Training Package
TP 27/20

Recent (3Q & 4Q of Year 2019) Accidents/Incidents in the Gases Industry in Asia

AIGA *Asia Industrial Gases Association*

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Recent (3Q and 4Q of Year 2019) Accidents/Incidents in the Gases Industry in Asia

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Introduction

At the regular Safety Advisory Group (SAG) meetings, members exchange information on accidents/incidents that have occurred . Accident/Incident details discussed at the SAG remain confidential.

The SAG has decided to share the more notable accidents/incidents on a regular basis with the national associations and member companies via the Training Package publications.

These slides contain the summaries, pictures and other relevant information to highlight the root causes and lessons to be learned.

Further Information:

These Training Packages are posted only on the Members Page and are meant for distribution among Members only.

While the best effort is made to provide sufficient information on the accidents/incidents, please contact the SAG (through the Secretary General) if you need further clarifications.

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Agenda

- Incident Cases
  - Product Transportation including Loading/Unloading
  - Process Safety
  - Working Injuries/Occupational Safety incidents
  - Maintenance Work/Construction related
- Learning from the Incidents
- AIGA standards related to the incidents

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Accidents/Incidents in Product Transportation including Loading and Unloading

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Event #1

High Severity Product Vehicle Accident

Consequences: *Damage to driver cabin*

What happened

- A driver started his trip by making one local delivery near a terminal before proceeding to the outstation trip located about 440km away at around 2200hrs. In between his trip, the driver took two rest stops at 0100hrs and 0330hrs respectively. Driver continued the journey but still felt tired and planned to take another rest when he reached the toll rest area.
- He passed three rest areas but did not stop for a break. A few kilometer before the toll area, there were road construction and one lane of the road was closed. At around 0500hrs, the tractor head collided with a road divider on the highway within the road construction area. No injury recorded

Major Cause(s):

- Driver failed to recognize his fatigue sign and symptom
  - Driver was found to be fatigued and had a micro sleep
- Driver continued his journey despite he still felt tired

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Event #1 Pictures

The right-hand side foot-step was badly damaged

The right-hand side front rim hit the road railing and was damaged

Views from the forward facing camera showed that the driver had a microsleep and the vehicle veered to the right and hit the road railing

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Event #2

Product Vehicle Accident

Consequences: *3rd Party Vehicle Damages*

What happened

- A product vehicle(PV) driver was driving on the 3rd lane behind a MPV what suddenly stopped on the road . The PV driver reduce speed, stopped the truck and attempted to change the lane. He checked the left mirror and applied left signal. He noticed there was a four wheeler truck passing him on the left and upon passed the PV truck, the driver moved the truck slowly to the left side but the front left wheel of the truck hit the right front side of a personal car that following the four wheeler truck. No damage to the product vehicle but the 3rd party MPV sustained minor damages on the right door. There is no injury recorded in this incident.

Major Cause(s):

- Driver failed to maintain his safe space around him to get the big picture
- Driver used the 3rd lane instead of 1st lane which is meant for the trucks.

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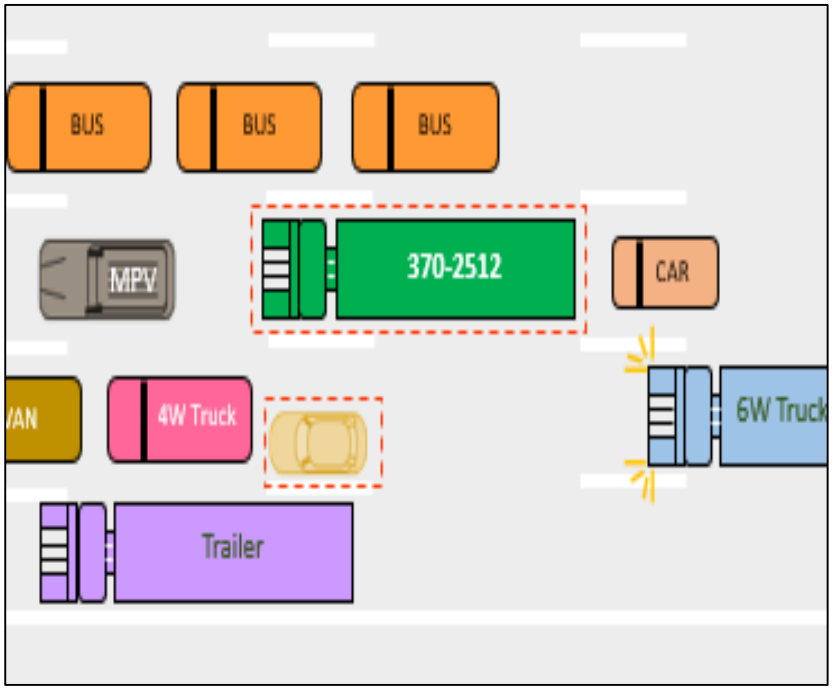
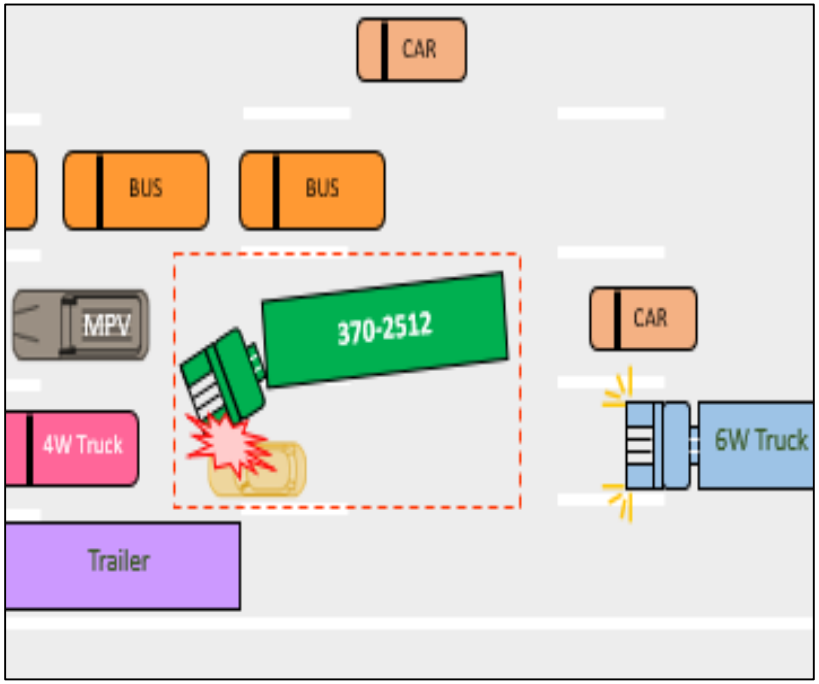
Event #2 Pictures





