Letter to Government of The Karnataka

Proposal Letter to setup Floating LNG Terminal

MR. AJAY KUMAR, (CHAIRMAN & MANAGING DIRECTOR)

Fox Petroleum Limited
T-8, Okhla Inds. Area,
Phase II, New Delhi -110020
Tel :-+91-11-40574200
Fax:-+91-11-40574204
Cell No. :- +91-9818258303

Fox Petroleum FZC
P.O. Box No. 10559
Rak FTZ, Business Tower
Ras-al Khaimah (UAE)
E-mail :- foxuae@foxpetroleum.net
Tel :- +971-5665-98970

Also - mcc Petroli Company
(Joint-Stock Company), Switzerland
Ajay Kumar – Director (India & Middle East)
E-mail : - ajay.kumar@mccpetroli.com

FOX PETROLEUM FZC
P : +971-7-207-6670
F : +971-7-204-1010
P.O. BOX : 10559, RAK - FTZ
UNITED ARAB EMIRATES
E-mail :foxuae@foxpetroleum.net
Web :www.foxpetroleum.net

Hon. Shri. P. K. Kunhalikutty
Hon'ble Chief Minister,
Government of the Karntaka,
No.323, 3rd Floor, Vidhana Soudha,
Bangalore **-** 560233,

<u>Subject :- Proposal for setting up Floating Storage Regasification Unit (FSRU) LNG Terminal Offshore to process 1 billion cubic feet (bcf) of gas per day and a storage capacity of 330,000 m3 of LNG Onshore and same capacity Offshore to cater the Energy Need of the State of the Karnataka.</u>

Honorable Sir(s),

1. Company :- It gives us immense pleasure to introduce ourselves as pioneer in development of infrastructure projects. We, the Fox Group, is engaged in various activities for development of Infrastructure projects in India, UAE, Bahrain, Switzerland, UK. We are into projects for construction of Buildings, and extended further into construction of Dams, Bridges, Flyover, Power Plant, Oil Exploration and Oil trading etc. Since inception.

The Fox consists of group Companies namely, 1. Fox Construction Limited 2. Fox Petroleum Limited 3. Fox Petroleum FZC, UAE(Based in UAE) 4. Fox Exim Limited. 5. Blooming Infratech Private Limited and associate companies like MCC Petroli Refinery, Herco Machinery Corp, USA; MCC Swiss Bank, SPA in Switzerland, and Sino Neft Petroleum Limited China.

Fox Petroleum Ltd. (FPL), an associate Company of Fox Petroleum FZC, United Arab Emirates; a part of USD 9.5 Billion United States Dollars Company with interest in Oil and Gas sector, Power Generation and Distribution is one of the leading Power Sector Company in Middle East. At present we have 1250 MW+ Approx Combined Cycle Power Plant Project in Bihar for 30MWE Capacity for each 38 Districts of Bihar. And FPL has also proposed to set up following Combined Cycle Power Plants consisting of 4 blocks of 750 MW (Combination of 8 GTGs + 8 HRSGs + 1 STG per block) totaling to 3000 MW capacity, located near Kota District, Rajasthan State and also Applied in Jharkand for 1250 Mwe.(Process of Land Acquisition is started).

2. Introduction:- The world's energy demand is growing far more rapidly than the energy industry can supply, so alternative resources are being investigated by the energy industry to address the deficit in energy production. Liquefied natural gas (LNG) is one of the alternatives being explored. Recent advancements in technology have given energy companies the ability to transport and deliver LNG long distances, and because of the impending energy shortage, federal regulatory agencies have relaxed the constraints that have been imposed in recent years on granting offshore construction permits in relation to LNG terminals.

These terminals will help in the delivery of LNG to onshore locations via an infrastructure of sub-sea pipelines. Six members of Fox Consultancy Services –Engineers of senior class were tasked to provide a front-end engineering analysis for a Floating Storage and Regasification Unit (FSRU) which is proposed located in the India Coastal region off the coast of Arabian Sea. The terminal is required to satisfy regulations as set forth by the Government of The Karnataka & Government of India, and other statutory and regulatory body of Government of India, as well as design constraints imposed by concerning operational expectations. Such constraints consisted of the following:-

- Will be permanently moored in 40 m of water
- Must be able to process 1 billion cubic feet (bcf) of gas per day
- Must have a storage capacity of 330,000 m^3 of LNG
- Must maintain a constant draft condition while loading or offloading
- Must sustain offloading operations in a 1-year storm event
- Must sustain shoreline delivery of LNG in a 10-year storm event
- Must survive a 100-year storm event

With these parameters defined, the team began its analysis.

