Training Package
TP 28/20

Recent (H1 of 2020) Accidents/Incidents in the Gases Industry in Asia

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Recent (H1 of 2020) Accidents/Incidents in the Gases Industry in Asia

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Introduction

At the regular Safety Advisory Group (SAG) meetings, members voluntarily exchange information on accidents / incidents that have occurred in the recent past. 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.

The following slides contain the summaries, pictures and other relevant information to highlight the root causes and lessons to be learned from these accidents / incidents .

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
  - Cylinder Handling
  - Process Safety
  - Occupational Safety/Maintenance & Construction
- Learning from the Incidents
- AIGA standards related to the incidents

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Accidents/Incidents in Product Transportation Including Loading & Unloading

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Event #1

High Severity Product Vehicle Accident

Consequences: *Roll Over & Equipment Damage*

What happened

LOX tanker with full load heading to a customer from a terminal was rolled over at around 06:00 hrs. The road was dry, and driver was cruising less than 78km/hr; which was below the max allowable speed of 80km/hr. There was no streetlights, but the truck headlight was bright enough. There was no injury to the driver, however, the co-driver sustained minor scratches on the left upper thigh. The driver wore his seat belt, while the co-driver was resting in the sleeper berth.

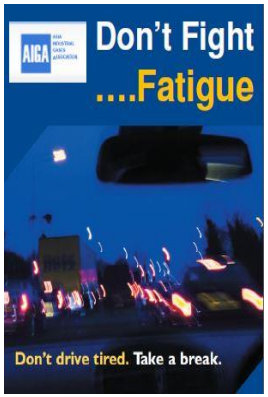
There was no product release, but the tanker was badly damaged. No 3rd party was involved. No major environmental impact in this incident.

Major Cause(s):

- Driver had a micro sleep - there was no sign that he applied the brakes.
- Driver felt sleepy about 15km before the rollover scene

  but there was no safe area for him to stop the tanker.

Event #1 Pictures



Event #2

High Severity Product Vehicle Accident

Consequences: *Roll Over with driver fatality*

What happened

An empty liquid nitrogen tanker met an accident on its way back to our depot after supplying the products to our terminal. After travelling around 150km from the terminal, on a hilly area and negotiating the right curved downward slope, the tanker hit the road-side metal railing and concrete wall.

Due to the speed and impact, the truck was rolled over and the driver was fatally injured. No major environmental impact in this incident.

Major Cause(s):

- Driver lost control of the empty product tanker due to rush driving
- At risk behavior - High speed while moving downhill and negotiating the right curve road
- Not using seat belt

Roll over + No seatbelt ⇒ Driver fatality

Event #2 Pictures

Event #3

High Severity Product Vehicle Accident

Consequences: *Vehicle Roll Over*

What happened

A 3/4th loaded LN2 trailer driven by a contractor driver was involved in a single vehicle roll over while negotiating a sharp bend. The driver was wearing seat belt and sustained minor scratches on his left hand. There was no product release. Local authority emergency response teams were present for the recovery of the product and vehicle.

Major Cause(s):

- Driver at risk behavior – Speed higher than required
- Inconsistent monitoring of in cab camera and feedback to driver/gap in Driver Coaching
- RSS was not completely implemented and less focus on the functionality
- Not following vehicle inspection/preventive maintenance procedures

Event #3 Pictures

Event #4

High Severity Product Vehicle Accident

Consequences: *Equipment Damage & Recordable Injury*

What happened

A packaged gases(PG) truck was making a delivery of 18 pallets of cylinders to another terminal. While traveling, the PG truck rear-ended a slow-moving timber truck. Due to the impact, the driver sustained minor injury to the cheek and chin. He was sent to the nearby hospital.

The incident happened at around 2:30am. The tractor truck was badly damaged while there was no impact to the packed cylinders and the trailer. The trailer was hooked to the replacement tractor head and continued the journey.

Major Cause(s):

- Lack of safe space ahead - based on the brake mark and impact
- Travelling too fast for the road conditions - night driving with poor visibility of the overhung timber logs.

Event #4 Pictures

Event #5

High Severity Product Vehicle Accident

Consequences: *Cylinder Vehicle Jack Knife*

What happened

A contractor driver was involved in a single product vehicle incident and resulted in a jack knife. The incident occurred along a dual carriage road.

The road surface was slippery due to rain when the prime mover swerved to the RHS onto the median and later steered to the LHS and finally jack knifed left into the ditch. The impact caused the vehicle ran over the road railing and had its cabin flipped over. The driver suffered minor bruises to his left shoulder

Major Cause(s):

- Bald tyres and Lack of maintenance inspections
- Driver at risk behavior with speed
- Contractor Management – Insufficient Checks and balances
- Inadequate Route risk assessment

Event #5 Pictures

Event #7

Product Vehicle Accident

Consequences: *3rd Party Two Wheeler Rider Recordable Injuries*

What happened

A product vehicle driver stopped at the traffic light to wait for the signal to change. It was the first vehicle waiting in the turn-right lane. While waiting, the driver did not realize/notice there was a motorcyclist who came from behind and waited exactly in front of his truck. Driver started to move a second before traffic light turned green and hit the motorcyclist ahead.