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Event #3

High Severity Product Vehicle Accident

Consequences: *Roll Over*

What happened

- A fully loaded product tanker (LIN Service) drove through the soft soil down slope of a newly constructed culvert. In the circumstance, the truck rolled over at the left side of the slope as left rear wheel went down the edge of the soft slope. This unit was not equipped with any basic technology devices either ABS/EBS or Rollover Stability Systems.

Major Cause(s):

- Driver failed to observe ahead to make a proper judgment
- Aggressive driving
- Not equipped with roll over prevention technologies

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Event #3 Pictures

This is the normal route to be used. It was detoured due to road construction

The truck rolled over at the detour road due to uneven soft ground

The poor condition of under construction road

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Event #4

High Severity Vehicle Accident

Consequences: *Roll Over*

What happened

An empty LIN tanker hit an ambulance which was coming from the opposite direction and was trying to make a turn towards the restaurant. Initially, the ambulance suddenly tried to cross the road and passing the wrong side of the LIN tanker. Due to the speed and impact, the truck rolled over.

LIN truck and the cryogenic tanker unit were badly damaged. Fortunately there was no injury to anyone involved in the accident.

Major Cause(s):

- Driver failed to apply safe driving skills - should have stopped his truck to give way to the ambulance.
- Unsafe driving by the ambulance driver.

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Event #4 Pictures

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Event #5

Cylinder truck rear end collision incident

Consequences: *Lost Time Injury to driver*

What happened

A contractor operated cylinder truck carrying empty cylinders in vertical cages rear ended a container truck. As a result of the collision, the driver of the cylinder truck received facture on his right leg and some minor scratches & brushes on his right leg and hand.

There was no injury to other two occupants & also no injury to any 3rd party. The vehicle had received moderate damage on the right side front part and windshield were broken. There was no product loss or media attention.

Major Cause(s):

- Driver not applying defensive driving technique for night driving
- Lack of effective feedback to driver by crew in cabin
- Lack of manpower to address communication with driver during shift change
- Third party truck parked on the narrow road passage

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Event #5 Pictures

Event #6

Product Vehicle Accident

Consequences: *Third Party motorcycle damage; Injury potential*

What happened

A cylinder truck was trapped in the traffic. At that moment, there were two motorcycle crossing the road in front of the truck to go to other way. One motorcycle passed through, while the other one stopped at the blind spot area. As the traffic was cleared, the driver started to move and immediately stopped when he heard a sound. His truck hit the motorcycle.

No injury to the rider as he immediately jumped out when the truck started moving.

Major Cause(s):

- Human Error: Driver failed to check the blind spot mirror.

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Event #6 Pictures

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Process Safety Incidents

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Event #7

Cylinder Valve Eject

Consequences: *Process Safety Incident*

What happened

- At 18:09, in a full cylinder storage area at a filling station the valve of a customer owned 12L CO2 cylinder of was ejected. The CO2 spurted with force but nobody was injured in the incident. The last qualified inspection was on 21 Apr 2018. The valve was manufactured in Jun. 2013.

Major Cause(s):

- Defective valve: suspected that the valve has been cracked for a long time.
- Poor cylinder qualification inspection: the cylinder owner failed to conduct the testing as required

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Event #7 Pictures

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Event #8

Illegal Modification of a Acetylene Cylinder

Consequences: *High Severity Potential Incident*

What happened

- A customer-owned dissolved acetylene (DA) cylinder body's paint cracked during the filling process at 250 psi. It was later discovered that there was a dent on the cylinder which was covered up by putty and painted.

Major Cause(s):

- Illegal modification on the DA cylinder by sub-dealer.
- Cylinder defect is not noticeable during pre-filling inspection. Damage is well disguised and hardly visible to naked eye.

