Training Package
TP 36/24

Recent (H2 of 2023) Safety Incidents in the Gases Industry in Asia

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Recent (H2 of Year 2023) Safety Incidents in the Gases Industry in Asia

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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

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Incidents in Product Transportation Including Loading & Unloading

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Event #1

Product Vehicle Accident

Consequences: *3rd Party injuries*

What happened:

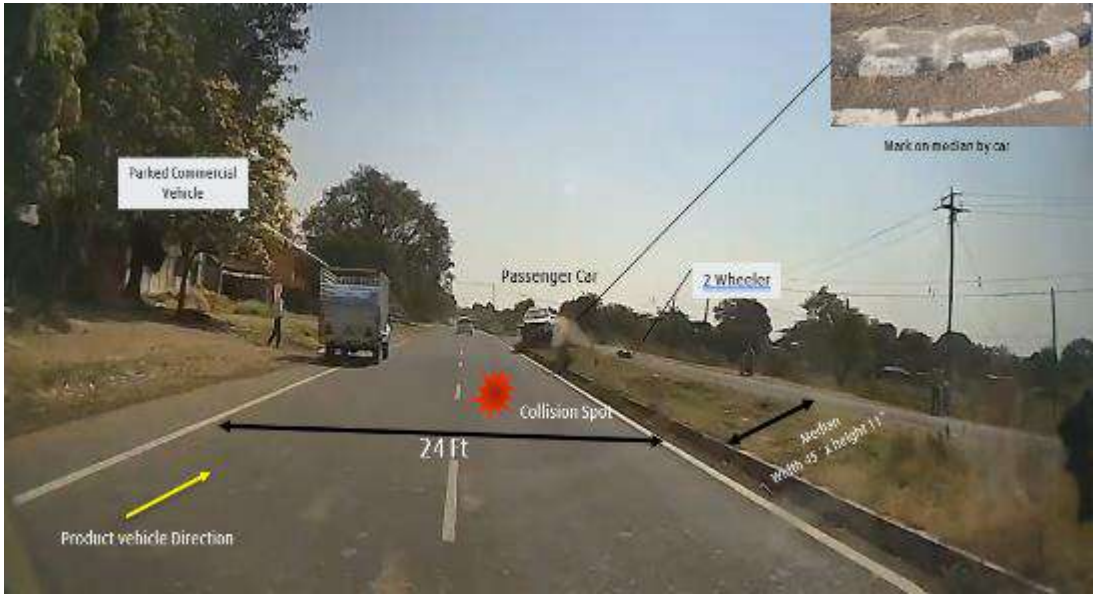
At 14:23hrs a product vehicle travelling at speed of about 46km/hr in its' legal lane was involved in collision with a 3rd party passenger car. The 3rd party car lost control at high speed, ran over the road median after it hit a 2-wheeler and entered in the lane of the product vehicle, hitting the vehicle on the front left side. Two-wheeler was approaching median on incorrect side. There were no product release and no injuries to the product vehicle driver and helper. 3rd party passenger car driver and passengers received injuries of various degree with one of the rear passengers had to be hospitalized for chest injury. Two wheeler rider also received stitches.

Lessons Learned:

- Passenger car was trying to avoid colliding with the two-wheeler after losing control
- Need for ongoing driver awareness campaign on vulnerable road users & "Expect the Unexpected"

Event #1

Pictures



Event #2

High Severity Product Vehicle Accident

Consequences: *Jack knife and minor damage to vehicle*

What happened:

Approx. 21:00hrs, a contractor operated full Liquid Nitrogen tanker was driving down a slope on wet road condition at speed of 48km/h as he applied brake to slow down for turning left at road junction, the vehicle skidded and lost control resulting in jack knife.

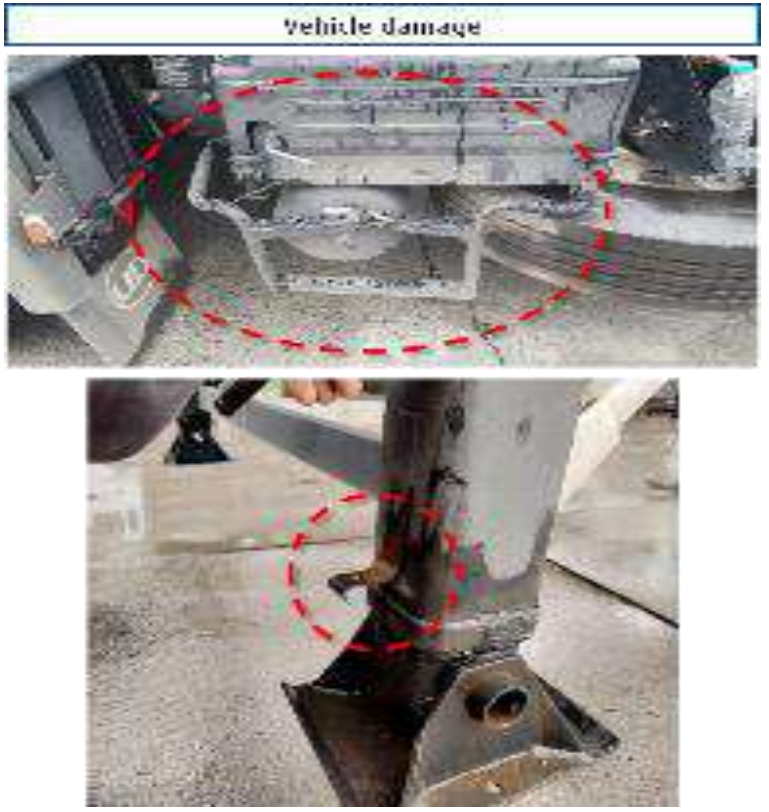
There was no injury and no product release but minor damages to vehicle

Lessons Learned

- Gaps in contractor management – no periodic assessment carried out on competency
  - Lack of competency of garage technicians performing preventive maintenance on fleet
  - No documented procedure and training for preventive maintenance on brakes etc
- Less than adequate tyre inspection procedure for drivers
- Driver oversteered to avoid crash and his speed was higher for an wet road condition.