The driver immediately stopped the truck and got down to investigate. The motorcyclist fell down but escaped with slight cut at the ankle. There was no damage to the truck, but the motorcycle was badly damaged.

Major Cause(s):

- Driver started to move truck one second before the light turned green
- Motorcyclist was in the driver's blind spot due to height of the product vehicle driver cabin

Event #7 Pictures

Event #8

High Severity Product Vehicle Accident

Consequences: *Equipment Damage*

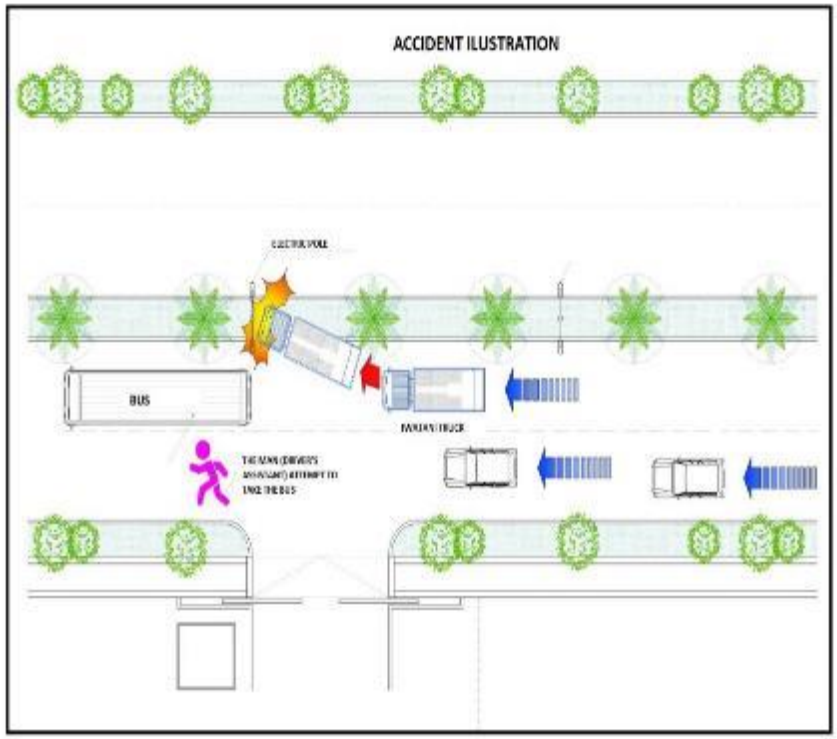
What happened

A cylinder truck crashed toward an Electric pole while the bus in front of truck suddenly applied hard break to pick up a man in the way. The situation made truck's driver spontaneously turned the steering to right side to escape rear ending the front bus. The truck went up the way separator and hit an electric pole . The truck speed was 40km/hr at the time of the incident.

Major Cause(s):

- Poor attitude of box truck driver (emotional and aggressive).
- The cylinder truck driver not focus in driving. (chatting with co-driver made him lose concentration and late to anticipate the situation)
- Not maintaining safe distance with the vehicle in front.

Event #8 Pictures



Event #9

Product Vehicle Accident Involving Cylinder Truck

Consequences: *Equipment Damage*

What happened

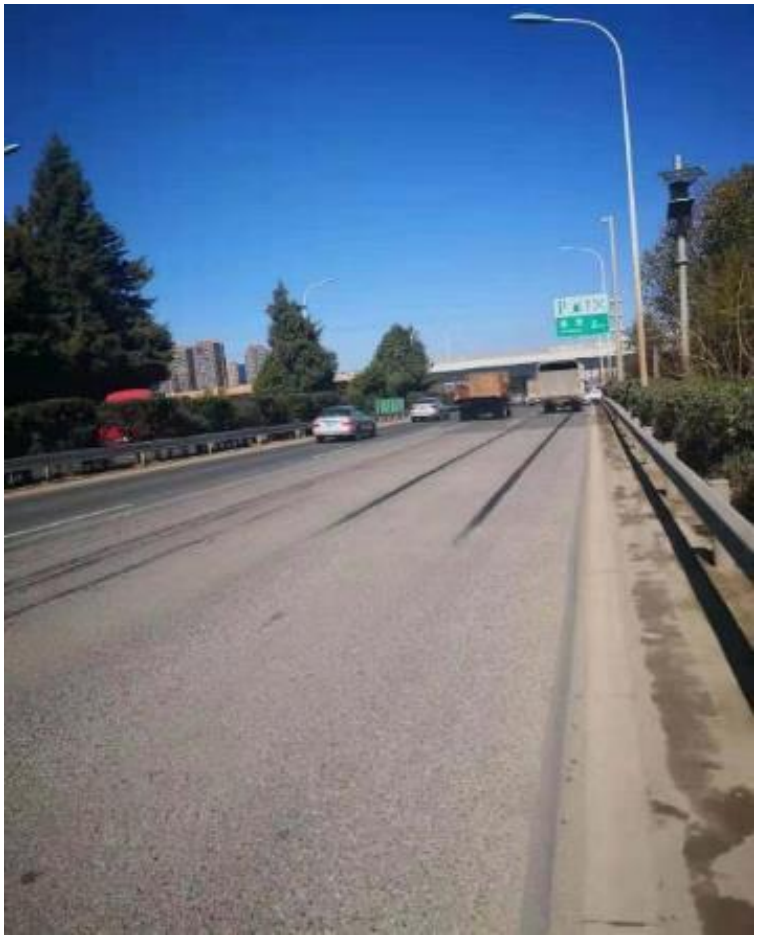
A cylinder truck rear-ended a passenger car on a Expressway. No one was injured but both the vehicles were damaged to different degrees.