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Event #8 Pictures

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Event #9

Process Safety Incident

Consequences: *Recordable Injury*

What happened

- A customer technician while on a routine inspection at the site, found that the tank was not building pressure. Using a ladder, he climbed up to check on the valves and regulator mounted on top of the tank. He found that the pressure building regulator was not working and decided make a replacement of kind. After isolating valves V5, V8 and V9, he then depressurized the tubing associated with V5 (@ 9 o'clock) by uncoupling the compression fitting (refer photo). This confirmation allowed him to disconnect the 1st connection.
- He proceeded to depressurize the tubing associated to V9 (@ 3 o'clock) by uncoupling the compression fitting. He then tapped the copper tubing using his right hand to dislodge the connection while his left hand was holding on to R1. Once the tubing was dislodged, LOX splashed out. He tried to connect back the tubing, but was unsuccessful, as cold liquid seeped into his leather gloves. He felt numbness in his hands and proceeded to rinse both of his hands with tap water. He repositioned his ladder nearer to V9 and managed to close the V9 tight.

Major Cause(s):

- The V9 valve not closed fully.
- Did not wear appropriate glove for line breaking.
- Did not do line tracing and miss out V3 valve for venting of trapped pressure.
- Not following proper Safety Work Permit and Lockout Tagout procedures.

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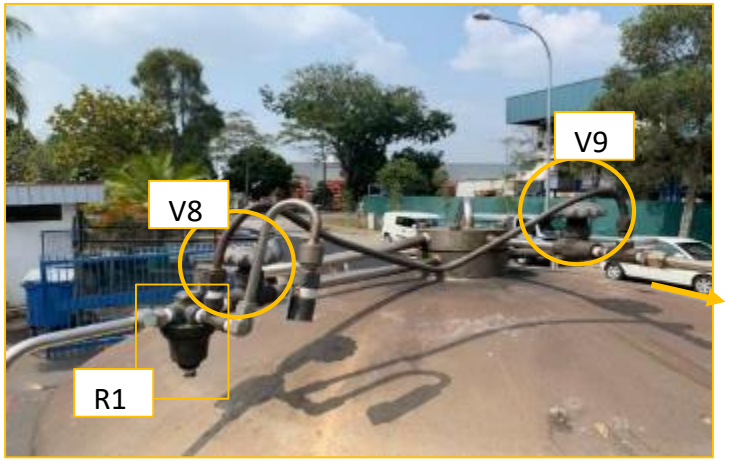
Event #9 Pictures



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Event #10

Process Safety Incident

Consequences: *Lost Time Injury – Fatality Potential Event*

What happened

- During plant turnaround, one electrical contractor inspected the inside of Unit 2-1 cubicle after Unit 2-1~2-5 VCBs withdrawal. He checked the live line in the cubicle using an electric detector on his left wrist. The alarm did not sound and he understood that the power system was de-energized. He thereafter opened primary shutter manually to inspect the fixed bushing parts of Unit 2-1. Then he held opened shutter with his left hand and inserted his right hand ring finger through opened shutter inside. Approaching very closely the exposed bushing (6.6kV), he got an electric shock.
- The contractor lost consciousness and laid on the floor. He was given CPR and massage at the site. AED was applied once. Later on he was transferred to the hospital. He received fracture on his left arm and electric burns on his left hand palm and right ring finger.

Major Cause(s):

- Energy Isolation procedure (LOTO) not correctly followed - allowed contractor access to energized equipment.
- Electrical Single Line Diagram (SLD) not used to mark up the energized/ de-energized sections.
- The hazard was not clearly understood by the contractor and preventive measure was not applied (Lock 2-1) even though it was identified before the start of work.

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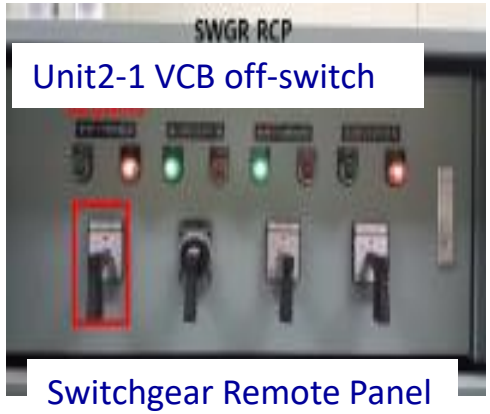
Event #10 Pictures

Switchgear Room



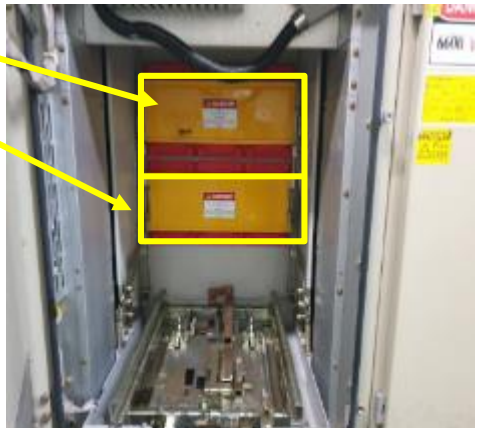
Switchgear Remote Panel

VCB Racking out / Withdraw

Primary Shutter

Secondary Shutter

Exposed live bushing with opening shutter inside cubicle.



