2015 UAD PROCESS SAFETY EVENTS*  
TIER 1 & TIER 2

* OMS quicklink 1.1 which includes  
PT-Platform Wells & Construction and  
UAD Logistics

Updated Through December 23, 2015
TIER 1 & 2 PROCESS SAFETY EVENTS THROUGH 12/23/15

Tier 1 = 2
- 4/26/15 – FPSO Fluminense: Uncontrolled Gas Release from Booster Gas Compressor
- 7/19/15 – Ursa: Tubing line failed on Pax 103 Crude Oil pipeline pump

Tier 2 = 15
- 1/14/15 – FPSO Espirito Santo: Fire in Gas Turbine A from turbine lube oil pump leak
- 1/22/15 – Mars: Chemical leak from tote during acid stimulation operation
- 4/18/15 – Ram Powell: Diesel leak from emergency sump
- 5/23/15 – Ram Powell: Methanol released to sump due to leaking check valve
- 5/28/15 – Enchilada: LOPC of gas/oil due to a failure of the HP separator sight glass
- 5/31/15 - FPSO Fluminense: Crude oil release from offtake line to dock
- 7/19/15 – PT Wells: LOPC from Slugging Pit Overflow on Olympus
- 8/2/15 – Mars: Umbilical tube failure during integrity test (Methanol released to sea)
- 8/3/15 – Olympus: Methanol/SD02 Well Fluid backflow into Methanol Hull Tank
- 9/25/15 – Mars: Methanol release to E-sump from open drain valve on filter/strainer pot
- 11/24/15 – FPSO Fluminense: Crude oil release to deck
- 12/6/15 – FPSO Espirito Santo: Biocide spilled to deck
- 12/8/15 – Mars: Corrosion Inhibitor released to E-Sump
- 12/9/15 – Cougar: Crude Oil released from transfer hose
- 12/17/15 – Ram Powell: Methanol release

June 2015
Overview: While starting up booster gas compressor A, a natural gas release was observed coming from the first stage discharge cooler fan tubes. There was a group of 5 people in the area at the time of the event. A gas cloud was carried by the wind to the gas detectors on the production deck and several went into the high alarm (LEL above 60). This initiated an ESD blowdown of the rest of the plant and equipment. It is understood that two tubes on 1st stage discharge fin fan cooler had ruptured, releasing raw natural gas to atmosphere.

Parties Involved: Modec, Shell

Findings/Root Causes:
- IRIS was performed on 30% of the tubes with a min thickness of 0.7 mm found but the remaining life was not officially informed.
- The equipment was OOS for an extended period of time after IRIS, and it was not understood at the time that this would very significantly increase corrosion rates.
- There was a personnel change (integrity engineer) when the report was issued and this may have contributed to a lack of follow up of the report.
- The statement of fitness focused on the BGCA compressor where gas releases had previously been seen.

Learnings/Corrective Actions:
- A Causal Learning investigation completed. The learning engagement was completed in Brazil and also in New Orleans.
TIER 1: URSA CRUDE OIL RELEASE FROM PAX PUMP (7/19)

Overview: On Saturday July 19th, a sheen was observed in the Gulf of Mexico. After further investigation the source of the oil was identified at the PAX 103 pipeline pump where a seal flush tubing fitting had failed. This incident resulted with a platform ESD and ICS was initiated. Consequence was a Tier 1 LOPC – 1662 kg, ~12 barrels crude oil escaped Primary Containment, Estimated 19 minute duration and an Environmental Release – Approximately 100’ x 45’ Sheen, 0.0159 gallons (~2 oz)

Parties Involved: Shell

Findings/Root Causes:
• Inadequate makeup of the ferrule set
• Multiple makeups of the same fittings
• Unaware of OPS0211 Tubing Training, Installation and Inspection Procedure
• Fitting components from different manufacturers
• Failure to learn from past incidents

Learnings/Corrective Actions:
• Check all tubing fittings on PAX-101/102/103 for proper make-up and replace where necessary
• Complete survey of ALL ¾” and larger tubing fittings in hydrocarbons service and rotating equipment packages across the GoM
• Purchase hydraulic swaging unit and use for all ¾” and larger tubing connections
• Add level rate of change alarm on emergency sump to notify operators of potential issues
• Embed use of OPS0211 using ISSOW JSA process
Overview: Flame detection in the enclosure of Gas Turbine A caused by a leak in the turbine lube oil pump. There was no F&G indication outside the enclosure of the turbine at any time. As this incident was originated from a LOPC, this incident is classified as Tier 2. Estimated asset damage of $12,000.

