

# Notifiable incident

**Incident ID** [6294](#)

**Duty holder:** Shell Australia Pty Ltd  
**Facility/Activity:** Prelude FLNG  
**Facility type:** Floating liquefied natural gas facility

Incident details	
<b>Division</b>	Occupational Health and Safety
<b>Notification type</b>	Incident
<b>Incident date</b>	20/11/2019 02:32 AM (WST)
<b>Notification date</b>	12/12/2019 06:33 PM (WST)
<b>NOPSEMA response date</b>	13/12/2019 06:38 PM (WST)
<b>Received by</b>	[REDACTED]
<b>Nearest state</b>	WA
<b>Initial category type</b> <i>(based on notification)</i>	Dangerous Occurrence
<b>Initial category</b> <i>(based on notification)</i>	Other kind needing immediate investigation
<b>3 Day report received</b>	15/12/2019
<b>Final report received</b>	17/01/2020
<b>All required data received</b>	23/01/2020
<b>Final category type</b> <i>(based on final report)</i>	Dangerous Occurrence
<b>Final category</b> <i>(based on final report)</i>	Other kind needing immediate investigation
<b>Brief description</b>	OHS-OKNI-Issue with level control in LP dry knockout drum
<b>Location</b>	
<b>Subtype/s</b>	Other
<b>Summary</b> <i>(at notification)</i>	<p>Operator advised that a production trip occurred due to a high level in the LP dry knockout drum.</p> <p>At the time the plant was being restarted following maintenance and at the same time work was being done on the LNG expander . The cause of the trip was identified as liquids from the expander accumulating in the knockout drum and also erratic readings from the radar type level transmitter in the drum due to the presence of cold liquids. The problems with the level transmitter were subsequently rectified and the plant restarted.</p>
<b>Details</b> <i>(from final report)</i>	<p>Operator advised that a production trip occurred due to a high level in the LP dry knockout drum.</p> <p>At the time the plant was being restarted following maintenance and at the same time work was being done on the LNG expander . The cause of the trip was identified as liquids from the expander accumulating in the knockout drum and also erratic readings from the radar type level transmitter in the drum due to the presence of cold liquids. The problems with the level transmitter were subsequently rectified and the plant restarted.</p> <p><b>** As Supplied by Duty Holder**</b></p> <p>What happened:</p> <ul style="list-style-type: none"> <li>• High Level Trip on LP Dry Knock Out Drum, 630LZAHH-1002 activates @2:32 AM on Wed 20th Nov, initiating GPSD.</li> <li>• This is an activation of the Instrument Protective System (IPS) and hence recordable in FIM and NOPSEMA.</li> </ul>

#### Sequence of Events:

1. LNG expander commissioning cooldown in-progress, the V-63002 Dry HP Flare Drum Liquid Level was open to V-63005 the Dry vaporiser. The level in the vaporiser vessel rapidly increased, and the vessel temperature had fallen to approximately -145degreesC.
2. To prevent continued level increase and temperature decrease in the vessel the inlet to V63005 ex V63002 was closed and a second vessel heater was started.
3. The pressure in V63005 increased to 1.3barg and the second heater was stopped. Whilst allowing V63005 level to weather off V63003 the LP flare drum level 630LZAHH-1002 activated triggering an FLNG cold end shutdown.

#### Work or activity being undertaken at time of incident:

Work or activity being undertaken at time of incident Initial Actions taken:

- Operations team verified safe shutdown of the LNG train occurred and plant was safe with no further potential for escalation.
- Maintained LNG Train Shutdown until the cause was understood and resolved.

#### What are the internal investigation arrangements?

Event was recognised as one requiring to be investigated and LNG train was to be remained shut in until cause of trip was adequately understood and managed.

Event logged in internal incident management system (FIM) and investigation has included detailed investigation into process side and level instrument side.

#### Action taken to make the work-site safe:

1. Verified that plant was safe in the 'shut down' state and no escalation possible.
2. Remained LNG train shutdown until cause understood and resolved.
3. Investigation into incident kicked off.
4. Cause understood and resolved.

#### Immediate action taken/intended, if any, to prevent recurrence of incident.

Action - Keep LNG plant shutdown until cause understood and resolved. Responsible - OIM.

Completion Date - From: 20th Nov 2019 @ 02:32 AM To: 25th Nov 2019 @ 06:00 AM

Action - Conduct investigation into cause. Responsible - Process Engineering Lead & PACO Lead.

Completion Date - From: 20th Nov 2019 @ 02:32 AM To: 23rd Nov 2019 @ 06:00 PM

Action - Resolve cause. Responsible - OIM/Maintenance. Completion Date - From: 23rd Nov 2019 @ 06:00 PM To: 24th Nov 2019 @ 10:00 PM

What were the immediate causes of the incident? Incorrect High Liquid Level detection (630LZAHH-1002) in V-63003 LP Dry Knock Out Drum – Note: level detection tripped 'early'/conservatively.

Part of calibration of this level detection was outstanding and documented and planned for later date. In order to allow safe operation, the level detection had been setup to act conservatively (or 'early' at lower than required liquid levels). This ensured that the Instrument Protective Function would always fail safe and to ensure safe operation of plant.

#### Root cause analysis:

Root cause 1 - Commissioning activities resulted in sending large quantities of very cold LNG to V-63002, which drained (by design) to V-63005.

Root cause 2 - It is believed that heavy hydrocarbons or water may have collected at the bottom of V-63005, which plugged the high-level protection of V-63005.

