Training Package
AIGA TP 40/25

Recent (H2 of 2024) Safety Incidents in the Gases Industry in Asia

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Recent (H2 of Year 2024) Safety Incidents in the Gases Industry in Asia

Disclaimer

All publications of AIGA or bearing AIGA's name contain information, including Codes of Practice, safety procedures and other technical information that were obtained from sources believed by AIGA to be reliable and/ or based on technical information and experience currently available from members of AIGA and others at the date of the publication. As such, we do not make any representation or warranty nor accept any liability as to the accuracy, completeness or correctness of the information contained in these publications.

While AIGA recommends that its members refer to or use its publications, such reference to or use thereof by its members or third parties is purely voluntary and not binding.

AIGA or its members make no guarantee of the results and assume no liability or responsibility in connection with the reference to or use of information or suggestions contained in AIGA's publications.

AIGA has no control whatsoever as regards, performance or non performance, misinterpretation, proper or improper use of any information or suggestions contained in AIGA's publications by any person or entity (including AIGA members) and AIGA expressly disclaims any liability in connection thereto.

AIGA's publications are subject to periodic review and users are cautioned to obtain the latest edition.

Agenda

- Incident cases
  - Product Transportation including Loading/Unloading
  - Occupational Safety/Maintenance Work/Construction related
  - Handling of Cylinders
  - Process Safety
- Learning from the incidents
- AIGA references related to the incidents

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Incidents in Product Transportation Including Loading & Unloading

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Event #1

Product Vehicle Accident

Consequences: *Rear ending with equipment damage*

What happened:

After the product vehicle driver finished the delivery to the 2nd customer and on the way back to the Plant, the product vehicle driver crashed into a 3rd party trailer that was parked on the roadside. Time of accident was about 1215 hrs and traveling at a speed of about 40 km/hr. It was a sunny day and the road condition was good and clear.

Thru the in-cabin camera, it was found that he was distracted with wiping his face with a cloth at the time of accident. It was observed that before the accident, he was also using his mobile phone and drinking water while driving. There are instances when he did not hold the steering wheel with both hands. During the accident, the 3rd party trailer was parked illegally at the roadside causing the road to be congested and the product vehicle driver hit the back of the trailer. The side mirror and the left side of truck's body were damaged.

Lessons Learned:

- Lack of Defensive Driving like distraction (wiping face with cloth) caused accident
- Unsafe behavior with use of mobile phone and both hands off the steering wheel

Event #1

Pictures

3rd party trailer parked at the roadside

Event #2

Product Vehicle Accident
Consequences: High Severity Potential Incident

What happened:

Around 0707 hrs on a day, a product vehicle driver wanted to truck out the full H2 tube trailer from the filling bay. The driver then coupled the tractor to the full H2 tube trailer. While moving the H2 tube trailer out, the tube trailer got separated out from the tractor. The supporting legs of the trailer did not touch the ground and were not damaged. The driver reconnected the tractor and trailer by lifting the tractor air suspension and raising the support legs. No product leakage and no one was injured in this incident.

Lessons Learned:

- Strictly follow the tractor/trailer coupling procedure and the need to inspect the engagement of 5th wheel and kingpin after coupling of tractor/trailer.
- Potential High Severity Incident if tractor gets disconnected on a busy highway.

Event #2

Pictures

Trailer was separated from tractor

Event #3

Product Vehicle Accident

Consequences: *Equipment Damage*

What happened:

At about 1035 hrs, upon completed the product delivery, a product vehicle driver moved the liquid bulk truck towards the exit gate and waited for the security officer to remove the traffic cones to clear the way for the trailer to exit. At the same time, the driver was preparing to return the gate pass without realizing that the vehicle moved forward and did not fully stop. The truck hit the top of the concrete gate post of the customer's exit.

No injury was recorded. The truck outer vessel was damaged, and top of the concrete gate post was broken.

Lessons Learned:

- Driver failed to secure the liquid bulk truck by activating the brakes.
- Driver was distracted as he intended to return the gate pass.

Event #3

Pictures

Liquid Bulk Truck knocking into concrete gate post

Damaged concrete gate post

Event #4

High Severity Product Vehicle Accident

Consequences: Product Vehicle Roll Over

What happened:

At around 2220 hrs, a rigid Liquid Oxygen tanker rolled over while traveling to the customer site. The tanker was traveling at about 38 km/hr when the incident happened. There was no injury to the driver or to 3rd party personnel

Upon investigation, the driver was found to be fatigued and had a microsleep. He momentarily lost control before going into the soft sloping ground on the left. The driver had been driving continuously for about 2 hours before the roll-over. There was no Fatigue Detection System installed in this tanker.

Lessons Learned:

- Driver had a micro sleep.
- Driver did not take an adequate rest and was fatigued while driving behind wheel.
- Take a break when you get fatigue symptom eg. yawning, heavy eyes, and loss of focus.

Event #4

Pictures

Rolled Over Tanker on soft slope ground

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Event #5

High Severity Product Vehicle Accident

Consequences: *Extensive damage to truck cabin*

What happened:

At about 1040 hrs., a product vehicle driver was driving the Bulk Hydrogen Tube Trailer (BHY TT) on the lane and intended to make a left turn at the road junction. He slowed down the BHY TT and signalled. When he turned the TT to the left, a 3rd party container truck travelling behind the BHY TT overtook the BHY TT on the left and collided into BHY TT. The left side door, left mirror, front mirror, cabin and left front bumper of BHY TT were damaged. There was no personnel injury and product released.

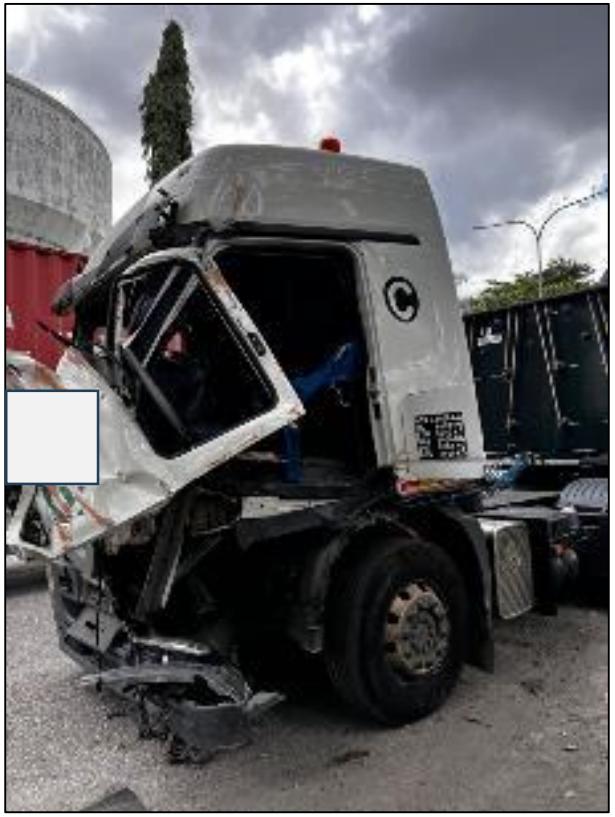
The BHY TT driver did not adequately check for traffic on the left side of product vehicle before making a left turn. The BHY TT driver kept too much space on the left side of his vehicle allowing 3rd party container truck to overtake on the left side of BHY TT.