As per the traffic police, the cylinder truck driver was fully responsible for the incident. At the time of the event, the speed of cylinder truck was about 70km/h, and about 20 meters away from the vehicle in front. The weather was sunny, thus the visibility was good.

Major Cause(s):

- Too close to the car in front
- Failure of rear wheel brake/ poor brake maintenance QC

Event #9 Pictures



Too close to the car in front, no traces of rear wheel brake mark.
Failure of rear wheel brake

Event #10

High Severity Product Vehicle Accident

Consequences: *Roll Over of Cylinder Truck*

What happened

Contractor operated product vehicle loaded 50 full & empty Argon-CO2 mixes cylinders, met with an incident at the intersection. While the product vehicle was negotiating the intersection, a third party trailer came from the left lane and hit the side rear-end of the product vehicle. Due to this impact product vehicle rolled over to its right at 90 degree. Speed of the product vehicle was 16 KM/H at the time of collision. The driver was seat belted and received no injuries. Also there were no damage or dents on the cylinders. The third party trailer received minor dents only.

Major Cause(s):

- 3rd party vehicle from service lane failed to control speed when approaching intersection
- Failure to yield the “Right of way” (Posted signages)
- Failure to lookout for vision barriers
- Failure to check in all directions and leaves a space cushion before starting up at intersection

Event #10 Pictures

Event #11

Product Decantation Incident

Consequences: *Product release and Lost Time Injury*

What happened

LCO2 tanker driver at a customer site connected the liquid phase hose to the tank and started decanting. At the end of filling, the driver wanted to close the liquid phase valve, but he wrongly opened the vapor phase valve. High pressure CO2 gas ejected suddenly from vapor valve and knocked him down. The driver fell backwards. He got up and closed the vapor phase valve, completed the delivery, drove off the customer's site and continued to work. Around 12:06hrs the helper reported that the pain felt by the driver was getting worse and sent the injured driver to the hospital for medical check. From the X-Ray report, its showed that the driver's right collarbone was fractured.

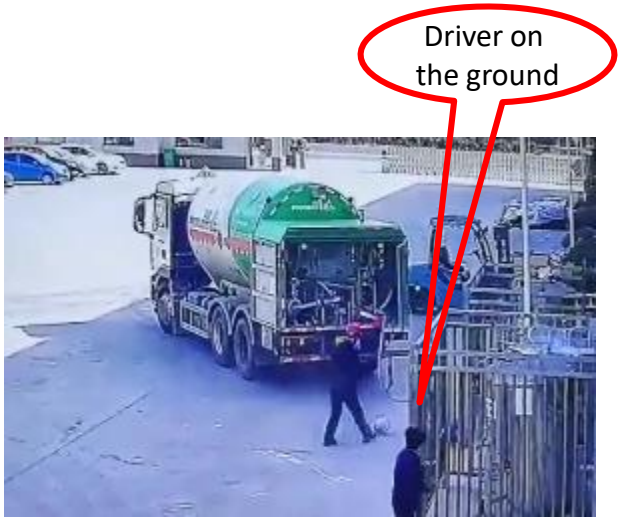
Major Cause(s):

- The driver mistake - opened the gas phase valve with high pressure CO2
- He stood in the 'line of fire'
- The impact from high pressure gas pushed the driver to fall backwards.

Event #11 Pictures

Driver wanted to close the liquid phase valve to finish CO_2 tank filling, but he opened the vapor phase valve by mistake

The high pressure CO_2 gas ejected suddenly from vapor valve and knocked on the driver.



Driver was knock down on the ground and injured

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Accidents/Incidents in Cylinder Handling

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Event #12

Cylinder Fall Incident

Consequences: *Lost Time Injuries to Cylinder Handlers*

What happened

A driver who was operating an electric pallet jack was pulling the basket of 6 cylinders onto the tailboard. While he was at the tailboard, it suddenly tilted downward causing the driver to lose balance. The pallet jack, driver and cylinder fell off the truck. Some of the falling cylinders hit the assistant who was nearby resulting in multiple fractures.