Parties Involved: Shell, Solar Turbines, SBM

Findings/Root Causes:
- Engine failed due to liberated first stage turbine blade
- 64 seconds after engine shutdown the fire extinguisher activated likely due to the buffer air tubes heat.
- Lube oil continued to pump into the engine till fire was extinguished by lack of oxygen and fuel.

Learnings/Corrective Actions:
- Lube oil pumps continued to pump lube oil as per design and logic and the lube oil flashed off inside the turbine due to the excessive heat and thus generated more heat, Solar to see if they can modify the logic to recognize catastrophic failure of Engine and then stop lube oil pumps.
- The self contained fire system of Solar worked very well so no further action.
TIER 2: MARS CHEMICAL LEAK FROM TOTE (1/22)

Overview: Petro Sweet 700, an H2S scavenger chemical for the A-11 acid stimulation flow back, was released into the environment through a vent on the tote tank. Approximately 207 gallons were released to the atmosphere. The chemical came in contact with process equipment and 2 personnel. The tote tank on Deck 4 was connected via tubing to two checkpoint pumps PZZ-865/866 with a PSV set at 1480 psi. A hose was run from the checkpoint pump to the instrument spool on the A-11 wellhead to provide the required chemical for flowback. When the SSV was opened to test the H2S scavenger equipment, the pressure from the wellhead, approximately 4500 psi, provided the source of pressure that caused the release. The well cavity was filled with water and the well was pressurized with Nitrogen; no hydrocarbons were released to the environment. The checkpoint pump was never turned on; however the pressure from the wellhead flowed back through the hose and caused the PSV on the checkpoint pump to lift. The discharge of the PSV is routed to the suction of the pump and therefore the pressure relieved through the tote to atmosphere.

Parties Involved: Shell, Grand Isle Shipyard (GIS)

Findings/Root Causes:

• Design of the equipment layout and insufficient barriers for pressure management and flow.

Learnings/Corrective Actions:

• Equipment design and pressure ratings are being assessed by engineering prior to this equipment being put in service.
• P&ID will be verified and updated by field engineers.
• Operations and engineering approved standard operating procedure for this piece of equipment.
Overview: The generator annual maintenance work occurred the week of April 8th for ZAN 703. After performing LOTO it appears the manual block valves off the diesel filter pot drains lines (pictured below) were inadvertently left open. On April 15th, ZAN 703 began operating on diesel which subsequently allowed diesel to flow into the drain trough to the ESump. A heavy rain on April 18th overwhelmed the ESump pushing diesel through the bottom discharge resulting in a sheen. Upon troubleshooting the sheen the source of diesel to the ESump was found to be from the ZAN 703 diesel filter pots.

Parties Involved: Shell, Solar

Findings/Root Causes:
- 2 block valves on LP Diesel filter and pot’s drain line were inadvertently left open
- Lack of Hazard Recognition, Lack of/Not Following Procedures

Learnings/Corrective Actions:
- Lock close and add to LO/LC Register the LP Diesel Filter pot drain line block valves on all 3 generators
- Investigate an alternative means to drain the LP Fuel Filters to avoid getting hydrocarbons back into the ESump
- Review/update Generator S/U and Fuel Swap procedure
- Initiate a PSSR Checklist for any annual maintenance PM work that will be performed on generators to assure any third party work is inspected by Shell Job Sponsor prior to starting up equipment.
Overview: On May 23, 13 bbls of MeOH reverse flowed from well A7 into the Production Sump. The leakage took place over a 3 hour period. Otherwise the well was blocked in on the topside and the intent was to flow the well the following morning. The upset resulted in hydrate formation in the well. The subsequent RCA determined the volumes involved.

Parties Involved: Shell

Findings/Root Causes: The root cause for this event was found to be a severely leaking check valve on the A-7 tree along with lack of manual isolation at the tree.

Learnings/Corrective Actions: The valves downstream of the check valve were open, leaving the check valve as the only barrier to backflow. The check valve was stuck open by debris inside the valve. The upstream valve was open providing a path to the production sump. Available instrumentation did not provide immediate feedback that a backflow was occurring (no alarms, no flow or level indication).

Mitigations: Create standardized pumping procedure. Table top drills with operations to stress the importance of closing unattended valves and not depending on check valves. Review hose cleanliness and commissioning protocols.

Lateral Learning: The LOPC nature of this event was recognized after the investigation and further evaluation, leading to a delay in proper classification.

