INTERNAL USE ONLY

Notifiable incident

Incident ID	6151
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	18/09/2019 02:05 AM (WST)
Notification date	18/09/2019 06:37 AM (WST)
NOPSEMA response date	18/09/2019 07:43 AM (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	20/09/2019
Final report received	21/10/2019
All required data received	21/10/2019
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-Gas detector activation
Location	Deck
Subtype/s	Alarm, Muster
Summary *(at notification)*	Operator advised that as part of the preparation for maintenance on loading arm #1 the liquid inventory was being drained. During this operation, 2 gas detectors 14 metres away went into alarm. This initiated an ESD 2 and GPA. All crew mustered. The drain valve was shut and the gas detectors immediately reset. All crew stood down. At the time of the notification, the facility was still shut down and preparations for start up have commenced. A determination of the release volume will also be included in the report to the be submitted to NOPSEMA.
Details *(from final report)*	Operator advised that as part of the preparation for maintenance on loading arm #1 the liquid inventory was being drained. During this operation, 2 gas detectors 14 metres away went into alarm. This initiated an ESD 2 and GPA. All crew mustered. The drain valve was shut and the gas detectors immediately reset. All crew stood down. At the time of the notification, the facility was still shut down and preparations for start up have commenced. A determination of the release volume will also be included in the report to the be submitted to

NOPSEMA.

** As Supplied by Duty Holder**

Positive gas detection on 2 point gas detectors (613GH1F30M and 613GH1F29M on Main deck 3S1) at 14m distance from draining point on LNG line to MLA1. Draining of the line was ongoing in preparation of maintenance work on MLA1 (swivel seal repair work, requiring breaking containment). Operator was in attendance and shut the drain valve when General Alarm was activated.

Gas detection resulted in ESD2 and EDP.
All executive actions happened as per design.
All personnel mustered.
Once F&G was clear, the fireteam was sent out to confirm no gas leaks.
Once confirmed all personnel were stood down and facility returned to normal status.

Work or activity being undertaken at time of incident: Preparation of maintenance work on MLA1 - swivel seal repair work, requiring breaking of containment.

What are the internal investigation arrangements? Preliminary internal investigation commenced immediately gathering data, pictures and documented evidence. NOPSEMA notified. Formal investigation to be conducted by onshore investigation team.

Was Emergency Response Initiated: Yes. Facility mustering and Emergency response team activation performance standards achieved.

** As Supplied by Duty Holder**

Was there any loss of containment of any fluid (liquid or gas)? Yes, estimated quantity 25kg of natural gas. Leak identified as 25% of valve opening, approx. 490mm2 release size at 0.1barg upstream pressure with a release duration of 3minutes. Release quantity estimated at 25kg given low upstream pressure.
Known toxicity to people and/or environment - People - Yes. Environment - No
How was the leak/spill detected? F&G detection
Did ignition occur? No
Has the release been stopped and/or contained? Yes
Duration of the release - 3 minutes
Estimated rate of release - Litres or kg per hour - 0.1354kg/s
What or where is the location of the release? Main deck, MLAs under 3S1 Module
What equipment was involved in the release? Marine Loading Arms
Is this functional location listed as safety-critical equipment? No
Weather conditions - Ambient temperature - 27C°
Relative humidity - 80%
Wind speed m/s NB: for enclosed areas use Air change per hour - 0.4m/s
Wind direction e.g. from SW - 45o, from NE
Significant wave height m - 1.2m
Current speed m/s 0.3m/s

System of hydrocarbon release - Process
Estimated inventory in the isolatable system Litres or kg - 50 kg
System pressure and size of piping or vessel diameter (d in mm) length (l in m) or volume (V in L):
Pressure MPag - 0.1barg pressure upstream. Size Piping (d) and Piping (l) or Vessel (V) - 80 mm
Estimated equivalent hole diameter d in mm - 25mm

Action taken to make the work-site safe - Operator was in attendance and shut the drain valve when General Alarm was activated.

Immediate action taken/intended, if any, to prevent recurrence of incident:
Action - Assurance activities to confirm ESD/ EDP system has operated as per performance standards, prior to restarting units. Responsible - Prelude OIM. Completion - Prior to restart of each unit.
Action - Stand down with operations team to re-enforce importance of isolation procedures.
Responsible - Prelude OIM. Completion Date - Completed 20/09/2019
Action - Clarification of procedure for preparing equipment for maintenance and isolating equipment.
Responsible - Prelude OIM. Completion Date - 20/09/2019

What were the immediate causes of the incident? Incompletely defined procedure for preparing this equipment for service, which resulted in technician venting the system to atmosphere within the unit,

subsequently causing the gas detectors to read levels sufficient to alarm and EDP the facility.

