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WHITEPAPER

CONDITION MONITORING OF LNG PLANTS

Industry maintenance requirements

Due to the projected growth in demand, the pace of constructing new LNG plants and extending existing ones is unrelenting. Although LNG is one of the more expensive forms of energy produced, there have been several successful efforts to drive down these costs. These initiatives include increasing the size of the trains, reduction of over-design margins, and grouping of critical machine components on the same shaft to name a few. Over the years, the net sum of these improvements has significantly reduced the cost of producing LNG, while concurrently increasing the risk of interrupting a larger portion of production in the case of a single component breakdown. Subsequently, effective machine condition and performance monitoring has become even more critical in ensuring the reliability and productivity of these production facilities.

Machine trains are becoming larger, over-design margins are diminishing, and critical machine components are being grouped on the same shaft. These initiatives were launched over the years to save production costs, but they also consequently increase the risk of lost production if a single critical machine is down. This is further compounded by efforts to downsize at the plants and the very competitive nature of the industry.

As in any sector of the petrochemical industry, ensuring the reliable operation of these machines is not a trivial task – even less so when considering the reduced maintenance staff and specialists at the plants and the very competitive nature of the industry.

In general, the machine monitoring requirements in the Petrochemical and Oil & Gas industry are demanding and especially so when monitoring an LNG plant. The sensors themselves must be able to withstand the extreme operational temperatures.

Add to this the fact that there are several potential failure modes that are not found on similar machines in other industries, which need to be detected and diagnosed both reliably and at an early stage. Furthermore, there is little tolerance for unplanned shutdowns either for inspection or for maintenance activities. For example, in the case of a machine trip in the liquefaction portion of an LNG plant, you only have a few hours to determine the cause and to get the machine up and running again before losing cooling capacity. Failure to do so can result in extended downtime of the entire production train.

Automated early detection of incipient faults is crucial to enable sufficient lead time to plan the necessary remedial maintenance actions. If the machines have different duty cycles, and are operating at different speeds and loads, the vibration signature and performance parameters will also differ. Therefore, the alarm limits need to be tailored to the different operating conditions to avoid false alarms. This adaptive monitoring concept, widely used in the petrochemical industry, is vital in the monitoring of LNG plants.

As a result of the operation and maintenance requirements of the machines and the increased risks involved with the industry cost-saving initiatives, condition monitoring plays a vital role in safeguarding the company's competitiveness.

Dedicated monitoring strategy for LNG plants – the Liquefaction Process

The Liquefaction process is one of the primary processes in the LNG plant. Machines in an LNG plant, especially those in the liquefaction process, are subject to extreme operating conditions. The thermal expansion of a refrigerant compressor, a pump or a hydraulic turbine between start up and full production at cryogenic temperatures is intense, thereby subjecting the bearings and other machine components to severe loads during start-ups and shutdowns. Even small variations in the composition of the natural gas being processed can have significant effects on the overall loading of the machines. Furthermore, many machines are operated at variable speeds and loads; thereby rendering the mean time before failure for the machine components both variable and unpredictable.

The typical LNG plant includes several trains and processes, as shown in Figure 1. We are currently monitoring many of the machines in each of these processes in many different LNG plants around the world, such as centrifugal and axial compressors, gas turbines, gearboxes, cryogenic pumps, liquid expanders, motors and generators, and reciprocating compressors. Typical critical machines monitored in the LNG liquefaction process are shown in Figure 2. Visit our website for more information on how we monitor these and what kinds of faults we typically detect early to prevent unplanned downtimes and production losses.

