

## **SPE Thailand Annual E&P Award 2012**

**Company:**

PTT Exploration and Production PCL

**Project:**

Arthit Asset

**'In-Situ Gas Lift' and 'In-Situ Gas Injection' Successfully Improve Oil Recovery in  
Arthit North Field**

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## Innovation Feature

The techniques to recover most out of oil rim reservoir using a gas lift that enhances tubing lift performance and a gas injection that maximizes recovery efficiency require high pressure compressed gas, commonly obtained using costly compressors and specific facilities. Thus, the absence of the compressors and injection facilities normally ends the journey of oil recovery improvement by gas injection.

The innovative and low cost recovery improvement strategies implemented in PTTEP-Arthit North field oil rim, using the so called 'in-situ gas lift' and 'in-situ gas injection' techniques have effectively disproved requirement for the earlier mentioned compressors and injection facilities. These techniques have increased oil production rate and recovery from the oil sand in well AT-X-1. Cumulative oil production is expected to increase from 316,800 barrels (at the time when the well was no flow) to 2,150,000 barrels by April 2014 with only little capital cost of perforations and few days of well AT-X-2 cleanup operation.

'In-situ gas injection': A high-pressure gas sand below the oil sand was perforated in well AT-X-2 located 300 meters from well AT-X-1. Inner tubing continuous cross flow of gas from gas sand into oil sand was the main objective by fully shut in well AT-X-2. In-situ gas injection subsequently initiated in the oil sand, numerous runs of production logging in well AT-X-2 indicated 2.9 MMSCFD of high-pressure gas cross flows from gas sand into the oil sand.

'In-situ gas lift': The very same gas sand was perforated 1-shoot at selected interval in well AT-X-1, intended to supply more gas into the well to optimize production GOR thus enhances lift performance. A production logging in well AT-X-1 indicated 1.3 MMSCFD gas flows from gas sand into the well; it successfully revived the well that was no flow as a result of an increased producing GOR from 450 to 1200 SCF/STB.

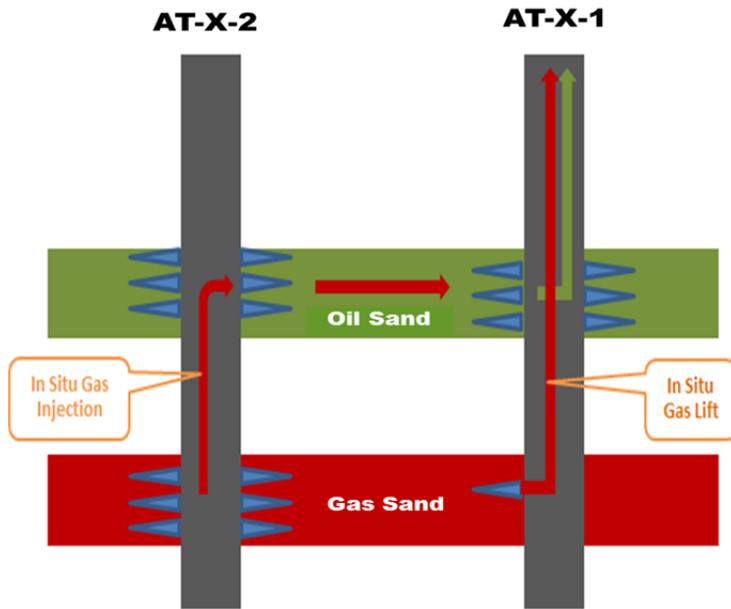
Timing of the implementation for the in-situ gas injection is as well part of the innovations and success features. The low cost and simple operation enables a timely in-situ gas injection process to achieve the main objective to preserve reservoir energy and maximize recovery from oil sand which at that point had only insufficient solution drive as its primary drive mechanism, as underlain aquifer and overlain gas cap were not active.

Another important success feature is a thorough evaluation that recognizes gas gravity segregation is pronounced when gas injection is implemented as the oil sand has highest quality layer at the bottom whilst lowest quality layer at the top and it contributes to successful improved recovery efficiency.