Major Cause(s):

- Human Error : Assistant pressing both down and tilt button at the same time
- No clear definition of roles in the unloading process (who to operate and when to operate, what to do etc)

Event #12 Pictures

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Event #13

Accident in cylinder handling

Consequences: *Lost Time Injuries of Truck Driver*

What happened

A driver and a escort recalled the empty cylinders at customer site with rear lift gate truck. 4 cylinders had been placed on the lift gate and the driver tried to roll 2 cylinders at the same time on the lift gate. One of the 4 other cylinders was about to topple when the driver tried to stop the falling cylinder with his left hand but failed. His hand was pinched by 2 cylinders and he suffered a fracture on the third metacarpal on left palm

Major Cause(s):

- The driver tried to stop a falling cylinder
- Failure to follow safe handling of cylinder by the driver when he rolled two cylinders at the same time
- Failure to fasten the cylinders on the lift gate with chains

Event #13 Pictures

Process Safety Incidents

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Event #14

Process Safety Incident

Consequences: *LOPC with Recordable Injury*

What happened

An operator was splashed on the right face with some sulfuric acid at the sulfuric acid tank area of ASU when the filling hose broke apart at the connection after the driver from acid supply vendor opened the tanker's valve. The victim flushed at the emergency shower for 30 minutes with the help of the shift leader and then he was sent to the hospital. The doctor prescribed some medication, gave him tetanus shots, and suggested the victim to return to the hospital for re-check the following day.

Major Cause(s):

- Sulfuric acid unloading hose broke apart at the hose connection.
- Driver doing Acid delivery did not obtain permission from the customer' employee before re-opening the tanker's valve to the unloading hose.
- Site operator didn't wear suitable PPE, such as face shield, apron, etc.

Event #14 Pictures

Event #15

Process Safety Incident

Consequences: *LOPC with Recordable Injury*

What happened

LIN tanker was on loading when the driver saw both filling stations tripped automatically in the Scale Room. Thru' the Truck Scale room window, he also observed that some vapor cloud was discharging from the trailer's PSV nearly at the same time. The driver rushed to the trailer rear. He stepped on the edge of the road, fell down and sprained his right foot. Then he opened the trailer vent valve to release the pressure, the PSV got reseat within 80~90 seconds. This led to a large amount of vapor cloud on site.

The driver was sent to the hospital for an X-ray. It showed that the fifth metatarsal bone on his right foot was fractured and needed to be fixed with plaster.

Major Cause(s):

- Incorrect fill setting
- Driver was not trained to respond to overfill situation

Event #15 Pictures

Event #16

Process Safety

Consequences: *LOPC – no environmental release*

What happened

ASU Plant was on turnaround. There were two tasks being executed simultaneously, one task was upgrading ASU CPU, another task was replacing lube oil cooler in the downstream of the main air compressor(MAC) auxiliary oil pump. The lube oil was suddenly spilled from the opened lube oil pipeline during the replacement of the aux oil pump and ~3800kg oil were released in total from the MAC lube oil tank. The CPU upgrading job triggered the aux oil pump startup automatically by mistake while SWP energy isolation was executed to wrong MCC electricity switch and no further verification was carried out. Later the spilled oil on the ground were collected and the workshop was cleaned up. No oil was released to water system or soil. No one was injured in this incident.

Major Cause(s):

- Functional engineer did not work together with SWP Issuer
- Wrong switch was lockout and tagout
- Blind flange was not installed on oil pipeline

Event #16 Pictures

Cooler was removed and pipeline kept open with plastic film covered.

1.Wrong switch was locked (G122 vs K122)

Event #17

LIN Dump pot overflow

Consequences: *Loss of Containment (no injuries)*

What happened

Approximately 915 kg of LN2 was released from the dump pot at an ASU over duration of 43 mins following an overflow of LIN product. There was no personnel injury nor property damages.

Preliminary investigation indicated that there was lack of understanding on the process alarm and actions taken in alarm acknowledgement resulted in product inadvertently introduced into the Dump Pot resulting in overflow.

Major Cause(s):

- Inaccurate level on transmitter
- Wrong setting of timer on Temperature device
- Instrument fault – no device to monitor LN2 product cooling temp
- Communication gaps between operators (remote and site)
- Lack of understanding on alarm management

Event #17 Pictures

Dump pot overflow sensor at -195.7 C, indicate the liquid N2 had reach the top of dump pot.

Event #18

Exposure to hot water steam

Consequences: *Process safety event with Lost Time Burn Injuries*

What happened

A contractor was exposed to hot vapor when he opened the top inspection cover of the gas engine generator expansion tank to check water level. He suffered 7% scald burns on his face, forearms and hands. 25 Days off work.

