

THE LINDE GROUP

*Linde*

# Tonnage Air Separation Plants





# Introduction.

The Linde Engineering Division is a leading international manufacturer of capital goods and equipment.

Linde's areas of activity cover design and construction of turnkey industrial plants together with a full range of engineering work for process plants. To date, the Engineering Division has built nearly 3,800 plants and has numerous patents in the Linde name. Extensive engineering know-how accompanied by many years of experience in project management and as a general contractor qualify the Engineering Division as an expert partner in international plant construction. A variety of over-the-fence supply schemes are offered by the Linde Gases Division.





## Engineering and fabrication facilities world-wide.

The Engineering Division - A global company with development of technology and plant concepts together with global engineering and fabrication centres under the leadership of the Munich centre of competence.

Engineering Division, Pullach, Germany



Linde-KCA-Dresden GmbH, Germany



Linde Engineering (Hangzhou) Co. Ltd., P.R. China



### Engineering Division, Pullach, Germany

Headquarters of Linde Engineering Division. Located in Pullach, 10 km south of Munich, approx. 1,800 engineers and other specialists. Global competence centre for air separation plants.

- Central research and development
- Global product management
- Sales
- Basic and detailed engineering
- Site services

### Linde-KCA-Dresden GmbH, Germany

Engineering centre for Eastern Europe and CIS with 530 engineers and other specialists.

- Sales
- Detailed engineering
- Site services

### Linde Engineering (Hangzhou) Co. Ltd., P.R. China

Engineering centre for China and South-East Asia, located 120 km south of Shanghai.

Approx. 130 engineers and other specialists.

- Sales
- Detailed engineering
- Site services

### Engineering Division, Schalchen Plant, Germany

Global competence centre fabrication, approx. 700 skilled craftsmen and engineers. 80,000 m<sup>2</sup> floor space. Fabrication of:

- Cold boxes
- Rectification columns
- Structured packing
- Plate-fin heat exchangers
- Coil-wound heat exchangers
- Other plant components

### Linde Process Plants Inc., USA

Engineering centre for US and NAFTA, approx. 240 engineers and other specialists.

- Sales
- Detailed engineering
- Site services

### Linde Process Plants Inc., Murray Hill, USA

Engineering centre for US and NAFTA, approx. 30 engineers and other specialists.

- Sales
- Detailed engineering

### Linde Engineering India Pvt. Ltd.

Global detail engineering centre, engineering centre for India.

Approx. 300 engineers and other specialists.

- Detailed engineering
- Site services

### Linde Process Plants Inc., USA

Fabrication centre for NAFTA area, approx. 160 skilled craftsmen and engineers. Workshop area with about 15,000 m<sup>2</sup> (3,250 m<sup>2</sup> sheltered).

Fabrication of packaged air separation plants.

### Linde Engineering (Dalian) Co. Ltd., P.R. China

Fabrication centre for China, approx. 230 skilled craftsmen and engineers. Total area of 87,000 m<sup>2</sup> (30,000 m<sup>2</sup> sheltered). Fabrication of:

- Cold boxes
- Rectification columns/condensers
- Direct contact/evaporation coolers
- Molecular sieve adsorbers
- Coil-wound heat exchangers

Engineering Division, Schalchen Plant, Germany



Linde Engineering (Dalian) Co. Ltd., P.R. China



Linde Engineering India Pvt. Ltd.



# General products.

## Air separation plants

For production of oxygen, nitrogen, argon and - in some special cases - other rare gases (krypton, xenon, helium, neon) through cryogenic rectification of air. The products can be produced in gaseous form for pipeline supply or as cryogenic liquid for storage and distribution by truck.

Linde has built approx. 2,800 cryogenic air separation plants in more than 80 countries and has the leading market position for air separation plants. This position results from the outstanding technology of our plants together with very reliable and effective contract execution.

## Packaged air separation plants

are modularly designed cryogenic plants with a daily production capacity of up to 450 tons (13,000 Nm<sup>3</sup>/h) of oxygen or up to 900 tons (30,000 Nm<sup>3</sup>/h) of nitrogen. If required these plants can also produce argon. Within the last 20 years, Linde has built approx. 500 packaged air separation plants. For a detailed description please refer to the respective product information.

## Tonnage air separation plants

are plants that are individually designed for the specific demands of our customers. These plants can produce oxygen, nitrogen, argon, krypton, xenon, helium and neon. Daily oxygen production capacities are between 450 tons (13,000 Nm<sup>3</sup>/h) and 7,000 tons (200,000 Nm<sup>3</sup>/h). Within the last 20 years, Linde has built approx. 100 tonnage air separation plants.

