Flare Redesign Enables Continuously Flowing High CO\textsubscript{2} Concentrations in Heavy Oil Well Offshore Vietnam

Optimized injection and flowback operation achieved reliable measurements without burner interruption or spillage

**CHALLENGE**
Monitor fluid changes and ensure optimal flaring efficiency during a CO\textsubscript{2} injection and flowback test in a heavy oil reservoir offshore Vietnam.

**SOLUTION**
Redesign the flaring scheme to improve flaring efficiency in high CO\textsubscript{2} fluids; develop and deploy temporary surface facilities for flowback to allow detailed fluid analysis on produced fluids.

**RESULTS**
Achieved frequent, accurate measurements of CO\textsubscript{2} concentrations while continuously and optimally burning hydrocarbons.

“Schlumberger provided a unique service through the design, planning, execution, and evaluation phases of the first high-CO\textsubscript{2} operation in Vietnam. The project’s complexity was thoroughly managed, and we were very pleased with the execution.”

**Enhance offshore pilot test operations**
An operator was conducting field tests to assess the feasibility of CO\textsubscript{2} injection to enhance recovery from a heavy oil reservoir offshore Vietnam. Test results showed substantial potential for increasing oil production while reducing CO\textsubscript{2} emissions by extracting the CO\textsubscript{2} from industrial waste.

To confirm field applicability, the operator decided to conduct a small-scale CO\textsubscript{2}-injection flowback (huff ‘n’ puff) pilot test. In this test, CO\textsubscript{2} was injected into the reservoir to produce the reservoir fluid and the injection gas together. The main objective of the test was to acquire the production data to identify any uncertainties that should be considered before field application. Another objective included monitoring fluid changes and ensuring optimal flaring efficiency.

**Redesign conventional well test design and flare**
Schlumberger offered recommendations on designing temporary surface facilities, conducting detailed fluid analysis on produced fluids, and overcoming the issue of efficient flaring of high-CO\textsubscript{2} fluids. Three major steps were taken to optimize the flowback methods chosen to complete the offshore test.

- Because CO\textsubscript{2} can affect seal integrity during explosive decompression, metal-to-metal seals were selected for the surface well test equipment; additional special seals were selected for various equipment downstream of the choke manifold.
- With the assistance of the Schlumberger Technology Center in Novosibirsk, Russia, the flare was redesigned to allow continuous and efficient flaring throughout the test.
- The new test scheme included performing frequent, accurate sample analysis onsite, which provided key data for establishing near-wellbore sweep efficiencies.

Redesigned burner concept. Schlumberger proposed angling the end of the flare to redirect the CO\textsubscript{2}-rich produced gas to the processed gas burning area.

**Well Testing**
Flow high CO₂ concentrations with no interruption

The flare system redesign enabled efficiently burning hydrocarbon with no interruption in operations. Concentrations of CO₂ were measured from pressurized separator oil every half hour using PVT Express™ onsite well fluid analysis service. During flowback, CO₂ concentrations as high as 97% were measured, an amount that gradually declined to 0% at the end of the test because the CO₂ injected for soak had been recovered. Additionally, the optimized flare design allowed the operator to flare continuously without spillage into the sea.

Decline of CO₂ concentrations and oil rate recordings during flowback.