Root cause analysis:
Root cause 1 Preparation for maintenance requirements of the LNG Marine Loading Arms had not been formally documented
Root cause 2 The Lock-Out-Tag-Out (LOTO) isolation process was not completely followed
Root cause 3 Handover between the people who started applying the ICC and the person who continued implementing it did not occur

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 Investigation Team:
Offshore Process Engineer, Onshore Operation Engineer, Storage & Loading (S&L) technician, Onshore & Offshore Permit to Work (PTW) Team and Production Support Technician (PST) were involved in this investigation.

Summary of Events:
• During the process of preparing LNG MLA 1 (Z-34001) for maintenance work on the swivel 5 water seal, QV-3400049 was cracked open, to prove double block and bleed as defined on the isolation, resulting in an LNG vapour discharge of approximate 25 KG. This led to gas detection at two nearby gas detectors, initiating general alarm and muster of all personnel and leading to facility shutdown and depressurisation.
• Initial investigation identified that the shutdown valve between the LNG tanks and the MLA's (340UZV-2424) had been left in the open position, when it should have been closed (only the actuator was isolated). 340UZV-2424 is normally open to allow for hydrocarbon to drain back to the LNG tank at the end of an offtake.
• Further investigation identified:
o Preparation for maintenance steps had not been documented or completed prior to installation of isolation for the offloading header: the expectations around 'prepare for maintenance' for this system (including de-pressuring, purging, flushing and venting (DPFV) as required) were not documented and therefore inconsistently applied before performing process isolations. It was understood the responsibility for DPFV is with the relevant Area Authority, but this was not formalised.
o Isolation process was commenced by the day shift team and handed over to the night shift team to finish the remaining isolations. When the day shift team reached the hydraulic valves for 340UZV-2424 and radioed the CCR, they were advised that the valve was still open and awaiting application of a bypass override (BPO) to force it closed. It was agreed the task would be completed by the night shift. The day shift S&L technicians submitted written shift logs and conducted face to face handover with their night shift counterparts who would be completing the task. The work scope was then re-assigned to the Production Support Technician by night shift. The PST was handed the ICC field pack and the investigation identified they did not receive verbal/written handover about the job. The PST then reviewed the pack, noting that day shift had circled the points on the ICC plan that they had completed but not marked up the PEFS, and proceeded to hang the remaining locks and tags. The PST had hung all the remaining locks and tags, except the tag for the BPO to force 340UZV-2424 closed. They believed this valve was in the closed position because they had applied the ICC to the hydraulic valves. However, 340UZV-2424 was not closed, increasing the potential volume of HC release when the bleed point was opened and triggered the gas detectors and ESD.

Actions to prevent recurrence of same or similar incident:

Review and update the Prepare for Maintenance procedure to include clear guidance on draining, flushing, purging, steaming and venting (DFPSV) requirements for a specified scope of work. Responsible - Production Coordinator. Completion Date - Completed
Review and update the current Loading Arms Maintenance procedure to include preparing the MLAs for maintenance.Responsible - Operations Manager. Completion Date - 30/11/2019
Review LOTO requirements for short duration isolations including double block and bleed implementation and requirements. Review and update the LOTO manual in alignment with Shell global control framework and communicate updates to all relevant parties [onshore and offshore]. Responsible - Operations Manager. Completion Date - 31/12/2019 Red-Lines to manual submitted for Review/Approval
End of Shift Reports (EOSR) needs to be updated and will include additional section to capture status of ongoing isolations/deisolation's and permit activities and this is to be discussed during face-to-face shift handover. This will also capture actions addressing to relevant parties and detail the DFPSV activities required in the Field Technician EOSR. Responsible - Production Coordinator Completion Date - 31/12/2019

Immediate cause/s	TBC
Root cause/s	
Root cause description	Root cause 1 Preparation for maintenance requirements of the LNG Marine Loading Arms had not been formally documented Root cause 2 The Lock-Out-Tag-Out (LOTO) isolation process was not completely followed Root cause 3 Handover between the people who started applying the ICC and the person who continued implementing it did not occur
Release type	Hydrocarbon gas
Gas (kg)	3

Duty inspector recommendation	
Date	18/09/2019
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	18/09/2019
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	18/09/2019
Inspector	[redacted]
Risk gap	Extreme
Type of standard	Established
Initial strategy	Investigate ASAP

Recommended follow up strategy	
Recommended strategy	Investigate ASAP
Supporting considerations	Two gas detectors activated to cause an ESD 2 (blowdown/shutdown of topsides). Have assumed that gas concentration could have been above LEL and found an ignition source, leading to fire/explosion. Potential consequence is serious (fatalities) and likelihood has been realised on more than one occasion within the offshore petroleum industry (probable). Benchmark should be Nil/Neg. --> Risk Gas = extreme. Standard = established (hazardous area etc.) therefore strategy = Investigate ASAP.

Non-major investigation decision	
Date	18/09/2019
RoN	[redacted]
RoN review result	Agree with recommendation
Strategy decision	Investigate ASAP
Supporting considerations	

Associated inspection	
Inspection ID	2084

Runsheet entries		
1	**Event date**	18/09/2019 04:16 PM
	Event	Update received from OIM that initial release volume of HC gas is 3kg.