Lessons Learned:

- Exercise lane discipline - Drive in the middle of the lane.
- Ensure that the space is clear before making a turn.
- Yield or stop the TT to give way to other vehicles.

Event #5 Pictures

Front view of damaged BHY tractor



Serious damaged to BHY Tractor

Event #6

Product Vehicle Accident

Consequences: *Equipment damage*

What happened:

At about 1248 hrs, a product vehicle driver drove back a Liquid Bulk tanker to the facility to load product for customer delivery. While approaching the main gate at a speed of abut 11 km/hr, the main gate was moving to close the entrance. The gate has a sensor activated system. Driver kept moving and stopped the tanker along the path of the moving gate. Due to faulty sensor, the gate kept moving and hit the tractor. The gate collapsed and was damaged from the impact. The tanker fender was scratched. Driver did not report the incident to his supervisor as he was rushing to fulfil the delivery.

Lessons Learned:

- Driver failed to stop the tanker before the gate and assess situation.
- Do not rush.

Event #6 Pictures

Scratches on vehicle's fender

Tanker entering the main gate while the auto gate was closing

Event #7

Product Vehicle Accident

Consequences: High Severity Potential Incident

What happened:

At about 1318 hrs, a Packaged Gases (PG) driver arrived at the customer site (located next to the main road) Along the main road, there are heavy traffic plying route and stop due to the congestion.

The PG driver attempted to reverse the PG truck to his left into the customer site while the PG truck protruded out on the main road and hit a stationary 3rd party passenger car (the car was stop due to traffic jam). Due to the impact, both the PG truck and the 3rd party passenger car had a minor damages. There was no injury and also no product leakage reported in this incident.

Lessons Learned:

- Assess the area around you for safe reversing. Perform Go Out And Look (GOAL) to ensure that you have the safe route to be taken.
- Be vigilant with the poor site condition. Report all the non-conducive customer site conditions to the supervisor.

Event #7

PG truck

3rd party passenger car

Side mirror view of PG truck colliding into 3rd party car

Event #8

Product Vehicle Accident

Consequences: *3rd party Vehicle damage*

What happened:

At about 0740 hrs, a product vehicle travelling on the second lane was passing a tunnel when the product vehicle driver attempted to switch to the 3rd lane in order for him to prepare for the right turn about 200 meters ahead. On the right side of the product vehicle(3rd lane) there was a 3rd party car who was traveling alongside the product vehicle truck. The product delivery driver failed to identify the existence of the 3rd party car and hit the 3rd party car while making a lane change to the right.

Lesson learned:

- Drivers to check the mirror every 5-8 second interval; left and right are equally important – to identify the potential risk around the truck.
- Turn on directional signal early to indicate intention to switch lane

Event #8

Pictures

3rd party passenger car that was knocked into by product vehicle

Event #9

Product Vehicle Accident

Consequences: *Minor damage to a 3rd party van*

What happened:

At about 0630hrs, when it was still dark, a product vehicle was travelling to facility plant for product pick-up. While passing the junction at a speed of about 67 km/hr, there was a parked 3rd party passenger car on the road shoulder which was involved in an earlier road accident. Parked 3rd party car did not have hazard light indicator switch on to alert other traffic. There was no street light for this stretch of road.

Due to the poor visibility as and lack of space, the product vehicle collided with the 3rd party passenger car. The product vehicle driver stopped the truck to investigate and later on put the warning triangle and safety cones.

Lesson learned:

- Driver should manage his safe speed and space while driving with poor visibility

Event #9

Pictures

Damaged rear of 3rd party passenger car

Product Vehicle Front Bumper

Event #10

High Severity Product Vehicle Accident

Consequences: *Cylinder Truck Rollover*

What happened:

At approximately 0915 hrs, a cylinder truck travelling at a speed of 67km/h on a rainy day on a straight road lost control and rolled over to the left side of the road in a ditch. There was no fatigue sign and also no alert triggered during the trip.

Driver and attendant were wearing seatbelts when the incident happened. The driver escaped with a minor cut on his scalp and no physical injury observed on the attendant. There was also no product release.

Lessons Learned:

- Seat belts probably had prevented more serious injuries to driver and attendant.
- Reduce speed in adverse weather and on wet road condition
- Have proper weight distribution on cylinder truck as uneven weight distribution can affect center of gravity.

Event #10

Pictures

Rolled over cylinder truck on soft ground

Driver not injured,

was wearing his seatbelt.

Event #11

Product vehicle accident

Consequences: *Damage to the vehicle involved*

What happened:

At about 0752 hrs a cylinder truck collided with a 3rd party passenger car after continuous lane changing in unsafe manner.

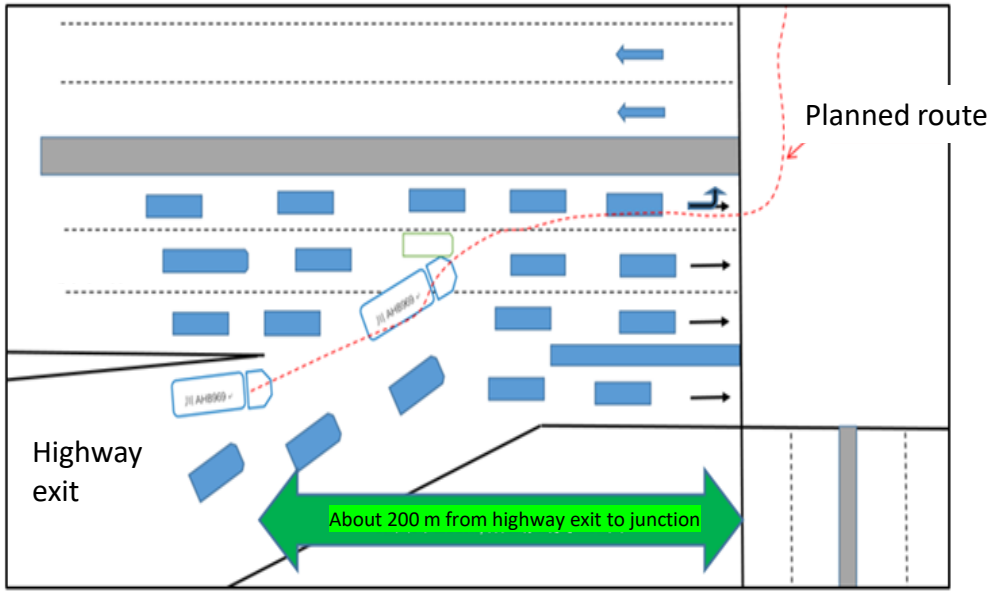
At the time of the accident, the cylinder truck was exiting the highway at a speed about 13 km/hr and entering the left side of the road where the cylinder truck collided into a 3rd part passenger car . There were no injuries and no product loss.