Air separation plant in Leuna, Germany





Aluminium plate-fin heat exchanger



Packings



Tray columns

## Longest track record in air separation.

### Superior plants availability

- Use of robust plant and component concepts with proven reliability in many Linde plants.
- Highly developed and proven control and redundancy philosophy to guarantee continuous production.
- Long established relationship with well-known and reliable sub-vendors, especially for rotating equipment.
- Design of cryogenic core components by Linde with fabrication in Linde's own workshops incorporating Linde's high standards of quality (certified acc. ISO 9000 and ISO 9001).



Air separation plant in Montereau, France

## Key features.

### Maximum efficiency

- Advanced engineering tools and methods for process design and optimization.
- Optimized efficiency for static and rotating equipment.
- Linde advanced process control system for continuous optimization of plant production adjusted to consumer requirements or power costs.

### Smooth plant operation and maintenance

- Design of plant for robust operation and easy maintenance.
- State-of-the-art plant automation system to ensure smooth plant operation and equipment protection automatically without intervention of the operating personnel.
- Highly sophisticated advanced process control functions that allow automatic start-up of the plant and fast and easy adjustment of plant production without operator interaction.
- Global remote support with direct access to plant control systems by Linde specialists.

### Protection of health and environment

- Design of all Linde plants worldwide acc. to international safety regulations and recommendations (IEC, OSHA, EIGA, CGA), German safety rules (UVV) and Linde's own stringent safety standards.
- Controlled process with continuous review of plant design to ensure safety of personnel and the environment.
- Numerous safety awards received from international authorities.

# References.

Air separation plant supplying the major industrial complexes in Saudi Arabia.

**Customer:**

Saudi Basic Industrial Corporation (SABIC)

Plant	Status	Oxygen tpd	Nitrogen tpd	Other products
Al Jubail 3	in operation since 1993 (turnkey)	1,200	900	argon
Yanbu	in operation since 1999 (turnkey)	1,200	1,500	argon
Al Jubail 5	in operation since 2004 (turnkey)	3,200	1,740	argon, krypton, xenon
Al Jubail 6	contract in 2005 (FOB)	3,600	-	-
Al Jubail 7	contract in 2005 (turnkey)	3,200	1,860	-
Yanbu 3	contract in 2005 (turnkey)	3,200	1,860	-



### References

The largest multi-train air separation plant in the world supplying nitrogen for enhanced oil recovery in Mexico.

**Customer:** Pemex

- Turnkey project
- 5 trains in operation
- Product capacity of 63,000 t/d nitrogen (17,500 t/d oxygen equivalent)



