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Unconventionals in China – Shell's Onshore Oil and Gas Operating Principles in Action

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Key words: China, unconventional oil and gas, hydraulic fracturing, operating principles

Abstract

Shell is operating four production sharing contracts (PSC's) targeting a variety of unconventional onshore tight gas and shale plays in the provinces of Sichuan and Shaanxi, all in partnership with Petrochina. Three offshore PSC's are also being executed in partnership with CNOOC targeting conventional gas in China.

Initial production started in 2007 in the Changbei field, which, with 3.3 Bcm yearly gas production, today delivers ca. 40% of Beijing's gas demand. The more recent acreage additions in Sichuan (Jinqiu, Fushun and Zitong) are in appraisal stage, with over 50 wells drilled since startup of operations in 2010. Sichuan is home to a prolific conventional hydrocarbon system with multiple high quality source rocks and reservoir levels. Generally, reservoirs are very tight and hence Basin Centre Gas plays are possible in addition to Shale Gas and Shale Oil plays. Currently long term testing is progressing, aiming to prove that viable options exist to profitably produce this resource.

Drilling and fraccing (hydraulic fracturing) in densely populated areas requires a high degree of care and sensitivity. Shell has introduced five operating principles that address safety and well integrity of drilling and completions, water use and disposal, safeguarding air quality, the footprint of our operations, and interaction with neighboring communities. Experience shows that achieving the quality that the five operating principles demand is equal in importance to finding the right geology or being cost competitive.

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Unconventionals in China

Unconventional gas is a key component of the energy reform of China – a country whose energy demand will nearly double by 2030.

Related to energy, the Chinese government recognizes three strategic drivers: 1] ensure the economic prosperity of its 1.3 billion people by supplying affordable energy, 2] improve domestic energy production and thereby reduce dependency on imported energy and 3] drive environmental improvement by substituting coal with gas (Fig. 1). While these strategic drivers are of great importance to the Chinese people, their implication in particular on the environmental and climate agenda have global reach: substituting coal with gas as the primary energy supplier can reduce the CO_2 footprint by up to 50%. For these reasons, China has set ambitious targets for unconventional gas production.

The China oil and gas scene is dominated by the three large national companies: CNPC (Petrochina), SINOPEC and CNOOC. Oil and gas infrastructure is installed and is being expanded at a relatively fast pace. China has excellent manufacturing capabilities and a long oilfield tradition, which means that drilling and fraccing equipment as well as oil field services are readily available. China has many prolific hydrocarbon basins (Fig. 2) in often fairly complex settings and a predominance of lacustrine source rocks. The latter are also the focus of the emerging unconventionals oil and gas activities.

Developing unconventional oil and gas as a

new resource has been a slow process with few foreign players acquiring acreage and only Shell being an active operator. The main reason for this slow pace lies in uncertainties as to the viability of the unconventional plays, immaturity of the regulatory framework, lack of freely available data, the high cost of the exploration and appraisal phase and finally, limited access to bidding rounds. To date, approximately 200 wells have been purposely drilled into unconventional targets with even fewer long term tests. This contrasts with over 10.000 wells drilled on a yearly basis in North America.
Many of the ingredients to make unconventional resources a success are present in China with good government support, a good supply chain and an active oil and gas industry. However, it is an industry in its infancy, with few players and so far limited experience.

Onshore operating principles

2012, Shell published its Onshore Oil and Gas Operating Principles. The company is making all of Shell's operated onshore projects where hydraulic fracturing is used to produce gas and oil from tight sandstone or shale, consistent with these principles and with local rules and regulations. The reason for making these public was in response to concern around the development of unconventional resources, especially with regard to the practice of hydraulic fracturing. It creates transparency as the public today demands and allows Shell to share «how we do our business». It also demonstrates confidence, which is based on 60 years of onshore operational experience, including the use of hydraulic fracturing, and underpins how the company works today and how it aspires to improve. The operating princi-



Fig. 1: The strategic drivers for China policy makers.

ples comprise five elements, each complemented with detailed and auditable instructions (not shown in this paper):

- Principle #1: Shell designs, constructs and operates wells and facilities in a safe and responsible way.
- Principle #2: Shell conducts its operations in a manner that protects groundwater and reduces potable water use as reasonably practicable.
- Principle #3: Shell conducts its operations in a manner that protects air quality and controls fugitive emissions as reasonably practicable.
- Principle #4: Shell works to reduce its operational footprint.
- Principle #5: Shell engages with local communities regarding socio-economic impacts that may arise from its operations.

The operating principles in action

In the following, two examples of applying the Shell operating principles in China are highlighted: Footprint reduction and community engagement.

