CHEMICAL ECONOMICS - REMOTE OPERATIONS

There are enormous resources in the world found in locations that are very remote from urban centres. These locations lack basic infrastructure and, critically, feature extreme climates. The extreme climates range from hot cyclonic conditions such as in north west Australia to the extreme conditions of the Arctic and potentially the Antarctic.

The lack of basic infrastructure coupled with an extreme climate results in considerably higher costs than in developed areas such as the US Gulf where infrastructure, both basic (roads, rail, water etc) and sophisticated (for example high pressure hydrogen pipelines), is available. Furthermore, labour productivity is much higher in developed regions whereas coping with extreme climates generally results in significantly higher labour costs. The result is that remote regions have considerably higher capital and operating costs than similar facilities in developed regions.

For a successful investment in a remote region clearly the financial result must justify the higher capital and operating costs. Generally this means developing a resource on a very large scale, which through the benefits gained from the economy of scale justifies the investment.

Although each development is different and demanding unique solutions, there are several approaches to remote developments which are common to various resources (oil, LNG, iron ore) and the various climates (hot deserts and Arctic conditions).

The Arctic Ocean and areas north of the Arctic circle are the sources of large reserves of oil and gas which are being developed by US, Canadian and Russian companies. Offshore oil and gas developments face issues such as ice flows and icebergs. A good example is the Hibernia oil field off the coast of Newfoundland. This oil field has been developed by a joint venture headed by ExxonMobil and includes an investment by the Canadian Government who provide the necessary insurances. The oil platform is protected from iceberg collision by its solid foundation as a concrete gravity platform containing 450,000 t of ballast and by a serrated skirt. Oil is stored within the platform and off-loaded onto an tanker. As a further precaution, a tanker is always on standby to tow away marauding icebergs or evacuate the platform should the need arise.

The Prudhoe Bay oilfield in Alaska was developed on more or less conventional lines of "stick-build". As watchers of *Ice Road Truckers* realise a lot of material has to be sourced from the ice free ports in the south of the state. However, some of the facilities such as utility systems have been modularised, placed on barges and sailed into position in the ice free summer months, then sunk into their final position.

An unusual aspect of facilities at Prudhoe Bay is that workers have to be protected from the local fauna by ensuring all plant is surrounded by steel mesh fencing. There is a story that in the early days two workers were breakfasting and looking out through a large picture window in a mess room. One of the locals spotted them and crashed through the window and attempted to eat one of the workers. His colleague (it being in the USA) exercised his rights under the Second Amendment and shot the intruder. The company was then faced with the dilemma of either prosecuting him for killing a protected species or giving him an award for saving his colleague.

Modular construction and barge mounting allows facility construction in major low cost shipyards and floating to the final location for permanent mooring or sinking in position. This is widely practiced. The method lowers capital costs in remote locations operations relative to a stick-build construction. This method can also be applied to non coastal locations by moving large modules from barges using large crawler vehicles which slowly move the units to the final position. This method has been successfully used for methanol plants in Saudi Arabia and the Synfuels plant in New Zealand.

However, some process operations are not easily constructed in modules. Major largely stick-built facilities have been successfully completed in the Middle East. To be successful, this requires the mass mobilisation of low cost labour to temporary housing near the worksite. For instance it is said that the Shell Pearl Gas to Liquids facility in Qatar used 50,000 workers (largely from Bangladesh) in its construction who were housed in a village covering 170 acres.

Until now, LNG facilities have not been amenable to modular construction. Constructing these facilities under Australian conditions has proved very expensive to the developers. Construction on the Australian NW coast and at Gladstone was initially slated to cost about $100 billion but this has blown out so that the facilities are now coming on-stream having to support capital expenditure of over $200 billion.

Since most of the gas for major LNG facilities worldwide lies offshore, one method to avoid high land based costs is the concept of the floating LNG facility. Again these are built in major shipyards and sailed to position. Gas liquefaction take place on the ship which has limited storage. Product has to be transferred at regular intervals to conventional tankers. One advantage is that the ship can be used to deplete relatively small reserves then sailed to another location. It will also be apparent that such vessels could be flagged in low cost jurisdictions thereby reducing operating costs.

Some chemical processing operations could also be placed of vessels to take advantage of undeveloped offshore gas reserves. There has been a particular focus on methanol production either as chemical or fuel grade. A major hurdle for the conventional technology is the massive structure of the stream reformer required to convert the natural gas into synthesis gas. On a floating platform, this would act as a giant sail making mooring difficult. Nevertheless, there have been several proposals for large scale off-shore methanol production including one off northern Australia.

Conversion routes avoiding the larger steam reformer would require the use of oxygen in a partial oxidation unit. On land this is a well known and a widely practiced approach, but the juxtaposition of oxygen production with hydrocarbons production has so far been a step too far from the safety perspective.

Developments of remote reserves is not yet at the stage that could successfully be applied to the Antarctic. So from the political perspective it is fairly easy to declare the continent a development free zone. The problem will inevitably come when technology is advanced enough to support Antarctic developments and the completing claims to jurisdiction of the continent will be brought into focus.

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Hibernia Platform (photo thanks to Hibernia Management and Development Company Ltd.