Reitbrook, a Successful Conversion of a Former Complex Oil Field into Underground Gas Storage

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Reitbrook is a former oil field located in the North of Germany in the periphery of the Hamburg city. The field was discovered in 1937 and developed directly the years afterwards. Depth is 700 m/s and oil was reputed to be closed initially close to the saturations conditions. The initial reservoir pressure was 84 bars and the oil has a specific gravity of 22 API. The field belongs to the Cretaceous period and the reservoir consists in a massive tight and fractured chalky limestone formation. The structure is a moderately faulted dome overcoming a salt dyapir of Zeichstein. The reservoir thickness varies from 65 to 80 metres. Despite a porosity of 25%, the matrix porosities range low values of 0.1 to 1 md due to the small thresholds of the porous media. At the opposite, dynamics data resulting from the well performances shows presence of permeabilities of 1 to 2 Darcy as a result of natural fractures distribution. Oil production reached a peak of 360 000 tons per year in 1940 after the drill of more 200 wells. In the period 1940-53, an injection of gas was implemented followed by a water injection in 1956. In 1964 until the abandonment exploitation achieved in 1973, the gas and the oil were exploited conjointly during a blow-down phase. In 1973, the decision to convert this oil field into underground gas storage (UGS) was taken and an intensive recompletion campaign of oil wells in gas wells and observation was made. In 1979, a first phase of the conversion was achieved with a capacity of 150 Mcum3 of working gas volume associated to a withdrawing rate of ca 200 000 m3 per hour. After the success of this first step, the gas capacity was extended by optimizing the strategy of the injection and withdrawing campaigns. Currently the capacity is 350 Mcum3 of working gas and 350 000 m3 per hour of the nominal withdrawal rate. Reservoir pressure varies between a maximum of 80 bar (beginning of the winter) and a minimum of 40 bar (end of the winter). Currently 78 wells are used as gas producers, water and oil producers and observation wells. To achieve such performance, vertical and horizontal liquid producing wells were drilled in the down-dip parts of the field. Such wells allow to limit the injection gas compression capacities by decreasing the reservoir pressure, by reducing the liquid breakthroughs in the up-dip gas wells. Thus, the partial invasion of matrix by the injected gas through the natural fractures is acting as an enhanced oil recovery process. The oil expelled from matrix and segregated by gravity in the fractures network is produced by these down-dip liquid wells. So far, oil is produced at an attractive and sustained rate. Experience of the increase of the gas storage capacities showed that more oil could be mobilized. In conclusion, despite a long past exploitation, Reitbrook has found a second life by combining in parallel oil production and the gas storage activities. Experience and the skills of the GDFSUEZ group in both domains of the Exploration/Production and the UGS has allowed to implement a win-win system permitting to delay the Reitbrook oil field abandonment, to develop business in gas transportation and domestic marketing and to continue to produce oil from a very mature field.

Keywords: Successful conversion of a oil field into underground gas storage