

LFI: Dangers of Carbon Monoxide





LFI Incident Description

- November 2017 a Mechanical Fitter lost consciousness due to inhalation of Carbon Monoxide (CO).
 - Pressurized Syngas (containing ~20% CO) vented out of the open flange he was working on.
- The fitter had been de-spading the Synthol Tailgas export line.
 - Preparing for Synthol Train 2 to be put online to take over from Train 3, which was experiencing an exchanger leak.
- Fortunately the Mechanical Fitter regained consciousness on the scene of the incident
 - Loss Time Injury.
- The Carbon Monoxide concentration at the scene was still above toxic level 2 hours after the incident (measured 41 ppm).



Dangers of Carbon Monoxide

- CO is a poisonous, colourless, odourless and tasteless gas. Toxic at concentration > 35 ppm.
- If inhaled it displaces oxygen from the blood, depriving vital organs of oxygen.
- Initial symptoms include impaired judgement, dizziness, fatigue and headache.
- Exposure to high level of CO can leads to confusion, collapsing, loss of consciousness and death (Suffocation).
- Syngas produced contains ~20% CO.



SAFETY ALERT

DANGERS OF CARBON MONOXIDE EXPOSURE

Carbon Monoxide (CO) is a poisonous, colourless, odourless, and tasteless gas. It is toxic to humans at a concentration greater than 35ppm. Although it has no detectable odour, CO is often mixed with other gases that do have an odour. So, you can inhale CO right along with gases that you can smell and not even know that CO is present.

Carbon Monoxide is harmful when inhaled because it displaces oxygen in the blood and deprives the heart, brain, and other vital organs of oxygen. Besides tightness across the chest, initial symptoms of CO poisoning may include headache, fatigue, dizziness, drowsiness, impaired judgement or nausea. During prolonged or high exposures to CO, symptoms may worsen and include vomiting, confusion and collapsing and potential loss of consciousness and muscle weakness. Large amounts of CO can overcome you in minutes without warning, which can result in death.

Syngas produced at the Reformer (Unit 06) and fed to Synthol (Unit 14) contains 20 - 24% CO. Units where the process gas contains high levels of CO include Unit 04, Unit 06, Unit 08, Unit 14 (Trains and Tail Gas section), Unit 19 (Lean Tail Gas section), HP and LP Flare Headers.

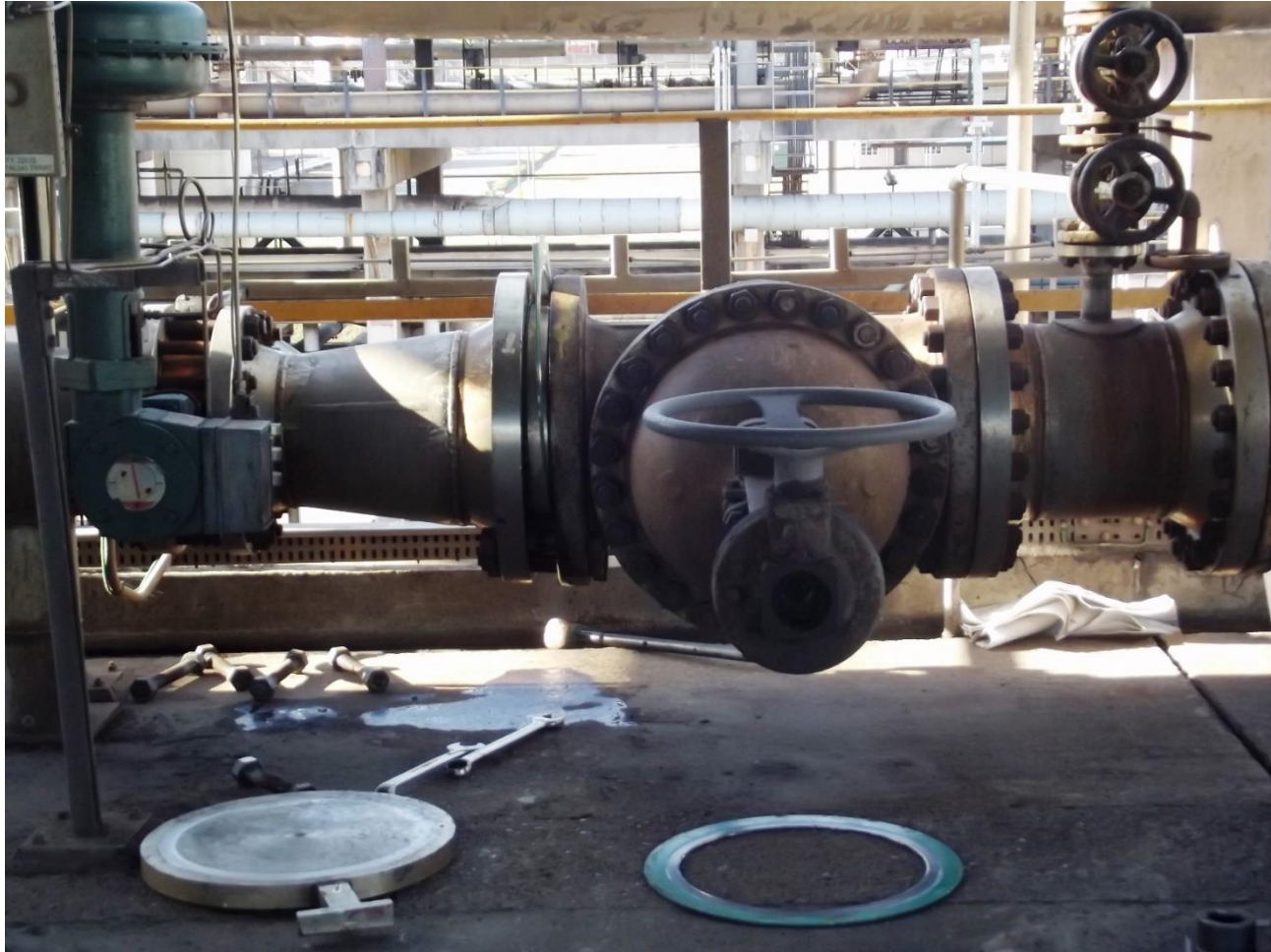
Work in these areas should always be done with due consideration for the potential exposure to CO.


