How the engineers of Sri Lanka can lead and exploit the Deepwater Gas reserves in Mannar basin”

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On the 4th November 2015 and it was Wednesday at 5.15 p.m. I presented a lecture to the Engineers of Institute of Sri Lanka at the Wimalasurendra Auditorium, on the topic of “Designing and Construction of a Floating Production and offshore storage (FPSO) ‘and I was pleasantly surprised at the enthusiasm and the knowledge of the young engineers who have come to listen to me. They were smart and curious, and they had a lot in common with a dearth to make a change in the field of engineering. Post presentation Q&A discussion with these fascinating engineers covered a wide variety of offshore engineering issues and demonstrated the appreciation that they had for an experience member of their profession. Following this lecture I was invited to attend a meeting with the engineers of PRDS (Petroleum Resource Development secretariat) by the Director Ms. Preeni Withanage. On talking to them I understood all them under the leadership Mr Saliya Wickramasuriya (an ex veteran Marketing manager from Slumberge) simply wanted to succeed and bringing this oil and gas exploit to a provision. Last thing any senior engineer could do is crush their belief. “When you hear someone say you can’t do something, know that you can and start figuring out how. Ask yourself, ‘What would I do if I weren’t afraid?’”

Today the pressure is on to find economically viable ways to develop Mannar Basin fields, in the Sri-Lankan Northern Western waters. It was also known that two gas discoveries roughly estimated as 300bcf and 2TCF in the Mannar Basin by Cairns India Ltd has been confirmed after spending an estimated US $ 215 million for the exploration and then deciding not to develop it for the simple reason of the field existence in deep waters. Commercialization of these finding have now become a very big challenge for Sri lankan Petroleum Resources Development Secretariat (PRDS) because the field sit in waters over 1000 meters depth. The question is can this be achieved by the engineers of Sri Lanka?

To my understanding emphasis is being placed on PRDS to secure an appropriate strategy by the present government to exploiting these reserves. My experience in this industry suggests that conventional solutions prove too costly or unsuitable for deep-water and remote fields. As such more novel and innovative engineering solutions are required here.

Marginal fields typically share one or more of the following characteristics given below, and may result in high risk to returns on capital investment; could have heightened sensitivity to product price, and/or escalation in Capex and Opex during field development and operation.
- **Low exploitable reserves** - typically 25-50 MMbbl oil (between 10,000-30,000 bo/d) or one that produces 60,000 cubic feet (1,700 m³) or less of gas per day at its maximum flow rate
- **Uncertainty** in extent of the proven reserves, field life, production profile or reservoir geology
- **Difficult access** and or to export – i.e. stranded or deep water assets
- Other factors including **difficult reservoir fluid characteristics** (high wax and wax appearance temperature, high concentration of H2S or CO2 etc.)

Where these factors apply, it is often more practical to ask the question “given an assumed production profile based on estimated reserves, what is the maximum Capex that still ensures an attractive return on investment?”

On the case of Mannar Basin existence of known and discovered reserve of 2.3TCF but in deep waters of over 1000m and near to no other LNG plant (although it is only 31 km from the coast) make this field requiring specialized and clever exploitation method. Having said this can our engineers in Sri Lanka establish an engineering plan for field development, subsea pipeline, offshore platform and construction of the required LNG the plant to exploit this finding into a viable project?

Let’s start with the plant, a small on shore processing LNG plant similar to that was built in USA/Canada border of Nova Scotia **The Bear Head LNG** which produces roughly 6 mtpa LNG for export will be ideal base design Sri-Lankas’ requirement. This volume of 6 mtpa LNG production for export in our case would leave more than 300 billion cubic feet (Bcf) per year that could be used locally by connecting to an internal grid similar to gas pipeline grid in Bangladesh.
Most of the sceptics in Sri Lanka will definitely say such project cannot be planned and delivered by the local engineers, but having done few projects with such tall orders around the world I truly believe new generation of Sri Lankan engineer with appropriate support have the tenacity to actualize such a project. To my mind the dream of yesterday becomes the hope of today and the reality of tomorrow. When we start doing what's necessary now and then do what's possible tomorrow and suddenly we will find that we are doing the impossible everybody else was dreaming about. Let me explain what steps I believe required to be taken to achieve such an impossible dream.

Although Mannar basin is not marginal in production volume it is still stranded & in deep waters and will be considered by specialist as field with Difficult access and or to export (stranded and in deep water assets). In performing concept engineering and selection, there are a number of guiding questions that is commonly used. First is finding most practical & desirable subsea design. This would include establishing number of well completions, field layout, and plan for through life drilling or well intervention, and dry or wet tree arrangement. Based on the available production volume Mannar field will have long period of operation and should consider permanent offshore solutions such as FPSO with an offshore platform with a land based LNG plant to process the gas and a domestic gas supply pipeline circuit to meet the domestic needs. What could be selected in offshore platform design will be limited to a floating semi-submersible platform based on water depth, met-ocean and other environmental parameters. There are also other peripheral factors to be considered such as sourcing the correct skill of manpower, training the local manpower and establishing the scope for operational management and intervention time to time to reduce and optimize operational cost.