The followings are the implemented simple steps of the 'in-situ gas lift' and 'in-situ gas injection'

- 1) Perforated gas sand (Gas Source) in well AT-X-2
- 2) Flowed the well to clean up gun debris and measure the flow rates
- 3) Shut-in well AT-X-2 to allow gas cross flow into the oil sand (in-situ Gas Injection)
- 4) Perforated 1 shot in the selected interval gas sand in well AT-X-1 to help lifting oil from the oil sand (in-situ Gas Lift)

(See 'in-situ gas lift' and 'in-situ gas injection' schematic below)



## **Thailand E&P industry impact and values**

Oil and gas is a dynamic and high technology industry. Engineers continually look for possibilities to produce oil and gas with improved recovery efficiency. For the case of the oil sand, the engineers have put forward a blend of a conventional groundwork of lift performance optimization and an advanced recovery technology of gas injection process, and as a result the engineers have recommended the low cost and realistic solution in-situ gas lift and in-situ gas injection which proven to have successfully improved oil recovery efficiency in the oil sand.

A thorough reservoir engineering evaluation frequently leads to a very sensible and low cost solution to improve oil recovery efficiency which consequently adds value to a great deal of E&P projects. The successful implementation of in-situ gas lift and in-situ gas injection techniques that is inherently trouble-free has confirmed realistic, low cost and speedy solutions for engineers to save on capital investment and operating cost thus it facilitates the creation of a maximized value to the project particularly in Arthit North field, and could ultimately be in the E&P industry throughout Thailand.

In-situ gas lift and in-situ gas injection increase recovery from partially depleted oil reservoir making use of energy from the existing gas sands, a thorough full field evaluation and PTTEP's thriving experience in valuing the techniques could instigate the recognition of oil reservoirs similar with oil sand that require the in-situ gas lift and in-situ gas injection. The low cost solution by in-situ gas lift and in-situ gas injection that was Baht six hundred thousand has successfully improved recovery efficiency of oil in Arthit North field and forecasted to generate a monetary benefit about Baht five point seven billion to the company, that is a 9500 of profit to investment ratio and it is remarkably growing financial value for the asset. Impact and values from these techniques to E&P industry in Thailand is significantly constructive when successful, however, as the techniques are positively low cost therefore no detrimental impact to the E&P industry when unsuccessful.

## **Essay, Why this project should win the award**

In-situ gas lift employs the tubing performance optimization concept whilst in-situ gas injection encompasses aspects of the advanced recovery process; the implementation of the two recovery techniques operated almost at no cost to the oil sand that exhibits a highest quality layer at the bottom and lowest quality layer at the top. Furthermore, improved oil recovery in Arthit North asset and gained monetary value remarkably.

The realistic and low cost solution with in-situ gas lift and in-situ gas injection that proven to benefit the project through its straightforwardness and robustness in improving the oil recovery efficiency will inspire others to come to an agreement that a low cost recovery technique can be as valuable as the high cost ones. Moreover, it will consequently motivate other E&P companies to value the importance of a thorough full field review identifying a number of stranded oil pools to be revived with low cost recovery techniques such as in-situ gas lift and in-situ gas injection, as a consequence, a secured availability of hydrocarbon energy within the country could be made more sustainable.

The in-situ gas lift and in-situ gas injection techniques proven to be exceptionally successful in Arthit North field; it is a self-supporting operation and the implementation confirms to steer clear of other gas producer wells as no requirement to interrupt production to modify surface flow lines and facilities, and no requirement for gas consumption for fuel utilization as no compressor unit required.

The in-situ gas lift and in-situ gas injection techniques effectively depleted resource from 20-00 oil sand which production ability is deteriorated owing to insufficiency of reservoir pressure support and producing GOR, the techniques perfectly provide the correct prescription to the well to revive and to be a distinct oil producer well.