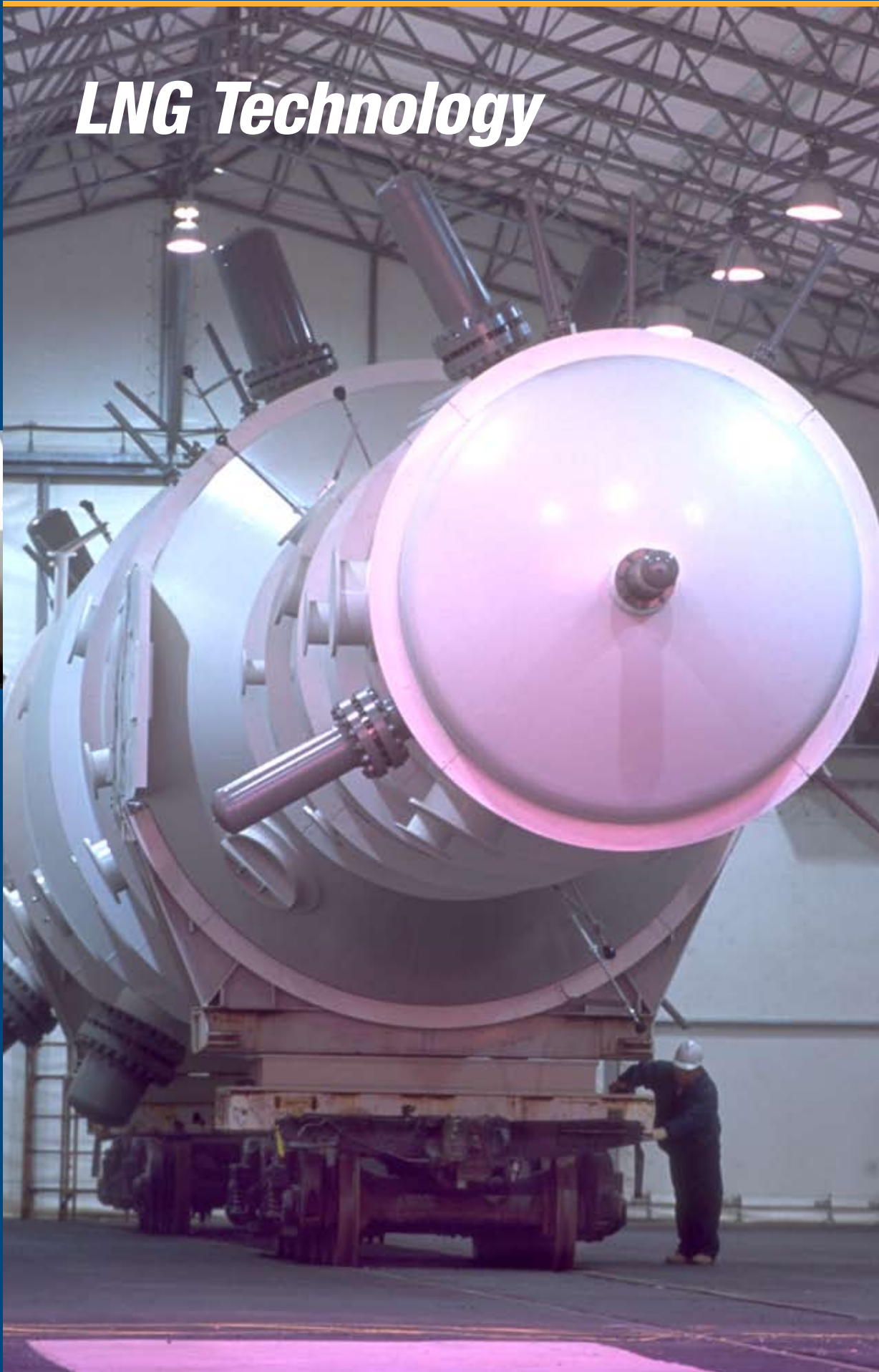


LNG Technology



*"We have one goal . . .
to meet the expectations
of our customers . . . and
we always find a way."*

Bill Gendall, a 45-year
veteran of Air Products



Our Baseload LNG Capabilities: Leading With Strength

Understanding our customers' specific needs has been essential to our becoming the global leader in LNG technology. Working closely with customers and building in-depth knowledge of their requirements has driven the continuous improvement in the LNG technology, equipment, and services that we offer.

We are undeniably proud of playing a major role in pioneering LNG technology and seeing that technology become the standard of comparison.

Today, the Air Products MCR[®] cryogenic heat exchangers (MCHE) and natural gas liquefaction processes are the world's standard for baseload LNG.

The key to our success has been our MCR (multicomponent refrigerant) Liquefaction Processes and MCR Cryogenic Heat Exchanger. Air Products' design and

engineering team was able to develop a unique way to successfully integrate the liquefaction process design and the mechanical design of MCHE to achieve an optimization of performance and reliability unmatched in the LNG industry.