Cubicle inside after VCB withdraw

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Event #11

Chemical Exposure

Consequences: *First Aid Injury but with high severity potential*

What happened

A plant operator was pouring 48% NaOH (Sodium hydroxide) chemical into a plastic drum when his eyes were splashed by chemical following an exothermic reaction that occurred in the drum. He was wearing safety glasses but not face-shield.

Immediately he proceeded to the eye wash area for first aid. Subsequently, he received medical treatment at an Eye Hospital

Major Cause(s):

- No chemical interaction matrix was developed and training provided
- Risk assessment of non-routine job was not done
- Inadequate implementation of Management of Change (MOC) for use of alternate chemicals
- Unclear or conflicting roles/ responsibilities

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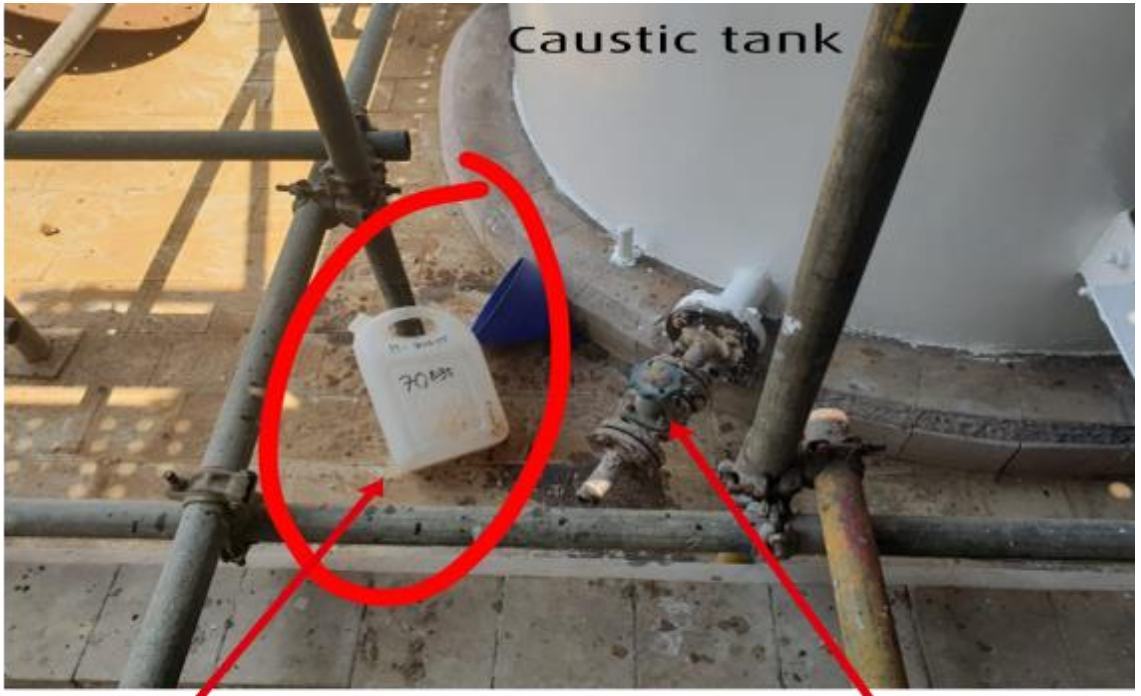
Event #11 Pictures



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Event #12

Catalytic Purifier Burn Out

Consequences: *Process Safety Incident, No Injury*

What happened

The purifier cartridges are designed to purify inert gases such as nitrogen which may contain some traces of oxygen. A backflow of air arrived in the purified nitrogen circuit and caused an exothermic reaction with the purifier catalyst causing damage to the purifier cartridge due to excessive heat generation.

The temporary purified nitrogen line used to purge the new Industrial Compressed Air line was not disconnected after use. Isolation valves on the Industrial Compressed Air line and purified nitrogen line were not closed when not in use.

Major Cause(s):

- Temporary connections were not being considered in the Commissioning phases - gap in pre-start up safety review
- Less than adequate engineering control