Lessons Learned:

- Proper lane changing protocol was not applied. Reinforce adherence to defensive driving and proper lane changing protocol.

Event #11 Pictures

Cylinder truck colliding into 3rd party passenger car.



Event #12

Product Vehicle Accident

Consequences: *3rd Party Motorcycle Rider Lost Time Injury*

What happened:

At about 1230 hrs, a product vehicle tanker was on way to the intersection of a road, when a two-wheeled electric bike was trying to turn left on the rightmost motor lane and scraped against the product vehicle vehicle in front of the right side. The electric bike rider (a 74-year-old male) fell down under the right front wheel. The driver stopped the vehicle immediately. The electric bike rider was taken to the hospital and was found to have soft tissue contusions around the left thigh, hip and knee joints after a CT examination.

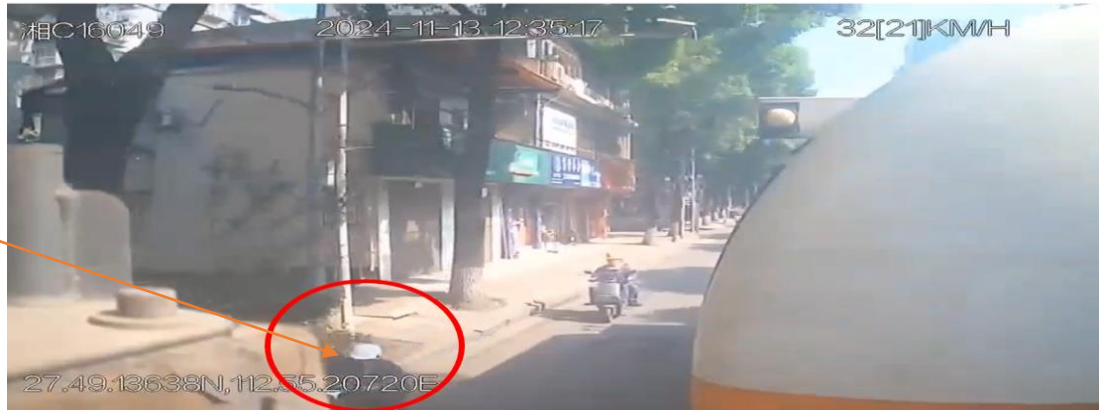
Lessons Learned:

- Driver failed to notice electric bike rider in the blind spot
- Emphasize that when turning, the escort should lower the window, assist in observing the road situation in the blind area on the right and alarm the 3rd party road user on the right.

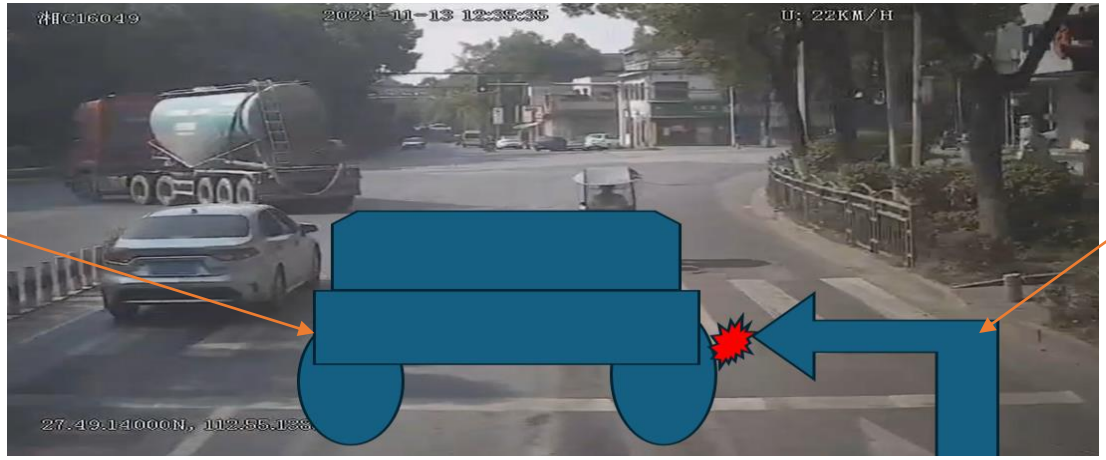
Event #12

Pictures

Electric bike rider



Product vehicle



Electric bike turning left brushed again the front wheel of product vehicle

Event #13

Product vehicle accident

Consequences: *Rear end collision*

What happened:

At 1819 hrs , a cylinder truck was on its way back to the factory after completing the distribution task. When driving on a certain non-highway section, a 3rd party light-box truck traveling in the same lane ahead braked to a stop, the cylinder truck rear-ended.

No one was injured in the accident. After being confirmed by the traffic police, the cylinder truck bear full responsibility for the accident

Cylinder truck was traveling at a speed of about 78km/hr just before the accident and had only about 10 m safety following distance from the 3rd party light box truck.

Lessons Learned:

- Keep a safe following distance from vehicle in front of your vehicle. Recommended safe following distance would be 6 seconds or more
- Increase the safe following distance when there is a big truck in front that blocking your front view

Event #13 Pictures

Damages on cylinder truck

The rear of 3rd party light box truck

Event #14

Product vehicle accident

Consequences: *3rd party car passenger injury*

What happened:

At around 1214 hrs a product vehicle departed from the factory for delivery. While driving on a certain non-highway road section at about 68km/hr, it collided with a small 3rd party passenger car entering into the product vehicle's legal lane from the same direction on the right side, causing damage to the left front wheel and bumper of the product vehicle truck, and the small car went into a rollover. There were no product leaks in the collision, but a passenger in the car received some injuries.

Product vehicle driver failed to perform adequate observation to anticipate the car from coming into product vehicle's lane.