In addition, Air Products manufactures and supplies specialty cryogenic machinery and heat exchange equipment integral to our patented AP-X[®] process for large trains.

The Strength of Experience

No company has more experience in the supply of natural gas liquefaction processes and equipment than Air Products. We helped pioneer the LNG industry, supplying our first LNG process and equipment over 35 years ago.

A Full Range of Capabilities

We'll provide a complete range of products and services for the successful design, construction, start-up, and operation of your LNG facility:

- Process development studies
- Detailed process engineering
- MCHE design and fabrication
- Installation and start-up advisory services
- Technical support services during plant operations

air products' baseload LNG projects

table 1

An MCR main cryogenic heat exchanger ready for shipment.



Location	Initial Start-up	Trains	LNG Run-down Per Train (MTA)	Process
Abu Dhabi	1977	2	1.7	C ₃ MR
	1994	1	2.6	C ₃ MR
Algeria	GL1Z 1977	6	1.3	C ₃ MR
	GL2Z 1981	6	1.4	C ₃ MR
	Skikda 2009	1	4.5	C ₃ MR/SplitMR™
Australia	1989-1993	3	2.5	C ₃ MR
Brunei	1972	5	1.3	C ₃ MR
Egypt	2004	1	5.0	C ₃ MR/SplitMR™
Indonesia	Bontang 1977-1997	7	2.6	C ₃ MR
	1999	1	3.0	C ₃ MR
	Arun 1978-1986	6	2.0	C ₃ MR
	Tangguh 2007	2	4.0	C ₃ MR/SplitMR™
Libya	1970	4	0.8	SMR
Malaysia	Satu 1982	3	2.5	C ₃ MR
	Dua 1995	3	2.8	C ₃ MR
	Tiga 2003	2	3.8	C ₃ MR
Nigeria	1999-2002	3	3.2	C ₃ MR
	2005-2007	3	3.7	C ₃ MR
Oman	2000-2005	3	3.3	C ₃ MR
Peru	2009	1	4.0	C ₃ MR/SplitMR™
Qatar	Qatargas 1996-1998	3	2.5	C ₃ MR
	Qatargas 2 2008	2	7.8	AP-X [®]
	Qatargas 3 & 4 2009	2	7.8	AP-X [®]
	RasGas 1999	2	3.3	C ₃ MR
	RasGas II 2003-2007	3	4.7	C ₃ MR/SplitMR™
	RasGas 3 2008	2	7.8	AP-X [®]
Yemen	2009	2	3.4	C ₃ MR/SplitMR™
Total		79		

An exchanger after completion at our manufacturing annex located at the Port of Bucks County, Pennsylvania.



MCR main cryogenic heat exchanger during manufacture.



The MCR Main Heat Exchanger: Prepackaged Efficiency

The Heart of Your Facility

The main cryogenic heat exchanger, or MCHE, is the heart of the LNG process. Air Products' MCHEs feature a proven and robust mechanical design, along with high-quality fabrication critical to the successful operation of the LNG process.

Each MCHE that we supply is custom-designed by our engineers, who are experts in cryogenic liquefaction and engineering and largely responsible for continuous improvement in the technology. Each MCHE consists of several spiral-wound tube bundles housed within an aluminum or stainless steel pressure shell designed to retain refrigerants in the event of a shutdown.

For LNG service the heat exchangers may consist of one-, two-, or three-tube bundles, each made up of several tube circuits. With this type of exchanger, the tube circuit areas can be matched to the process requirements. The result is a very efficient and compact design.

Attributes of MCR Cryogenic Heat Exchangers

We are the world's largest supplier of baseload LNG heat exchangers. Each MCHE is manufactured at our state-of-the-art facility at Wilkes-Barre, Pennsylvania, convenient to eastern United States ports. At Wilkes-Barre, tube bundles, separators, distributors, piping, and other components are fabricated and positioned within the heat exchanger shell.

We complete final assembly of the large MCHEs at a manufacturing annex at the Port of Bucks County, also in Pennsylvania, to

eliminate welding after the exchanger arrives on-site. The typical exchanger may be as large as 16.5 feet (5.0 meters) in diameter and 180 feet (55 meters) high and weigh 500 tons (455 metric tonnes).

The large size of the individual heat exchanger tube bundles facilitates the design of large process trains. In addition to providing economies of scale, this leads to simple piping and control systems and, consequently, to reductions in installation, operation, and maintenance costs.

Air Products' MCHEs are of robust design and contain no moving parts, ensuring minimal downtime and long service life. Heat exchangers we supplied more than 35 years ago are still operating, many at production rates well in excess of their original design capacity.



Ongoing Engineering and Technical Support

Naturally, you can count on us to give you essential engineering and technical service support from preliminary design to commissioning and start-up.

