

LNG Plant Services: Liquefier Operations

Maximize production, reliability,
efficiency and equipment life

Ongoing Technical Support

Air Products has over 50 years of experience supporting LNG plant operations and currently offers technical support to over 100 LNG liquefiers in operation. This includes efficiency optimization, troubleshooting, such as avoiding freeze-out of natural gas contaminants, and providing guidance to alternative operating modes, such as loss of feed compressor.

Support is offered for the Air Products process design scope, including:

- Feed gas chilling for moisture removal
- Fractionation pre-cooling for NGL (natural gas liquids) removal
- Fractionation – scrub column, LPG (liquefied petroleum gas), NGL, expanders
- Liquefaction, including the MCHE (main cryogenic heat exchanger)
- Refrigeration, including subcoolers, compressors, economizer cold boxes for AP-X® and AP-N™ LNG processes
- Flash gas
- Nitrogen rejection
- Helium extraction

Periodic site visits provide valuable opportunities for knowledge transfer between our liquefaction experts and your operations and engineering teams.



Operator Training

Refresher training soon after start-up, and periodically thereafter, to enhance your team's understanding, share best practices, and provide useful answers to questions.

AP-OptiPlus™ Liquefier Optimization and Training Program

A proprietary software tool that can empower your operators and engineers with detailed knowledge and rapid, effective data analysis for troubleshooting and optimizing the liquefaction unit. Multiple operating modes can be analyzed, and automated logic charts can be used to quickly identify potential solutions for operating the liquefier at peak performance. It provides effective training to both new and experienced operators utilizing real plant data. The AP-OptiPlus offering is supplemented with periodic site visits and remote support from product experts.

AP-OptiPlus™ Program Success Stories

- Currently optimizing operations on 9 LNG Trains
- Providing structured problem solving to potentially improve reliability, production, and efficiency
- Proven results include up to 3% liquefaction production or efficiency gain
- Positive customer feedback
- In commercial use since 2009

Enhanced Control Program

Air Products' LNG processes offer high efficiency, but suboptimal process control during operations can reduce the benefits. Air Products' Enhanced Control scheme enables the MCHE to fully realize the potential of the process 24 hours a day, 7 days a week. This supervisory control system has simple set points such as LNG production and MCHE outlet temperature. Operations can automatically take advantage of lower night temperatures to potentially boost production with Air Products' unique control scheme.

AP-AutoCool™ Program

A proprietary cooldown technology that automatically cools the MCHE. Potential benefits of the AP-AutoCool program include:

- Faster and smoother cooldown within MCHE design limits
- Reduced flaring during cooldown
- Maintain target cooldown rate
- Increased plant availability
- Consistent cooldown method
- Customized for new or existing plants



Maintenance Services and Parts

For equipment supplied by Air Products, including:

- Coil wound heat exchangers (MCHEs, subcoolers and precoolers)
- Refrigerant compressors and cold boxes (AP-X® and AP-N™ LNG processes)
- Helium extraction cold boxes

Air Products' experienced personnel and state of the art programs may improve the profitability of your operation.



Debottlenecking and Operations Improvement Studies

Maximize the potential of your plant. Many LNG facilities are interested in boosting production with minimal capital investment. Air Products has a successful track record of assisting customers in debottlenecking their liquefiers. Air Products performs detailed simulations and provides start-up support for various options, including:

- Larger or upgraded propane condenser
- Additional power for liquefaction, such as:
 - Endflash / BOG recycle to fuel or feed
 - Gas turbine inlet air chilling
 - Supplemental propane compressor
 - Refrigerant driver and / or compressor upgrades
 - Feed gas booster compressor addition or upgrade
- Modifications to accommodate changing feed gas compositions, such as increasing nitrogen content, to increase production and reduce flaring through upgrading or adding nitrogen removal equipment
- Assess the impact of upcoming changes to operation, such as new feed gas compositions, low availability of certain refrigerants, or reduced feed gas pressure
- Use of alternative refrigerants (such as ethane instead of ethylene)
- Reduce flare start-up (i.e. direct cooldown)
- Implementation of advanced control systems
- Evaluation of mechanical systems and heat exchanger integrity for improved operations



Debottlenecking Success Stories

- Up to 40% increase in LNG production from a single train
- Multiple trains—10 to 20% extra with minimal capital investment

Dynamic Simulations

Air Products has 30 years of experience carrying out detailed dynamic simulations, which can help you understand the effect of changes to your operating plant. Rigorous models include the capability of simulating single and multiphase flows to capture both the short and long time-scale dynamics of the process, and give high fidelity results.

Dynamic Simulation Success Stories

- Refrigerant compressor blocked discharge study—saved project costs by reducing design flare loading.
- AP-C3MR™ SplitMR™ process feed booster compressor trip study—helped plant to avoid refrigerant compressor trip during the transition. This configuration is now widely accepted and practiced utilizing the full power available from two identical gas turbines.
- AP-C3MR™ parallel refrigerant compression string trip study—results enabled the plant to avoid sympathetic trips of additional compression strings when one string trips, allowing continued production at the lower rate.
- AP-X® process control and operability study—enabled smooth implementation of this novel process design that currently operates with high reliability in the largest LNG trains in the world (7.8 MTPA/ train).



About Air Products

Air Products is a world-leading Industrial Gases company in operation for over 80 years. The Company's core industrial gases business provides atmospheric and process gases and related equipment to manufacturing markets, including refining and petrochemical, metals, electronics, and food and beverage. Air Products is also the world's leading supplier of liquefied natural gas process technology and equipment.

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