



Key Lesson from Incidents Involving Confined Space Entry

Introduction

A confined space is referred to as a space which is large enough for someone to enter and work, is an enclosed or partially enclosed space, has restricted entry/exit routes, is not designed, or intended to be primarily used for human occupancy and contains or has the potential to contain a hazardous atmosphere. Confined space entry (CSE) is used in a wide range of industries to perform a range of tasks including cleaning and maintenance. The key concern relating to CSEs is that should an incident occur it often results in serious injury or fatality to personnel for those working within the CSE. The need for a CSE should always be challenged although should it be unavoidable, a safe system of work must be in place to assess the risks.

Case 1 – Chemical Plant Nitrogen Asphyxiation:

On 27th of March 1998 a staff member (Worker A) was killed, and a contract worker seriously injured due to asphyxiation from nitrogen (N₂) exposure while completing an unplanned internal blacklight inspection of a 48” pipeline. The work party asked two nearby contractors to assist by holding and keeping a black plastic sheet in place during their daytime inspection. The process plant had two separate uncoordinated activities taking place, replacement of the oxygen feed mixer and replacement of the catalyst within the reactor. Worker A had assisted in the catalyst replacement job the day prior to carrying out the inspection and instructed N₂ to be injected to protect the new catalyst reactor from moisture build up that had been installed. Worker A required an N₂ flow path and opened bypass valves on the reactor discharge line allowing N₂ to flow into the rest of the process, including the north end of the open pipe where the inspection would take place the following day.

Key Findings:

The investigation found that the blacklight inspection was not planned or scheduled to take place, only a visual inspection of the flange faces. A lack of leadership, communications, planning and personal direction with those working on the plant and equipment resulted in no preparations occurring for a confined space entry. There was no consideration for simultaneous operations as two work parties were on a connecting process at the same time. There may be a possible culture issue as it was also noted that earlier in the day other contractors who were instructed to clean the flange faces and had been exposed to high concentrations of N₂ when removing the clear bags, yet the incident was not reported. Lack of safe system management through no formal isolations, signs, barriers, or atmospheric testing in place.

Case 2 – Trawler:

On 14th August 2018 a second engineer onboard, a trawler collapsed while inside a refrigerated sea water (RSW) tank while attempting to manually sweep residual sea water into a bilge well in preparation for maintenance work on a heat exchanger. Freon Gas (4x heavier than air) had leaked from known corroded tubulars within the heat exchanger into the RSW. Three colleagues attempted to rescue him before suffering breathing difficulties which then resulted in another two colleagues donning breathing apparatus to perform an emergency rescue. The individual entered the tank on his own accord with none of the safety precautions typically associated with CSE activities in place. The refrigeration plant had undergone historical maintenance in January 2018 due to leaks within the system where tubulars had been plugged.

Key findings:

In January 2018 it was noted that the heat exchanger tubulars were beginning to fail as corrective maintenance was carried out resulting in corroded, leaking tubulars being plugged. There was no management of change or adequate risk assessment for this. There was no safe system of work or any up-to-date procedures onboard the trawler with investigations highlighting the last update to the risk assessments was 11th September 2000. There was no atmosphere monitoring equipment onboard, no rescue procedures or equipment, no positive isolation, and no risk assessment. There was a valve closed but was later found to be passing as it was designed to be watertight. The investigation found that the absence of appropriate safety measures had become normalised onboard.



Figure 1: ISC Framework

The ISC believes that leadership across six key functional elements is vital to achieve good process safety outcomes. These elements are:

- systems & procedures
- engineering & design
- assurance
- knowledge & competence
- human factors
- culture

In the *What can I do* section below you can see how each of these elements plays a part.

What can I do?

Management

● ● ●	<ul style="list-style-type: none"> Ensure that safe work systems, such as permit to work, lock out tag out and atmospheric monitoring systems are in place and followed.
● ● ● ●	<ul style="list-style-type: none"> Ensure that there are written procedures on the requirements to be in place for confined space entry. Including the requirements for atmospheric testing are understood and complied with.
● ●	<ul style="list-style-type: none"> Ensure that an emergency response team and equipment are available prior to entry.
● ●	<ul style="list-style-type: none"> Ensure that changes to scope are adequately assessed and approved prior to any work taking place.
● ● ●	<ul style="list-style-type: none"> Ensure at all required personnel are adequately trained and competent in the permit to work systems, and that they know how to use the atmospheric monitoring devices.
● ● ●	<ul style="list-style-type: none"> Ensure there is a maintenance management system that defines how work is identified and scoped, and people are trained and competent in its use.
● ● ●	<ul style="list-style-type: none"> Have in place an effective Management of Change (MOC) process to adequately record changes from normal operations.
● ● ● ●	<ul style="list-style-type: none"> Ensure risk assessments are reviewed and updated at adequate time intervals to reflect current conditions.

Process Engineer/Supervisor

● ● ●	<ul style="list-style-type: none"> Make sure to follow company rules and operating procedures to protect workers.
● ●	<ul style="list-style-type: none"> Perform regular checks of the worksite to ensure controls are in place and working.
● ●	<ul style="list-style-type: none"> Ensure atmospheric monitoring is being performed for CSE activities.
● ● ●	<ul style="list-style-type: none"> Ensure that all scope changes are adequately risk assessed and documented. Any changes must be reviewed to ensure the conditions are suitable for the work to be performed.
● ● ● ●	<ul style="list-style-type: none"> Ensure plant is designed to allow adequate isolation for the substance. IE – double block and bleed etc.
● ● ● ●	<ul style="list-style-type: none"> When issuing a permit to work, ensure at all hazards specific to the task are identified and that controls are implemented to manage these hazards ensuring those involved are familiar with the hazards and controls.
● ● ●	<ul style="list-style-type: none"> Ensure all isolations fully documented and perform a line walk to verify all isolations are correct and tested.
● ● ● ● ●	<ul style="list-style-type: none"> Have daily or shift briefs to ensure site teams are aware of ongoing work scopes, SIMOPs and effective barriers are in place.

Operator

● ● ● ●	<ul style="list-style-type: none"> Ensure all plant is safely isolated as required by permit to work systems – perform daily or shift checks.
● ● ●	<ul style="list-style-type: none"> Ensure drain, flush, purge, and vent operations are completed prior to releasing worksite for site entry, for all activities involving breaking containment.
● ●	<ul style="list-style-type: none"> Ensure all atmospheric monitoring is completed as required by permit to work systems.
● ● ● ●	<ul style="list-style-type: none"> Perform regular plant checks on all work to ensure it is being performed as required and following the permit to work controls. Audit if required.
● ● ● ●	<ul style="list-style-type: none"> Stop the job and report any deviation from the permit to work system including additional members of the work party.
● ● ●	<ul style="list-style-type: none"> Ensure sufficient handovers are in use documenting all activities.