped chain.

Twenty seconds later he started gasping for air and fell from the chain seat face down into the accumulated water at the bottom of the manhole.

An autopsy determined Oxygen deficiency as the cause of death.

Identify the hazards and what controls measures should have been used to mitigate the identified hazards.

List the primary and immediate causes of this incident.



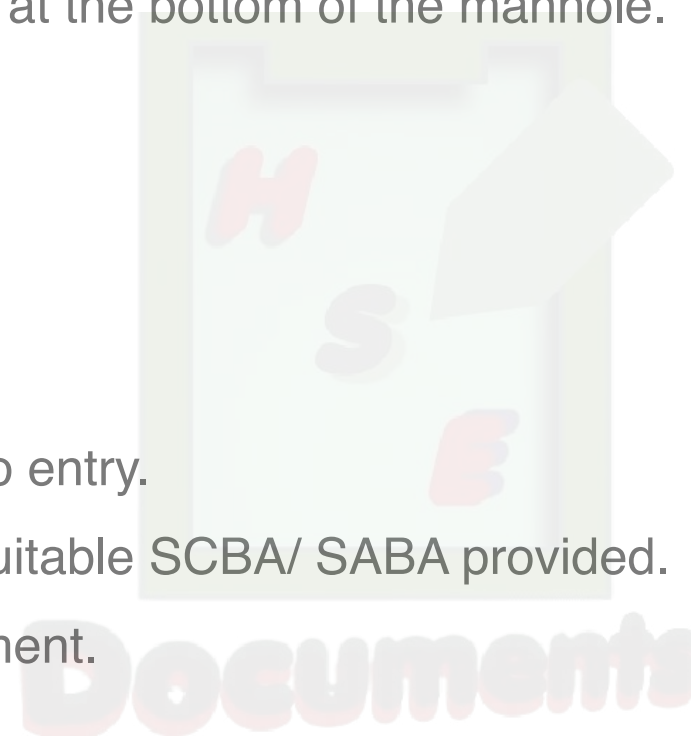
Case study 3

Example Hazards:

- Atmospheric hazards such low Oxygen, Toxic gases such as Methane, H₂S etc.
- Engulfment from accumulated water at the bottom of the manhole.
- Falls from height.
- Limited entry capabilities.
- Inexperience.

Example Controls:

- Air monitoring of entire space prior to entry.
- Continuous ventilation of space or suitable SCBA/ SABA provided.
- Correct entry/exit and rescue equipment.
- Training.
- PPE, fall protection, rescue line, harness and tripod.
- Planning.
- Administrative i.e. confined space entry permit, procedures etc.



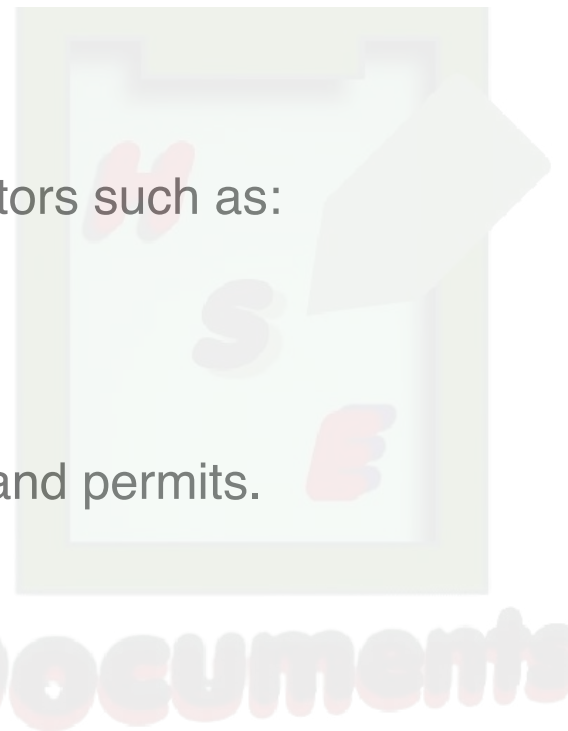
Case study 3

Example Primary/Immediate Causes:

- Unsafe atmospheric conditions.
- Fall from height.

There may have been other contributory factors such as:

- Air monitoring.
- Training.
- Inadequate confined space entry system and permits.
- Access arrangements and equipment.
- Inexperience worker.
- Lack of communication or rescue arrangements.



The message is to identify all hazards and implement and follow all controls.

Case study 4

Five contractor laborers were trying to open a sewer line blockage from the manhole, when one of them became unconscious and fell down into the manhole.

Two others went down to rescue the first victim and both of them also fell unconscious.

The fourth laborer reported the incident to Industrial Security (ISO).

Industrial Security, Fire Protection and LPD responded to the incident.

Three dead bodies were retrieved.

Identify the hazards and what controls measures should have been used to mitigate the identified hazards.

List the primary and immediate causes of this incident.



