Small Scale LNG

Operational flexibility is an essential design requisite for today's small scale LNG plants. LNG as transportation fuel is currently enjoying a tremendous growth potential in the U.S since it is a low-cost, clean, abundant, and domestic fuel. Many fleets of ships, trucks, and buses are converting to LNG as new engine technologies are introduced, and LNG fueling infrastructure are built to take advantage of the price "spread" between diesel and natural gas. (See Figure 1). Furthermore, LNG is also expanding into off road high horse power application in drilling rigs, remote power generation, and even locomotives. This has led to a growing network of small scale merchant LNG plants to supply this "new" LNG market. (See Figure 2)

However, the adaptation of LNG into the transportation and the off road industries will take some time as the market deals with the classic "chicken or the egg" problem. The LNG suppliers are waiting for the users to convert their engines to LNG while users are waiting for suppliers to build the LNG fueling supply infrastructure. As such, the early market entrants of LNG plant owners and operators will have to deal with uncertain and fluctuating demands during the early stage of the plant life. It is vital for small scale plant owners to have a plant with flexible operating range as well as scalability to grow with market demand to be successful.

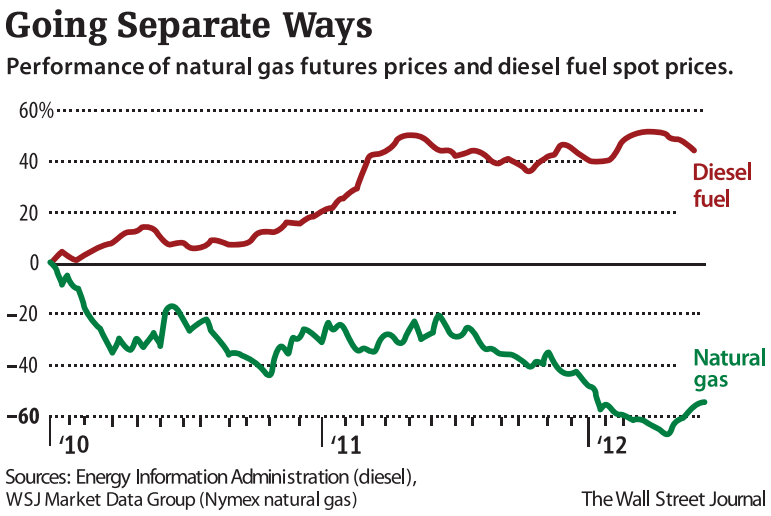

Figure 1 – Natural Gas versus Diesel Fuel Prices

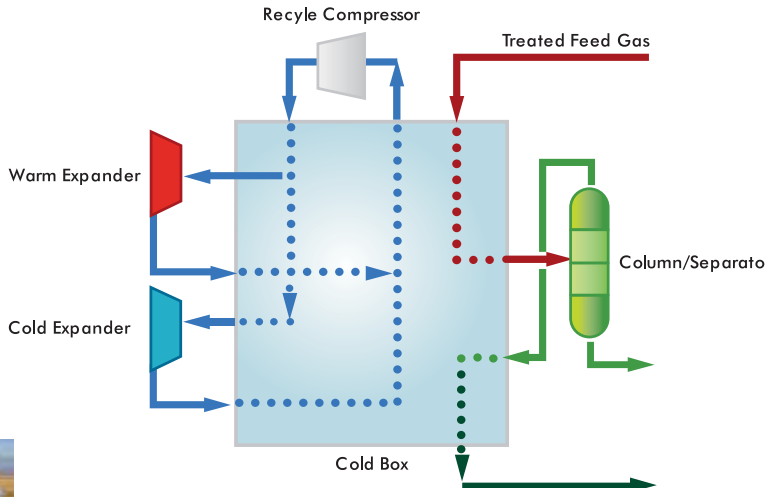

Figure 3 – Cosmodyne's Natural Gas Liquefier Nitrogen Cycle

Figure 2 – Clean Energy Fuel, Boron CA LNG Plant

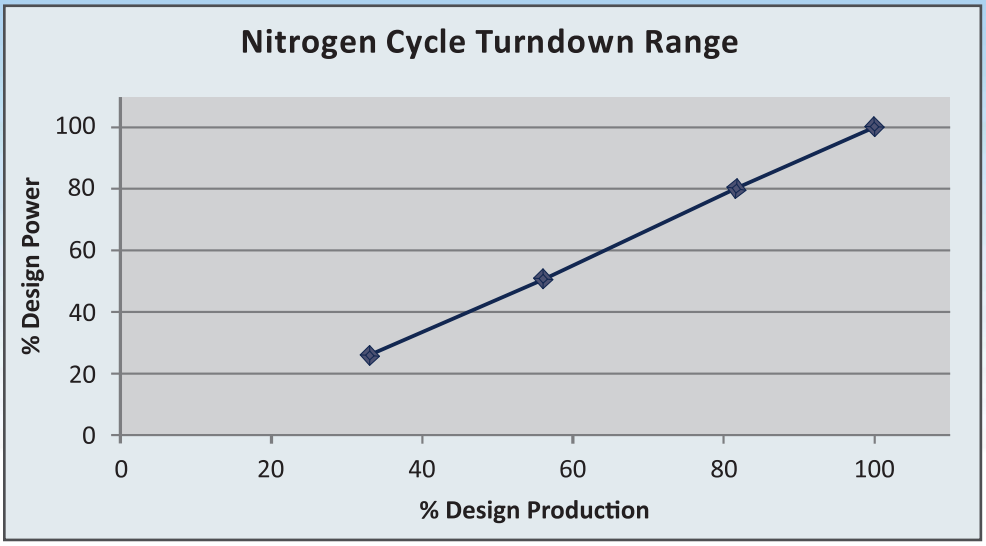

Figure 4 – Typical Cosmodyne Turndown Graph

In light of this market need, Cosmodyne improved the nitrogen expander natural gas liquefier to maximize the turndown range. Cosmodyne's nitrogen cycle LNG plant can operate down to approximately 25% of the design capacity with proportional power savings. This wide turndown range is possible since nitrogen refrigeration loop is always in a gaseous phase and can be easily manipulated to operate at reduced flows without recirculating flow through the compressors. (See Figure 3) The plant operator can vary the plant production to match the actual demand to minimize operating costs. Below is a typical turndown range for Cosmodyne's nitrogen expansion natural gas liquefier. (See Figure 4)

