

# Floating LNG (FLNG) capabilities: World-class LNG technology adapted for offshore applications



## Petronas FLNG Satu

World's first offshore FLNG facility utilizing Air Products AP-N™ LNG Process – 1.2 mtpa  
Initial location: Kanowit gas field, South China Sea, Sarawak, Malaysia. Started-up: 2017.

In 2019 the facility was successfully moved to a new gas reserve offshore Sabah over the Keabangan gas field, requiring only an Air Products' engineering verification. This marked the first-ever relocation of an operational floating LNG plant. (Photo courtesy of Petronas)

## Petronas FLNG Dua

Utilizes Air Products AP-N™ LNG Process – 1.5 mtpa. Started-up: 2020

Air Products' cryogenic equipment and natural gas liquefaction processes have become the standard for baseload LNG, both onshore and offshore. Our liquefaction systems are widely used because of their proven low cost, high reliability, high efficiency and operational flexibility. Air Products has tailored its cryogenic equipment designs and developed natural gas liquefaction processes specifically for the unique offshore environment of an FLNG facility.

## Air Products' LNG technology: comprehensive options, customized and optimized

Air Products offers a comprehensive range of natural gas liquefaction technologies to support customer-specific project requirements. Our offerings include various mixed refrigerant (MCR®), Nitrogen (N<sub>2</sub>), and methane (C<sub>1</sub>) liquefaction process cycles (see Figure 1), and we provide performance guarantees on LNG production, specific power and quality. Our proprietary liquefaction equipment is robust, reliable, compact and efficient:

- Coil wound heat exchanger (CWHE) for liquefaction and containment of hydrocarbons, both LNG and refrigerants, which is a robust piece of equipment where high thermal transient process conditions can occur
- Companders – highly efficient expansion turbines with a robust, fully skidded design required for the offshore FLNG environment
- Cold boxes with plate fin heat exchangers in economizer service, gas on gas heat exchange, which are suitable for low thermal transient process conditions

Our engineers can optimize our proprietary equipment and processes to address the full spectrum of economic factors, feed gas compositions, ambient conditions, LNG product specifications and FLNG vessel design constraints.

We work with clients from conceptual development through project execution, commissioning and start-up, and continue through the life of the FLNG facility.

## Experience you can trust

### Built on proven success

Air Products is the premier global supplier of LNG technology and equipment, proven in over 100 trains worldwide. All performance tests were successfully passed the first time.

Air Products supplied liquefaction technology and equipment to the first four offshore FLNG projects: Shell Prelude, Petronas FLNG Satu, Petronas FLNG Dua, and Coral South FLNG, and has participated in over a dozen FLNG FEEDs since 2010.

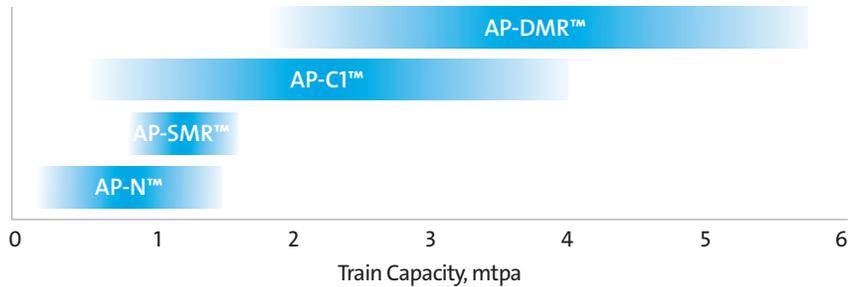
### A foundation for trust

We executed a rigorous, 15-year-long FLNG development and marinization program to ensure that our proprietary equipment and liquefaction processes are suitable for offshore conditions. Our FLNG technology reflects the Air Products culture of safety, reliability and operability from more than 80 years of owning and operating cryogenic industrial gas facilities. Our center of technical excellence, located in Allentown, Pennsylvania, USA, provides a centralized point of service.

## About Air Products

Air Products is a world-leading industrial gases company celebrating 80 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.

Figure 1: Air Products' FLNG Liquefaction Technology



Coral South FLNG facility utilizing Air Products AP-DMR™ LNG Process – 3.4 mtpa due to come onstream in 2022 offshore Mozambique. (Graphic courtesy of ENI)



Equipment built at Air Products' manufacturing facilities:

1. Coil wound heat exchanger
2. Cold box with plate fin heat exchangers
3. Companders

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