Root cause 3 - The heaters in V-63005 were activated while the equipment was overfilled, resulting in liquid carryover to connecting vessel V-63003

#### Full Report:

The investigation was conducted by Operations Engineers, PACO Engineers, and Process Engineers using Shell Causal Reasoning Methodology.

A summary of the incident is below:

- As part of commissioning activities of the LNG Expander, the unit was being cooled down by LNG, which was being drained to the high pressure (HP) dry flare system. By design, all of the dry flare system is capable of handling cryogenic liquids.
- Liquid was being received in dry flare HP KO drum V-63002. Some of this liquid was drained to dry flare vaporiser V-63005. V-63005 is designed to improve liquids handling capacity of the dry flare system through batch vaporisation.
- As liquid was being drained, the level within V-63005 appeared to be ~40% when the operators activated the electric heaters.

- Suddenly the liquid level from the level transmitter rose above 90%, however the independent level trip transmitter stayed at approximately 30%, thus the high-level protection of V-63005 did not activate.
- As the heaters continued to heat the liquid in V-63005, the pressure inside the vessel increased, resulting in liquid carryover up through a vent line (designed normally for vapours)
- This vent line joins the low pressure (LP) dry flare header, but the line is sloped back to the dry flare LP KO drum V-63003. As liquid entered the dry flare header from the V-63005 vent line, it drained back into V-63003.
- The liquid level increased in V-63003, however it is believed that the vaporisation of liquid in V-63003 caused spikes in the level resulting in 2003 level transmitters voting to trip, as the level signal from each transmitter in V-63003 was very unstable. It is believed the actual liquid level inside V-63003 was much lower than the trip setpoint, supported by the unstable level readings, and that ice on the vessel wall and level instruments was below the normal transmitter trip height. Because 2003 transmitters voted to trip, a cold end trip was initiated, which is by design to protect the facility from sending excessive liquids to flare.

During the investigation, it was found that the level transmitters on the dry flare KO drums (V-63002, V-63003) were not adequately calibrated. LNG production was not restarted until these level transmitters were properly investigated and recalibrated (on 24/11/19).

Dry flare vaporiser V-63005 has been taken out of service until the investigation and rectification of its level transmitter has been performed.

Note the wet flare KO drum level transmitters (V-63001, V-63004) had already been calibrated earlier in 2019 so there was sufficient confidence in these instruments.

It was suspected that there may have been heavier hydrocarbons or water present within V-63005 that have frozen as a result of the LNG sent to dry flare HP KO drum V-63002. V-63005 is able to drain heavier fluids which is normally done as a manual operation.

Due to the above two causes, an engineering review into improvements that can be made to the level transmitters of the dry flare system is underway.

The investigation also found that procedures around the use of V-63005 heaters and on the method of commissioning the LNG expander should be updated to improve clarity to avoid a repeat incident.

Actions to prevent recurrence of same or similar incident:

Action - Investigate and correct the calibration of level transmitters on V-63002 and V-63003.

Responsible - Lead PACO Engineer. Completion Date - 24/11/2019 (completed)

Action - Take V-63005 out of service until investigation and calibration of its level transmitters has been conducted. Responsible - Production Coordinator. Completion Date - 20/11/2019 (completed)

Action - Investigate and identify potential engineering improvements to dry flare level transmitters.

Responsible - Lead PACO Engineer. Completion Date - 27/05/2020

Action - Improve procedures for commissioning the LNG expander to avoid exceeding V-63005 operating window. Responsible - Offshore Commissioning. Completion Date - 24/11/2019 (completed)

Action - Revise operating procedures for draining persistent liquids from V-63005 and for activating flare vaporiser heaters to avoid repeat incidents. Responsible - Upstream Operations Engineer.

Completion Date - 21/02/2020

<b>Immediate cause/s</b>	TBC
<b>Root cause/s</b>	
<b>Root cause description</b>	<p>Root cause 1 - Commissioning activities resulted in sending large quantities of very cold LNG to V-63002, which drained (by design) to V-63005.</p> <p>Root cause 2 - It is believed that heavy hydrocarbons or water may have collected at the bottom of V-63005, which plugged the high-level protection of V-63005.</p> <p>Root cause 3 - The heaters in V-63005 were activated while the equipment was overfilled, resulting in liquid carryover to connecting vessel V-63003</p>

Duty inspector recommendation	
Date	13/12/2019
Duty inspector	
Recommendation	Do not conduct Major Investigation
Reasoning	Does not meet MI threshold based on information received
Supporting considerations	

Major investigation decision	
Date	13/12/2019
Decision	Do not conduct Major Investigation
Reasoning	Does not meet MI threshold based on information received
Supporting considerations	

Non-major investigation review and recommendation	
Date	16/12/2019
Inspector	
Risk gap	Moderate
Type of standard	Established
Initial strategy	Investigate

Recommended follow up strategy	
Recommended strategy	Investigate
Supporting considerations	Flare KO drums High High trips utilise a 2oo3 configuration. In such a configuration, it is highly unlikely that there will be a "spurious" trip without some form of common mode failure across the devices. If there is such a common mode failure scenario, this may imply that the assumptions made in the SIL assessment and verification are wrong for some process conditions. It could be reasonably assessed, therefore, that the High High trip is impaired under some scenarios. As yet, Shell has not provided enough information for NOPSEMA to form the reasonable conclusion that the Flare KO drum High High trips will operate as required under all scenarios and that the assumptions made for the SIL verification remain valid. Recommend investigate at the next PI.

Non-major investigation decision	
Date	16/12/2019
RoN	
RoN review result	Agree with recommendation
Strategy decision	Investigate
Supporting considerations	

Associated inspection	
Inspection ID	<a href="#">2129</a>