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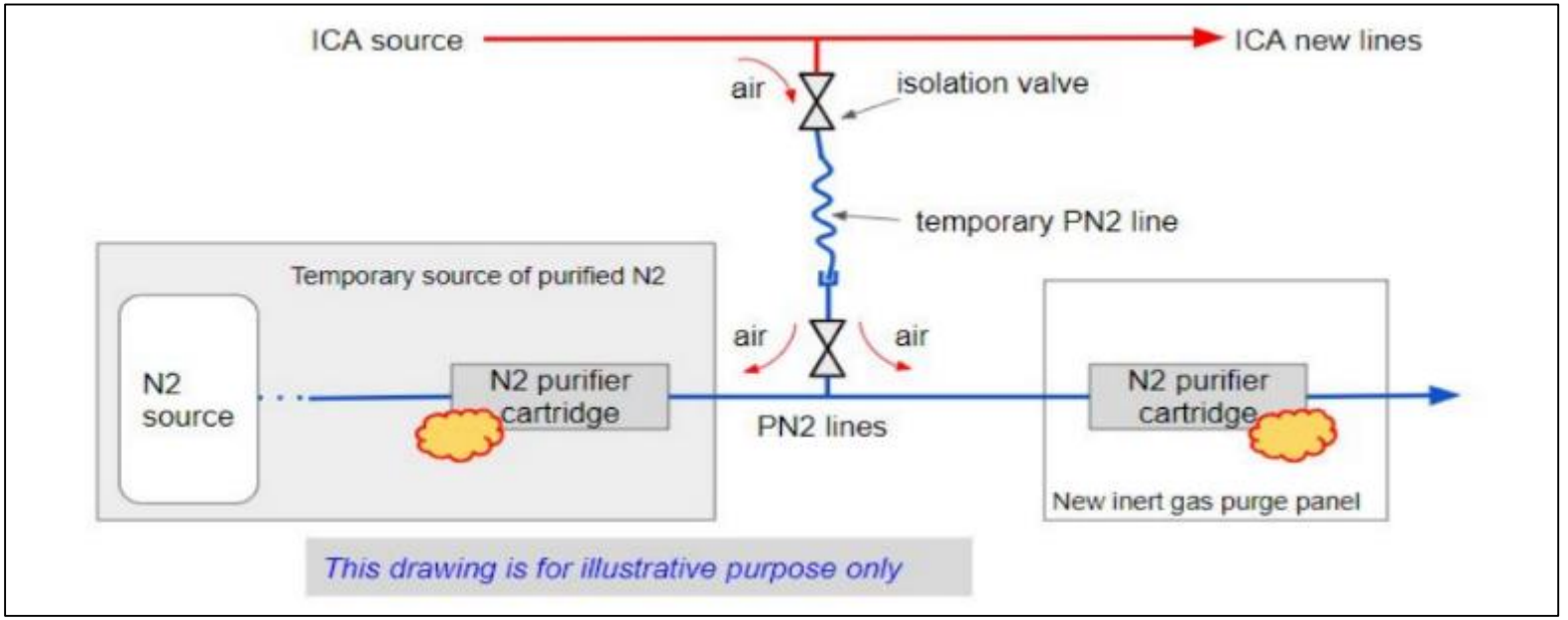
Event #12 Pictures



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Working Injuries / Occupational Safety incidents

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Event #13

Working Injuries / Occupational Safety incidents

Consequences: *Lost Time Injury*

What happened

- Around 15:00 hrs, a helper suffered a fracture on the middle finger of his left hand while he was unloading the cylinders from a pallet. One cylinder fell down by his incorrect operation, and he tried to hold the falling cylinder, but failed. The cylinder hit his hand and caused the injury.

Major Cause(s):

- Unsafe act by the helper - The helper pulled the cylinder forcefully, and caused the bottom of the cylinder slipping off the loading cant board

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Event #13 Pictures

Event #15

Working Injuries / Occupational Safety incidents

Consequences: *Lost Time Injury*

What happened

- A cylinder loader slipped from the truck on the ground during cylinder loading with his head and right shoulder to the ground. After medical check, the loader injured with subcutaneous blood stasis of the brain, and some soft tissue contusion at his right shoulder

Major Cause(s):

- The operator stood on the truck and pulled the cylinder, posing a risk of falling
- The old fixed bottle cap is easy to loosen due to its long life
- Horizontal transportation has a higher safety risk than vertical transportation

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Event #15 Pictures

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Event #16

Working Injuries / Occupational Safety incidents

Consequences: *Recordable Injury*

What happened

A driver and his helper were unloading empty cylinders from the truck when one of the horizontally laid cylinder slipped and made contact with other vertical freestanding cylinders on the ground. The helper who was holding an empty cylinder had his finger pinched when the cylinders started to impact each other. He was brought for medical treatment immediately.

Major Cause(s):

- Lack of risk assessment for flatbed truck loading/unloading activities
- Lack of MHE(Mobile Handling Equipment) at site such as tail lift and side lifter.

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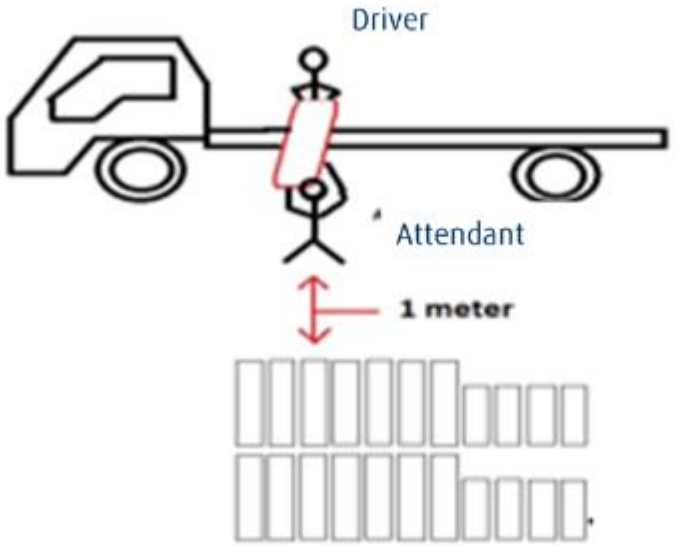
Event #16 **Pictures**



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Event #17

Working Injuries / Occupational Safety incidents

Consequences: *Recordable Injury to Cylinder Helper*

What happened

A cylinder helper was unloading full cylinder when one full cylinder got unbalanced and was about to fall down on the ground. The cylinder helper's left-hand palm was caught between the cylinder and the cylinder holding restraint. He suffered a fracture on the index finger.

