Notifiable incident

Incident ID	6280
Duty holder:	Shell Australia Pty Ltd
Facility/Activity:	Prelude FLNG
Facility type:	Floating liquefied natural gas facility

Incident details	
Division	Occupational Health and Safety
Notification type	Incident
Incident date	03/12/2019 02:40 PM (WST)
Notification date	03/12/2019 04:23 PM (WST)
NOPSEMA response date	03/12/2019 05:26 PM (WST)
Received by	[redacted]
Nearest state	WA
Initial category type *(based on notification)*	Dangerous Occurrence
Initial category *(based on notification)*	Unplanned event - implement emergency response plan
3 Day report received	04/12/2019
Final report received	17/01/2020
All required data received	23/01/2020
Final category type *(based on final report)*	Dangerous Occurrence
Final category *(based on final report)*	Unplanned event - implement emergency response plan
Brief description	OHS - UPE Flame detector activation resulting in GA and Muster
Location	
Subtype/s	Alarm, Emergency response, Muster
Summary *(at notification)*	Two (2) flame detectors initiated at the same time in a topside utility module resulting in a general alarm, full facility shut down and muster. In the following 10 minutes 4 other flame detectors initiated in the same area. At the time the facility was in steady state production and preparing to moor an FLNG carrier. On initial investigation it appears to have been a false alarm and the detectors were reset at 25:12 hours. Mooring operations have recommenced but production will not restart until root cause is fully understood. Investigation ongoing 3 day report to follow.
Details *(from final report)*	Two (2) flame detectors initiated at the same time in a topside utility module resulting in a general alarm, full facility shut down and muster. In the following 10 minutes 4 other flame detectors initiated in the same area. At the time the facility was in steady state production and preparing to moor an FLNG carrier. On initial investigation it appears to have been a false alarm and the detectors were reset at 25:12 hours. Mooring operations have recommenced but production will not restart until root cause is fully understood. Investigation ongoing 3 day report to follow. **As Supplied by Duty Holder** What happened: At 14:40 two flame detectors were initiated in 4S1 module on A deck which resulted in a General Alarm (GA) and full facility shut down (GPSD). An additional four flame detectors came in to alarm in

the subsequent 10 minutes in the 4S1 module. All executive actions from the flame detection were initiated as per the cause and effects including GPSD and deluge activation in 4S1.
Flame detectors were reset at approximately 15:12 and Fire Teams were deployed and confirmed no fire in the field.
Full facility muster achieved.
LNG carrier remained alongside but not moored to FLNG.

Work or activity being undertaken at time of incident - Normal plant operations and mooring procedure.

What are the internal investigation arrangements? 5 Why Causal Reasoning Investigation

Action taken to make the work-site safe - Facility muster and emergency response. Mooring operations ceased but vessel remained along side.

Details of any disturbance of the work site - Nil

How effective was the emergency response? Effective Response and full muster achieved.

Immediate action taken/intended, if any, to prevent recurrence of incident:
Action - Test for possible interference by Ships Radar by putting overrides on affected detectors (did not replicate Detection). Responsible - Services Coordinator. Completion Date - 3/12/2019
Action - Investigation into F&G system performance. Responsible - [redacted] Team Leader. Completion Date - ongoing

What were the immediate causes of the incident? This cause is still being investigated.

** As Supplied by Duty Holder**

Has the investigation been completed? Yes

Root cause - While the LNG Carrier ([redacted] was being moved into the berthing position alongside Prelude, GCU (Gas Combustion Unit) emissions from the exhaust gas outlet of the LNG Carrier was seen by multiple flame detectors in 4S1 and 3S1 as the carrier travelled from aft to forward. The flame detectors activated the executive action as per the intended design and this resulted in a General Platform Shut Down (GPSD).

Full Report:
Describe investigation in detail, including who conducted the investigation and in accordance with what standard/procedure with reference to attachments listed in the 'attachments table' (following) as applicable
Technical investigation and causal reasoning investigation completed by Prelude onshore engineering investigation team with input from fire and gas subject matter expert and shipping operations. The investigation was to determine what activated the various flame detectors (causing the GPSD) and why the GPSD activated during this LNG carrier offtake and not during previous offtakes. This investigation was conducted in accordance with Shell 5 Causal Reasoning questions investigation process.

Initial Observations: The trends and data obtained from the DCS clearly indicate positive confirmation from the flame detectors and as such these were not spurious events. The detectors functioned correctly and in accordance with the intended design.

