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Please fill in your abstract title.	Successful Integration of Well Logs and Real Time Data Acquisition with Numerical Fracturing Model to Optimise Reserve Tapping in Tight Oil Sands

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Abstract

Barmer Hill Turbidites (BHT) are low permeability reservoirs in the Vijaya & Vandana field with an approximate in place reserve of a billion barrels. The field was discovered in 2004 with the discovery wells V-1 and V-2 respectively. Post drilling and completion these wells were tested without any stimulation technique, resulting in ~ 10 – 20 BOPD flow owing to tight nature of these formations. Subsequently the zones were hydraulically fractured and tested resulting in ~ 10 – 15 folds increase in the production rate of the oil. Also, the testing of multiple stacked reservoirs in these two wells further confirmed BHT-10 to be the most prolific zone in terms of commercial flow rates achievable. Apart from being tight formations, the low net to gross on reservoirs (<20%) further added to the challenges of devising a strategy to make these reservoirs flow at sustained commercial oil rates. Hence, when the field was taken for the next stage of a hydrocarbon field lifecycle i.e. the appraisal campaign, two very clear objectives were identified for achieving a successful appraisal campaign viz. hydraulically frac and test two of the existing wells in the field while aiming to connect the maximum available KH and ensure effective data acquisition through injection tests and temperature logs with an aim to calibrate the existing stress logs and eventually build a robust frac model.

The dynamic geo-mechanical parameters i.e. Young's Modulus and Poisson's Ration were calculated from the open hole sonic logs and were converted to static data using the lab measured value from the core tests. Stress logs generated from these static data points were used for the initial frac designing in the wells. During the execution phase of the frac campaign, at every opportunity available, injection tests were carried out and fall off data were acquired to estimate the closure pressures actually observed in these zones. Post acquiring the measured stress data, the earlier calculated stress logs were calibrated using these measured closure points (frac gradients) by incorporating the stress components due to strain factors (ɛmin & ɛmax) in both max and min direction of the principle stresses.

Post every data injection, temperature logs were also acquired. This gave a better control on frac height (hydraulic height) based on the cool downs observed on the temperature logs. This proved to be a very important data set in comparing the height predicted by the calibrated stress logs versus the height estimated from the temperature log cool downs. This step helped in gaining confidence on the model predictability. This also helped in real time frac design optimization and placement of perforation intervals for the main frac designs. Further to above, the entire model calibration exercise also helped in arriving at a porosity based leak off equation.

The paper endeavors to discuss in detail the entire workflow used during this appraisal campaign to arrive at a calibrated and a robust frac model. This will ensure on the sharing of the learnings that evolved in terms of the frac geometry propagation in these BHT formations of the Vijaya and Vandana field and also emphasize on the importance of carrying out such data acquisitions during the appraisal phase of a field to gain better control on the models. This paper will also elaborate on the strategy deployed for these data acquisition to optimize the fracs in real time and to integrate different data sets for calibrating the geo-mechanical and frac simulation models.