


<b>Incident Title</b>		<b>Condensate Stripping Pump Leak</b>	
<b>Incident Type</b>		Explosion	
<b>Date</b>		11 <sup>th</sup> February 2015	
<b>Country</b>		Brazil (offshore)	
<b>Location</b>		Camarupim gas field	
<b>Fatalities</b>		<b>Injuries</b>	<b>Cost</b>
9		26	US\$ 316 m (2021) – Ref. 2
<b>Incident Description</b>		<p>A natural gas condensate leak occurred in the aft pump room of the Cidade de São Mateus (CDSM) Floating Production, Storage and Offloading (FPSO) vessel while a cargo tank was being pumped out to the aft slop tank via a temporary line-up and stripping pump. The CDSM was originally a very large crude carrier (VLCC) which had been converted to an FPSO in 2008 and was moored in 790 m (2560 ft) of water at the Camarupim gas field. Several gas detectors in the pump room alarmed, confirming presence and movement of an explosive atmosphere. However, emergency responders entered the area multiple times to locate, assess and repair the leak. Attempts to clean-up the leaked material with adsorbent mats were unsuccessful, so a fire hose was deployed to perform a "water sweep" while the repair was ongoing. A major explosion occurred, destroying the bulkhead between the engine room and the adjacent pump room, breaching the main deck and wrecking the single access route to the pump room. The hull remained intact, but the vessel developed a severe list to the stern because the pump room flooded (due to fire water and sea water main ruptures and damage to the sea chest valves).</p>	
 <p>Credit: Brazilian Navy/Reuters</p>			
<b>Incident Analysis</b>		<p><b>Basic cause</b> was overpressure of an isolation blind on the discharge side of a reciprocating-type stripping pump resulting in loss of primary containment (LOPC) of natural gas condensates and creation of an explosive atmosphere in a confined space.</p> <p><b>Critical factors</b> included: 1) Natural gas condensate was stored in the crude oil cargo tanks contrary to the conversion project specification (condensate should be reinjected into gas export line when no oil production), 2) Isolation blind did not meet the pipe spec for the service, 3) Stripping pump was operated with discharge valve closed, 4) Use of fire hose for "water sweeping" leaked hydrocarbon condensate (static generation), 5) The single access/egress route to the pump room was destroyed by the explosion.</p> <p><b>Root causes</b> included: 1) Failure to follow proper pumping procedures (discharge valve closed), 2) Inadequate risk assessment (entry into confined space with explosive atmosphere present), 3) Failure to complete VLCC to FPSO conversion project before FPSO commissioning (eg. stripping pump stroke counter and high discharge pressure alarm not installed), 4) Inadequate management of change (storage of condensate in crude cargo tank and installation of blind restricting pump transfer line-up options), 5) Inadequate supervision (poor decisions to send multiple crew members into high hazard area in violation of installation safety procedure and prematurely de-mustering the crew while incident was ongoing).</p>	
<b>Lessons Learned</b>		<p>1) Never enter a confined space containing an explosive atmosphere, 2) All projects involving a change of service and/or process fluids should undergo a rigorous management of change (MoC) review and a pre-startup safety (PSSR) review, 3) Individual (deep well) submerged pumps in each tank are an inherently safer design which avoids the need for a pump room.</p>	
<b>More Information</b>		<p>1) "Investigation Report of Explosion Incident Occurred on 11/02/2015 in the FPSO Cidade de São Mateus", National Agency for Petroleum, Natural Gas and Biofuels (ANP), August 2015. 2) "100 Largest Losses in the Hydrocarbon Industry", Marsh Property Risk Consulting Practice, 27th Edition (2022).</p>	
<b>Industry Sector</b>		<b>Process Type</b>	<b>Incident Type</b>
Oil & Gas		Offshore FPSO	Explosion
<b>Equipment Category</b>		<b>Equipment Class</b>	<b>Equipment Type</b>
Mechanical		Piping	Blinds