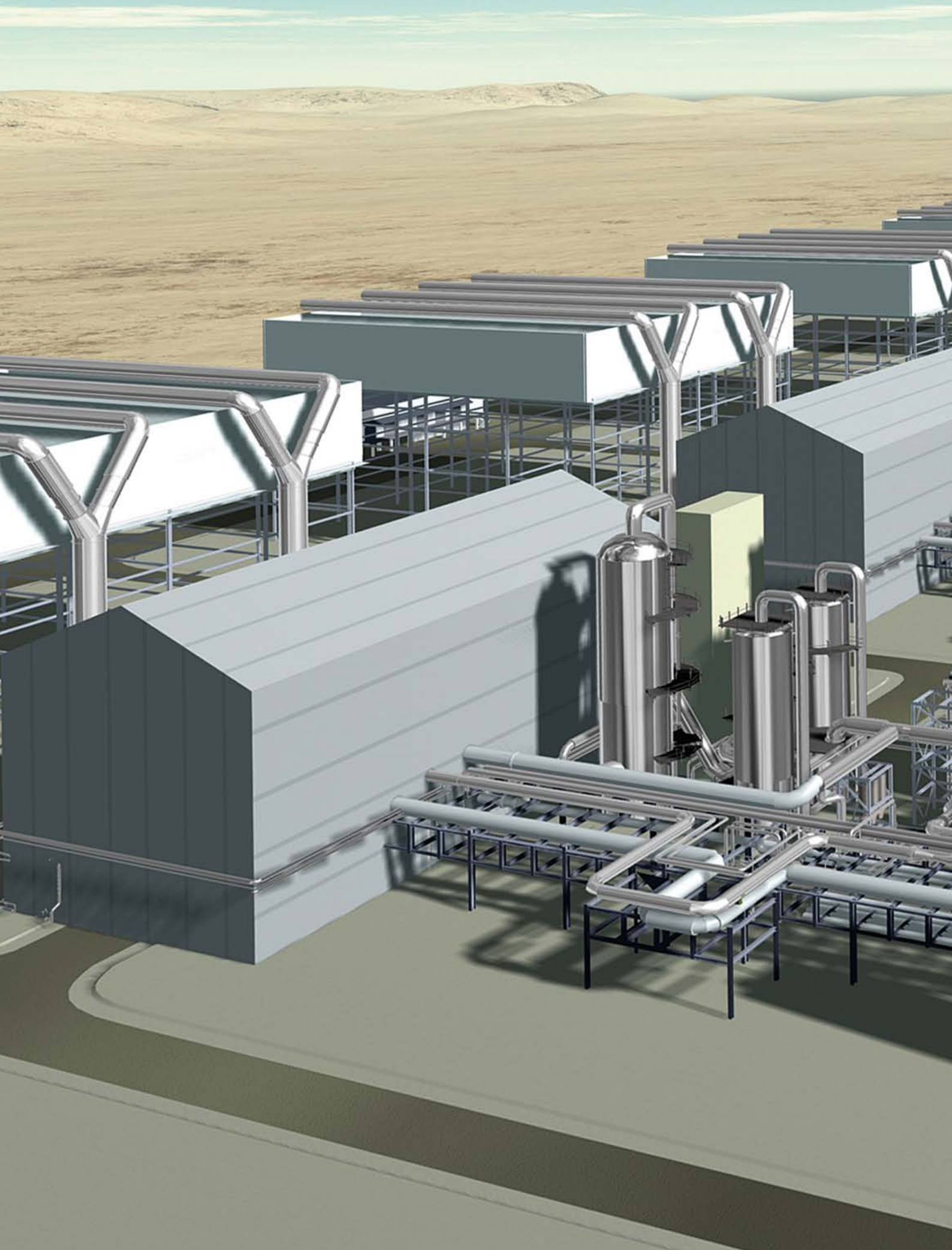


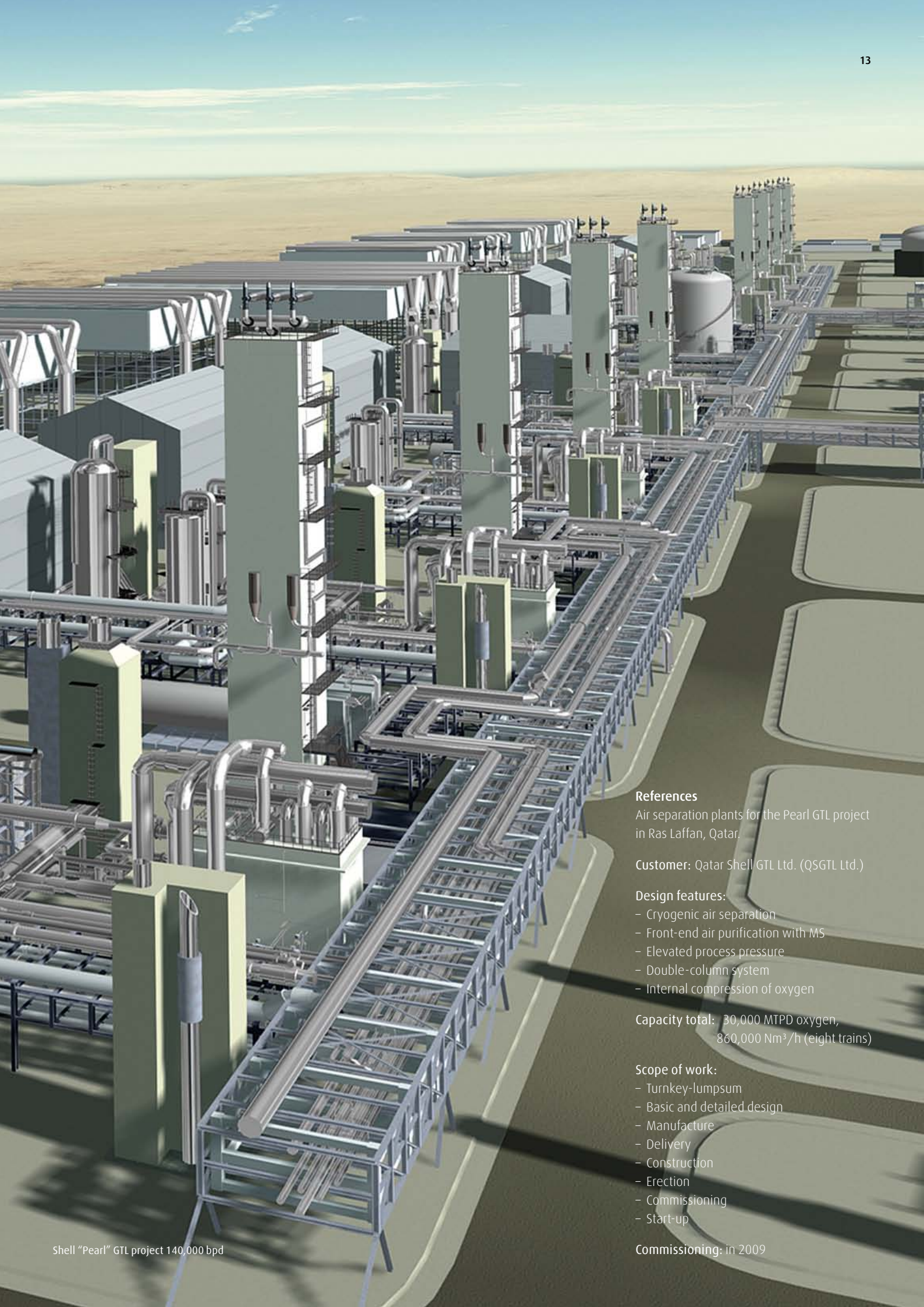
### References

One of the largest steelworks in China supplied with oxygen, nitrogen and argon from Linde air separation plants.

**Customer:** Wuhan Iron and Steel Company

Plant	Status	Oxygen tpd	Nitrogen tpd	Other products
A/B	commissioned in 1975	690	600	-
C/D	commissioned in 1982	690	605	argon
E/F	commissioned in 1992	2,100	1,810	argon, krypton, xenon
G/H	commissioned in 2004	4,190	4,860	argon, krypton, xenon, helium, neon
I/J	contract in 2006	4,190	4,860	argon, krypton, xenon, helium, neon





#### References

Air separation plants for the Pearl GTL project in Ras Laffan, Qatar.

Customer: Qatar Shell GTL Ltd. (QSGTL Ltd.)

#### Design features:

- Cryogenic air separation
- Front-end air purification with MS
- Elevated process pressure
- Double-column system
- Internal compression of oxygen

Capacity total: 30,000 MTPD oxygen,  
860,000 Nm<sup>3</sup>/h (eight trains)

#### Scope of work:

- Turnkey-lumpsum
- Basic and detailed design
- Manufacture
- Delivery
- Construction
- Erection
- Commissioning
- Start-up

Commissioning: in 2009

# Services.

## General

The Engineering Division has extensive experience in executing large complex multi-national turnkey projects particularly for large petrochemical and LNG plants (e.g. Hammerfest LNG plant: 1.6 million engineering hours, 9 construction sites, 120 suppliers, 19 main subcontractors).

The Engineering Division is the only company that has comprehensive experience in the execution of turnkey contracts for air separation plants in China and in the Middle East.

## Basic engineering

Process design and optimization with advanced process simulation software OPTISIM (developed by Linde). The process design incorporates features of numerous in-house patents.

Design of plant operation and control using Linde's own extensive operating experience.