In any project it is necessary to secure the correct skills and the failure to secure the skills and commitment of key people may result in damaging project delays, budget blow-outs, reduced productivity and falling revenues. We have to ensure we have the right skills already in place and with sufficient mobility to respond to unforeseen increases in workloads or variation on projects without compromising on capacity elsewhere. We also would be necessary to develop succession plans with most effective operating model to deliver and deploy and meet talent requirements.

To some extent we need to engaging skilled professionals and companies from LNG/ offshore oil and gas industry around the world to train and coach our engineers and tradesmen. We also have to develop use best leverage and manage third party relationships to deliver our business objectives. By securing appropriate quality candidate with experience we turn the country diversity in skills to our advantage. It is absolute that we are required to train coach and equipped our line managers (and others who make the decisions) to make good use of the most diverse range of skills and talent available in country. We can reach out to our own LNG professionals in other countries and also tempt those skilled Sri Lankans expats to return work at home. Looking ahead, it’s clear that a short term or tactical approach to immediate hiring needs is unsustainable and diverting resources to longer-term staffing solutions will become crucial. By keeping most part of the engineering activity local it is possible upgrade local engineering and technological skill while and reducing the overall cost considerably.
Let me walk you through the phases of the FEED (Front End engineering Design) and detail engineering parts of the project. To carryout FEED and Detail Engineering for LNG project the consulting company requires considerable previous experience in LNG and offshore projects experience. A skill which is not available among companies operating in Sri Lanka as such this part need to be done by a leading external engineering group such as KBR (Kellogg Brown and Root) or similar. During the FEED, the defining of the production facilities subsea gas gathering network, a floating central offshore processing facility for the gas, floating production storage and offloading facility (FPSO) for the condensate, and a sub-sea gas pipeline to the plant requires to be established. By involving a local engineering company such as Hayley’s Energy Services Lanka (Pvt) Ltd as joint venture partners with KBR and most of the engineering requirement can be sourced from local engineering pool while the most senior technical requirement can be brought from foreign sources. I am sure General Manager of Hayley’s Ltd Mr. Rick Barnett would be only too pleased see his engineering team to be involved in a challenging project like this.

Offshore construction phase will involve the construction of a central production and processing and utilities platform and accommodation platform. The recovered liquids can be piped to a floating production, storage and offloading (FPSO) facility. A total Integrated Group Approach, with alliance between Ceylon Dockyards Ltd and DSME (Daewoo Shipbuilding & Marine Engineering Korea)or similar should be selected as the engineering and procurement contractor for the construction of the FPSO and semi-Submersible. A senior project engineer similar Mr. Gayantha Karunarathna from Ceylon Petroleum Corporation whom I met in the presentation would be a good candidate to lead the construction of some of the modules on the FPSO and offshore platform.
Floating storage and offloading facility

The integrated condensate and LPG storage offloading facility, will be require and it should be able to store 820,000bbl (130,000m3) of condensate, 300,000bbl (95,000m3) of propane and 300,000bbl (47,500m3) of butane. It will have no propulsion system of its own, and is about 250m-long, 50m-wide, with a tonnage of 150,000dwt. Accommodation should be available for 60 people. The purpose-built FPSO will be permanently positioned offshore in the field. It processes the condensate and LPG, and stored before they are loaded onto tankers for export. As such, it should be designed to exploit remote oil and gas reserves in the basin that might otherwise be stranded for decades.

This FPSO can be built by converting a Suemax tanker hull. The FPSO will have a turret with a dis connectable buoy (Buoyant Turret Mooring or BTM) allowing it to weathervane in normal conditions and disconnect from the FPSO upon the approach of a hurricane. The BTM will be configured with Steel Lazy-Wave Risers which will be ideal application for this FPSO. The mooring system should also incorporate the ability to adjust line tension during operations by use of an In-Line Mooring Connector. SBM Offshore’s over 30 years of turret experience including the delivery of nearly 50 systems will make it an ideal candidate for supply this pioneering BTM system. Having the turret mooring fabricated in Ceylon Dockyards in Colombo, or Trincomalee would be of advantage cost reduction for the project while up skilling our engineers and technicians.