Major Cause(s):

- Proper PPE was not used - Arms and face were not protected
- No permit to work was used.
- Non standard operating practice to remove the tank cover for inspection
- Tank pressure was not verified before inspection cover was opened
- Sight glass was removed and not replaced

Event #18 Pictures

Event #19

Acetylene Generator Carbide Charging

Consequences: *LOPC and Flash Fire*

What happened

Two operators were remotely charging carbide into the ALDA Class 19 Low Pressure Acetylene generator hopper when they observed smoke & dust on top of the slide valve gate On seeing the smoke, the operator escalated the matter and observed from distance. Emergency nitrogen purge was introduced into the generator, slide valve was closed at the generator and complete shut down of plant was enforced.

Major Cause(s):.

- Cleaning & starting of two Generators at the same time might have diluted the SOP/procedures
- Not following the guidelines for using the new carbide such as trail consignment test & approval process
- Possibility of keeping the N2 isolation valve (near slide valve) closed by mistake

Event #19 Pictures

Momentary flash during carbide charging

Generator hopper –no sign of internal fire

Event #20

Cylinder filling Incident

Consequences: *Process Safety Incident-Flash Fire*

What happened

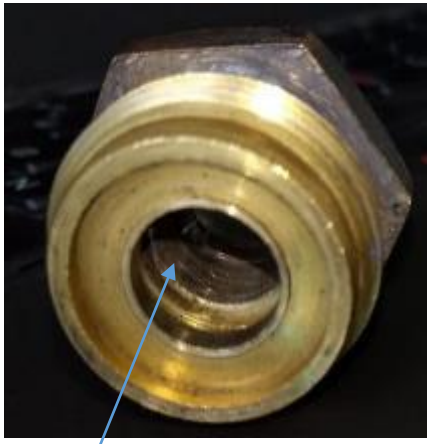
Industrial O2 cylinders was filling at the right side bus-bar and reached the set pressure (14.8Mpa). The operator switched to the left side and try to close the valves of right side cylinders. Flash fire was noticed in cylinder valve when the operator was closing the valve (the first valve he tried to close)

The operator took shelter and the burning flame quickly went off, thereby no injury to the operator.

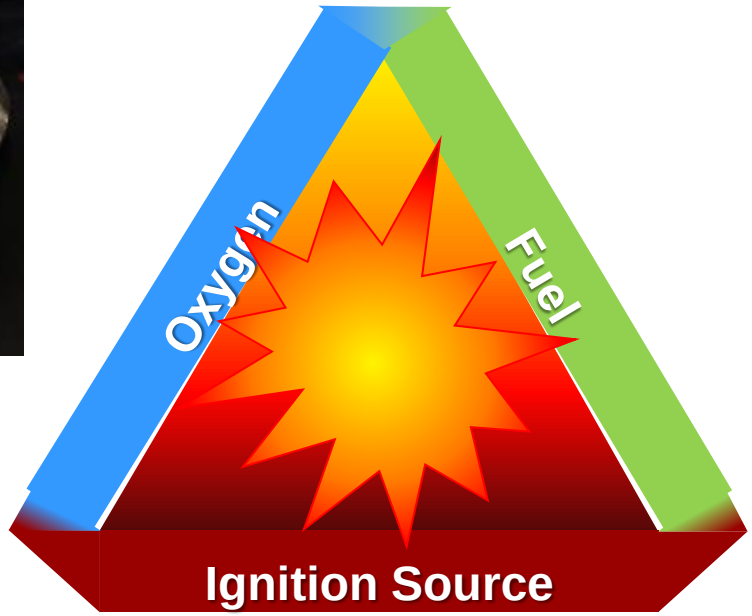
Major Cause(s):

- The lack of O-ring on the sealing surface of the cylinder valve and the contamination on the sealing surface increase the possibility of valve leakage.
- Not taking Proper measures to check the seal of the cylinder valve during filling.
- Turning on and off oxygen valves too fast.