Event #2

Pictures



Event #3

Product Vehicle Accident

Consequences: *Equipment damage*

What happened:

Around 17:48hrs, a contract driver was driving a products vehicle at 78km/hr on the expressway to another plant for product pick-up. There was a broken-down concrete truck which was parked on the road shoulder and partially invaded the traffic lane. The concrete truck driver did not apply the safety cones nor switched on the hazard signals. The condition was dark during that time. When our driver was approaching that area, he did not realize the parked concrete truck and was unable to react promptly to avoid the collision. As a result, the right side of our tractor collided with the parked concrete truck. The right-hand side of our tractor and the left side of the concrete truck sustained significant damages.

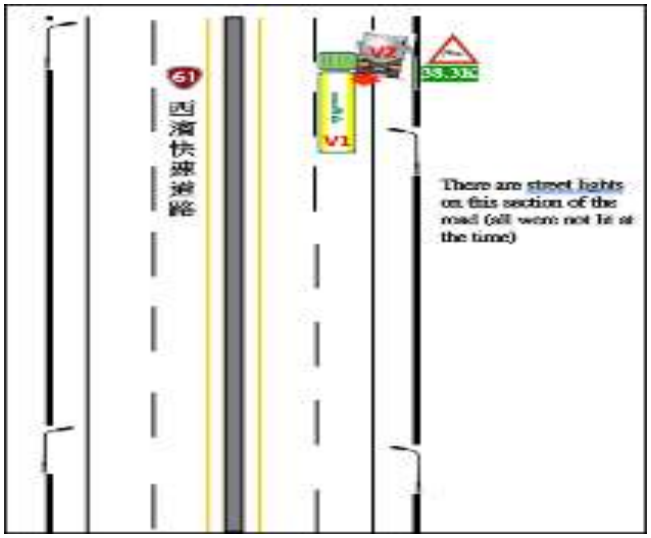
Lesson learned:

- Driver failed to reduce speed to suit night driving with poor visibility.
- 'Get The Big Picture' and 'Position' the tanker to be able to see ahead.
- Follow the Defensive Driving key 'Leave Yourself An Out' to escape from such hazard.

Event #3

Pictures

Damage to the Product
Vehicle front right side



Concrete Truck

Event #4

Product Vehicle Accident

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

What happened:

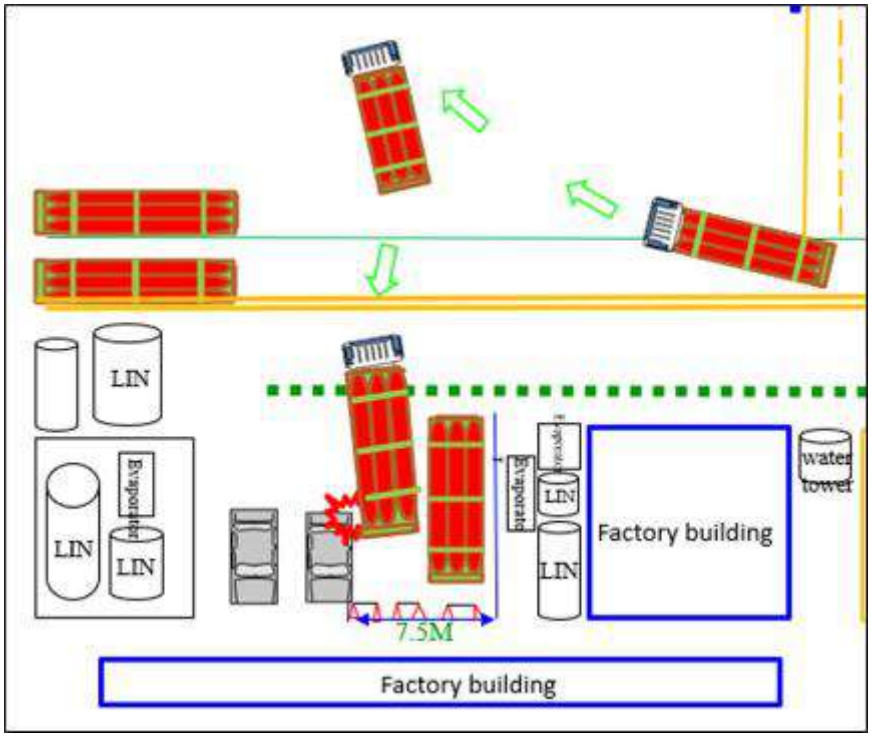
Around 21:31hrs, a contract driver decided to park the Bulk Hydrogen Tube Trailer(BHY TT) into the allocated parking space. He carried out GOAL. While reversing, the rear left side of the BHY TT collided with the van that was parked next to it. The rear light of the van was damaged as a result of the collision.

Lesson learned:

- Driver misjudged the space required for the BHY TT.
- 'Stop the job' when visibility is poor.
- Mark out the designated parking lots in the parking area.

Event #4

Pictures



Event #5

High severity product vehicle accident

Consequences: *Employee driver fatality and lost time injury to helper*

What happened

At around 18:09 hrs, an employee driver with a contractor escort was driving an empty LIN tanker on the way back from delivery. When driving off the highway and approaching an intersection of a provincial road, the tanker hit a stationary third party truck waiting at a traffic light. Ambulances arrived at the scene promptly and sent the driver and escort to local hospitals for emergency treatment. The driver passed away in the hospital soon after arrival. The escort's left leg was fractured and his jaw received 5 stitches. There was no product leakage however the LIN tanker was severely damaged. There was also no third party injury. During investigation it was found that within the last one minute before collision, the In-cab camera captured the driver closed his eyes four times. The accompanying escort was checking the new route direction on his smartphone due to road closure, thus he was also not focusing on the road before the collision and could not alert the driver. An automatic system generated alert happened to warn the driver but that was when the truck was too close to the vehicle in front. It came just <1 sec before the collision.

