



## Dangerous Goods Safety Significant Incident Report No. 01-19

### Ammonia release during ship unloading

#### Summary of incident

On 21 July 2018, a major release of ammonia gas occurred at a Western Australian port.

As part of a standard operation, an ammonia tanker vessel was supplying anhydrous ammonia to a process plant. Following the completion of liquid ammonia unloading, purging of the loading arm and pipework was commenced with ammonia gas supplied by the ship via the onboard storage tank head space.

While the purging operation was underway, an operator inadvertently partially closed a line valve. As the line valve was no longer fully open, a control signal was sent to the plant emergency shut-down (ESD) valve to trip closed.

This resulted in increasing internal pressure and hydraulic hammer in the loading arm, creating significant forces against the loading arm quick connect/disconnect coupler which was not sufficiently tightened for the conditions. These forces caused the loading arm to decouple from the ship's flange and release ammonia gas. Ammonia continued to flow from the ship manifold until the ship crew manually tripped the ship's ESD system. The release was estimated to be 1200 kg over 24 seconds.

Five personnel present at the jetty were taken to the hospital for medical examination or assessed by ambulance services. All were released the same day.



Photograph of the loading arm coupler

#### Direct factors

The loading arm quick connect/disconnect coupler disconnected from the ship due to internal pressure.

## Contributory factors

- The unloading of ammonia was completed without correct engagement of the coupler. This can be attributed to:
  - insufficient written instruction provided

The standard operating procedure provided little detail on the correct process for the coupler engagement.
  - the control panel provided ambiguous information

A green indicator lamp on the control panel indicated that process to engage the coupler was starting. This indicator can be misconstrued as meaning full engagement has been achieved.
  - there was no procedural system to validate the coupler engagement prior to commencing ship unloading

There was no visual check to confirm that the two indicator lines aligned as per the manufacturer's instructions.
  - there was no interlock to prevent unloading unless the coupler was fully engaged.

The process relied on procedural controls.
- There was full reliance on the coupler installation with no secondary back-up system.

At the flange connection, there was only one control measure to ensure continuity of attachment. As the coupler is an electric-hydraulic system, various faults in the system could result in a loss of connection.
- Hazard identifications and risk assessments did not adequately identify all reasonable control measures for the interface between the ship and the plant.

Manual intervention by a third party was required to stop the flow of ammonia from the ship. There was no automated system to shut the supply of ammonia from the ship in the event of a plant emergency at the time of the incident.

## Actions required

To ensure similar incidents do not happen, the following actions are recommended for all operations involving quick connect/disconnect couplers.

- Ensure the quick connect/disconnect coupler is correctly engaged by:
  - confirming the standard operating procedure provides adequate written instructions
  - attending periodic refresher training from the vendor
  - implementing checklist hold points to confirm critical systems are in place prior to unloading
  - installing transducers on the coupler and interlock with the safety system.
- Install a locking mechanism on the coupler to ensure it cannot be inadvertently decoupled.
- Review and revise the hazard identification and risk assessments to ensure all reasonable control measures are in place at the interface with third parties. For ship transfers:
  - install a ship to shore safety shutdown system to automatically close the ship manifold valve in the event of a plant ESD.
- Revise competency and refresher training for all personnel working with couplers.

## Further information

Visit [www.dmp.wa.gov.au/ResourcesSafety](http://www.dmp.wa.gov.au/ResourcesSafety) for information on dangerous goods safety.

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19 March 2019