Major Cause(s):

- Inappropriate manual handling techniques
- Vehicle is not equipped with tail lifts for unloading/loading activities
- Lack of supervision of unsafe act for loading/unloading activities

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Event #17 **Pictures**

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Event #18

Working Injuries / Occupational Safety incidents

Consequences: *Lost Time Accident*

What happened

An employee went in front of a cylinder basket immediately after the forklift stopped when a cylinder toppled from the basket and hit the employee's right ankle, resulting in a fracture. The incident happened when he was unloading cylinders at a customer's site.

Major Cause(s):

- Human :Stood In the line of fire
- Organisational : Job Hazard Analysis was not conducted

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Event #18 Pictures

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Event #19

Working Injuries / Occupational Safety incidents

Consequences: *Recordable Injury*

What happened

- A helper was using an electric forklift to move the pallet in the filling station. The electric forklift couldn't be stopped due to the fault in the control system of the electric forklift and the improper operation of the helper. The helper got a injury on his right foot

Major Cause(s):

- The operation button of the electric forklift was out of order
- The protective cover was missing
- No risk assessment for this operation (small space between the pallets)

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Event #19 Pictures

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Event #20

Working Injuries / Occupational Safety incidents

Consequences: *Recordable Injury*

What happened

After delivering bundle cylinder to a customer, the driver stood next to the vehicle to remotely operate tail lift to raise up. Suddenly the lift unfolded and the right side of the lift grazed the driver's right side of forehead.

The injured person went to hospital with manager, he received 4 stitches with prescription at the hospital and returned back to office on the same day.

Major Cause(s):

- The driver stood on the line of fire to operate the tailgate with distraction - he was looking at the other side when the switch was operated.
- Lack specific Job Safety Analysis or Safe Working Instruction
- The ground was slopped about 15 degree.

