Dynamic Behavior of the MH1 Reservoir Interval in the Jubilee Field, Offshore Ghana: Monitoring and Interference Testing During Extended Shutdown Allowing Unique Study of Injector-Producer Connectivity in a Deep-Water Turbidite Frontal Splay Reservoir

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ABSTRACT

In 2016, an extended shut down of production took place during engineering works on the field FPSO. One of the producing intervals, MH1, characterised by turbidite frontal splay reservoirs, had until that point been producing for six years using an array of water injection-producer pairs. Reservoir models have to this date provided good quality matches to production data however during the shut down period, the static pressures differences between wells were observed which highlighted further complexities within the reservoir behaviour. Taking advantage of an opportunity which rarely arises within a producing field, the team evaluated the initial data from the shutdown period and designed an extended interference test on one of the key reservoir intervals to evaluate in detail the connectivity and flow in this zone, by systematically testing the connectivity relationships between the three injectors and five producer wells. Several parallel relationships were evaluated through staged injection from different wells while maintaining production. All tests were completed in 2016. Challenges of balancing production requirements with data acquisition required careful planning, taking into account voidages, and other reservoir unit production, at the same time maximising overall field production to fill availability facilities capacity. Valuable data were gathered, and initially presented a challenge to fully match within models. Complex 3D patterns of connectivity were seen within the zone. The dynamic data were however combined with detailed seismic mapping, and conceptual geological models, within the multi-disciplinary team, with testing of multiple conceptual models to evaluate the potential causal relationships and establish conceptual approaches and practical solutions that could be implemented in model updates and to inform further reservoir development. Some producer-injector links were confirmed and relative contributions of different injectors to producer wells better understood. The evaluation aligned geological concept with dynamic prediction and allowed systematic model updates to improve match to the pressure behaviours and water breakthrough data. The paper presents a unique multi-disciplinary approach during a period of enforced partial field shutdown that yielded large amounts of dynamic data and follow-on calibration with existing conceptual, static and dynamic behaviour of a deep-water turbidite, frontal splay-dominated, giant oil field.