Lessons Learned:

- Professional driver must be alert at all time and need to anticipate other drivers actions

Event #14 Pictures

Product Vehicle

Rolled over 3rd party passenger car

Occupational Safety/Maintenance Work/Construction related

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Event #1

Occupational Safety – Maintenance Work

Consequences: *Electric flash and burn injury*

What happened:

A Safe Work Permit (SWP) was issued for working on the pressure switch of the Gas Nitrogen compressor, work was completed on the pressure switch, then Lock Out Tag Out (LOTO) was removed to take the no load trial. Before the start of the motor, electrician turned on the power supply to the local electrical panel (415 Volt) and started to check between the component. At that time, an electric flash was observed (no one was near to the electrician) that caused burn injury to the hands of the electrician up to the forearm. During investigation it was observed that the Electrician did not perform the right electrical measurement before turning on the power supply. It was also found that there was a phase to phase short circuit between the primary terminals across the main and delta contactors what caused melting of the main contactor terminals and bolts as the resistance between cables R and Y found to be only 3.4 ohms. The low resistance indicates insulation was compromised between these two phases.

Lessons Learned:

- There is inconsistency between SOP & Training (Process of Electrical training was not followed)
- No temporary protection/cover (tarpaulin etc) provided for preservation of the electrical panel from dust and moisture was arranged

Burnt mark on electrical multimeter

Event #2

Occupational Safety

Consequences: Recordable Injury

What happened:

At about 1800hrs, a product vehicle driver was performing pre-filling inspection when the cement cover under the driver's feet suddenly broke, and the driver's left leg fell into the cement ditch. The wire in the broken cement cover cut the skin of the driver's left calf. The driver did a simple treatment at that time and returned to the terminal after unloading. Then he went to the hospital for examination, the wound was 4 centimetres long, the doctor stitched 6 stitches to the wound.

Lesson learned:

- Be aware of the road conditions and watch your step when walking.
- Identify slip/trip/fall hazard while walking

Event #2

Pictures

Broken cement cover

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Event #3

Occupational Safety Incident

Consequences: *Injury to a 3rd party mechanic*

What happened:

At about 0905 hrs, a 3rd party repair workshop send their mechanic to the plant to attend to a trailer brake problem. The mechanic intent to release the brakes on the trailer in order to haul the trailer back to the workshop to repair the leaking bellow on the axle. The leaking bellow on the axle cause the air pressure unable to build up in the air chamber, resulting in brake engagement. In order to haul the trailer to the workshop for repair, the mechanic will need to release the brakes on the trailer before hauling to workshop. At about 0920 hrs, the plant personnel was informed of the injury on the mechanic face, due to the brake chamber give way and the released chamber cover hit the mechanic face. The 3rd party mechanic was sent to the maintenance office before calling ambulance to convey him to the hospital via ambulance.

Lessons Learned:

- Did not identified hazard on compressed spring as stored energy
- Follow truck repair procedures and manage using Permit To Work System (PTW)
- Wear Proper PPE

Event #3

Pictures

Chamber cover that hit the mechanic

Warning label of stored energy in spring

Event #4

Occupational Safety Incident

Consequences: : *Worker injury from a fall*

What happened

At 1450 hrs, a production team operator employee was commuting to work on an electric bicycle for her shift. While passing through the company's main gate and entering the passageway (slope section) in front of the public office building to park her electric bicycle, the front wheel of the bicycle slipped, due to losing her balance and step on her right foot. She felt uncomfortable on her right big toe and went to the hospital. She was diagnosed with a fractured toe and treated in brace and returned to work.

Lessons Learned:

- Refresh hazards recognition & dynamic risk assessment training for employees.
- Conduct bicycle Safe driving training for related employees.

Event #4 Pictures

While passing through the company's main gate and entering the passageway (slope section) in front of the public office building to park her electric bicycle, the front wheel of the bicycle slipped, due to losing her balance and step on her right foot

The operator was diagnosed with a fractured right big toe

Event #5

Occupational Safety Incident

Consequences: *Driver Recordable Injury*

What happened:

At about 1745 hrs, after adding oil (a step that requires raising the cab), a driver was operating the cab return to the original position.

The driver used iron pliers with his left hand to adjust the reversing lever from the raised position to the lowered position and with his right hand which held the electric lift switch and leaned against the top of the reversing device when the reversing lever was adjusted to the lowered position, the cab was then lowered, the door trim boards pressed on his right hand, resulting in injuries to the tip of the index finger of his right hand.

Lessons Learned:

- Hand was in the LINE OF FIRE
- No Job Safety Analysis (JSA). Develop JSA for these kind of maintenance job and formulized the work instruction.

Event #5

Pictures

Event #6

Occupational Safety Incident

Consequences: *Lost Time Injury of Driver's Helper*

What happened:

The incident happened on the outside of a customer station's storage tank area. At about 0851 hrs, the product vehicle driver found that the fence door of the customer station was not closed while he was parking the product tanker, the product vehicle driver asked the helper to close the door to prevent the collision with product tanker and the doors.
Due to the icy ground in the area and the fog at the site, the helper slipped and fell while walking.
The helper was immediately sent to the hospital for an examination, which confirmed a comminuted fracture of the right patella and contusion of surrounding soft tissues.

Lessons Learned:

- Identify slip hazards and eliminate risks in the workplace.
- Avoid distraction and focus on the ground where you are walking
- Take smaller step when walking on slippery ground

Event #6

Pictures

The slipped helper

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Event #7

Occupational Safety Incident

Consequences: *Fracture on Nose*

What happened:

At the 0230 hrs an ASU plant was shutdown and at about 0235 hrs the onsite operator was returning to the control room after he closed the feed valve to the Liquid Argon tank.

Due to cold and foggy weather and low visibility, the operator's helmet hit the cable tray that causing the inner eaves of the helmet punch his nose.

The operator suffered a minor fracture on his nose.

.

Lessons Learned:

- Enhance the safe behavior – no rush
- Walk on designated walk path and do not take short cut at site

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Event #7

Pictures

He was moving quickly in a low visibility and dark area while his helmet hit the cable tray

The cornice inside the helmet punch his nose

Event #8

Occupational Safety Incident

Consequences: Lost Time Injury to Driver Helper

What happened:

A Liquid Nitrogen product vehicle arrived at a customer's door for product delivery at around 1055 hrs. As it was close to lunchtime, the helper informed the product vehicle driver that he was going to buy lunch. The helper went across the road (a four-lane road without a median strip) to buy lunch. The driver parked the vehicle and registered at the gatehouse. At 1103 hrs, when the helper was returning (without buying any food), accidentally tripped over a raised reflective warning block in the middle of the road and fell on both knees. After the incident, the driver helped the injured helper to rest at the customer's door and reported the matter to their transport manager.

