

LFI – June 2020: Leak on S&T Exchanger Flange



LFI: Incident Description

- Syngas was taken into Synthol Train 3 at 09h23 on Saturday and then taken out 20 minutes later when at 09h44, the outside operator reported to the SS on duty that there was oil “spraying” out of the northern side dome of the Heat Exchanger, XES310 (Train 3 Hot Pump Around Cooler).
- There was some “fuming” but no fire, and a fire monitor was opened and water was put onto the leak to dissipate any collecting fumes and then also to act as a preventative mitigation for any potential and possible fire.
- It was reported that there was no leak on the XES310 when the gas was taken into the Train, but when the Hotfeed Valve was closed - that is when the XES310 started leaking oil on that northern side dome.
- Mechanical engineer and gasket specialist were called out, scaffolding was erected, the Train depressurised, and the northern side dome was hi-torqued and corked.
- The work was completed, and the Train was pressurised and a stand test was conducted. XES310 northern dome passed with “no leaks”, proving the hi-torque and corking exercise successful.
- Synthol Train 3 was brought on line at 04h25 Sunday morning.

LFI: Sequence of Events

SOE 1	Train 3 decommissioned.	<i>Due to loss of reformer, opportunity maintenance executed. Repairs of two instruments valves XFV3216 and XLV3213 completed.</i> <i>Replacement of XES310 south dome gasket. As part of safe making, the BFW across XES310 was blocked-in and shell side drain valves opened to empty the inventory. The dome and shell flanges inspected and found free from any defect; the gasket inspected and found damaged at 6 o'clock position. The gasket damage was consistent with steam cut. Gasket replaced and work on XES310 completed.</i>
SOE 2	Train 3, cold start up.	<i>The CFO was signed on Friday 22/05/2020 and production started with commissioning activities during the night, the BFW was blocked-out and train was pressurised.</i>
SOE 3	Train 3 took in gas from Reformer.	<i>After gas was introduced to Train 3 an oil leak "spraying" from XES310 channel head end-cover flange (North side) was report by operator to the shift supervisor, at 09H44 the train was taken offline, fire water was opened to dissipate fumes. Emergency teams activated and maintenance team called out.</i>
SOE 4	XES310 North side channel head end-cover flange leaking oil.	<i>Maintenance team evaluated the leak and a decision taken to do temporary repairs. Train was depressurised, flange was re-torqued, and online leak sealing contractor caulked the flange and injected sealing compound, leak stopped.</i>
SOE 5	Train3 took in gas from Reformer.	<i>After the repairs, the train was pressurised and no further leaks noted. The leaking flange was not opened in order to conduct proper inspection and to determine the cause of the leak.</i>

LFI: Root Causes & Remedial Actions

RC 1	Process Safety Management System - PSSR, i.e. Mechanical Completion verification checks not done to the required standard.	<i>TJR was raised for re-rating of XES-310 tube-side design temperature from 260°C to 320°C. XES-310 have been operating above tube-side design temperature since the start-up of refinery. The maximum operating temperature has been 297°C versus the original design of 260°C. The design temperature of 320°C was recommended based on operating temperature of 290°C plus normal temperature margins of 30°C. These changes were implemented and drawings updated accordingly. The gasket also changed from SS 316 double jacket ASB to Camprofile gasket, which still used today.</i> <i>Design AIA Engineer was requested to calculate and to determine both the torque values for XES-310 channel head cover flanges and impact of thermal expansion of the materials during the cycling operations. The calculated torque values based on gasket seating condition at design pressure and temperature is 2069Nm and 1647Nm based on 90% bolt stress load. Both values are higher than the applied based on the QCP and flange management certificate from the contractor.</i> <i>The calculations into the thermal expansion of material during cycling operations revealed the expansion of the flange diameter is 6.366mm from ambient to full design temperature 320°C.</i> <i>The mechanical box-up QCP which included flange management certificate issued in 2019 as part of turnaround mechanical completion (MC) pack indicated that on XES310 channel Head Cover a SS 316 camprofile gasket and SA-193 Gr B7 bolts were used. The flange was tightened to a final torque of 1142Nm. these torque values are not consistent with PetroSA design calculated values. There was no leak reported at the exchanger since start-up of Train 3 after turnaround when the train pressurised and passed the stand test. The first time a leak was reported on the channel head end cover was 5 months later.</i>
RC 2	Human Performance Difficulty - Error	<i>REFRESH CFO (Clearance for Operation) authority and technical responsibilities and the implications thereof. REFRESH Startup/Shutdown procedures pertaining to the criticality of maximum heat up rates (50 °C) for all panel operators. Institute consequence management as proven.</i>

Thank You...