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Event #20 Pictures

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Event #21

Working Injuries / Occupational Safety incidents

Consequences: *Contractor Employee Lost Time Injury*

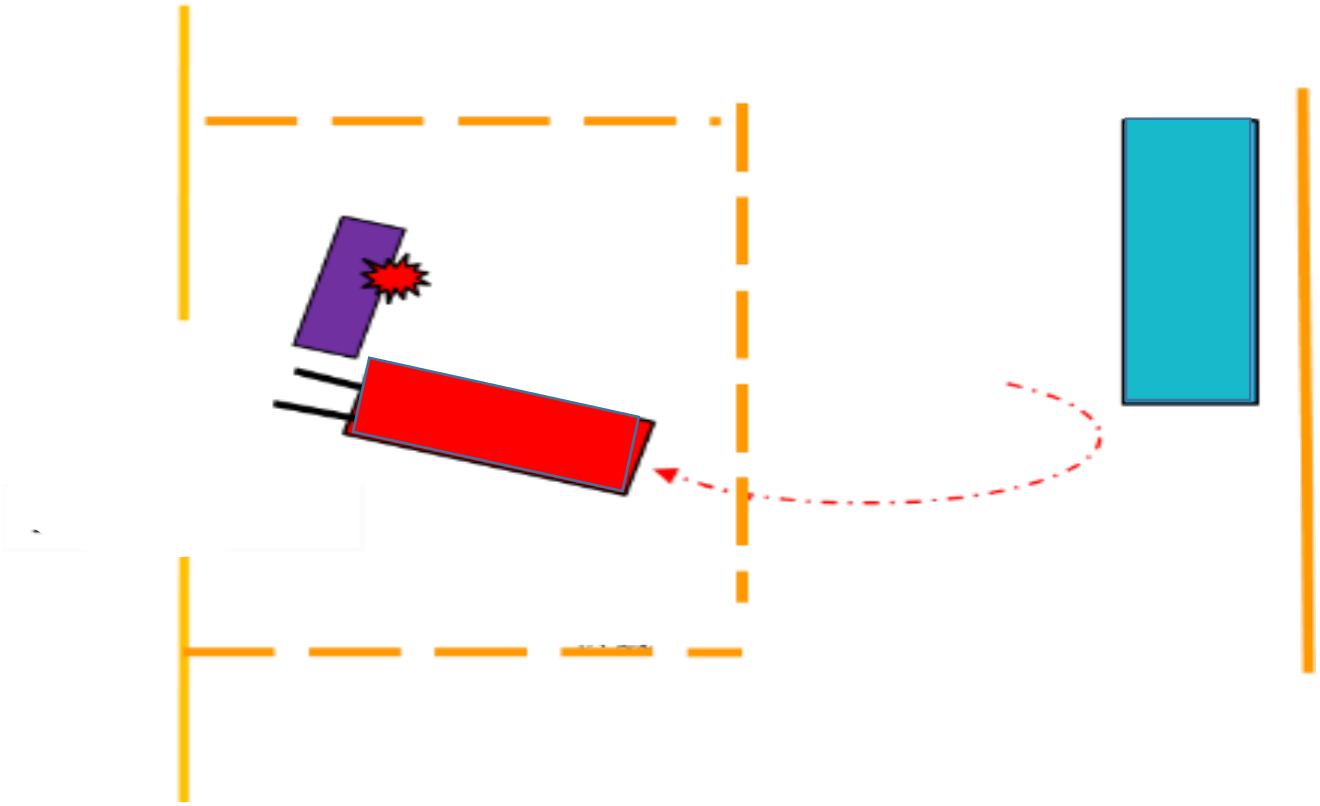
What happened

- The incident happened at a site which was in the transition period from construction to operation. A contractor was driving a forklift with a electric low voltage electric cabinet (size: 800 mm * 1000 mm * 2200 mm weight: 200 kg). The incident happened when he arrived at a gentle slope, the low voltage electrical cabinet got dumped at a contractor employee, and pressed his left body to the ground. The employee suffered a multiple soft tissue injury (foot, vertebra) who was wearing a safety helmet but no safety shoes.

Major Cause(s):

- The contractor fails to strictly obey the safety operation rules and isolate the unloading area
- The forklift driver did not strictly follow the operation rules of forklift and did not fix or lay down the objects that might be dumped

Event #21 Pictures



Event #22

Working Injuries / Occupational Safety incidents

Consequences: *Recordable Injury*

What happened

Around 18:30hrs a Mini Bulk driver delivered LIN to customer. There was a lot sundries around the tank and the driver had to stepped on them to vent the tank. After he opened the vent valve, he tried to step back out without turning around due to the space limitation, he was tripped and his right hip landed on uneven objects. The driver stood up and found nothing except a little pain on his hip. Afterwards he continues the last 2 deliveries.

On the next morning, the driver went to local hospital to take the MRI since he felt worse from the previous night. The MRI report said a little soft tissue injury without broken bones or cracked spine.

Major Cause(s):

- Poor safety awareness at trip hazard, doesn't follow 'Master The Basics'.
- Poor housekeeping and insufficient lighting at customer site.

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Event #22 Pictures

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Event #23

Working Injuries / Occupational Safety incidents

Consequences: *Recordable Injury to Operator*

What happened:

- Around 23:30 hrs an operator heavily dropped to a platform after checking/operating a valve which was located on a valve operation platform for a pipe rack. He suffered from a calcaneal fracture of his right foot. The operator was wearing appropriate working shoes. The ladder was not too high and the operator also didn't hold any tool in his hands.

Major Cause(s):

- Act of negligence - While climbing down the ladder the operator assumed to have reached the platform. So he loosened his grip on the ladder and fell down.

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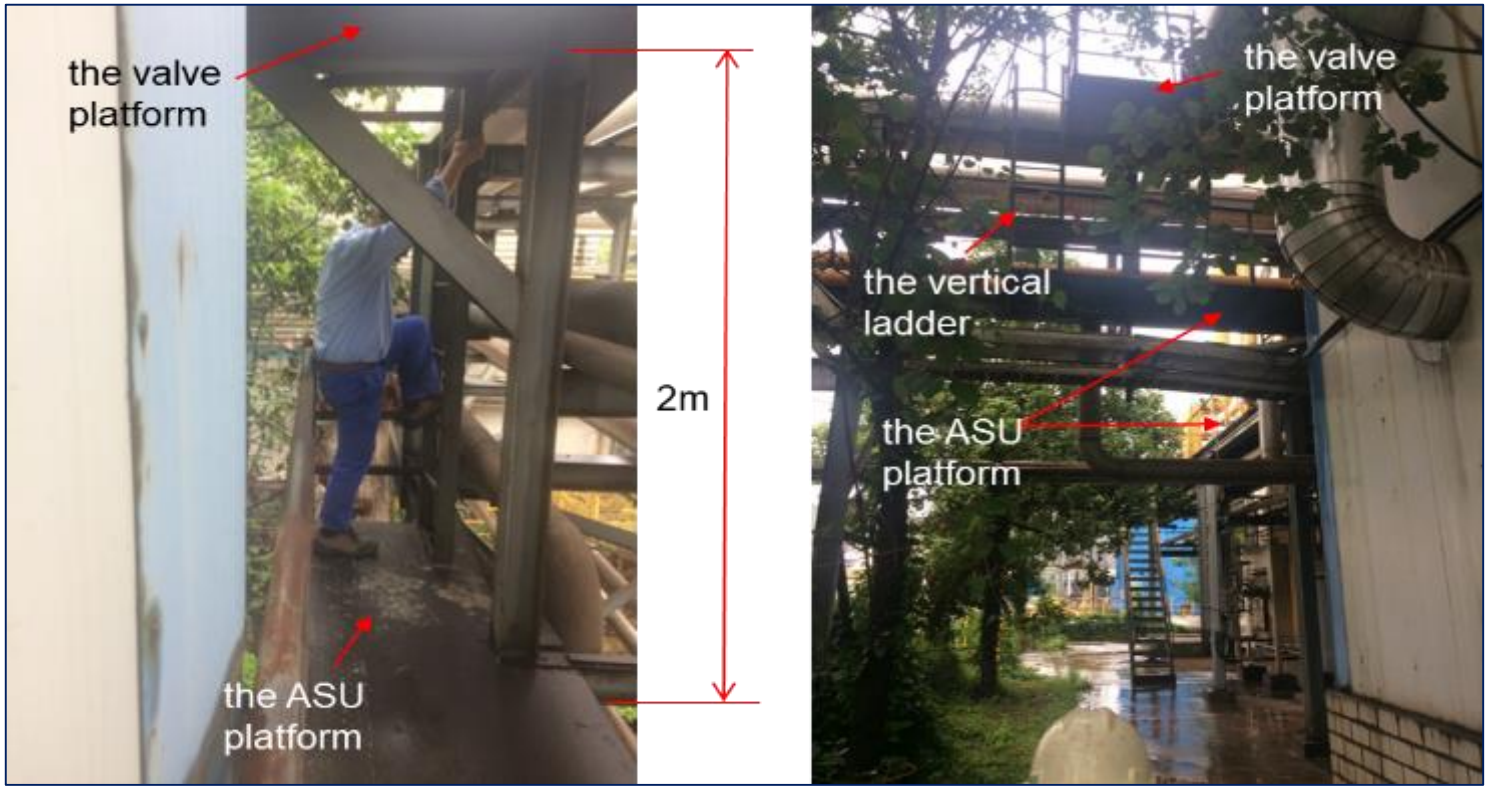
Event #23 Pictures