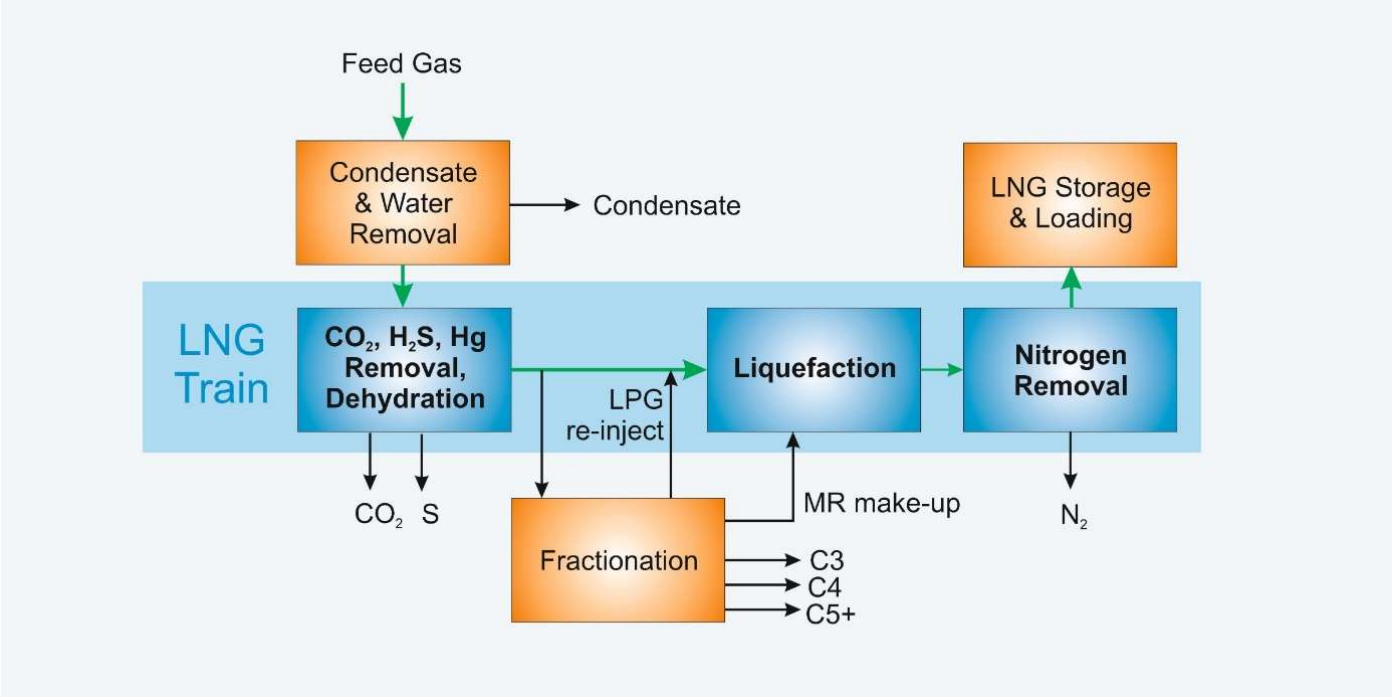

Figure 1. Processes in LNG plant where machines are monitored.

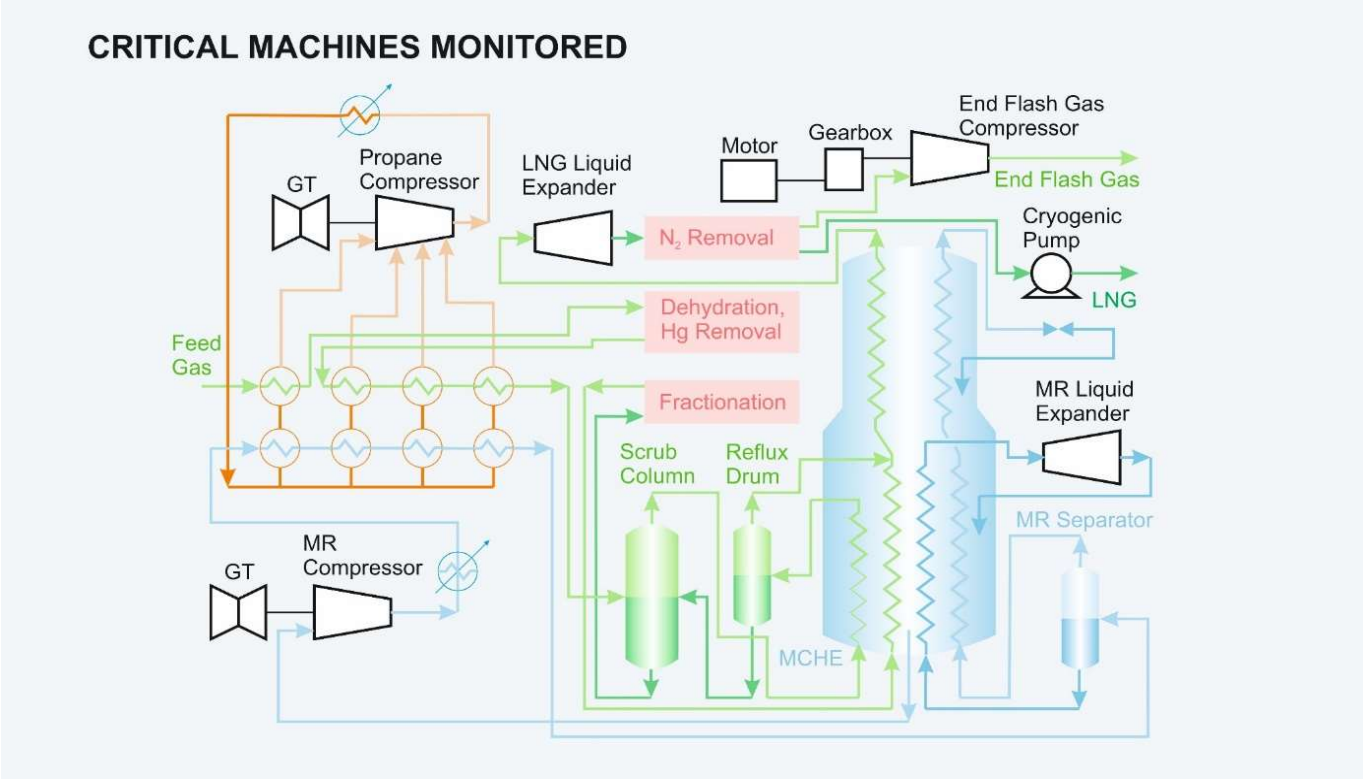

Figure 2. Critical machines monitored in the LNG liquefaction process.

Monitoring system implementation

Our products for machine monitoring can be easily interfaced to the user's process control system (DCS), enterprise and maintenance management systems, emergency shutdown system, operator workstations and even other pre-existing monitoring systems. In many of these applications remote monitoring with secure communications over long distances is a requirement.

For more information, visit **www.bkvibro.com**