After finishing their deliveries for the day (around 10 pm), the helper went to a hospital for examination where the doctor advised him to rest and monitor for two days for healing. However, after resting for two days at home, the helper felt an increase in pain. The helper then went to another hospital for further examination where he was diagnosed with left knee fracture and tear on ligament.

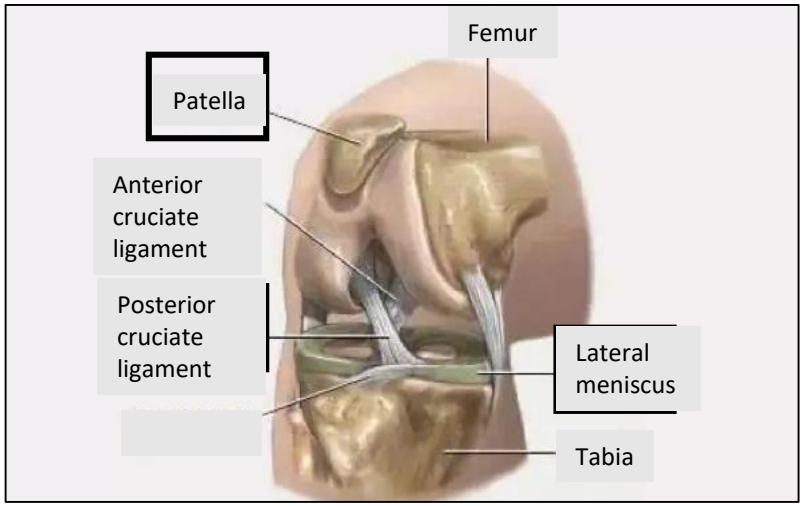
Lessons Learned:

- Pay attention to the surrounding and road conditions while walking and crossing a road.
- Walking slowly and carefully, watching your step.

Event #8

Pictures

Raised reflective block



Swollen knee

Handling of Cylinders

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Event #1

Liquid Cylinder Handling Incident

Consequences: *Recordable Injury*

What happened:

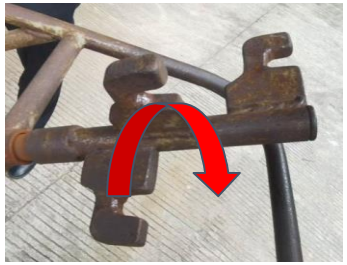
At 1841 hrs, a Packaged Gas (PG) driver was loading Liquid Gas Cylinders (LGC) at the supplier's site. When he was moving a full Liquid Oxygen LGC (165L) from the tailgate to the truck, the LGC suddenly fell off from the hook of the trolley. Under the influence of gravity, the LGC trolley pressed the driver's left thumb to the guardrail of the tailgate, causing the distal phalanx of the driver's left thumb to fracture. After treatment in the hospital, he was assigned temporary job at site work the next day.

Lesson learned:

- Use only an approved trolley.
- Conduct inspection of equipment before use.

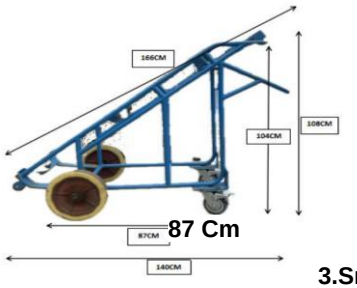
Event #1

Pictures



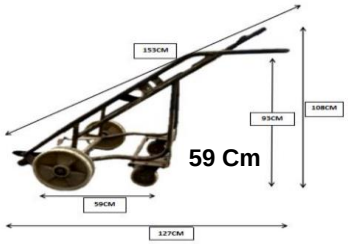
1.Rotating and round head

2.Spring position different



Approved trolley

3.Smaller size



Non-approved trolley

Event #2

Cylinder Trolley Handling Incident

Consequences: Recordable Injury

What happened:

At about 1150 hrs., a Packaged Gas (PG) driver was at a customer's facility. He moved the cylinder onto the trolley and secured it with a metal chain. As he tilted the trolley, he heard a loud noise. He saw the cylinder slipped off from the trolley and fell to the floor. At the same time, the trolley was broken at 3 supporting points, the metal handle of the trolley struck his hand. He removed his gloves and found a cut injury on left hand. Customer provided cotton gauze and bandage for first aid. The plant manager arrived at the site and sent him to the hospital. X-ray revealed a hairline crack on his left hand. He was prescribed antibiotics, painkillers, and the 3 cm cut was stitched.

Lessons Learned:

- Periodic detail inspection and certification of fitness of use for trolley.
- The cylinder trolley broke and caused the cylinder to slip and hit driver's hand. Inspect cylinder trolley before use.

Event #2

Pictures

Blood stains of glove

Cuts on the glove

Support rods broken

Event #3

Liquid Cylinder Handling Incident

Consequences: *Recordable Injury*

What happened:

At about 1330 hrs., at a product transfill parking lot, a Packaged Gases (PG) escort was unloading a dewar cart from the tailgate of the PG truck. The dewar fell off the hook at the cart head. Our escort failed to drawback his right hand from the pinch point between the falling dewar and the hook. The supervisor accompanied him to the hospital where he was diagnosed with fracture on his right index finger, middle finger and was sutured. The ring finger was also sutured, and he was given a tetanus vaccination. The escort was discharged from the hospital before 1700 hrs.

Lessons Learned:

- Ensure that the trolley hook and dewar lift slot are fully engaged.
- Use only approved trolley
- Place hands on designated position of trolley

Event #3

Pictures

Injured fingers

PG driver's hand placed wrongly on LGC

Event #4

Cylinder Handling Incident

Consequences: Finger Injury to a Driver

What happened:

At 1520 hrs in a customer site, a Packaged Gas (PG) driver was rolling a cylinder with both hands from a pallet, the last cylinder in the pallet started toppling down. In an attempt to catch, driver's right hand was injured by the valve protection resulting in open injury of the fingertip of the middle finger.

