

# LNG engineering services: dynamic simulations



## Understand the effect of plant changes before you make them



Since the late 1980's, Air Products has been active in developing first principle dynamic models and performing dynamic simulations throughout our portfolio of liquefaction technologies. These rigorous models include the capability of simulating single and multiphase flows to capture both the short and long time-scale dynamics of the process. The dynamic simulation flowsheets, incorporating plant-specific parameters, can be built with:

- Air Products' proprietary MCR® coil wound heat exchanger model
- Closed refrigeration loops including compressors, heat exchangers, accumulator, evaporators, companders, and hydraulic turbines with associated valves and controllers.
- Air Products' enhanced liquefier control scheme
- Booster compressor system
- Liquefaction End Flash system
- NGL/Fractionation systems

### Benefits of dynamic simulations include:

- Aiding startup and operation engineers by accurately modeling transitions and process upsets. The flowsheet captures the effect of the disturbance as it propagates through the liquefaction system. Control responses can then be developed and tested before these disturbances occur in the physical plant.
- Refining cooldown and shutdown procedures based on the plant's specific process parameters.
- Calculating relief analyses, which due to their transient nature may yield a lower relief flow rate than calculated by steady state simulation, potentially reducing capital cost.

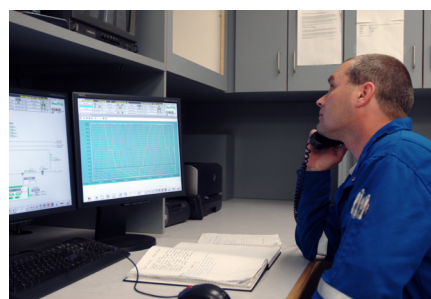
Our dynamic simulation engineers develop and run these simulations calling upon the in-house expertise of our senior LNG start-up and process engineers. Their input provides practical, accurate and realistic responses to what is happening in the dynamic simulator, yielding high fidelity results.

## Experience

Air Products has performed multiple dynamic simulation studies across our portfolio of liquefaction technologies and accommodating a variety of compressor configurations. Below are a number of our success stories.

## 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 celebrating more than 75 years of operation. 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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