Event #20 Pictures



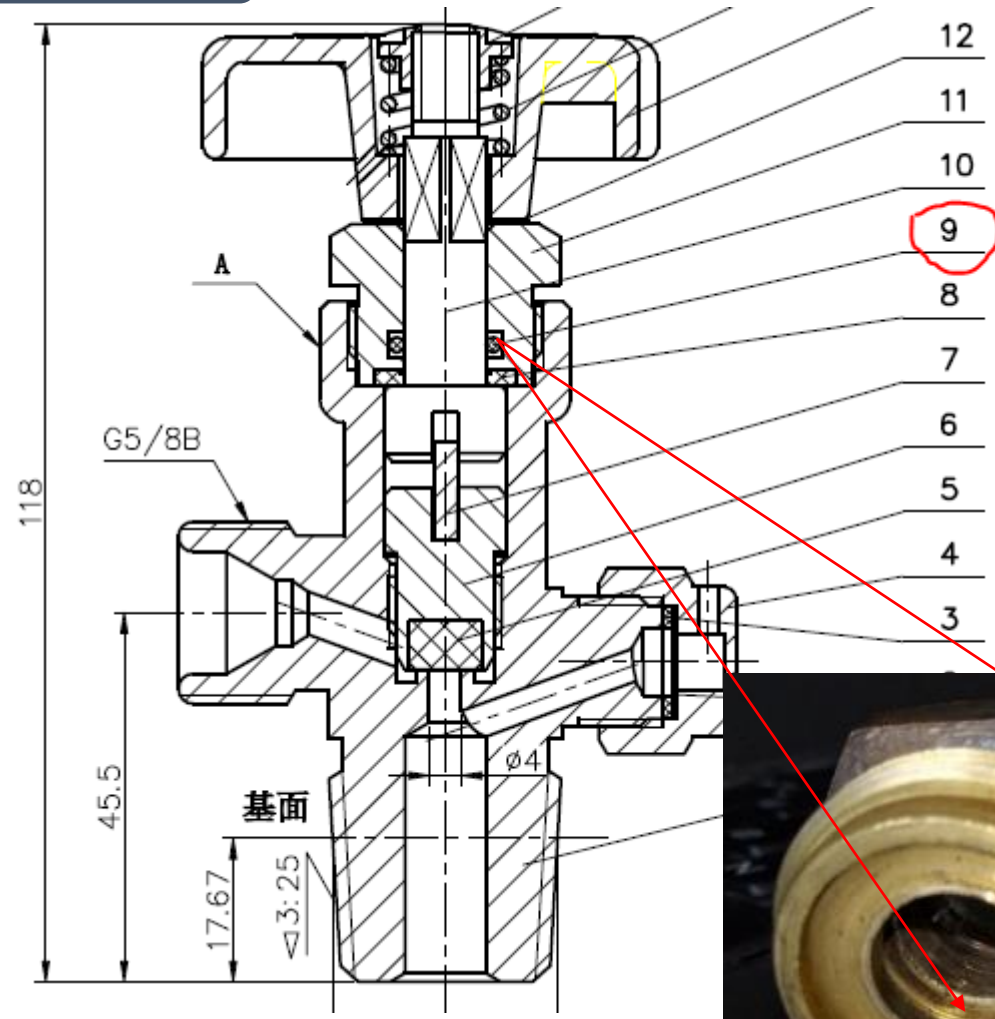
- No O-Ring inside the valve gland
- O2 leak during filling



- Friction when close the valve?
- Electrostatic discharge?

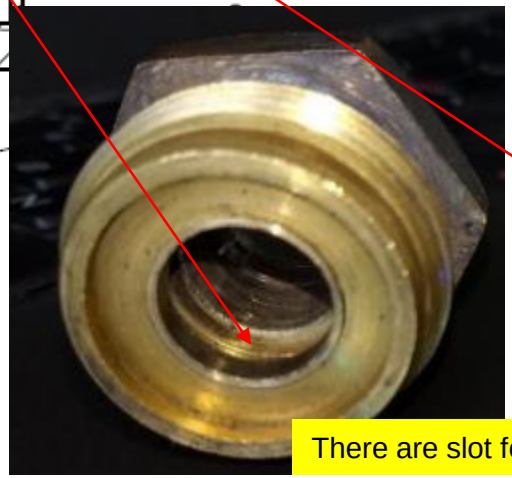
- Dirt inside the leak valve
- Dirt also be found inside the same type valves

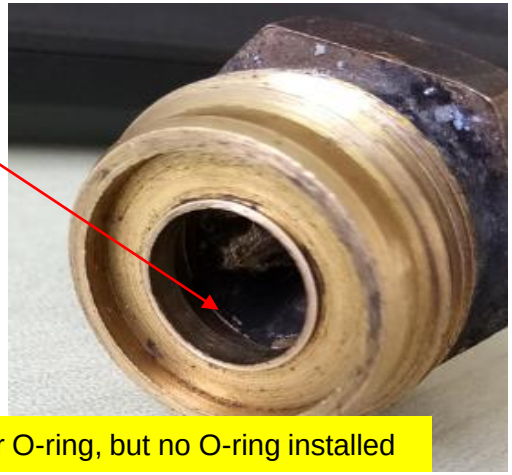
Event #20



O-ring sealing by design

In the leakage valve, there is no O-ring in the slot (position 9)





There are slot for O-ring, but no O-ring installed

Event #21

Process Safety Event

Consequences: *LOPC – no injuries*

What happened

A contractor driver completed the pump cool down process and started pump to transfer the product to customer tank. While driver was operating the bypass valve (Gas phase), the valve stem and valve bonnet came out from the valve body and gas released into the atmosphere. The driver stopped the pump using emergency stop button. Driver evacuated himself from the area immediately and escalated to his supervisor