Lessons Learnt:

- The driver had been identified as High Risk Driver previously, but there was a lack in follow-up for the improvement actions - having a close loop system is the key for all types of Safety management, including the management of identified high risk drivers.
- Driver warning system based on technology to meet the purpose

Event #5

Pictures

Cabin condition after collision

Severe damage to tractor

Event #6

Product Vehicle Accident

Consequences: *Potential Fire due to overheat*

What happened

A driver just finished loading pallet to customer site and was about to leave the premises. When rolling down the window to make a transaction at the toll gate, the driver noticed a strong odor like burning of grease coming from outside. After completing the toll transaction, the driver decided to stop the truck and look for the source of the smell. Upon checking, the driver found that the left rear tyre was overheated and there was melted lubricant around the wheel rim. The driver called the maintenance team who arrived soon at the location and immediately carried out inspection and replacement of the tyre. It was found that tyre 4 was deflated that resulted in tyre 3 and tyre 4 rubbing against one another. Tyre installation did not comply with tyre manufacturer's installation standards. The site does not have any tyre management standard procedure nor assigned workshop.

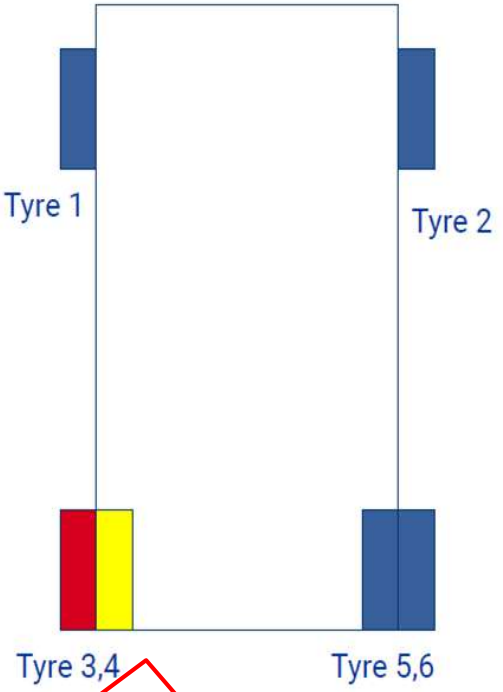
Lessons Learned:

- Change existing tyre and check all the existing tyres on trucks based on Manufacturer standard.
- There is a need for assigned workshop to do tyre management and SOP on tyre management with installation & maintenance guidelines.

Event #6

Pictures

Emergency parking



Overheating of Tyre 3 was caused by deflation of Tyre 4

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Event #6

Product vehicle accident

Consequences: *Minor damage to the vehicles involved*

What happened

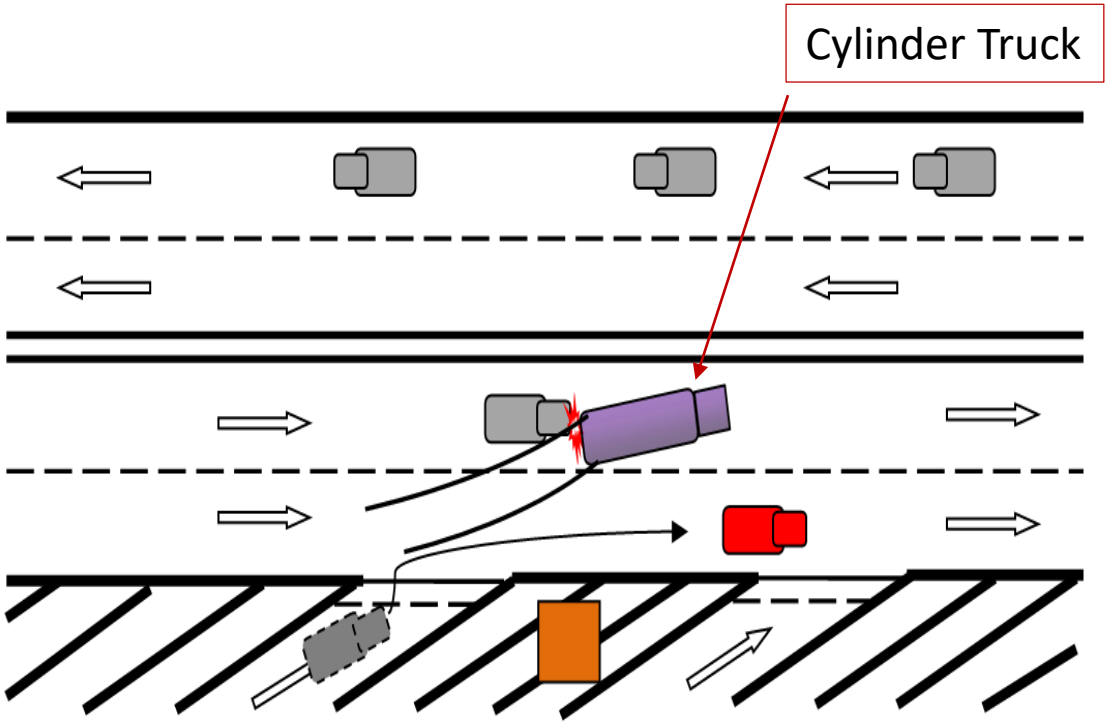
At 10:55 hrs a driver was driving a cylinder truck to deliver products to Customers when the accident happened. A car was driving on the same direction abruptly changed the lane to left obtrusively. To avoid the front car, the cylinder truck was braking and changing to the left lane, when the left rear collided with a mini van at the left lane behind. Both vehicles received minor damage but no injuries.