Investigation: The investigation determined that there was a total of eight flame detectors that activated on positive confirmation of any two of the following conditions: hot CO2, Infra-Red or a flicker (approx. 12Hz). This was in-line with the operating principle of the flame detectors and confirmed by the manufacturer.
In addition, evidence from DCS trends clearly identified that these were positive activations and not spurious.
What was not clear at the time, was the source of the hot CO2, Infra-Red and/or flicker considering that no fire in the field was confirmed. Shipping logs obtained from the [redacted] confirmed that the engines were on diesel and that the Gas Combustion Unit (GCU) was operating at the time of the GPSD.
GCU's on LNG carriers are used to control the pressure within the LNG carrier storage tanks and are designed in accordance with the International Gas Code so that no external visible flame can be present at the exhaust gas outlet and that the uptake exhaust temperature should not exceed 535 degrees Celsius.

	This prevents an undesired ignition source in the event of a flammable gas release from the LNG carrier or from the facility. All flame detector ranges and coverage in module 4S1 were investigated, and provided evidence that it was highly likely that while the LNG Carrier [redacted]) was being moved into the berthing position alongside Prelude, GCU emissions from the exhaust gas outlet of the LNG Carrier were seen by the flame detectors on the starboard side in modules 4S1 and 3S1 as the carrier travelled from aft to forward. CCTV footage was reviewed and eventually provided credible evidence that supports the theory that the various flame detectors on the starboard side of Prelude activated chronologically, in line with the movement of the vessel, after seeing the GCU emissions from the exhaust gas outlet. To provide further evidence to support the GCU theory, a photo of the subsequent LNG carrier after the GPSD was taken during berthing and clearly shows that the GCU was visibly in line with the first flame detector that activated in module 4S1 during the GPSD event. What cannot be clearly explained is why the previous or subsequent LNG carriers had not activated the flame detectors resulting in a GPSD, considering that other LNG carriers are of similar heights and lengths and did have both their diesel engines and GCU's running at the same time. The only plausible explanation is the flow rate at which the GCU's are operated on each vessel. It is recommended that they are operated at minimum flow however the flowrate is not recorded on ships logs and therefore could not be interrogated further. Actions to prevent recurrence of same or similar incident: Action - Capture in the Prelude Compatibility Process and the Compatibility Checklist request for confirmation that the GCU is functional with respect to International Gas Code requirements. International Gas Code (IGC) 7.4.1.1, "Thermal oxidation systems shall exhibit no externally visible flame and shall maintain the uptake exhaust temperature below 535°C". Specify in the Prelude LNG Terminal Information Book the requirement to minimise the use of GCU. Responsible - Terminal Manager. Completion Date - 31/1/2020 Action - Capture the requirement in the LNG Carrier Prearrival Checklists confirmation by the TTL/Pilot that the GCU is functional with respect to International Gas Code requirements. Responsible - Terminal Manager. Completion Date - 31/1/2020 Action - Marine Assurance Coordinator to ensure that this event is recorded in the Global Maritime Assurance System (GMAS) so that they can be followed up with the vessels operator. Responsible - Marine Advisor. Completion Date - 31/1/2020 Action - Determine whether FOV limiters or re-alignment of flame detector coverage within 4S1 is required based upon the results of a more focussed mapping study in consultation with Technical Safety and FGS SME. Responsible - Senior Instrument Engineer. Completion Date - 31/3/2020 Action - An operational risk assessment (FSR # 623107) has been implemented to ensure any potential ignition risk associated with GCUs is managed while an LNG carrier is alongside Prelude. Responsible - Services Coordinator. Due Date: Completed 17/12/2019
Immediate cause/s	TBC
Root cause/s	
Root cause description	Root cause - While the LNG Carrier ([redacted]) was being moved into the berthing position alongside Prelude, GCU (Gas Combustion Unit) emissions from the exhaust gas outlet of the LNG Carrier was seen by multiple flame detectors in 4S1 and 3S1 as the carrier travelled from aft to forward. The flame detectors activated the executive action as per the intended design and this resulted in a General Platform Shut Down (GPSD).

Duty inspector recommendation	
Date	04/12/2019
Duty inspector	[redacted]
Recommendation	Do not conduct Major Investigation
Reasoning	Does not meet MI threshold based on information received
Supporting considerations	

Major investigation decision	
Date	04/12/2019
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	04/12/2019
Inspector	[redacted]
Risk gap	Moderate
Type of standard	Established
Initial strategy	Investigate

Recommended follow up strategy	
Recommended strategy	Investigate
Supporting considerations	The facility shut-down system operated as designed. However, multiple detectors activated - cause unknown, moderate risk gap.

Non-major investigation decision	
Date	04/12/2019
RoN	[redacted]
RoN review result	Agree with recommendation
Strategy decision	Investigate
Supporting considerations	

Associated inspection	
Inspection ID	2129