The wide turndown range has many benefits compared to plants that operate in "campaign mode." "Campaign mode" operation is when a plant runs at full capacity until the storage tank is filled to a set level and shuts down. The plant restarts when the storage tank runs down to a low level set point.

First, with turndown operation, the plant does not need to be turned off and on. Frequent starting and stopping of a plant can reduce reliability and plant equipment life.

Secondly, in many areas, electric utility companies adjust the electricity rates on the plant's peak load (maximum) electricity draw during a billing cycle. Hence, during the early stages of the LNG plant life where the demand is lower than the full capacity of the plant, "campaign mode" operation will result in higher electricity rates since the rate will be based on LNG plant's full capacity load. With wide turndown, the LNG plant will operate at much lower production with lower power resulting in lower electricity rate.

Lastly, many plant feed gas supply agreements have a mandatory minimum take requirement. Plants operating in "campaign mode" will be penalized since the LNG plant owner must pay the minimum gas costs even when the plant is turned off. Furthermore, even without a minimum take requirement, uncertain demand for LNG can make scheduling pipeline draws difficult and can result in unnecessary penalties for under or overestimating the amount of pipeline draw. Operating the plant at a lower capacity can make scheduling more predictable.

Cosmodyne's nitrogen cycle natural gas liquefier's wide turndown range gives the operating flexibility to deal with the unknown market demands during the early years of the LNG plant life. This new feature will allow the LNG plant operators to minimize their operating costs even when the plant is operating at lower than the full plant capacity and deal with the uncertainties of the market.