CEMENT ASSISTED MULTI LATERAL

DESIGNED BY FCRL Fire Creek Resources Ltd.

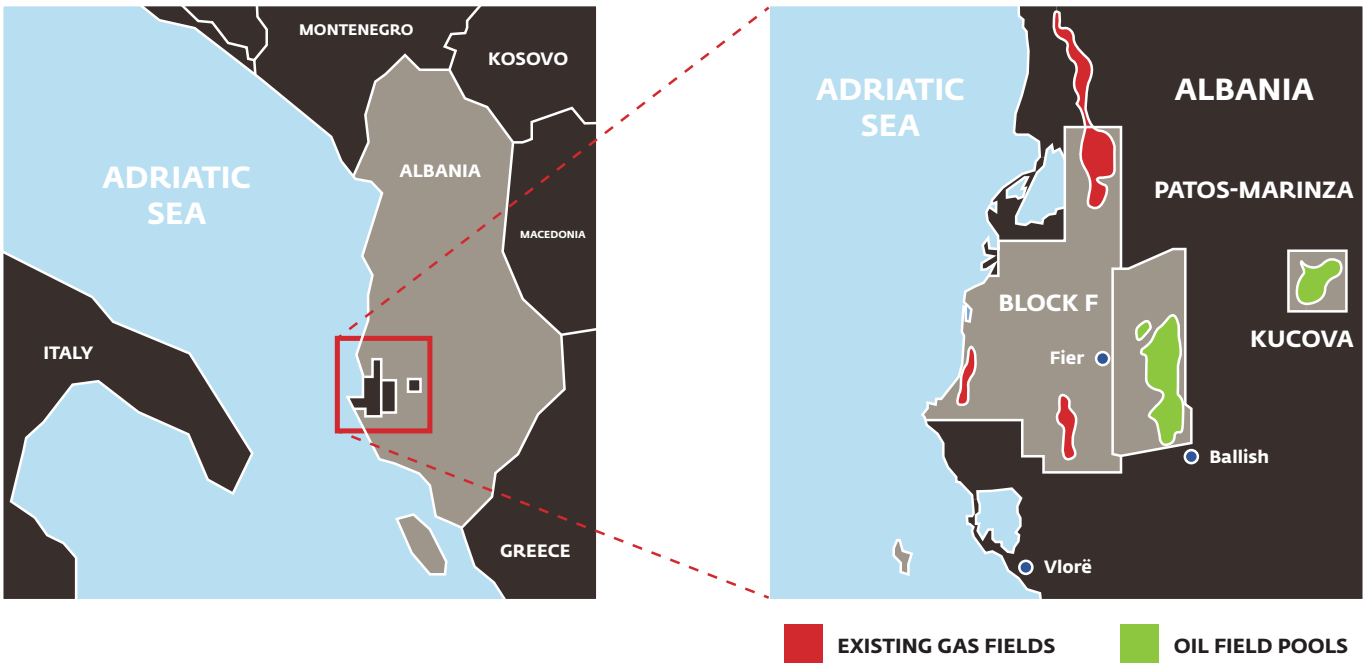
CASE STUDY

CEMENT ASSISTED MULTILATERAL JUNCTION ENABLES ECONOMIC DEVELOPMENT OF HEAVY OIL IN ALBANIA

BACKGROUND

Discovered in 1928, the Patos-Marinza is an onshore heavy oil field located in southern Albania. Measuring ~5 km by ~14 km, the original oil in place is estimated to be 5.4 billion barrels – 2.4 billion of which is in an area proposed for redevelopment.

Over 2,700 wells have been drilled throughout the field, more than 500 of which are horizontals. The field comprises approximately 27 stacked unconsolidated sandstone formations with significant variation in oil density, live and dead oil viscosity, gas:oil ratios and reservoir pressure. The latter is further complicated by historical comingled production, which has reduced the reservoir pressure and oil saturation in a non-uniform way across the field.



CHALLENGE

Heavy oil exploitation requires very tight well spacing to effectively capture reserves. The complexity of this mature field and the high viscosity oil required a completion method that not only improved reservoir exposure to increase initial production and ultimate recovery, but enabled economic development.