3. General Arrangements: The team considered three design alternatives. The first option consisted of a ship-shape barge with Moss (spherical) LNG tanks located longitudinally along the beam of the terminal. The second option was catamaran-shaped, with twin hulls bridged by a large square platform and spread-moored to the sea floor. The third option was the same catamaran hull, but with single-point (turret) mooring. After careful consideration and input from industry representatives, the team decided to design the terminal as a ship- shape barge with LNG tanks contained within the hull. The final dimensions of the FSRU are as follows:

- Length between perpendiculars (LBP) – 340 m
- Breadth – 65 m
- Molded depth – 33 m

Five semi-prismatic type B (SPB) tanks were selected for the LNG containment. SPB tanks are advantageous in that they are independent from the hull structure and the geometry of the tanks can be designed to conform to the hull’s final shape. The ballast tanks were designed as five adjacent J-tanks on each side of the terminal, for a total of ten tanks. A double-hull layout was a direct effect of this ballast configuration, which optimized the safety of the terminal as well as complying with ABS steel vessel design guidelines. The offloading system selected for the terminal is a series of four “In-Air Flexible” offloading mechanisms designed by Fox Consultancy Services. This system was selected because of the internal flexibility of the hoses and the added range of displacement within the support booms. The possibility exists that these mechanisms will not be available from world known contractor upon project completion; therefore, a contingency design using conventional mechanical arms designed by FMC has been considered. The mechanical arms have a smaller overall range of displacement, requiring more stringent design constraints and thus giving the team versatility in using either offloading system without a significant redesign or reanalysis.

4. Stability: The overall stability of the terminal is a function of the draft, which in turn depends on the lightship weight. The lightship mass of the terminal, including the hull, ballast tanks, LNG tanks, and topside equipment, is 91,235 tonnes. One of the design constraints is that the terminal must maintain a constant draft so that the terminal's vertical position remains unchanged as it takes on cargo from berthing carriers. Whether the terminal is loaded or unloaded, the draft remains constant at 11.6 m. With the estimated lightship weight determined and the dimensions of the ship optimized, the team conducted a stability analysis using StabCAD, a graphically-oriented simulation program. StabCAD calculates the maximum KG a vessel can have while remaining stable under different stability criteria. If the vessel's KG is larger than any of the allowable values, the vessel is unstable. After simulating the terminal and running the analysis for the intact vessel, the smallest calculated allowable KG is 36.6 m. The actual KG of the terminal is 17.4 m, which is lower than the smallest allowable KG value. The FSRU is therefore stable in its intact condition. In addition, ABS requires that the ship maintain stability when two adjacent ballast tanks are damaged simultaneously. The smallest allowable KG value in the damaged condition was calculated using the same procedure as the intact analysis, but with different stability criteria. The terminal's KG value is lower than the smallest allowable KG for both a single tank damaged and two adjacent tanks damaged. Therefore, the terminal meets the ABS damaged stability requirements.

5. Global Loading/General Strength and Structural Design: A global loading and general strength analysis was performed to determine how the vessel responds to applied loads. These loads include the weights of the vessel, topside structures, LNG, and buoyancy. Weights lower than 3,000 kN were treated as point loads whereas weights greater than 3,000 kN were treated as distributed loads. Three load cases were evaluated for the global loading analysis. The first is in the calmest conditions where the buoyancy force is distributed evenly along the keel, representing still water. The second load case is where two wave crests are located at the bow and stern, and the third case is where one wave crest is located at mid-ship. The last two cases are the worst-case scenarios. Load case two produced the largest shear and moment magnitudes. These values are in compliance with those calculated from ABS requirements. The moment of inertia was calculated using ABS guidelines, which yielded 1.45×10^{7} cm^2 $–m^2$ The inertia was then used with the cross-sectional area to determine a minimum hull plate thickness of 0.032m (1.25in).