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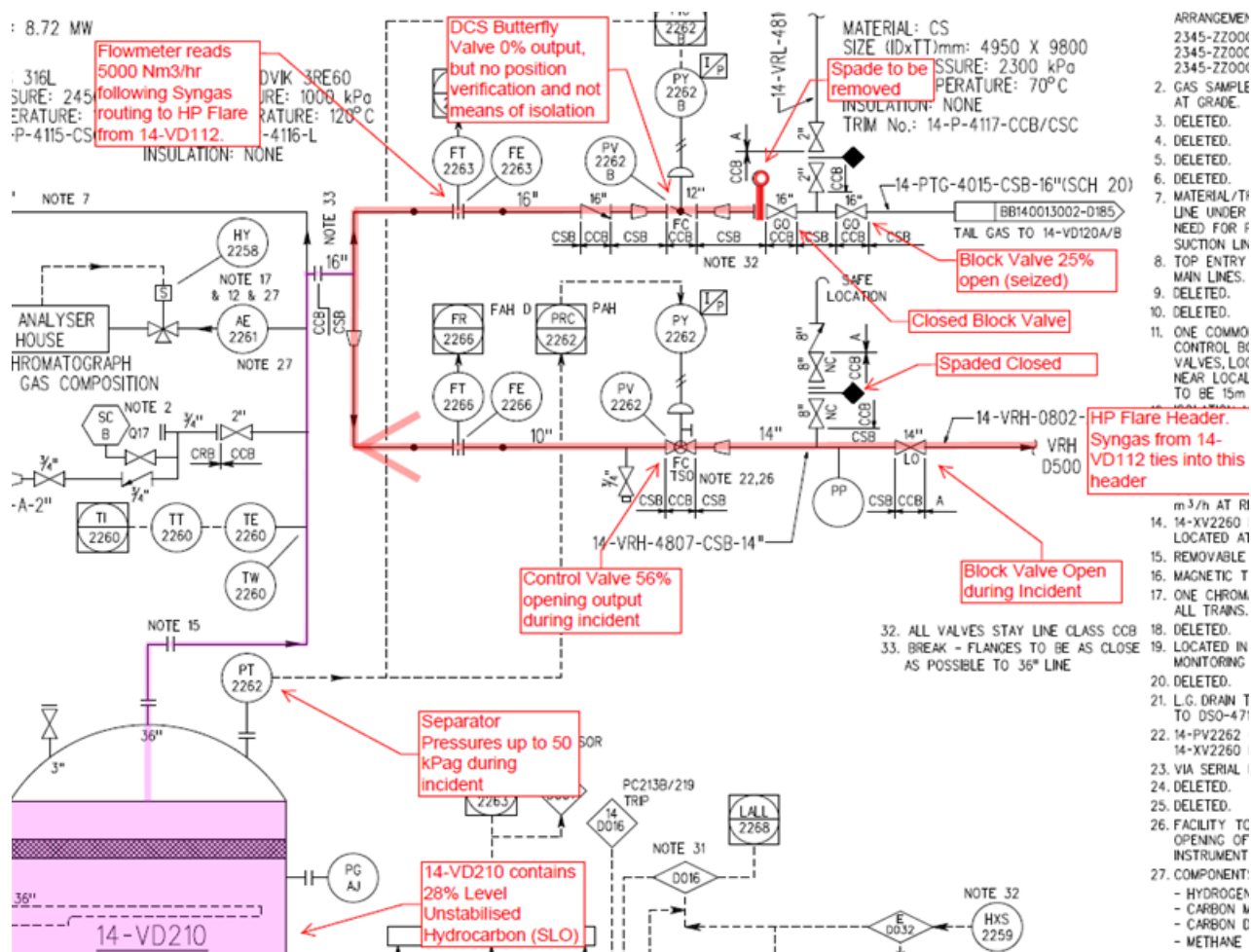
15 December 2017