A reservoir model based on the production history of four horizontal wells suggested an optimum spacing of between 35 and 50 m. Because the Patos-Marinza formations with the heaviest and deepest (1,530 m TVD) oil are too deep for thermal methods and too heavy (5° API with live oil viscosity of 5,000 – 10,000 cP and dead oil viscosity of 25,000 – 50,000 cP at reservoir temperature) for polymer flooding, multilateral wells were considered. The goal of using multilaterals within the Patos-Marinza was to reduce the cost per metre of reservoir exploited.

Beyond the economic drivers were the technical requirements for a multilateral completion method that provided a sealed junction for both pressure integrity and a debris (sand) barrier due to the unconsolidated nature of the reservoir. In addition, the system had to maintain full drift inside diameter (ID) of the intermediate casing and slotted liner to enable intervention work such as coiled tubing cleanouts and pump placement, as well as shut-off and workover operations.

SOLUTION

FCRL was approached by an operator working in the Patos-Marinza to develop a new multilateral completion junction that met both the primary economic driver, as well as satisfy the technical requirements. A standard Patos-Marinza horizontal well consisted of 7-in. (178 mm) intermediate casing with 4 ½-in. (114 mm) slotted liner terminated using a conventional sealed liner hanger. This formed the base design for the multilateral well.

The multilateral well design had to meet the following criteria:

- Cost a maximum of 40% per leg of the standard horizontal
- Maintain full drift accessibility of the intermediate and liner casings with a minimum of 3 legs
- Provide a debris barrier to hold back the unconsolidated formation sand during production
- Provide pressure integrity capable of holding maximum differential pressure of the reservoir during production, injection, and workover operations
- Capable of withstanding thermal steam injection temperatures for potential future pilot projects
- Applicable to other standard casing sizes and weights

Due to the economic limitations for the development project, commercially available TAML Level 5 and 6 systems could not be applied. FCRL designed a new, low-cost cement assisted multilateral (CAML™) junction that provided a full drift pressure and debris seal which can be repeated approximately every casing joint.

The CAML junction does not conform to other commercial junction systems available and does not strictly fall into the industry recognized Technology Advancement of Multilaterals (TAML) classification levels. CAML is a mechanical junction that can be described as a hybrid Level 5 that does not use a Level 6 metal-to-metal seal or cased hole packing and slip-type elements of a Level 5. Unlike other multilateral systems, the physical hardware costs are a fraction of the overall expenditure, with the majority related to drilling time; therefore, additional legs are not cost-burdened.

RESULTS

The main pilot project goals were to prove the concept of multilateral well drilling in the Patos-Marinza heavy oilfield and evaluate the benefits to production rate, EUR, and finding and development (F&D) costs. The operational goal was to successfully place a multilateral junction that provided a debris and pressure seal.

The initial pilot well was planned as a dual lateral. Drilling operations were run without incident within 5% of planned time, and costs were in line with initial estimates. The second leg costs were 60% of a conventional horizontal. Cost estimates for additional legs would fall within the 40% criteria.

Horizontal wells in the Patos-Marinza typically produce 0.5 – 1% sand, with occasional higher sand cuts. Depending on the fluid rate and viscosities, the sand produced can drop out of the produced fluid within the lateral section causing sand plugs requiring coiled tubing clean out. After initial cleanup, an average 0.5% sand cut was indicated on production of the CAML junction pilot well. At 100 days of production, workover operations were required due to a tubing leak. Re-entry with tubing was able to get to the bottom of the first leg with no indication of sand inside the intermediate casing or slotted liner.

Initial production results were in line with predicted rates and outperformed analogous single lateral wells in the field, suggesting that both laterals contributed to production. Production increased after the workover to the maximum downstream capacity of 20 m^3/day.

The success of the pilot well has led the operator to continue applying the CAML junction to further multilateral wells in the Patos-Marinza, including a tri-lateral design. The CAML junction can be used for multilaterals wells in other cost-restrained reserves, such as mature or marginal fields, that require tight well spacing for exploitation.