Lessons Learned:

- Always use defensive driving techniques
- The truck did not take early deceleration when there was a traffic junction in front: should reduce speed in advance according to signals/road condition at a distance
- The driver took braking and turned to the left to change the lane: drive in the appropriate lane based on road condition and while approaching a traffic junction

Event #6

Pictures



Event #7

Product Vehicle Accident

***Consequences**: Equipment Damage*

What happened:

A liquid nitrogen tanker drove to a junction and needed to turn left. The turning wheel of the left-turning vehicle was completed (the front of the vehicle had passed the junction, and the half body of the trailer was still in the junction) when it collided with the vehicle going straight opposite.

There was no injuries, no product leakage but the right bumper of the trailer was damaged. The 3rd party vehicle received damages to front bumper, hood, the right door and other areas in certain degrees.

Lessons Learned:-

- In the process of turning left, the vehicle did not slow down or stop when crossing the center line of the intersection with obstructed vision.
- Did not communicate effectively with the other vehicle; the other party did not perceive the existence of the N2 Tanker

Event #7

Pictures

Event #8

Product Vehicle accident

Consequences: *Equipment Damage*

What happened

At about 14:30hrs, a Bulk Liquid tanker was passing through a viaduct with slope and wet road conditions. It appeared that the wet road was mixed with water and oil. The tanker lost control, moved to the right and crashed into the concrete guardrail. Due to the impact, the truck right door was damaged.

Lesson learned:

- Driver failed to reduce speed while passing the wet road condition
- Observe ahead and anticipate the hazard that may be present

Event #8

Pictures

Occupational Safety, Maintenance Work and Construction related incidents

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Event #1

Occupational Safety – Slip, Trip & Fall

Consequences: *Head injury*

What happened

A driver, after parking the truck at deport parking area went to the office for paperwork. Later upon recalling that hehas left his ID in another truck earlier, he went to this truck. He opened the left side door of the truck and entered. He was then getting out of truck by stepping backwards when he fell backwards. This caused him a head injury and was sutured with some stiches.

Lesson Learned

- While getting off the truck the driver did not make 3-point contact for stability
- Helmet was not securely worn with shin strap fastened

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Event #1

Pictures

Event #2

Occupational safety - Slip, Trip & Fall

Consequences: *Worker injury*

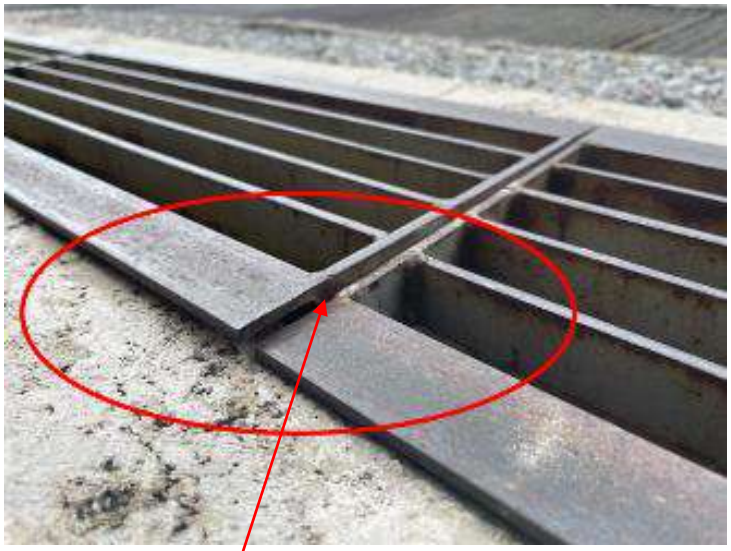
What happened:

Around 10:53hrs, a day-shift contract boiler operator was walking towards the chemical analysis room after recording the site water treatment chemical inventory. He crossed over from the tarmac walkway onto the drain grating. He felt his left safety shoe got caught on the edge of an uneven drain grating. He tripped, fell onto the drain grating and sustained cut to his forehead and nose. He proceeded to rise from the fallen position independently and headed to main office. First aid was applied to the wound by the plant manager and maintenance mechanical supervisor to stop the bleeding. He was then sent to the clinic for stitches to the wound.

Lesson learned:

Boiler Operator did not walk on the site designated walkway and also needs to focus on the path ahead while walking

Event #2 Pictures



Event #3

Occupational safety – Slip, Trip & Fall

Consequences: *Fall and burn injury to an Operator*

What happened

About 8:45 hrs, a plant operator was walking down the stairs towards the control room after collecting the cooling water samples. He slipped, fell and felt heat from the mobile phone in his pant's left back pocket when he stood up. Immediately, he threw out the scorching cell phone. He informed his supervisor and went to the hospital. The doctor diagnosed moderate burn and treated with pain killer and anti-tetanus injection. Operator returned to the site for continuing with the work for the day.

Lessons learned:

- Wear anti-slip safety shoes with deep sole threads and remove sand/debris underneath the shoes.
- Operator was distracted; holding two measuring cups without lids. Replace with sample bottle with lid.
- Relocate the water quality analyzers to upper floor, to avoid walking down the stairs

Event #3 Pictures

Event #4

Workplace safety

Consequences: *Worker injury*

What happened:

At about 9:40 hrs, an employee was delivering gas cylinders to a customer. While waiting for the elevator at the customer's workshop, his left elbow was hit by a copper plate, ejected through the acrylic protective guard of the CNC machine. The copper plate was 15cm long, 8cm wide, 0.5cm thick, and weighs 300g. Customer site personnel immediately bandaged our employee injured area. He was taken to the hospital for treatment by an ambulance.