Lesson learned:

- Do not try to catch a falling cylinder. Move out of harm's way
- Secure lone cylinder with chain to sturdy structure

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Event #4

Pictures

Fallen cylinders

Event #5

Cylinder Handling Incident

Consequences: *Finger Injury of an Operator*

What happened

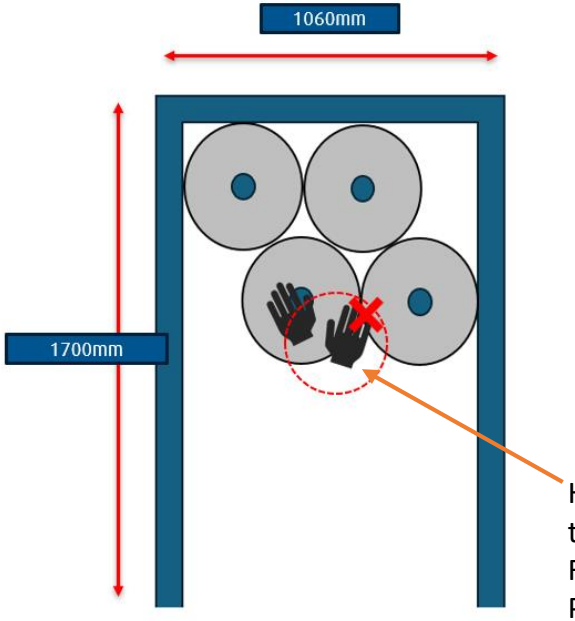
At 1500 hrs, a Packaged Gas (PG) operator was moving full R-134a refrigerant gas cylinder (total weight 140kg) onto the pallet. While moving the 4th cylinder, he lost control and his right hand's ring finger was caught between the other cylinders. He was taken to a nearby hospital and received treatment on the injured finger. There was no product release from the event.

Lesson learned:

- Identify hazards and do not place hand into LINE OF FIRE (Pinched Point).
- Avoid distraction and look at hand movement when moving cylinders.

Event #5

Pictures



Cradle pallets used for loading trucks using forklifts

Event #6

Cylinder Handling Incident

Consequences: *Recordable Injury of a Driver*

What happened:

At about 1430 hrs, after unloading two bundles at the customer's site, the driver found that the gas cylinders inside one of the old cylinder rack in the carriage had already been tilted.

Then the driver loosened the cylinder straps and then sorted out the cylinders, in this process, two cylinders slipped out and the bottom of one of the cylinders touched and smashed the driver's ankle. The driver suffered a light injury on his ankle and certified fit for work by the doctor and back to the work in the next working day (Job transfer temporary).

Lessons Learned:

- Use only approved cylinder rack.
- Secure the cylinders with strap to the cylinder rack frame.

Event #6

Pictures

Cylinders strapped but tilted

Injured ankle

Event #7

Cylinder Handling Incident

Consequences: Employee Foot Injury

What happened:

A cylinder delivery person took off safety shoes as it was not allowed at the Elderly Care Facility. He rolled the cylinder and it fell and hit the employee's right foot toe in front of the lift lobby where there was a slight slope. It was noted that:

1) The floor was wet due to the rain. Distance from trunk to lift is about 10m.

2) As this is the first time he is visiting this Care Centre, injured party was given a briefing by the driver on how to do the delivery before he started

Lessons Learned:

- Use cylinder trolley and avoid rolling of cylinders
- Use appropriate PPE

Event #7

Pictures

Injured toe

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Event #8

Cylinder Trolley Handling Incident

Consequences: *Lost Time Injury to the Operator*

What happened:

An Operator was pushing a trolley transporting 2 cylinders towards the cargo lift. One wheel got caught in the cargo lift doorway gap, causing the trolley to stand upright. This sudden upward movement and impact caused his left shoulder to be dislocated. The injured person had reported the incident to his supervisor. This incident resulted in a lost time injury where the injured person was granted 20 days medical leaves for dislocated shoulder.

Lessons Learned:

- Using only one hand to push the cylinder trolley instead of two hands, caused person to lose control when wheel got caught in a gap.
- Improper assessment of the risk associated with uneven floor to the lift

Event #8

Pictures

Uneven floor height between cargo lift and floor

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Process Safety

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Event #1

Process Safety Event

Consequences: *Lost of Primary Containment (LOPC)-Syngas Leak*

What Happened:

Syngas was leaking while operator was collecting the sample gas from a process gas outlet. The portable gas was reading over range of high alarm level at 1m away.

From leaked source . He used Snoop liquid leak detector to find the leak point(threaded connection) and found that there was a strong leak with pressure 16 barg at sample valve connection

Lessons Learned:

- Review the sampling connection activity in maintenance strategy and identify the inspection/maintenance activity

Event #1 Pictures

The leak point

Event #2

Process Safety Event

Consequences: *Al Cylinder Bursting with Lost Time Injury*

What happened

At 09 55 hrs an operator at a packaged gases facility was conducting the venting & purging job to a cylinder (8L, aluminum material) connected to the designated panel. When starting depressurizing, the cylinder burst suddenly at site, the scraps of the burst cylinder and energy released injured the operator. The operator suffered fractures on his left leg and scratches to his neck, arms, legs and body.

Lesson Learned

- Cross contamination from different products in the same venting panel.
- Cylinders of different product should not be connected to the same venting panel. Update the venting & purging SOP.

Event #2 Pictures

Broken pieces from ruptured cylinder

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Event #3

Process Safety Event

Consequences: *LOPC with Cryogenic Liquid Burn Injury*

What happened:

At about 1300 hrs., a driver and escort were on duty to off load LN2 to Mini Bulk (MB) tanks at a customer site. After 15 mins of filling operation, suddenly the rupture disc of another MB tank nearby the filled tank was broken, resulted in Liquid Nitrogen vapour cloud around. The escort managed to switch the divertor valve in one(1) minute, but felt hurt in the ankle due to LN2 spray burn. He washed his right foot for 30 mins with water, then felt no pain but a little redness and swelling in the skin. Later that evening, the driver took the escort to the hospital, doctor issued treatment of ointment. During that period, there was no report to the supervisor until 15 days later from the incident , as he found that the wound was infected. He got some prescribed medicine on the 16th day.

Lessons Learned:

- During an emergency, stop the leakage only when it is safe to do so. Do not put your body in the LINE OF FIRE
- 2 MB tanks interconnect together without check valves. Higher pressure from 1 MB tank flow to the other MB tank.
- EMOC is required for non-standard design.

Event #3 Pictures

Some MB tanks interconnected together

Cryogenic burn on leg

Injured leg in bandage

Event #4

Process Safety Event

Consequences: *Lost time Burn Injury from hot coolant*

What happened:

At about 1610 hrs., a contract driver was on the way back to terminal after loading. He saw warning lamp for anti-freeze on the vehicle's dashboard. He stopped the tanker at the rest area. He opened the hood and opened the cap of anti-freeze solution container to check. Hot coolant splattered on his forehead and flowed down to his shoulder and chest. He washed his face with water, then contacted his manager and call 119. 119 took him to the hospital. He suffered 2nd degree burn to his head, face, neck, torso, shoulder and arms. He received dressing treatment and was prescribed with intravenous fluids containing antibiotics and prescribed medication.

