Optimization of High Water Cut Wells Without Gas Lift Capability and High Gas Oil Ratio Wells, Leveraging Live Data, Hydraulic Modelling and Data Driven Approach - Mature Deepwater West Africa Fields Examples

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Abstract

Production optimization can be a challenge in mature fields where water cuts (WCUT) and gas oil ratios (GOR) have increased, especially when wells were completed without gas lift (GL) capability or capability were temporarily disabled due to mechanical reasons, and the facilities are constrained by gas handling. This paper will provide field cases in mature Deepwater West Africa fields of successful optimization, overcoming these challenges using live well data, hydraulic modelling, and field testing to verify that changes deliver the expected uplift.

Production well testing and live well data (current and historical) were used to understand well performance and interactions between wells, and to develop optimal well operating strategies within actual well and field constraints. Hydraulic models were used to assess optimization scenarios (e.g., well routing, choke and flow assurance) to guide field testing. Field testing results are then used to compare with model recommendations and helped to further tune well operating strategies.

Our first optimization challenge was for high water cut wells. These wells have no GL capability, so as WCUT increased, the wells struggle to flow. Field case 1 involved a well with a high liquid rate and WCUT (Well 1). Field data showed that Well 1 was able to flow if commingled with a high GOR well (Well 2a or 2b or both). A hydraulic model was used to calculate the minimum gas rate needed in the flowline. Well 1 was successfully brought online (BOL) once Well 2b operated at the recommended WHP. Field case 2 involved a well (Well 3a) that ceased to flow due to interactions with another well (Well 4). Since Well 3a is high WCUT with no GL capability, the well was BOL by temporarily shutting-in another well with the highest WHP (Well 4). This helped to establish a BOL sequence strategy between Well 3a and 4. Our second optimization challenge was for high GOR wells. Field case 3 involved developing an HGOR wells cycling strategy to manage the field gas handling constraint. Periodic multi rate tests and live well parameters was used to establish a cycling strategy. Field case 4 involved routing optimization of HGOR wells to minimize back out impact to other wells.

The paper will share field examples, where outside the box approaches (creating “riser GL effect”, BOL sequence) challenged previous field practices where wells would be shut-in (SI) until GL capability was restored or until enough build up pressure. Field cases will also share examples of using field data to effectively cycle high GOR wells and leveraging network modelling to minimize production back-out impact via routing optimization vs previous practices of choking back / SI wells to manage flare / production back-out.