Footprint reduction

Sichuan has a population density of about 600 people per km^2. The terrain in the operating area is hilly with small villages, minor roads and an abundance of small and medium rivers. As one of the most fertile regions of China, Sichuan hosts intense agriculture and is considered the bread basket of China. For drilling and fracturing operations, a well pad approximately the size of a football field (ca. 4.500–6.000 m^2) needs to be constructed. This area provides room for the rig, crew accommodation and fraccing equipment. Following successful testing, the well pad is converted into a production station, and

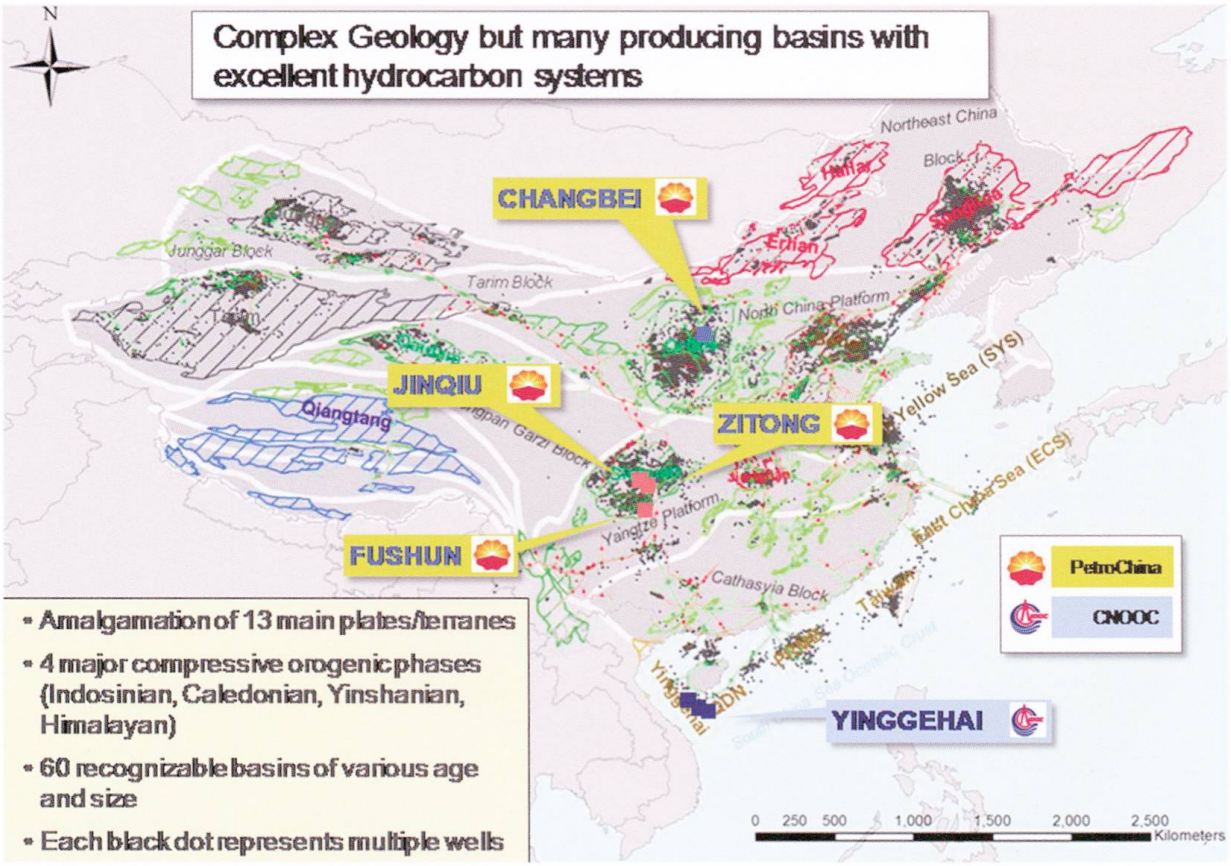


Fig. 2: Simplified tectonic map of China overlain with existing drilling locations and Shell's operating locations (modified from IHS data).



Fig. 3: The challenge of land acquisition in a densely populated province like Sichuan.