6. Environmental Conditions: After obtaining the raw environmental data from sources, the data was shoaled to the depth at the terminal. The environmental conditions for the 40-meter water depth for the 1-year, 10-year, and 100-year return periods were determined to be:

- Significant wave heights: 2.29 m, 2.66 m, and 3.04 m
- Peak periods: 15.0 s, 15.3 s, and 15.5 s
- Periods of maximum wave: 13.4 s, 13.6 s, and 13.8 s

Those conditions were used to calculate the environmental forces. The forces for the 1, 10, and 100 year return periods, respectively, in the three headings were calculated to be:

- Bow Seas: 698.8 kN, 827.8 kN, and 1090.3 kN
- Beam Seas: 3436.7 kN, 4165.8 kN, and 5328.1 kN
- Quartering Seas: 949.7 kN, 1128.1 kN, and 1463.9 kN

As the results indicate, forces in beam seas are significantly larger than bow and quartering seas because of the substantial surface area along the length of the vessel. The terminal will therefore be oriented with the bow facing in the southwest direction.

7. Hydrodynamics: Establishing the natural periods in pitch, roll, and heave is essential for determining the terminal's ability to achieve the given design constraints. After careful analysis, none of the periods corresponding to each degree of freedom coincide with the environmental peak periods; therefore, resonance will not occur. The periods were computed and produced the following results for unloaded and loaded conditions, respectively:

- Heave: 10.74 s and 10.74 s
- Pitch: 5.37 s and 5.37 s
- Roll: 9.30 s and 9.39 s

These results also indicate that heave will produce the largest displacement. The maximum displacement of 2.23 m occurs when the two vessels are 180 degrees out of phase. This displacement is within allowable tolerances (± 2.0m vertical and ± 1.7m horizontal) of the FMC mechanical offloading arms for vertical displacement. Since the FMC arms have a smaller allowable displacement than the "In-Air Flexibles", the terminal motion meets the requirements for both offloading systems.

8. Mooring/Station Keeping: The mooring system must be designed to satisfy maximum tensions and offset requirements as specified by API. The line tension is allowed to reach 60% of its breaking strength for an undamaged line and 80% for a damaged line in a 100-year event. The radius of the watch circle can be no more than 25% of the water depth, or 10 meters at the current location. The mooring system must not fail during a 100-year event. The mooring design for the regasification terminal is a spread system due to the benign and directional nature of the environmental conditions. A mooring system consisting of 12 lines (three lines per vessel quadrant) made up of 114.3 mm (4.5 in) chain was assessed. Line tensions under damaged and intact cases are 9,693kN and 5,685kN respectively. In each instance, the constraints are met. The offsets produced in the aforementioned environmental conditions during a 100-year event are 4.2 meters for intact lines in oblique seas and 5.3 meters for damaged lines. These values are both below the 25% allowed by API. The expected maximum tension for a 100-year return is 5,685 kN, which is 45% of the breaking strength of the 114.3 mm inch chain (12,440kN). The system therefore remains intact in a 100-year event.

9. Cost Analysis: Fox Consultancy Services Team provided with the unit cost of each terminal component for three shipyards in Korea, Japan, and Spain respectively. At current market prices, Spain is the least-expensive location. The total cost for constructing the FSRU in Spain, including

FOX PETROLEUM FZC

P : +971-7-207-6670
F : +971-7-204-1010
P.O. BOX : 10559, RAK - FTZ
UNITED ARAB EMIRATES
E-mail :foxuae@foxpetroleum.net
Web :www.foxpetroleum.net

construction, transportation, and contingency, is US $563 million only offshore and onshore US $495 Million.

I, therefore request you to allow us submit our document, and complete the project within time. By the grace of Almighty God, we have sufficient funds to flow into the project to follow the contours and gradients of our vision duly assisted by some of the best talents drawn from respective Industry. We are open to any suggestions that will serve the business model and mutual interests and look forwards to harness the best technology and make our project a further harbinger of International repute and be partner in socio economic development of The Karnataka, in the district of Dakshina Kannada, Mangalore .

We hope full co-operation from your end. So, that exertion of task will be easier to complete. Waiting to hear from you.

Thank You.

Sincerely Yours,

Ajai Kumar

(Chairman & Managing Director)

Copy to :

1. Chief Secretary, The Government of The Karnataka
2. Secretary, Commerce and Industries, The Government of The Karnataka
3. Commissioner, Development and Planning, The Government of The Karnataka
4. Environment, The Government of The Karnataka
5. The District Officer, DC of Dakshina Kannada, Mangalore; The Govt. of Karnataka