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Natural Gas Pre-Treatment for LNG Liquefaction Facilities

Introduction

Newpoint Gas, LP. (Newpoint) has been contacted on numerous occasions to provide inlet gas pre-treatment upstream of LNG liquefaction facilities. These facilities have been located both onshore and offshore and each system has been somewhat different in gas composition, flow, pressure and temperature. However, Newpoint has developed a “modular” process flow scheme that addresses each area of pre-treatment and which can be custom arranged to meet the specific system requirements including the removal of CO₂, water, mercury, and heavy hydrocarbons. The following Process Description describes each process module and the way in which Newpoint can design, fabricate and deliver these units to our customers.

Process Description

Inlet gas enters the bottom section of the Amine Contactor(s), where it is typically contacted with sufficient formulated amine solution to meet the required outlet CO₂ specifications (typically less than 50 ppmv). The gas exiting the top of the Amine Contactor(s) is routed to the Sweet Gas Cooler and any condensed water is removed in the Overhead Gas Scrubber. Inlet filter separation/coalescing is provided upstream of the Amine Contactor(s).

The rich amine will enter the amine regeneration system, feeding into the Amine Flash Tank. The Amine Flash Tank is designed to provide 10 minutes of residence time and includes a hydrocarbon collection sump. Any flashed vapors from the amine will be pressure controlled and routed to skid edge for disposal.

The liquid amine from the Amine Flash Tank flows through a 100 gpm capacity Charcoal Filter and then through a 100% capacity Sock Filter before going to the Lean/Rich Exchanger, where the rich amine is heated to approximately 210F. A level control valve is located on the rich amine stream, downstream of the Lean/Rich Exchanger, to control the level in the Amine Flash Tank.

The rich amine and reflux stream combine to feed the top stage of the Amine Still. The Amine Still is also packed with structured packing. A water-cooled heat exchanger, is provided for the Reflux Condenser and a horizontal vessel serves as the Reflux Accumulator. The acid gas vapors off the Reflux Accumulator will be pressure controlled and routed to the edge of the skid for final disposal. Two Reflux Pumps (one

operating and one stand-by) are also provided. The Amine Still Reboiler utilizes a horizontal thermosiphon design, with a TEMA Type BEM exchanger. Heat for the Amine Still Reboiler will typically be provided by 50 psig, saturated steam or hot oil.

The lean amine from the bottom of the Amine Still flows into an equalized Lean Amine Surge Tank. This is a horizontal vessel designed to provide five (5) minutes of surge capacity. The lean amine leaves this vessel and flows through the shell side of the Lean/Rich Exchanger and is cooled to approximately 215F.

The lean amine out of the Lean/Rich Exchanger is then pumped to about 60 psig in one of the two Amine Booster Pumps. From the Amine Booster Pumps, the lean amine is cooled to 120F in the Lean Amine Cooler. The Lean Amine Cooler is a Shell and Tube exchanger that uses cooling water.

The lean amine from the Lean Amine Cooler is then fed to the Amine Circulation Pumps. These pumps (one operating, one stand-by) will pump the amine to a pressure approximately 50 psi above that of the entering gas stream, for delivery to the top of the Amine Contactor(s).

The gas exiting the Overhead Gas Scrubber is routed to the Molecular Sieve (mol sieve) and mercury removal system where water vapor, carbon dioxide and mercury are extracted. The gas first passes through an Inlet Filter/Coalescer to remove any liquid or solid particles that may be present. The scrubbed gas then is fed into two of the four mol sieves (the other two will be in regeneration) where the water and trace amounts of carbon dioxide are adsorbed onto the desiccant beds. The water content of the outlet gas will be less than 1 ppmv. Exiting the mol sieves, the gas passes into the Mercury Guard Bed, where any trace amounts of mercury are captured on the adsorbent. After leaving the Mercury Guard Bed, the gas passes through a Dust Filter to catch any fine particulate that may have come from the upstream desiccant beds and then goes to the Gas Conditioning system.

The clean, dry gas from the Molecular Sieve system enters the Inlet Gas Chiller, where it is chilled and any heavy-end hydrocarbons are condensed. The liquid and vapor streams are separated in the Warm Separator. The vapors are routed to skid edge for delivery to the LNG Plant. The Warm Separator liquids are combined with a high pressure liquid/gas stream from the LNG Plant and used as the cooling medium for the Inlet Gas Chiller. The Inlet Gas Chiller will be a brazed aluminum plate fin heat exchanger, designed to handle both liquid and gas feeds on the cold side. The two-phase stream exiting the Inlet Gas Chiller is fed to the Regeneration Gas Scrubber, where the remaining liquid hydrocarbon is separated and routed to skid edge for disposal/recovery. The exiting vapor is heated to 475F in the Regeneration Gas Heater and used to regenerate the mol sieves. The regeneration gas is heated using 650 psig steam, or some other appropriate heating medium. The regeneration gas leaving the mol sieves is routed to the plant fuel system.

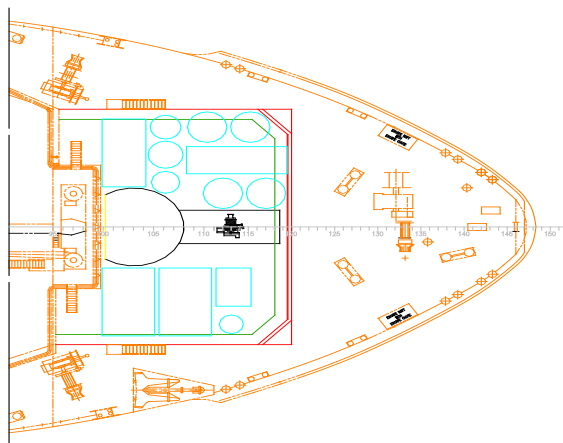
All control valve stations and PSV's shall be located on an upper level of the skid modules. This is to eliminate potential line pockets and allow plenty of room for Operations and Maintenance personnel to work on these systems. Except for services where H₂S may be present, all PSV discharge piping shall be routed to atmosphere. In the case of sour PSV operation, discharge shall be into the line downstream of the Reflux Accumulator pressure control valve station.

Newpoint provides a local Motor Control/Starter Panel for all of its plants. This panel can be shipped separately and installed at a remote location, if so desired by the customer.

The treating equipment is provided as skid mounted modules to reduce installation time and costs. These modules are laid out to reduce treating equipment foot print while maintaining access for operations and maintenance.

Offshore/Mobile Facilities

Newpoint Gas and its subsidiary, Newpoint Offshore can provide facilities for use on offshore vessels and platforms. Newpoint has experience with DNV and ABS certifications and procedures. This experience is essential to providing treating facilities in a cost effective and timely manner. These savings in time and money are result of the reduced number of design iterations and change orders.



Vessel-based Pretreatment System Layout

Conclusions

The effective pretreatment of natural gas before liquefaction is essential for efficient operation of the entire LNG plant. This pretreatment includes the removal of contaminants such as CO₂ and water and may also include removal of mercury and heavy hydrocarbons. Treating equipment that is skid mounted reduces installation time and costs. Also, if the treating facility is on a platform or vessel, Newpoint can ensure that the treating equipment will meet the standards of internationally recognized certification authorities such as DNV or ABS. Newpoint Gas, LP. can provide treating facilities that meet all of the pretreatment needs of the LNG industry.