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Abstract

Prolific gas field with high temperature signature in Sarawak waters had numerous operational production and well integrity issues since the early life of production. Objective of this paper is to address challenges in high temperature field and the practices followed for mercury management, effluent discharge quality (EDQ) handling and well integrity issues.

To manage highly complex field, a comprehensive mercury mapping surveillance program is required. Since the day of production till current, the well reading of mercury observed to increase tremendously from 15 ppb. wt to average of 2500 ppb. wt. Subsurface study carried out to establish qualitative correlation on mercury origin to geological subsurface properties and features. Cross-plot of subsurface properties distance to fault, permeability, karst, and others plotted with mercury. Strong correlation observed for wells closer to fault and fracture which will be matured for future infill development strategy. Additionally, offshore condensation mercury filter (OCMF) has been installed at platform to remove up to 1 micron size mercury particles. Based on Figure 1, mercury in condensate has been reduced from 1800 to 1300 ppb.wt from the installation of OCMF.

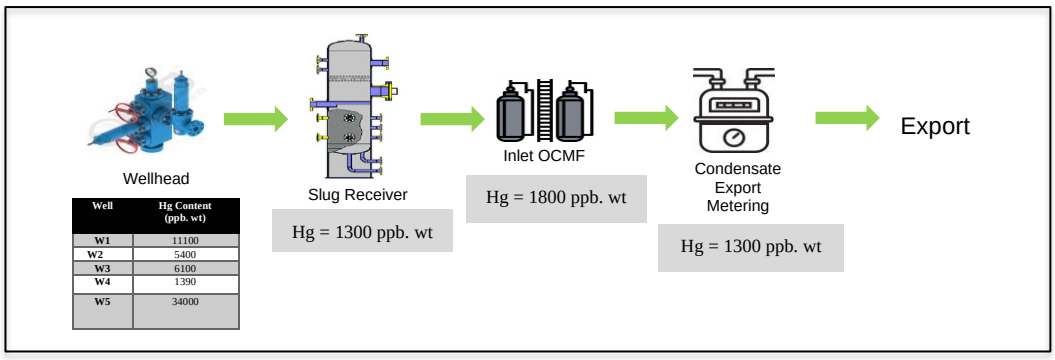

Figure 1-Mercury in condensate stream in ppb.wt mapping result

Additionally, post-production this field also faced biggest threat in EDQ management due to underdesigned Produced Water Treatment System (PWTS). Deoiler, a polymer type chemical trialed at

two injection points, production header and inlet of condensate water separator. Field trial indicates injection at production header yield better success due to high temperature, but it produces flocculants as byproducts due to polymer reaction which accumulates at the slug receiver. The chemical dosage optimization has further trialed with the different production rates from each well. As shown below from Figure 2, the wells located at west pinnacle W2 and W3 has a broader envelop compared to the wells located at the east pinnacle. The surface Condensate Gas Ratio (CGR) from tracer dilution indicates the west pinnacle wells double the measured CGR than east pinnacle wells. Production balancing approach has been taken commensurate to the different surface CGR measurements curtailing west pinnacle wells has proven in overall platform EDQ measurement.

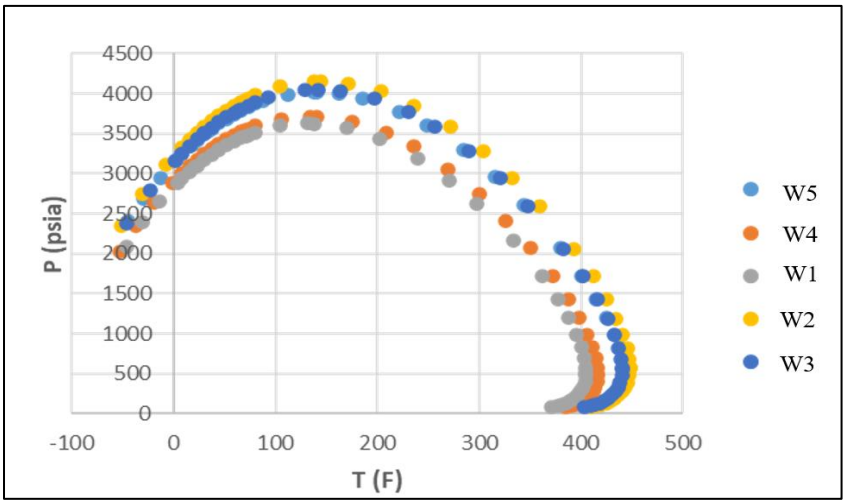

Figure 2-Phase Envelop Stack Up from Surface Well by Well sample

Correspondingly, one of the wells had sliplock failure which holds the Drill Pipe Head Housing (DPHH) and conductor together. Therefore, External Sliplock Bracket Support (ESBS) has been designed specifically to mitigate DPHH relative growth issue (Figure 3). Based on the finite element Analysis, full assemblies able to withstand maximum axial load 1200 kips. Early ESBS installation had ensured security supply of about 150 MMscf/d gas production per well.

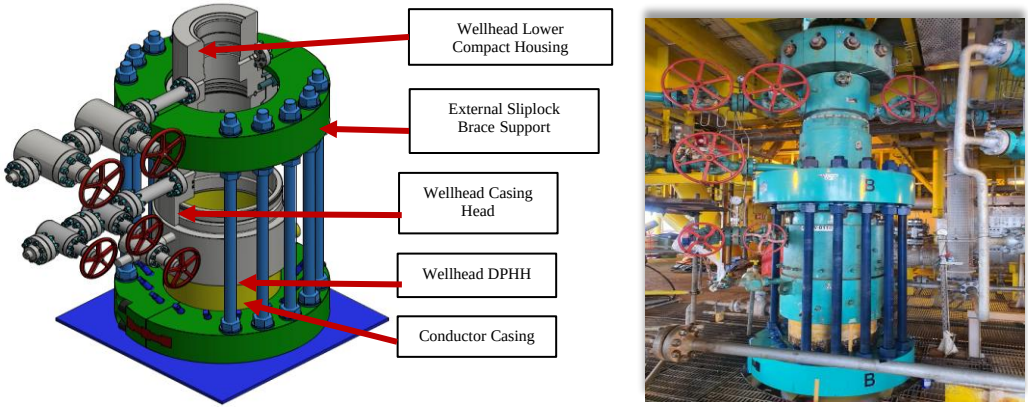

Figure 3- External Sliplock Bracing Support (ESBS)

Figure 4-Expandable Tubing Patch with fully covered elastomer

Besides, one of the high producers well has tubing to A-annulus communication and it was verified to be tubing leak. Approximately 30 Bscf of gas volume accelerated via this short-term expandable steel patch application. C276 steel patch found to be compatible for high mercury and corrosive environment. Fully covered elastomer option was employed to minimize metal-to-metal contact between tubing and patch (Figure 4). Relative movement of patch C276 and UHP-17Cr-110 minimal as found that the coefficient of thermal expansion is close from 90 degrees to 160 degrees Celsius around 11.2 $E^{-6}K^{-1}$ to 11.8 $E^{-6}K^{-1}$. This will not lead to wear, degradation, and crack of the patch due to relative thermal expansion.

The highlight of this paper are the approaches taken to manage production and series of well integrity issues which would require different areas of attention for high temperature signature field.