We'll be there, too, after your successful start-up. Long-term customer relationships are what we are all about. We are fully committed to helping your facility operate at peak performance. Our ongoing services include:

- Engineering analysis and dynamic simulation of plant systems and operating conditions
- Operator training
- Analysis of system modifications and operating improvements
- Maintenance support services and materials
- Expertise in advanced control systems, including MPC (Model Predictive Control)

You will also benefit from our leading-edge commitment to LNG technology. We have spent, and continue to spend, millions of dollars on research to bring our customers quality, reliability, performance, and the best return on capital.

Safety Number One Issue

At Air Products we are focused on human and product safety and respect for the environment. Nothing is more important than safety—not sales, not production, not profits. It's a commitment we all share.

We design and operate our facilities throughout the world to the highest safety standards. We have earned more safety-related awards than any other industrial gas company. Year after year, we stand among the top performers of the American Chemistry Council.



Careful inspections ensure high quality of our equipment.

The Air Products Advantage: We Build Success Into Your LNG Project

Air Products' technology provides a world of advantages to your LNG project for greater profitability and success, including:

- Economical production, with
 - readily available refrigerants
 - large train sizes for economies of scale
 - high efficiency/low feed gas consumption
- Reliability as a result of
 - fewer process components
 - proven performance, demonstrated by plant onstream records

- Operational advantages, including
 - ease of start-up to minimize the time to achieve full capacity
 - operational flexibility to handle a wide range of conditions at high efficiency
 - flexible and efficient turndown capability
- The result is improved profitability by getting plants onstream sooner and achieving optimum plant utilization with maximum effectiveness.

Our experience in LNG technology is unmatched. We'll put it to work for you.

Air Products' technology helps customers achieve the lowest possible capital per ton of LNG produced.

air products' LNG technology



(photo copyrighted Oman LNG LLC)



MCR® Liquefaction Processes: Optimum Production With High Efficiency and Low CAPEX/MTA

Proven State-of-the-Art Technology

Air Products developed MCR processes for natural gas liquefaction plants in baseload service. Our process is optimized using multicomponent refrigerant streams in compression refrigeration systems. This system provides cooling at a continuum of temperature levels to liquefy the natural gas feed stream. By using a mixture of gases rather than single refrigerant components, the thermodynamic efficiency of the process is enhanced and the liquefaction system is greatly simplified.

We offer process options to best meet your specific liquefaction requirements. The MCR option, including our latest patented large train cycle AP-X,® remains the process of choice for baseload LNG because of its proven performance starting in the 1960s. It is reliable, flexible, thermodynamically efficient, and easy to operate.

Integrated Process Designs Mean Peak Performance

We believe that we can offer you our best by becoming involved in your project at the earliest stage. Our LNG specialists are fully experienced in thorough process scoping studies and preliminary process designs that enable you to develop the soundest design.

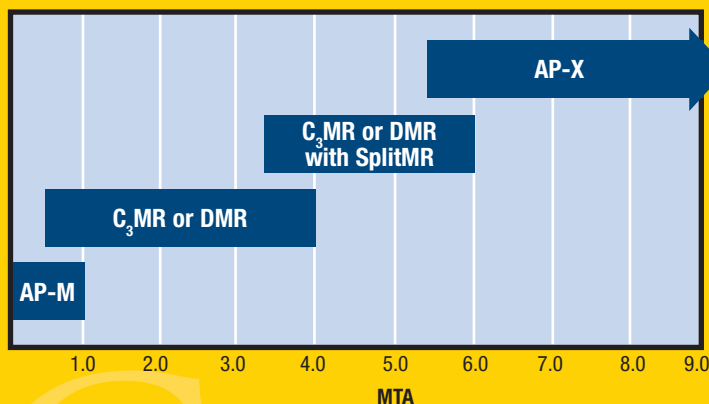
Our process and machinery engineers will then work closely with you to develop the optimized liquefaction system that integrates the main cryogenic heat exchanger with the refrigeration compressors and drivers and the supporting process systems. The liquefaction process design and main cryogenic heat exchanger are customized and optimized for your particular project requirements and plant conditions.

Project-specific parameters, such as site ambient conditions, feed characteristics, production requirements, and economic factors, are properly balanced to your requirements to engineer the most cost-effective and efficient system.



*We strive to develop
and deliver innovative LNG
technology that
provides the competitive
edge you need.*

Air Products' MCR LNG Process Technologies



LNG



About Air Products

Air Products serves customers in industrial, energy, technology and healthcare markets worldwide with a unique portfolio of atmospheric gases, process and specialty gases, performance materials, and equipment and services. Founded in 1940, Air Products has built leading positions in key growth markets such as semiconductor materials, refinery hydrogen, home healthcare services, natural gas liquefaction, and advanced coatings and adhesives. The company is recognized for its innovative culture, operational excellence and commitment to safety and the environment. Air Products has annual revenues of \$10 billion, operations in over 40 countries, and 22,000 employees around the globe.

Worldwide

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