Lesson learned:

- Strengthen the protective guard of CNC machines
- Be aware of surrounding work environment
- Share this incident with all drivers and escorts

Event #4

Pictures

CNC machine

Event #5

Operational safety – Slip, Trip & Fall

Consequences: : *Driver injury from a fall*

What happened

At a customer site, a driver missed his step and fell to the ground while he was climbing down from the valve operating box on the rear of a road tanker. The driver did not use the footboard while climbing down from the valve operating box. His ligament of elbow joint was torn.

Lessons Learned:

- The safe operating practices that make sure to use the 'Three-point contact' should be defined and trained be imparted to the drivers accordingly.
- The risks of the actives that up and down the narrow operating boxes were not identified, and therefore safe operating practices and training were not developed.

Event #5

Pictures

The right way for going up and coming down –
Use three point contact

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Event #6

Workplace incident

Consequences: *Lost Time Injury to Operator*

What happen:

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:

- Due to complacency, the injured person was using only one hand to push the cylinder trolley instead of using two hands, caused him to lose control when to pass the cargo lift doorway gap as one wheel got caught in the gap.
- Improper assessment of risk. Floor was found to be uneven due to some renovation works are going, which leading to the unstable movement of the cylinder trolley from all the way to the lift.

Event #6

Pictures

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Event #7

Workplace Incident – Slip, Trip & Fall

***Consequences**: Worker injury from a fall*

What happened:-

During the maintenance of a compressor, a equipment engineer went to the equipment platform to discuss the hoisting scheme. He fell down from the second floor platform (height 2.5m). Due to the height limit of lifting, the factory removed the platform guardrail in advance and temporarily surrounded it with a yellow warning belt. Correct wearing of the helmet, prevented any head injury of the employee but he received fracture in temporal bone and on left rib.

Lessons Learned:-

- Lack of fall prevention measures (such as safety nets, temporary quick-removal protective railings or hard isolation of the edge area) after the original platform was removed.
- The personnel responsible for the maintenance failed to effectively identify operational risks and take effective measures
- Need for refresher training to people carrying out such activities

Event #7

Pictures

Guard rail was temporarily removed

Event #8

Workplace safety- Slip, Trip & Fall

Consequences: *Lost Time Injury to a contract worker*

What happened:

Two contractor workers were repairing the wall of the office building of a mothballed facility. When one of them was moving on the scaffold, the scaffold board suddenly tilted, causing him to lose balance and fall to the ground from 3.7m height as he was not wearing fall prevention equipment. The injured contractor worker was then taken to the hospital for treatment. The left femoral and right wrist joint distal radius of the injured contractor worker were fractured what required him to stay 35 days in hospital for recovery.

Both contractors were not wearing fall prevention equipment and also no Safe Work Permit was issued for this task. Also there was no written identification of risks and control measures. Site coordinator was not on site when the contractors climbed onto the scaffold to perform the work. Contractor's qualifications were not verified on site, and site did not have any trained and qualified safety Supervisor. Also the mothballed facility was not included in the Company's system management.

Lessons Learnt:

- Identify applicable safety management procedures, emergency response procedures related with the activities of mothballed facilities, and train on-site employees.

Event #8

Pictures

Contractor losing balance when scaffold board tilted

Contractor falling from 3.7m

Contractor not wearing fall prevention equipment

Event #9

Work Place Safety – Slip, Trip and Fall

Consequences: *Operator injury from fall*

What happened

At a cryogenic liquid dewar filling site, an operator missed his step on the dewar filling platform (for fishtruck) and fell to the ground. the operator got a fracture of a transverse process of his lumbar. When walking on the platform, the attention of the operator was not concentrated, he missed his step and fell to the ground

Lessons Learned:

- Inadequacy in work place design – narrow unguarded platform at height
- Training for safety awareness and behavior safety based observation
- Carry out proper risk assessment for workplace

Event #9

Pictures

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Handling of Cylinders

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Event #1

Incident involving handling of PLC

Consequences: *Recordable Injuries to a helper*

What happened:

A 200L (350kg) LN2 Portable Cryogenic Container was moved to the tail lift of a cylinder truck by a helper. On completion of this activity, the helper stood on the tail lift. The driver activated the remote switch to lower the tail lift, however, the tilt function was activated at the same time. The tail lift tilted downwards, resulting in loss of balance of helper and PCC falling onto the ground. As a result, the helper sustained bruises on his forehead. No product was released.

Lessons Learned:

- Tail lift design – Risks of tilting not identified
- Engineering Review and Improvement of the tail lift gate design to minimize the impact due to human errors
- It is important to conduct periodic Job Safety Observations - Monitoring loading/ unloading activities either with technology/ camera or in person

Event #1

Pictures

Event #2

Cylinder Forklift Incident

Consequences: *Pedestrian injury*

What Happened:

- A forklift driver was transferring a full CO2 MCP pallet to yard when the loaded forklift collided with a pedestrian who was walking along the yard area. The pedestrian was diagnosed with a torn Achilles tendon on his left leg and underwent debridement by doctor.

Lessons Learned:

- At risk behavior by pedestrian : To be vigilant and aware of forklift hazards
- Procedure of reversal not followed- driver should reverse if load is blocking front visuals
- Inadequate Management Supervision and consultation with operating teams on layout of walkway and general design of yard

Event #2 Pictures

Event #3

Cylinder handling incident

Consequences: *Lost Time Injury of a Cylinder Truck Driver*

What happened:

At about 9:50 hrs on a day, a cylinder truck driver was rolling the empty cylinders to the outside of the tailboard of the truck, one of the empty cylinder placed on the ground suddenly tumbled forward due to the uneven ground of the customer site. The driver tried to catch the tumbling cylinder, but he did not make it when his hand was hit by the cylinder.