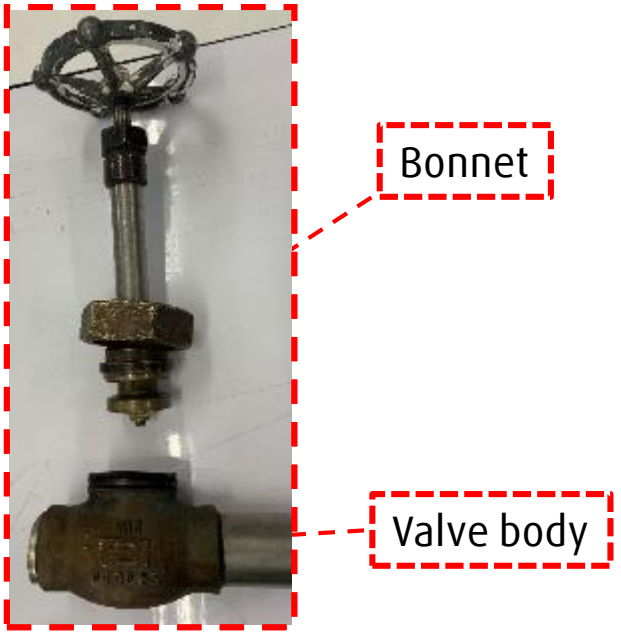
Approximately 816kg/hour N2 gas was released to atmosphere but no injury was reported.

Major Cause(s):

- At risk behavior by driver- use of improper tool to tighten/tap valve
- Old design of tanker – valve bonnet not provided with retainer

Event #21 Pictures

Released point inside the cabinet



Bonnet clamp

Accidents/Incidents in Occupational Safety & Maintenance Work

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Event #22

Occupational Safety

***Consequences*:** *Contractor Injury*

What happened

Three contractors were dismantling the lifting pipe rack crossbars which overlie the pipeline at the pipe gallery platform.

One contractor removed the bolt and shook the crossbar of the hanger in order to separate them. At that time, the pole fell and hit the back of the contractor's foot. The injured person was sent to the hospital immediately.

The diagnosis was the bottom of the second metatarsal base of the right foot fracture.

Major Cause(s):

- The person was in the line of fire
- Ineffective contractor Management, SWP not applied

Event #22 Pictures

Event #23

Occupational Safety Incident

Consequences: *Lost Time Injury*

What happened

A field operator at a HYCO facility took a water sample at a clarifier overflow tank and returned to the field operating room. Due to the large discharged steam condensate vapor in the area, our field operator did not see the surrounding environment and accidentally stepped into the trench with hot water discharged by the steam trap and burned his right ankle. His colleague immediately reported to the line supervisor, and the injured employee was sent to the hospital for medical treatment. At around 03:30am, the injured employee's right ankle was treated with a scalding cream and bandaged by a doctor. He was hospitalized for further medical treatment.

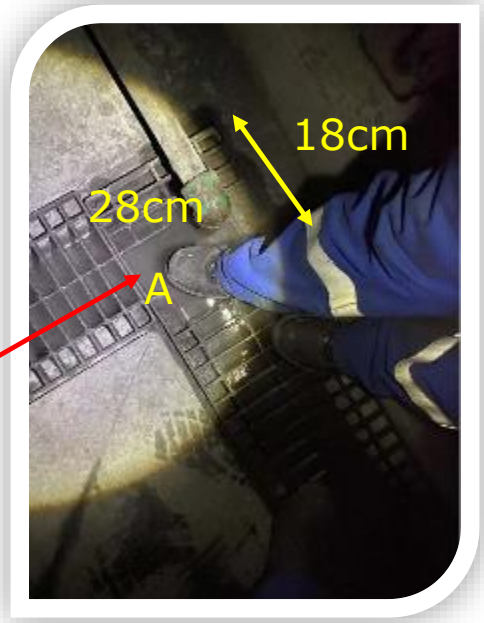
Major Cause(s):

- Employee did not focus on the ground and was not aware about the surrounding; he did not notice the gap in the trench due to the hot steam vapor.
- Gap in trench was not identified fully, part gap in trench was covered and the other part was not.

Event #23 Pictures

Description with Picture

A. Gap in trench
-insufficient lighting in this area
-steam condensate discharge with gap in trench cover and large vapor in this area



A. Gap in trench
-size was 28cm L x 18cm W x 40cm depth
-hot water temperature by steam trap discharge
-injured employee right foot stepped into the trench gap

Event #24

Occupational Safety Incident

Consequences: *Recordable Injury*

What happened

An operator after finishing an argon dewar transfilling was intending to unload the dewar from the cart and put it to upright position. However, he failed at the first time due to heavy weight of the full dewar, but he didn`t notice the pothook had already loosened. When he tried for the second time, his middle finger of right hand was pinched by the space between the dewar and cart due to hand slip. Though he wore hand gloves but the injury from the pinch required stitches for wound recovery as was advised by the doctor.