Case study 4

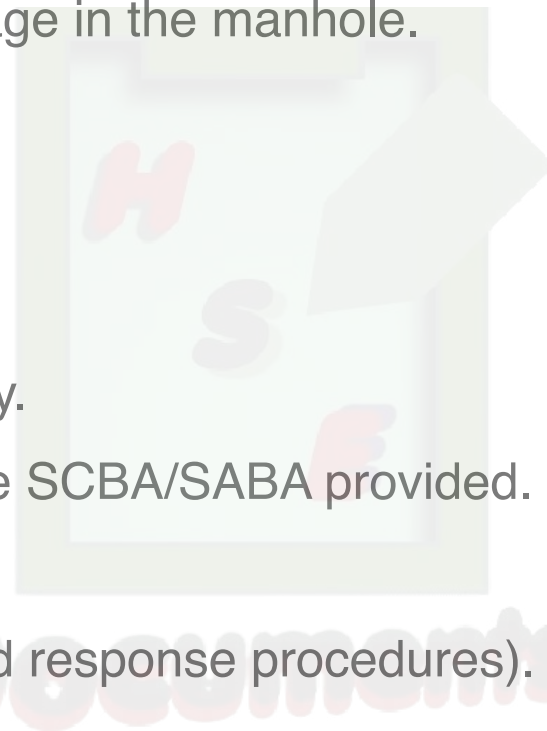
Example Hazards:

Atmospheric hazards such low Oxygen, Toxic gases such as Methane, H₂S etc

- Engulfment from accumulated water/sewage in the manhole.
- Falls from height.
- Limited entry capabilities.

Example Controls:

- Air monitoring of entire space prior to entry.
- Continuous ventilation of space or suitable SCBA/SABA provided.
- Correct entry/exit and rescue equipment.
- Emergency arrangements (notification and response procedures).
- Training.
- PPE, fall protection.
- Planning.
- Administrative i.e. confined space entry permit, procedures etc.



Case study 4

Example Primary/Immediate Causes:

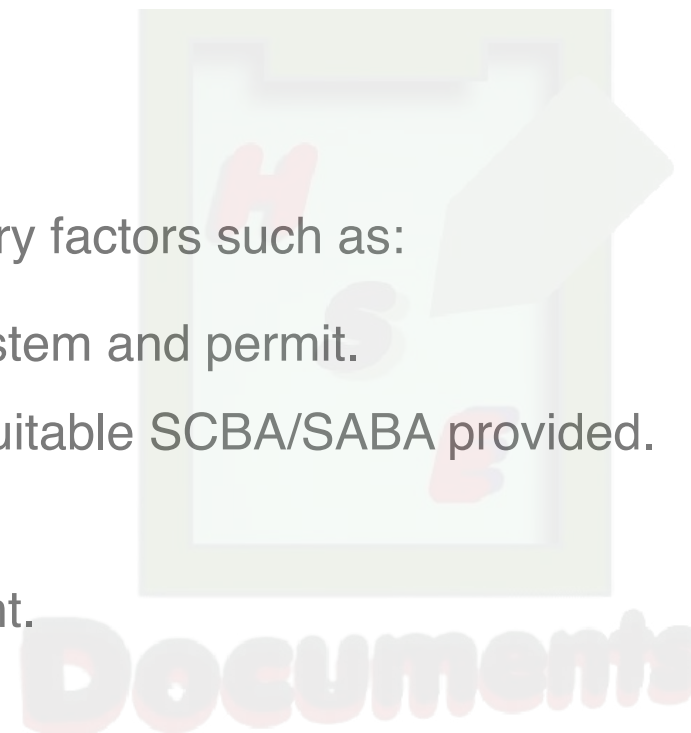
Exposure to Toxic sewer gases.

Unsafe atmospheric conditions.

There may have been other contributory factors such as:

- Inadequate confined space entry system and permit.
- Continuous ventilation of space or suitable SCBA/SABA provided.
- Training.
- Access arrangements and equipment.
- Inexperience workers.
- Lack of communication/rescue arrangements.
- Lack of Standby Man.
- Failing to follow procedures (entering the space to carry out rescue).

The message is to identify all hazards and implement and follow all controls.



Summary

In Module 5 you applied the knowledge that you have learnt over the previous CSE modules.

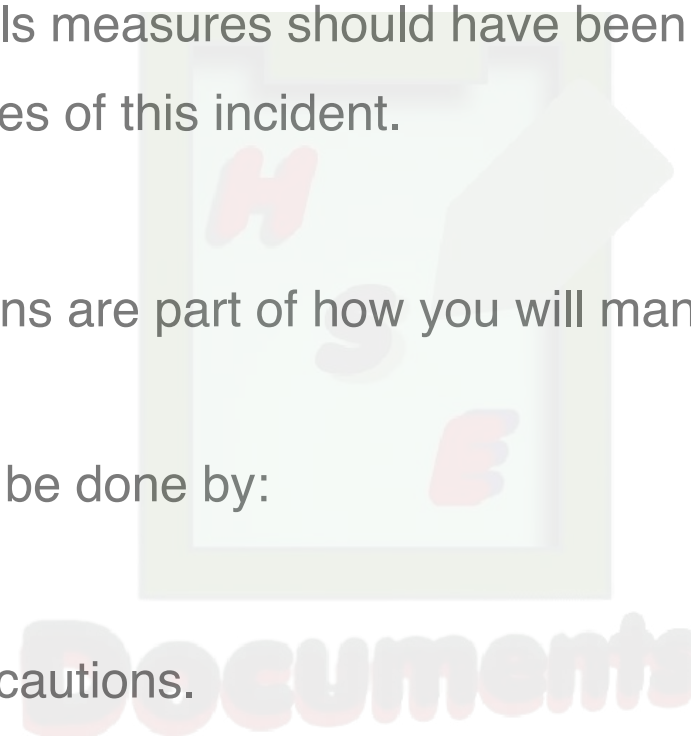
You should now be able to:

- Identify the hazards and what controls measures should have been used to mitigate the identified hazards.
- List the primary and immediate causes of this incident.

Identifying CSE hazards and precautions are part of how you will manage your site safety risks so that you and your co-workers can work safely.

Safe completion of your work can only be done by:

- Proper preparation and supervision.
- Agreeing to the minimum safety precautions.





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