The driver did not give feedback to the company in time. After several days, the driver still felt discomfort in his hand and needed to take time off to go to the hospital for treatment, when he reported it to the company

Lessons Learned:

- The operator was rolling two cylinders at the same time and performing other operations without ensuring that the cylinders were placed stably.
- Freestanding Cylinders were not properly secured. Also when the cylinder was tumbling, the operator tried to stop it.
- It is strictly forbidden to roll two cylinders at the same time, do not try to catch tumbling cylinders, and ensure that the cylinder is firmly secured during operation.

Event #3

Pictures

Event #4

Incident in Handling of PLC

Consequences: *Lost Time Injury of a Driver*

What Happened:

When moving a Portable Liquid Cylinder(PLC) onto a slope at the customer site, one Packaged Gases(PG) driver and 2 customer employees were pushing the PLC from behind while one PG driver was pulling the PLC from the front. Suddenly the PLC fell on the PG driver pulling from the front and hit him above the hip of his body as he stood in the line of fire when handling the PLC. The driver felt pain and was laid down on the floor until the ambulance arrived to send him to the nearest hospital.

Upon diagnosis at the hospital, the X-ray showed a fracture on his spine bone (T12). No surgery was required but the driver had to stay in bed to restrict his movement.

Lessons Learned:

- BSV conducted on this task previously but did not highlight that driver's position was in the line of fire when performing PLC handling
- Insufficient PLC frame design leading to easily topple due to high COG and may fall outside its base from any uneven floor condition
- Need for enhancing safety awareness for Customers and PG drivers on PLC handling

Event #4

Pictures

- Tall & Narrow Base
- Small Wheels

Unsmooth concrete joint at the beginning of the slope

Process Safety

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Event #1

Process Safety Incident

Consequences: *Hose whip and driver injury*

What Happened:

A 3rd party tanker was purged with gaseous nitrogen to lower the tanker purity to within specifications. The LN2 tanker was positioned to perform gas nitrogen purging. A ¾" PVC hose between the medium pressure gas nitrogen header and tanker bottom fill flange through adapter. On both sides, the hose was pushed through a threaded nipple and tightened with Jubilee Clamps.

During the process of opening the bottom fill valve by the driver, the purge hose snapped out of adapter clamping and hit the filler who was standing close to the connected hose. The filler sustained laceration above the left eye lid and received stitches on the wound. Corrective retina laser surgery was performed on him subsequently

Lesson Learned:

- Conduct MOC for design safety reviews
- Revise and improve procedure
- Conduct job observations and engage team

Event #1

Pictures

A: Engineer, B: Filler, C: Driver


Laceration on eye lid


Sharp Edge of the Clamp

Event #2

Process Safety Incident

Consequences: *Underground gas nitrogen pipeline puncture*

What Happened:

Gaseous Nitrogen (GN2) underground pipeline at customer premises was punctured by customer construction team. The pipeline was damaged by a bore pile machine. The pipeline was for supply of gaseous nitrogen to various customers at an industrial area.

Total estimated amount of GN2 released was 23,700 kg (~4.86 hrs), based on the flowrate at around 4,876 kg/hr what caused temporary interruption of GN2 supply to two pipeline customers.

Lessons Learned:

- Customer internal communication failure as their main contractor did not communicate to their subcontractor regarding the live pipeline at their pile points.
- Clear scope must be identified as well as the sequence of the works must be clearly established with customer, when there are different agencies involved for the pipeline relocation works,

Event #2

Pictures

Event #3

Process Safety Incident

Consequences: *Injury of a driver*

What Happened:

About 7:24hrs, a driver (Driver1) found that the fill coupling was leaking while filling the LCO2 Micro Bulk Truck at a plant. The driver hit the LCO2 tank's fill connection with a brass hammer to tighten it, and the gas return hose suddenly detached from the tank's fill coupling. The hose swung and hit the driver's foot (Driver1), causing a deep cut to his left foot. He fell down to the ground and his abdomen was bruised. The driver (Driver1) closed the CO2 tank gas globe valve immediately. Another driver (Driver2) closed the valve on the tanker and shut down the pump. The injured driver's leg was bandaged and sent to the hospital immediately! The X-ray results showed that the foot had a traumatic injury without fracture but the injury on the left leg required some stiches.

Lesson learned:

- Hose female coupling was not fully tightened into male headpiece thread
- Apply too much Teflon tape onto male thread
- Driver did not use the anti-whip chain on the hose

Event #3 Pictures

Event #4

Process Safety Incident

Consequences: *Nitrogen leak from a ruptured pipeline.*

What Happened:

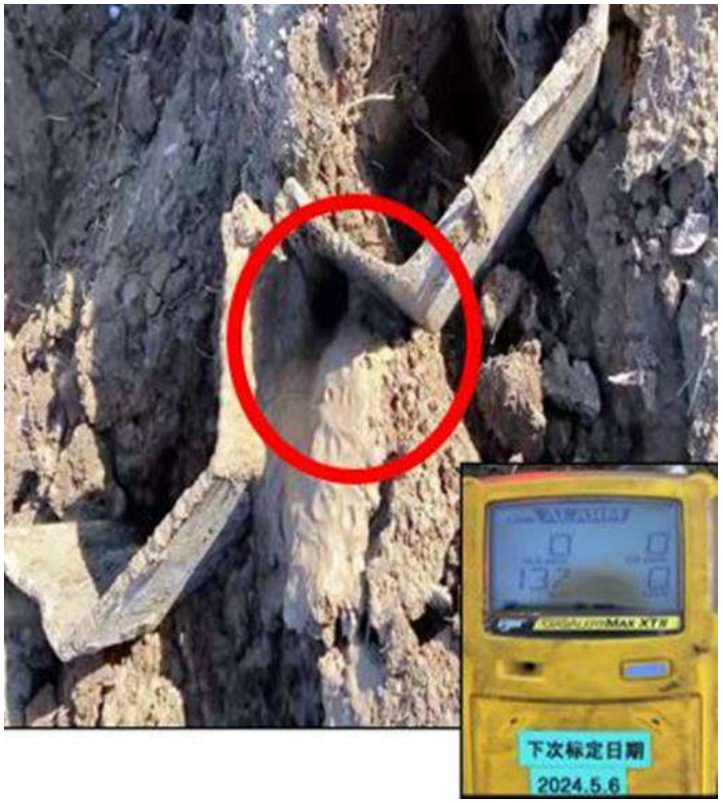
At about 8:50 hrs, underground gas nitrogen pipeline was hit by steel sheet piling during municipal construction. Nitrogen leak caused the pipeline supply pressure to drop and the backup system kicked in accordingly. The N2 pipeline was isolated at 9:18 hrs. No personnel injury was reported.