This FPSO would typically be a Generation 2 design with a processing facility capacity of 60,000 barrels (6,656 tons) of condensate per day for export. The Suez-max hull will be able to store 820,000 barrels of condensate and total topsides weight will reach about seven thousand tons. Out of the senior engineers such as Mr Wininda K. Piyaratha from Ceylon Dock yards ltd I met in Colombo, there are plethora of engineers working in Ceylon Dock yards we could
choose to lead various aspect of the FPSO conversion project. Obviously they would require appropriate guidance from senior Sri Lankan Expats from offshore oil and gas industries.

The extraction of lean gas from the reservoir processing on the offshore platform shall be transported to Mannar via a 31km, 24” pipeline, where it is liquefaction of LNG at a single-train processing plant and to be shipped customers will take place. It will have a production capacity of 3.24 million tons LNG a year to be managed by Ceylon Petroleum Corporation to market and supply Sri-Lankas customers for next 25 years. This pipeline need to be laid on the sea bed under water by a reel ship pipe laying vessel similar to Apache-11 by Technip offshore or Rock water ltd.

The Project will require a 1.1 kilometer LNG jetty to reach from shore to deeper waters made of pre-fabricated preassembled structures totaling approximately 30,000 tons, which would including the pre-assembled racks (PARs), jetty roadways and gangways, LNG loading platform jackets and decks, tug pen pontoons, berthing dolphins, steel caisson topsides and vessel lighting navigation systems.

The plant can be built under as a lump-sum turnkey contract with engineered units of the Bechtel Corporation. The concrete LNG storage tank with perlite insulation can be subcontracted to a consortium of Simon Carves (UK) and State Engineering Corporation Sri-Lanka or similar. The field production can be started initially with ten production wells being drilled by a external drilling contractor such as Halliburton.

The combined service contract for the project sub-sea development should be given to a group such as Master Divers Ltd and the contract work should comprises pipeline inspection surveys, grouting services and ROV inspection of the project's pipelines and platforms.
The FPSO and Central Production Platform topsides should be built at the Hyundai fabrication yard in Ulsan, South Korea or Sri Lankan fabrication partner in Sri Lanka.

A well-known company such as FMC Technologies will be the ideal candidate to be contracted for the supply of subsea equipment for the project. The installation of the subsea production system and umbilical’s can be managed by leading Sri-lankan owned and operated Diving company such as Master Divers under the control of an experienced leader such as their managing Director Mr. Ruwan Wickremanayake (my good friend). Any requirement of deep water ROVs can be sourced from operators such as Hallin marine Singapore pte ltd. The Risers will be routed via a hang off frame located on a cellar deck of the topsides of the semi Submersibles. All hazardous process equipment should be kept in open and freely ventilated space, and to provide good, multiple accesses to emergency escape routes on this facility.

Using proven technological advances in deep-water facilities – for instance, subsea and downhole power management, more effective ways of managing drilling processes and assuring access to hydrocarbons in a safe and predictable manner to reduce the cost of exploiting deep-water, while being safe and environmentally responsible. The major themes include the modularization and standardization of subsystems and interfaces between subsystems that comprise deep-water installations will improve reliability, safety and economics in the architecture of the deep-water field installation.

We must always remember that projects those seems hard are not necessarily complex. It is my belief that there are four elements makes any project complex those are technical complexity, cost complexity, schedule complexity and political complexity. The key to managing complexity is to understand where the complexity originates, and ensure that a strategy is put in place up front to manage each element of complexity identified by the analysis. The bigger and more complex a project gets, the more you need formal processes and techniques to effectively manage the work. The larger the project, the more important it is that this information is mapped out formally and explicitly. All projects should start with this type of upfront planning to prevent
problems caused by differing viewpoints on the basic terms of the project. Any Fool Can Make something more Complex; But It takes commonsense approach make it simple again

**Conclusion**

On a finishing note I like reiterate a new era has dawned in Sri Lanka and peace have been consolidated after a bloody 30-year civil conflict which was the result selfish agenda of individual interest groups. We should learn from our past mistakes and model Sri Lanka’s economic future similar to Singapore as services & manufacturing destination to produce goods which plug into regional and global value chains, particularly in engineering and tourism. To achieve this it requires having access to energy supply. Availability of Gas in Mannar basin is a golden opportunity we should manage it and exploit it to the benefit of the whole country without squandering it as many African nations have done.

The world of oil and gas industry is constantly evolving to meet new economic and environmental challenges. Sri-Lanka’s young engineers should be given the opportunity to learn the engineering methodologies that allows them to take advantage of the latest technology. It is clear that in order to continue to survive in offshore gas industry one should try to drive down Capex, particularly in an era of uncertain gas price, much smarter engineering combined with better ways to manage technical and economic risk is required. Sri Lanka’s energy use presently is about $200 \times 10^8$ TJ per day it is possible to supply $300$TJ per day from this system to the countries grid and produce 7 million ton LNG per year for nearly 240 years.

Think about it.