No: 290

Incident Scene



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Investigation Findings: Cause 1

• Work Permit is issued with no special precautions to detect or mitigate a release of process gas from the open flange (i.e. gas testing, air-line mask).

- The high CO safety risk associated with the work is not recognized:
 - No isolation from the High Pressure Flare Header or separator drum hydrocarbon inventory (safe making consists of depressurisation only).
 - Mechanical Isolation was specified on the Work Permit, but not verified.
 - Potential for carbon monoxide exposure not identified as a hazard.
 - Permit and Generic “3 Whats” risk assessment fail to identify potential for toxic gas.
 - Missed opportunities to involve others to identify appropriate safety precautions
 - No safety authorisation despite potential exposure to toxic gas.
 - Permit risk scoring required a higher level of risk assessment than was performed).



Investigation Findings: Cause 2

- **Work on flange is continued (re-positioning of Jacking Bolts) despite radio instruction from Senior Process Controller to stop.**
 - increased exposure to CO until loss of consciousness.
- Fitter shows poor judgement of the danger of the process gas venting from the flange:
 - Impaired judgement is a symptom of exposure to Carbon Monoxide.
 - Lack of a safety standby misses opportunity for independent, unimpaired identification of unsafe conditions & verification that an instruction to stop work is adhered to.
 - Possible general poor awareness of dangers from exposure to process gas.
 - No sensitisation by Permit risk assessment.



Investigation Findings: Cause 3

- **Work with risk of exposure to toxic and flammable gases is performed unnecessarily**
 - Spading of the Export line (performed April 2017), in addition to the double block & bleed isolation, is not justified for an Open-Clean-Shut since:
 - Synthol Train remains full of hydrocarbon and open to the high pressure flare
 - There is no dedicated Open-Clean-Shut procedure
 - Selective application of the Synthol Turnaround procedure relies on individual discretion for which spades to install



Recommendations

1. **For line openings where there is a risk of exposure to toxic gases such as CO or H₂S, the Work Permit should specify an airline mask, continuous gas testing and a safety standby as a minimum (PTW procedure update).**
2. **Evidence of Isolation is to be issued with the work permit in the form of a marked-up MFD for line openings where mechanical isolation is certified on the Work Permit (PTW procedure update).**
 - Ensures a more rigorous verification of isolation by Production.
 - Enables an independent check of isolation by the Responsible Person.
 - Similar to a confined space entry permit which has to be accompanied by a blank list.



Recommendations

3. Increase Awareness of Dangers for Carbon Monoxide Exposure:

- Safety Alert for safety moment sent via Internal Communication for dangers of Carbon Monoxide Exposure.
- Awareness session held for mechanical fitters and production personnel in Synthol Area. Area specific induction to be updated.
- Incident Safety stand-down presentation to promote general awareness.

4. Dedicated procedure for a Synthol Train Open-Clean Shut (or amend Synthol turnaround procedure to include the situation where hydrocarbon is left in the train)

- Identify appropriate spading and risk assess.
- Ensure isolation from the HP flare header when opening pipelines.

Thank You...