Lesson learned:

- N2 pipeline location (piping route & depth cover) was inconsistent with the as-built drawing.
- Site Ops Team lack tools and methods for underground pipeline detection. Qualify pipeline detection vendor.
- Improve pipeline SOP. Update related drawings and records.

Event #4

Pictures



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Event #5

Process Safety Incident

Consequences: *High severity potential incident*

What happened:-

A cylinder refilling personnel was working in the nearby laboratory when he heard a bursting sound coming from the refilling ramp. Upon checking, the team found out that the Vacuum Gauge at one of the ramps has burst. The pressure in that refilling ramp was at 200 bars when the incident happened. Luckily, there was no injury reported as there was no one working in the vicinity at the time of the incident. Cylinder filling activities were stopped immediately. The refilling team then replaced the damaged vacuum gauge.

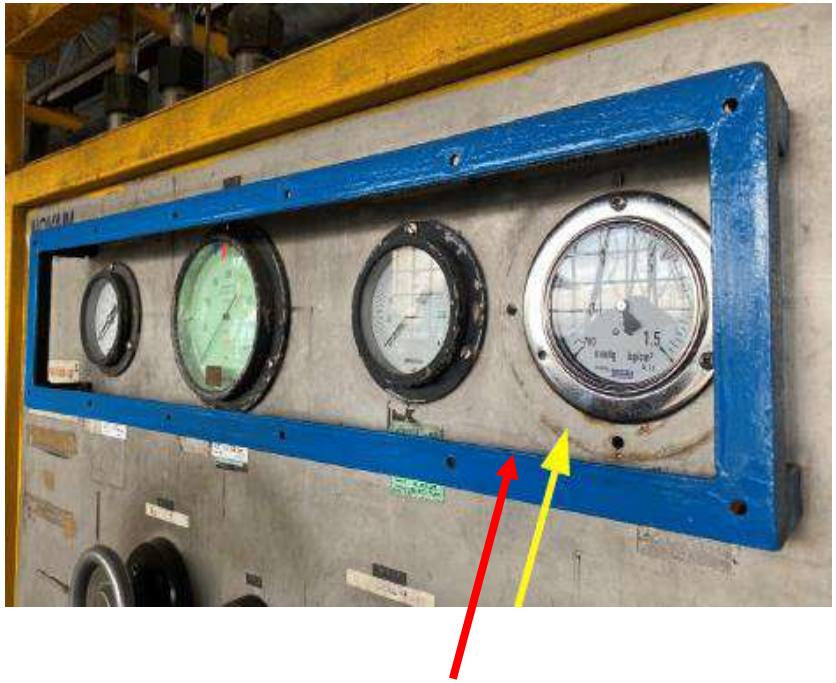
It was found during investigation that night shift refilling personnel started the purification process and turned over the activity to the next shift. Day shift operator who continued the process failed to check if the vacuum valve was closed before starting the filling process (as per facility SOP, vacuum valve must be closed before the filling process).
Dead weight flange with O-ring was not included in the original design/installation of vacuum line of this ramp, thus over pressure protection was not covered for this fill ramp.

Lessons Learned:

- Carry out Risk Assessment and provide over pressure protection
- Provide protective cover (polycarbonate) to all gauges at Refilling ramp.

Event #5

Pictures



Newly replaced vacuum gauge

Damaged vacuum gauge regulator and scattered broken glass cover

Event #6

Process Safety Incident

Consequences: *Cryogenic burn injury*

What Happened:

A tanker driver tried to disconnect the flexible hose from the tanker while there was still residual pressure inside the hose which happened during a automatic filling sequence. After 30 min of yellow light (indicating of residual pressure of more than 0.3 barg), the driver decided to loosen the 'bayonet coupling' while communicating with the operator about the condition. The operator arrived on site to check the conditions and told the driver to immediately close the bayonet. Instead the driver knocked open the valve while the operator was holding the bayonet's flexible hose. Within few minutes, LOX splashed over the operator causing irritation to his right arm. The operator immediately flushed himself with fresh water and was escorted to the nearest hospital for further treatment.