Major Cause(s):

- Lack of full attention while performing the work: Operator was feeling a little tired after moving five dewars
- Fastening device on dewar cart was not working well due to wear

Event #24 Pictures

Event #25

Workplace incident at the office

Consequences: *Recordable Injury*

What happened

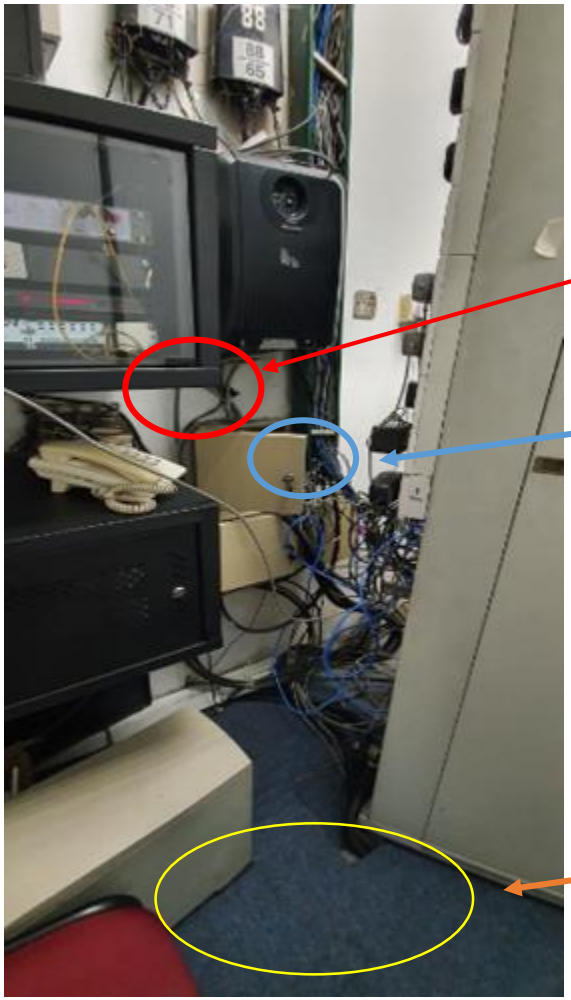
Employee was performing troubleshooting in the office server room to reinstate internet connection following a power supply trip. He accidentally hit his head against the edge of a metal panel and experienced dizziness. He continued with his work at the office.

On the following day, he returned to work and was subsequently hospitalized when he sought for medical help at a hospital in the evening after feeling dizzy and drowsy

Major Cause(s):

- Poor housekeeping in the server room
- Employee failed to identify hazard and not trained for the task
- Extended working hours during COVID19 lockdown

Event #25 Pictures



Corner of metal panel where employee hit his head against

Power switch

Position of employee kneeling down while trying to reach for the power switch

Event #26

Incident during Product Transfer

Consequences: *Employee Recordable Injury*

What happened

A driver of a LN2 micro-bulk tanker was standing on the tail lift while doing product transfer at a customer site. When approaching full loading, the driver got off from tail lift to close the valve of the depot tank, but he lost his balance and sprained his foot. He could continue working though he felt a little pain.

But after he finished the trip in the afternoon and went back the terminal, his pain got worse and went to the hospital for a check up. The CT report showed the metatarsal bone on his right foot was fractured. The doctor used plaster fixation to treat the bone fracture.

Major Cause(s):

- Did not follow procedure to lower the tail lift before dismounting
- Underestimated the height of tail lift to the ground

Event #26 Pictures

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Lessons learned from the safety events(1)

★ Transportation safety

- Driver **Fatigue Awareness** programs are critical for transport safety
- **In cab camera** is an effective tool to monitor driver behavior, fatigue & distraction
- Importance of **Transport Contractors' Management** through and periodic audit
- Refresh **Defensive Driving Skills** in driver and pay attention to avoiding High Speed, error in judgement about road condition, driving in wrong lane, …
- **Seat belts** help to prevent and/or reduce severity of injuries to drivers
- Proper tyre condition and vehicle maintenance and inspections are key to safety

★ Cylinder Handling

- Importance of **Human Factors** in manual handling
- Lack of **Role clarity** can cause safety incidents
- Not following Safe Practices

Lessons learned from the safety events(2)

★ Occupational Safety, Maintenance Work and Construction

- **Designs:** Gaps not identified
- **Employee Training and Safety Orientation: P**roperly trained personnel not to carry out hazardous work
- **Unsafe act** and not following correct procedure
- Use of proper **PPEs**
- **Poor Housekeeping**
- **Not being attentive** while doing an work/activity
- Never stand in the **'line of fire'**

★ 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
- **PPEs**: Non compliance
- Gap in **Alarm Management**

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 108/20: Safe Handling of Dewars on Wheel Bases
- AIGA 099/20: Process Safety Management Framework

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Thank you

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