Key learning is that unintended operational events should be evaluated for the process safety implications and possible LOPC classification.
Overview: A failure of the High Pressure Separator Penberthy sight gage glass for the safety level control bridle lead to a gas and oil release. The release caused a platform ESD and initiated a full system depressurization. Oil was contained in secondary containment. Once the source of the leak was confirmed to have been isolated and the vessel was bled down, the ICS team investigated the failure. A 3.5” section of the sight glass was missing. The sight glass was removed and replaced with stainless steel plugs and the facility was restarted after completing a Statement of Fitness for Asset Restart after Incident.

Parties Involved: Shell

Findings/Root Causes:
- From the sight glass failure analysis: Suspect excessive torque applied to sight glass bolts put additional stress on the gage glass which eventually led to the failure.

Learnings/Corrective Actions:
- Sight glass failures or seepages have led to four loss of containment events in 2014 & 2015, including one Tier 2 process safety event, two platform ESDs and 90MBEQ in deferment at Enchilada and Salsa.
- Sight glasses are rarely utilized by operations and there are only a select few applications where a sight glass is the preferred level indication by operations.
- A number of sight glasses were identified across Shell GoM platforms in applications that do not coincide with requirements from the DEM1 Standard on Piping requirements (DEP 31.38.01.11) and the DeepWater Instrumentation Standard. (ENG0066SP). Work is ongoing to determine whether these can be removed.
- LFI being developed to share incident learnings more widely
Overview: There was a spill of oil from 24” flange at the metering skid, as the marine department commenced pressurizing the export metering package in preparation for a cargo offtake. The pressurization was stopped, the leak was contained within a 210 liter container, and the oil which leaked on the deck was contained using SOPEP materials. Overall volume of spill is 250 liters, 60-90 of which was directly on the deck and the rest in a drum.

Parties Involved: Modec

Findings/Root Causes:
- Inadequate preparation and planning.
- Lack of ownership and communication issues.
- Pressure test did not include the leaking flange.

Learnings/Corrective Actions:
- Prepare Procedure for interventions on the offtake metering skid, including scaffolding, lighting, integrity test, etc.
- All personnel working in flanges, make sure of the pipe specifications along with the marked up P&IDs are included in the PTW.
Overview: While circulating Synthetic Based Mud (SBM), #2 pop off valve lifted causing #2 slugging pit to overflow 3bbls of SBM into secondary containment. The job was stopped. No fluid entered the gulf.

Parties Involved: H&P

Findings/Root Causes:
- While circulating Synthetic Base Mud the pop off valve was set at 5200psi. At 4600psi the valve lifted causing 3bbls of SBM to overflow into the secondary containment.
- Slugging Pit Alarm was set too high
- Screen on Drillers console was not showing the slugging pit

Learnings/Corrective Actions:
- Alarm was reset to 5bbls
- Slugging pit will be kept empty while not in use
Overview: During a planned pressure test of the Mars Europa CI umbilical, the M4/M5 MeOH circuit failed at 7000 psi topsides pressure. The point of failure was subsea with a calculated release of 7 barrels of Methanol to the Gulf of Mexico.

Parties Involved: UAD Subsea and Ops and PTP

Findings/Root Causes:
- Release potential was anticipated but team did not realize Tier 2 LOPC potential
- Umbilical design deficiency that is susceptible to Hydrogen embrittlement

Learnings/Corrective Actions:
- A decision was made to not fully displace the umbilical contents in order to limit the handling exposures (pumping, lifting, transport, disposal, etc.) of hazardous chemicals. Future decisions will consider consequences of loss of primary containment.
- Incident reporting requirements and appropriate notification protocol are understood by the Subsea Team and will be followed going forward.
Overview: During the SD02 unload in early August, MeOH was being pumped to the subsea injection system to prevent hydrate. A leaking needle valve created a flow path from MeOH TUPA to MeOH tank (a lower pressure system). As a result, the MeOH started to flow towards the hull tank and stopped maintaining positive pressure on the well. This also allowed SD02 well fluid to flow from the tree to the Surface Flow Line and back up the umbilical into the hull tank.

Parties Involved: Shell

Findings/Root Causes:
• The tubing drain line in question was added with an MOC in Oct 2014 to ease draining activities
• Single isolation valve was installed to block/throttle fluid back to the methanol tank from the sub-sea tree
• There was no alarm for detecting the differential pressure to determine potential reverse flow scenario (Well head vs Pump out)

Learnings/Corrective Actions:
• A needle valve should not be used as a throttling valve due to increased risk of valve cutting and leakages
• Reverse flow scenarios should be considered for all piping/tubing changes
• TUPA change was put back into original design (eliminated the flow path)
• Implement a differential pressure alarm to warn of potential well fluid flow back
Overview: A drain valve underneath a filter / strainer pot was inadvertently left open following the replacement of Methanol piping. Methanol from the storage tank drained through this valve into the skid pan undetected. The leak was later found by an IT working in the adjacent area. This incident resulted in a Tier 2 PSE with a total of 12,500 gallons of MeOH released to the skid containment system then to the sump.