Lessons Learned:

- Do not open the cap of vehicle's radiator or coolant container when it is hot.
- Only perform task that you had been trained before

Event #4 Pictures

Hot burnt injuries to arm and hand

Event #5

Process Safety Event

Consequences: *LOPC with Recordable cryogenic burn injury*

What happened:

Driver arrived at the customer's site at 1136 hrs to unload the LOX. The driver opened the emergency shutoff valve (EV1 in next slide) in accordance with operating procedures to cool the pump. The LOX was spewed out from the filling connection (E1 in next slide).The driver pressed the emergency button and then went to close liquid bottom valve. His left leg was exposed to LOX. The driver immediately took a shower for his leg about half an hour and got a further medical treatment at a hospital. The driver suffered a light frostbite on his leg and certified fit for work by the doctor and back to the work in the next working day (Job transfer temporary).

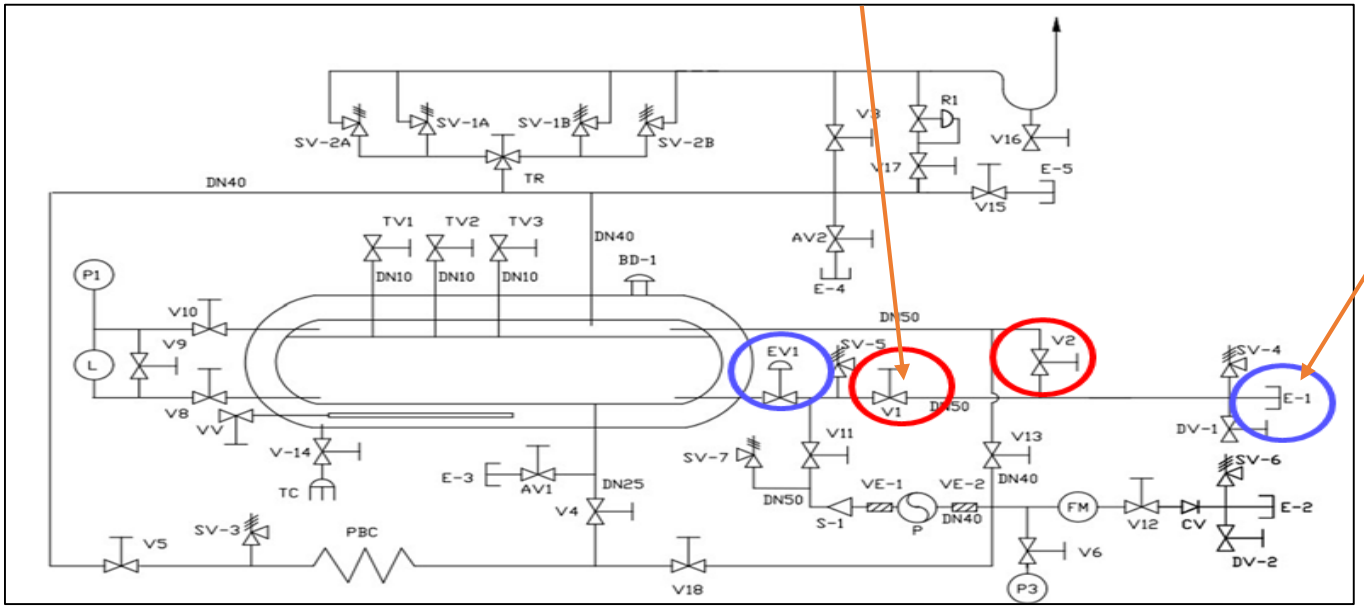
Lessons Learned:

- V-1 was not closed and E-1 was not capped during unloading operation.
- To strictly follow valve operation sequence and procedure

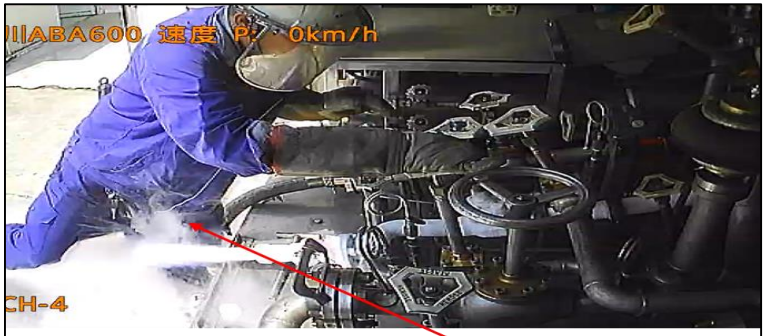
Event #5

Pictures

Valve was not close during unloading operation



Fill port was not cap during unloading operation



The driver's left leg was facing the filling port when he was closing the liquid bottom Valve.

Event #6

Process Safety Event

Consequences: *Cylinder Rupture and Lost Time Injury*

What happened:

At about 16 20 hrs, while the operator was filling argon/ CO2 cylinders of 47L/200 barg , one of the cylinders ruptured. There was a loud sound when the cylinder ruptured. Filling pressure at the time of incident was about 150 barg. All employees evacuated to the assembly area. The Operator was thrown backward. No cylinder hit him during this incident. Blood was coming out from the head, his hands and small area at the stomach had bruises, loss of partial hearing on his right ear and his left eye was red. The Operator was discharged from hospital after 3 days hospitalization.

Lessons Learned:

- Manufacturing and material integrity of the customer cylinder could not be verified as it was a non standard/unverified cylinder
- Provide SOP and ensure incoming checks for internal condition of the cylinders are done

Event #6

Pictures

Ruptured cylinder

Defect on the inside of cylinder

Event #7

Process Safety Event

***Consequences**: LOPC with Lab operator minor burn injury*

What Happened:

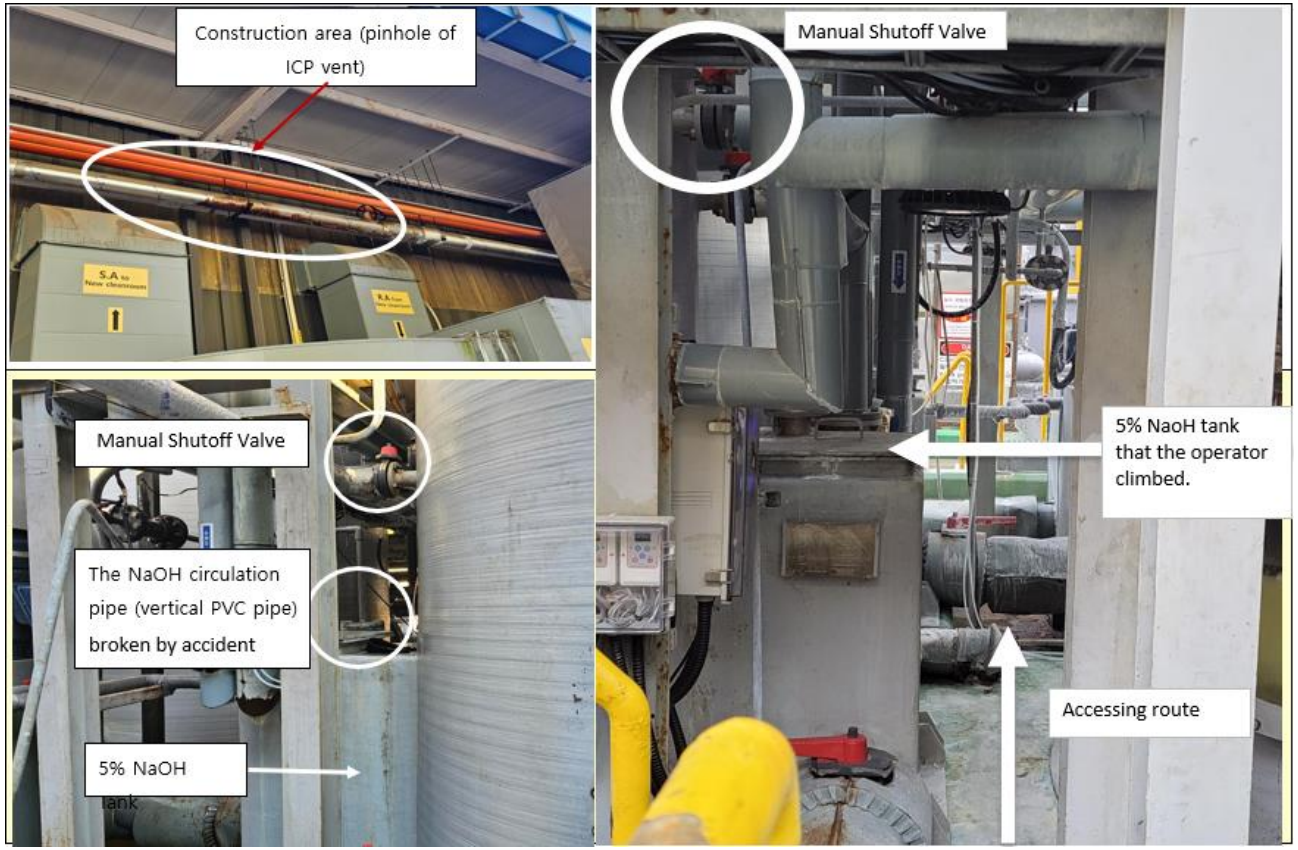
To repair a leaking pipe connected between the lab vent line and the Boron Trichloride (BCl3) scrubber, the worker was to isolate the pipeline by closing a valve installed in the middle of scrubber chamber. The worker climbed onto the 5% Sodium Hydroxide (NaOH) tank, closed the valve and the supervisor left the scene thereafter. While descending from the tank after the work, the worker accidentally bumped into the NaOH circulation pipe (PVC pipe) connected to the 5% NaOH tank and broke the PVC pipe, causing the 5% NaOH solution to spray out onto his face. He was wearing his safety glasses. After promptly rinsing off his face in the emergency shower nearby, the supervisor and HSE specialist took him to the burn center. The worker did not suffer injury to his eyes but was diagnosed to require minor outpatient care. The affected worker took an appropriate skin treatment and returned to work on the following day.

Lesson learned:

- The worker had to climb up to isolate the pipeline shut off valve and PVC pipe not well protected from climbing action. Relocate the shut off valve to a lower height.

Event #7

Pictures



Event #8

Process Safety Event

Consequences: *Oxygen Filter Fire*

What happened

After installing the oxygen filter on a Reciprocating Oxygen Compressor, the oxygen was online. About 20 hours later, the filter caught fire, and some downstream valves and pipe fittings were damaged.

After the investigation and verification, it was found that the material of the filter net provided by the supplier was not PTFE as indicated, but Poly Propylene (PP) which was not suitable in oxygen environment.

Material	AIT	∆Hc	O.I.
PTFE	510-525	1274	100
PP	230-260	11000	18

Lessons Learned:

- Incompatible soft material for oxygen system
- Improve the control standards of oxygen-related non-metallic materials

Event #8

Pictures

Internal picture of the filter after the fire

Lessons learned from the safety events(1)

★ **Transportation safety**

- Continue reinforcing Driver **Fatigue Awareness** programs
- Periodic monitoring of **In cab camera** output is important in preparation to Driver coaching / feedback sessions
- Constantly remind Drivers about **Defensive Driving Skill areas**– Speed management, adapting to road conditions, pre planning, rolling the eyes, etc.
- Revisit your Vehicle inspection programs – tyres, periodic maintenance verification, any mobile equipment like lift gates / cranes on vehicles, etc.

★ **Handling of Cylinders**

- Discuss about the importance of **Human Factors** in manual handling
- Communicate clear **roles and responsibilities** to the teams with training
- Following **Safe Practices** is critical
- Never stand in the **'line of fire'**

Lessons learned from the safety events(2)

★ Process Safety

- **Operating Procedures**: Follow procedures; Stop and ask questions
- Ensure **Risk Assessments and Hazard Reviews** are done consistently for all changes or new processes or systems
- **Permit to Work/LOTO:** Discuss whether these are implemented per standards
- Ensure proper **inspection of vendor supplied equipment** before installation at project site.
- Ensure **Oxygen Compaitble** materials are used

★ Occupational Safety, Maintenance Work and Construction

- **Designs:** Ensure detailed design safety reviews by competent personnel
- **Employee Training and Safety Orientation:** Critical for carrying out any hazardous work
- **Unsafe act : Not** following correct procedure and use of **PPEs**
- **Good Housekeeping keeps everyone safe**
- **Being mindful and attentive** on task is important
- Always use **3 point contact**

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 SP 11: Safety Poster on ‘Safe Transport of Cylinders and PLCs’
- ❑ AIGA SB 11: Human Behaviour in Transport Safety Operations
- ❑ AIGA SB 12: Transportation Safety, Challenges and Improvement Strategy
- ❑ AIGA SB 27: Vehicle Specification and Maintenance
- ❑ AIGA 005: Fire Hazards of Oxygen and Oxygen Enriched Atmosphere
- ❑ AIGA 008: Safety Training for Employees
- ❑AIGA 011: Work Permit System
- ❑ AIGA 015: Safety Management of Contractors
- ❑AIGA 041: Defensive Driving
- ❑AIGA 066: Selection of Personnel Protective Equipment
- ❑ AIGA 099: Process Safety Management Framework
- ❑AIGA 119: Overview of Fleet Safety Technology and Vehicle Specification

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org

Thank you

website:https://asiaiga.org/

No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526
Tel: +65 67055642 Fax: +65 68633307
Internet : http://www.asiaiga.org