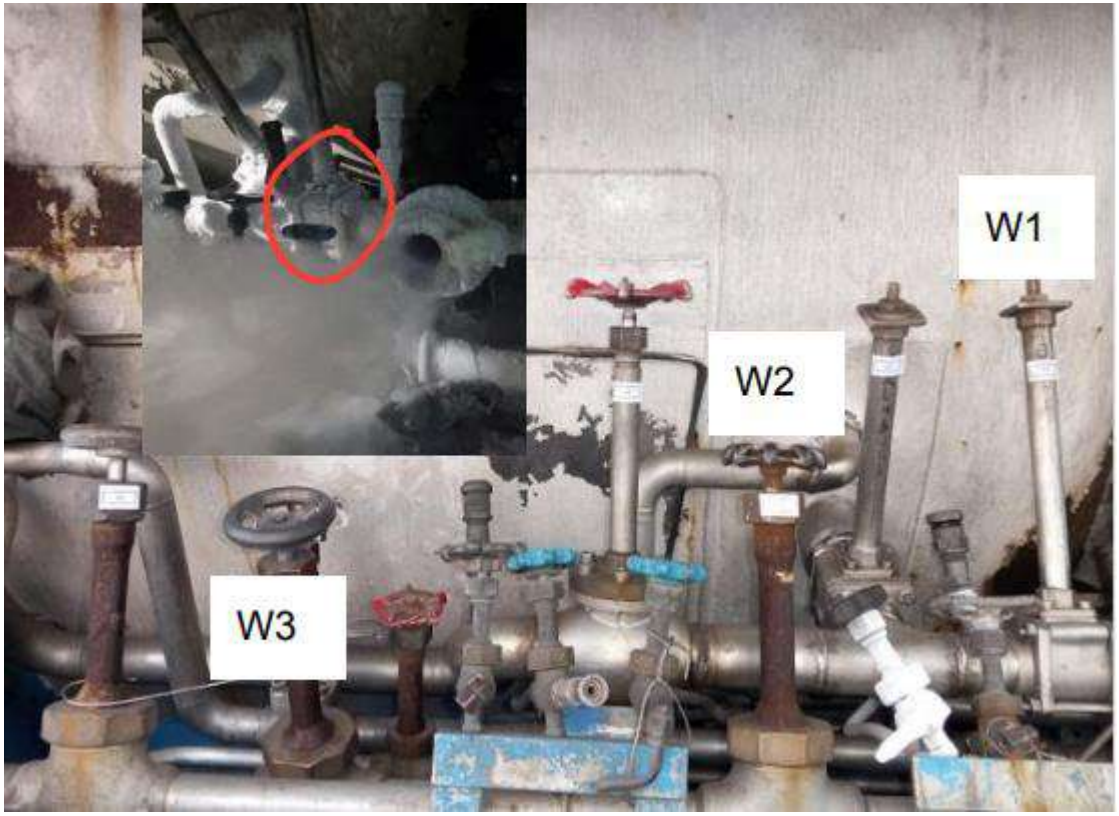
It was identified during investigation that the driver did not hear instructions from operator due to loud noise in the area. Similar incident happened in the past when driver reacted by opening the bayonet to release pressure, which was not reported until this event.

Lessons Learned:

- Report any issue to supervisor when ever there's a deviation in the automation
- SOP on management of deviation

Event #6

Pictures



Event #7

Process Safety Incident

Consequences: *O2 Cylinder blow out and flash flame*

What Happened

Around 13:44 hrs, a HP O2 cylinder valve suddenly failed several minutes after the finish of the filling (P: 15.2Mpa, T: 45 C) which resulted in the O2 blow out from the valve with flash flame. No one was injured. Dirt particles might have blocked the closure of the valve gasket and caused local deformation of the gasket, eventually causing a sudden oxygen leak. It is suspected friction between the high velocity gas flow and the gasket and/or the impact of particles caused ignition source. The valve spool gasket was tested and confirmed to be made of polysulfone which incompatible for oxygen service , not PTFE as claimed by the manufacturer.

Before the customer's oxygen cylinders were put into use, the filling station did not carry out the internal inspection, which failed to eliminate the risk of the cylinder valve with a small amount of grease, rust, dust and other debris.

Lessons Learned:

- The oxygen cylinders hosted by the customer should be properly inspected before the first commissioning.

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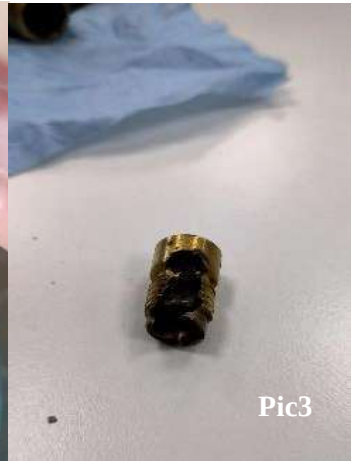
Event #7

Pictures


Pic1


Pic2


Pic3

Event #8

Process Safety Incident

Consequences: *O2 filling hose ruptured and fire*

What happened:

A filling station was filling a batch of industrial oxygen - 69 40L single cylinders. At 16:05 hrs, all cylinder valves were closed after the filling finished(pressure 14MPa). The incident happened when the filler opened the discharge valve on the manifold to relieve pressure. Both ends of a filling hose on the manifold suddenly exploded with shooting out of about 200mm high-blue flame from the broken end of the cylinder valve, accompanied by jet-like fireworks and a huge sound. A filler near the accident cylinder was grazed on the back of his left hand by the rebound of the burst hose. Both ends of the filling hose were broken, and there was burn mark at the end close to the valve connection (Pic 1), on the valve inlet and the connection of the filling clamp (Pic 2). The valve spool had a melted cavity and the sealing gasket was completely burned out Pic(3).

It is suspected in the process of cylinder turnover flow, the cylinder valve was polluted by grease, and it was not found before filling. Also the filling system has been in operation for a long time, and no filter was installed on the oxygen pipeline. Also the system has not been purged during the years' of operation, what led to chance of accumulation of certain metal oxide particles.

Lessons Learned:

- It is important to have a full proof oxygen cleaning management system and practice for O2 cylinder filling.

Event #8

Pictures

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, assessment of contractors etc.

★ **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**
- **Being mindful and attentive** on task is important
- Always use **3 point contact**

Lessons learned from the safety events(2)

★ **Handling of Liquid and Gas 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'**

★ **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
- Underground Pipeline Safety – Requires **close coordination** with external agencies and customers
- **Importance of Oxygen Cleaning** for HP O2 Cylinder filling systems

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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 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

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Thank you

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