Parties Involved: Shell

Findings/Root Causes:
• Drain valve at bottom of FX-801A Filter Pot was inadvertently left open after using it to verify de-inventory of filter pot for construction crew
• Drain valve was not included in LOTO so there was no record of this valve being opened

Learnings/Corrective Actions:
• LFI being developed
Overview: During Hot Oil circulation of Bijupira Manifold 2, a leak was discovered by a Production Operator on the 4” inlet piping to PSV 1020-2 in Module 1. In addition to covering a large portion of the FPSO’s deck, oil was also sprayed into the sea from the starboard side. Estimated size of the sheen was 350-400 meters long and 20 meters wide. The release was classified as a Tier 2 Process Safety Event with 300 liters of oil released on the deck and 5 liters released to the sea.

Parties Involved: Modec

Findings/Root Causes:
• Awaiting results of Modec investigation

Learnings/Corrective Actions:
• TBD
Overview: After decanting Biocide EC6579B the operator found that the level increase in the fixed storage tank was not matching the volume of the tote decanted (1500 liters). Inventory of EC6579B on 05/12 was 3128 liters - inventory on 06/12 was 447 liters. Consumption for Biocide II treatment 05/12 1500 liters for treatment of slops. Volume spilled estimated 1180 liters. Failed coupling found on flexible hoses running between MOD-15 and MOD-22 below the main deck.

Parties Involved: SBM

Findings/Root Causes:
- Failure of the Biocide hose coupling was due to incompatibility with biocide
- Expect further information from SBM’s internal investigation

Learnings/Corrective Actions:
- TBD by SBM
Overview: At approximately 6:30 PM on Tuesday December 8, 2015 an overflow vent was found to be discharging Corrosion Inhibitor (CRO-9185) into a chemical injection pump bank skid pan. The release was found when a deck operator was completing rounds and smelled a distinct chemical odor. Upon investigation, the operator found a stream of chemical flowing into the skid pan. The operator immediately closed a 3/8” tubing valve at the drain discharge point and reported the release. The total reported amount lost was 629 gallons (2144 kg) in less than 14 hours, resulting in a Tier 2 process safety event.

Parties Involved: Shell

Findings/Root Causes:
- Investigation ongoing but initial findings include:
  - Tubing arrangement on this tank is different than sister tanks.
  - Discrepancies between field equipment and drawings were found upon initial investigation, specifically the vent line involved in the LOPC was not shown in the drawings.
  - The top of vent line extending above the tank was disconnected and found to be full of fluid, pointing to a possible overflow or siphoning event.

Learnings/Corrective Actions:
- LFI to be developed once investigation is finalized

Shell
TIER 2: COUGAR: CRUDE OIL RELEASED FROM TRANSFER HOSE DURING ABANDONMENT ACTIVITIES (12/9)

Overview: An LOPC occurred while transferring oil from the MBK-300 vessel (Bulk Oil Treater) to the MV Harvey Colt during abandonment activities. A 2” hose W/ cam-lok fitting was connected to a diaphragm pump for the transfer. Pump was located in a 56 gal. containment pan. The hose fitting leaked and quickly filled the pan to overflow. Approximately 19 gal. of oil was spilled on the deck. The 75 gallons of crude oil released was classified as a Tier 2 Process Safety Event.

Parties Involved: Gibson/Trussco/Shell

Findings/Root Causes:
• Investigation revealed that the Cam-Lok fitting on the pump inlet was installed without a proper gasket
• No verification was made that a gasket was present in the fitting at the time the hose was installed

Learnings/Corrective Actions:
• Confirm Abandonment procedures include detailed steps for transfers and pre-use hose inspection checklists
• Review procedure requirements in tailgate talks prior to starting the job
Overview: On 12/17/15 at 4:00AM, the LSL alarmed on the Methanol Storage Tank ABJ-832. Deck Operators were sent to investigate and did not notice any leaks or spills. The low level was validated in the Methanol Storage Tank. This provided an indication that approximately 8,000 gallons of Methanol was apparently released to the Production Sump then entered the E-Sump which was then released to the Gulf of Mexico. No sheen was observed. Further calculations indicated that approximately 8,300 Gallons of Methanol was released over a 30 hour period resulting in a Tier 2 Process Safety Event classification.

Parties Involved: TBD

Findings/Root Causes:
- Investigation Ongoing

Learnings/Corrective Actions:
- TBD