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Maintenance work and Construction related

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Event #24

Working Injury During Maintenance Work at a Plant Site

Consequences: *Recordable Injury*

What happened

- Employee A and Employee B (injured person) worked on filter cleaning task (a routine preventive maintenance). They first used potable water to flush dirty filter but could not clean well, when employee A decided to use 0.5Mpa LP steam to clean by connecting a temporary hose from steam distribution station.
- When opening the steam valve, the steam hose whipped. Employee B's left ankle was scalded by whipping hose with steam(~158℃) discharge. The employee A reported to production supervisor via walkie-talkie, the injured employee B was delivered to hospital for medical treatment. The employee B returned to work after applying burn ointment.

Major Cause(s):

- Inadequate hazard identification - hose whipping and burn hazards with steam were not identified and listed in JSA (Job Safety Analysis) or SWIM(Site Work Instruction Manual)
- Inadequate safety orientation for new employees
- Inadequate hose management - no detailed requirements for hose usage in utility

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Event # **Pictures**

Filter for cleaning

Hose connected from utility ~0.5Mpa steam

Prescription medicine

The injured person returned to work on the same day.

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Event #25

Construction Safety Incident

Consequences: Roll Over of a Bobcat

What happened

At a piling site, a skid steer loader (Bobcat) was used to lift a pile head waste (around 1 meter length and 160kg weight) from a trench. While removing the pile head waste, the soil and interlocking brick underneath the bobcat near the trench slid, causing the bobcat to lose its balance and subsequently rolled on its side.

The seat-belted driver secured with body safety guard within the protective cage was not injured. There were no other reported injuries nor property damages.

Major Cause(s):

- Failure of contractor to inform that Bobcat to be used for suspended lifting during subsequent JSA session
- Lack of competency of PTW(Permit to Work) issuer
- Site management monitoring/ engagement insufficient

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Event #25 **Pictures**

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Lessons learned from the safety events

★ Transportation safety

- Driver **Fatigue Awareness** programs are critical for transport safety
- Defensive Driving **– Training and Application of** training are essential
- Around **3rd Party Two Wheelers**: Attention to blind spots, make sure they see you and give them first right of way
- Use of seat belts is a **life 'saver'**
- **Installing** ABS, EBS, RSS, etc., can help in preventing roll overs

★ Process Safety

- **Operating Procedures**: Not following or gaps in procedures
- Lack of adequate **Risk Assessment and Hazard Review** prior to doing any work can cause serious incidents
- **Permit to Work/LOTO:** Insufficient and/or not paying attention
- **Gaps** in EMOCs
- **PPEs**: Non compliance

Lessons learned from the safety events

★ Work Injuries/Occupational Safety

- **Designs:** Gaps not identified
- **Employee Training and Safety Orientation of new employees:** Lack of properly trained personnel carrying out hazardous work
- **Unsafe act** and not following correct procedure
- Use of proper **PPEs**
- Avoid **Unauthorised modifications**
- **Poor Housekeeping**
- Never stand in the **'line of fire'**

★ Maintenance Work and Construction related

- **Permit to Work**: Not carrying complete Risk Assessment and not identifying the Hazards before issuing HWP
- **Unsafe Act** by Operators and **gap** in supervision
- **Review competency / training of** Mobile equipment

List of Useful AIGA documents for incident prevention

- AIGA SP 01 & 02: Safety Poster on Driver Fatigue
- AIGA SP 03 & 04: Safety Poster on Driving Distraction
- AIGA SB 12/18: Transportation Safety, Challenges and Improvement Strategy
- AIGA 039/16: Road Transport Emergency Preparedness
- AIGA 041/10: Defensive Driving
- AIGA 040/15: Good practice guide for loading & unloading of cryo liquid tankers
- AIGA 008/10: Safety Training for Employees
- AIGA 066/18: Selection of Personnel Protective Equipment
- AIGA 011/04: Work Permit System
- AIGA 015/15: Safety Management of Contractors
- AIGA SB 05/10: Recent cases of asphyxiation in confined spaces in Asia
- AIGA 008/18: Hazards of Oxygen Deficient Atmosphere
- AIGA 099/18: Process Safety Management Framework

Thank you

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