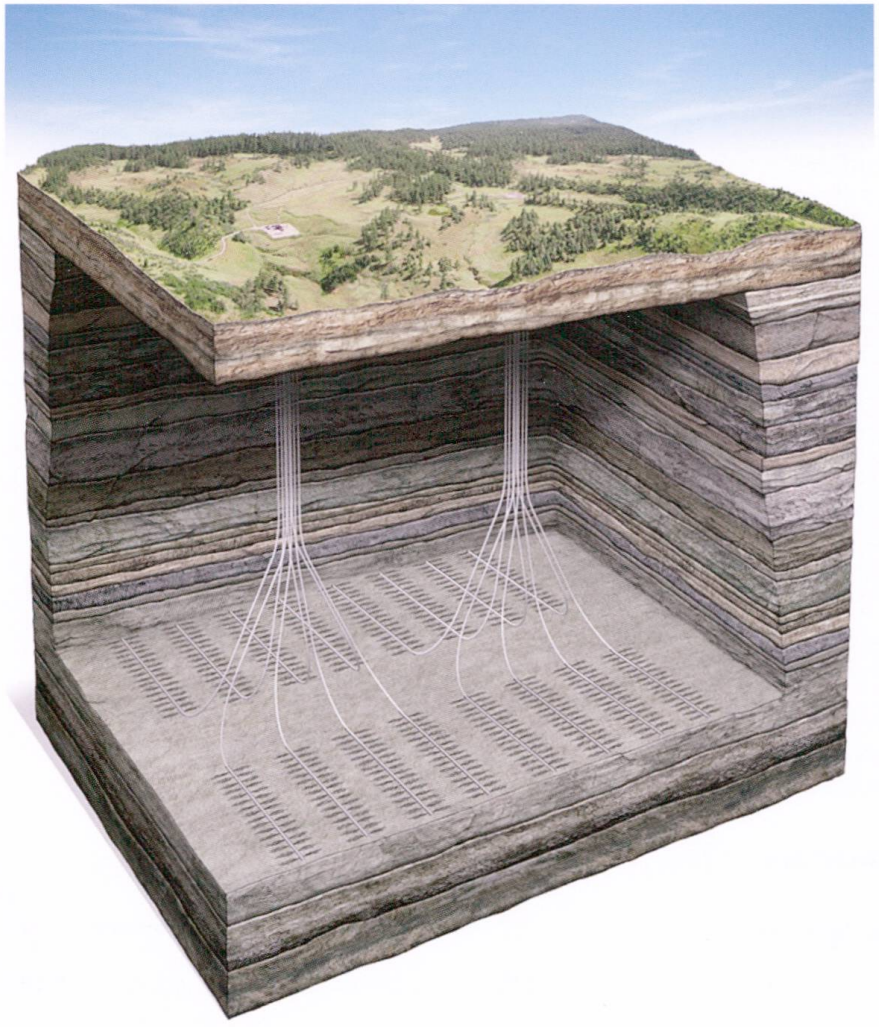


Fig. 4: Multiple horizontal wells from each location dramatically reduce the operational footprint.

excess land restored to vegetation. Finding appropriate well locations can be a challenging exercise in heavily populated areas, as can be seen in Fig. 3. Many farm houses, terraced fields and steep sided hills dominate the picture. In addition to the well pad itself, sufficient safety distance from the nearest house must be maintained.
As unconventional developments can typically comprise hundreds, if not thousands of wells, minimizing the footprint not only is an important operating principle but is a key ingredient for success. The solution is to use the same well pad for multiple wells – up to 32, and use horizontal, far-reaching wells to drain a large subsurface area during development as is show in Fig. 4.

Community engagement

Entering a new location requires diligent work with the community ahead of any engineering activity. Community liaison officers are the first on the scene to engage the village inhabitants, especially the village leadership and anyone living near to the intended operational area. The officers' task is to generate an understanding of what a site construction and drilling operation entails, thus giving the community the opportunity to voice both concerns and needs. Thanks to the feedback from the community, the impact of operation can more effectively be minimized. In addition, Shell aims at creating win-win situations where the community gains long-term benefit from the company's presence in the area. This can take the form of employment opportunities, social investment focused at improving people's livelihood or the purchase from the community of goods and services to support the operations.

Similar to the previously mentioned footprint reduction, successfully working with the community is understood by Shell as a prerequisite for success. People will make their sentiment felt by opposing an activity or blocking progress. Hence, regardless how good the geology is, if the relationship between community and company is not sustainable, the company will not be able to operate efficiently. Fig. 5 shows how easily operations are stopped when a community disagrees with a certain activity – in this case what was considered excessive trucking activity passing through a small village road. Likewise, when the relationship is based on mutual respect and trust, it can be



Fig. 5: Peaceful community protest.

beneficial for both parties. The example in Fig. 6 shows the community close to the well site celebrating the completion of an irrigation project that Shell put in place.

In summary

The exploration and production of unconventional resources in China are in their infancy, with relatively few wells drilled, an immature regulatory framework and a contractual regime designed for conventional oil and gas. However, several unconventional plays are producing first gas, government support is strong and an excellent supply chain is emerging.

Having strong operating principles in place has proven essential for progressing Shell's operations in China. Adherence to these principles minimizes impact of the company's operations on environment and people and also serve as a foundation for a sustainable interaction with the community. In short, demonstrable adherence to the Onshore Oil and Gas Operating Principles is considered to be of equal importance as for instance a good hydrocarbon system or a cost effective drilling operation.



Fig. 6: Celebrating the completion of an irrigation project that was executed for a local farming community by Shell and PetroChina.