Specification of rotating equipment in cooperation with world renowned subvendors.

## Detail engineering

Mechanical design using 3D CAD software to establish a complete model of the plant.

Specification of the electrical equipment and design of the power supply networks with specific expertise in large drives (up to 60 MW).

Specification of control system hardware from well-known international automation companies. Programming of control functions using pre-engineered and pre-tested basic control functions.

Implementation of advanced control functions (automatic load change, automatic start-up, automatic product adaptation) using the Linde advanced process control system.





Air separation plant in Assaluyeh, Iran

### Project management

Project managers with extensive experience of complex multi-national/multi-partner projects.

Advanced tools and methods for project control (scheduling, cost control).

Reliable tools, methods and procedures for global sourcing and material logistics.

### Construction

Extensive experience of turnkey projects for large plants (including Middle East and China).

Methods and experience in controlling complex pre-fabrication and construction activities as well as material flow.

### Commissioning and training

Skilled experienced commissioning teams ensure smooth start-up and handover of the plant to the customer.

Remote support for the commissioning team on site by specialists of every discipline (e.g. process, control, machinery) makes the whole Linde expertise available on site.

Extensive safety procedures and safety training ensure safe commissioning and operation of the plant.

### After sales service

Prompt response to any customer request by qualified specialists.

Global remote on-site support to optimize operation and minimize plant downtimes.

Plant optimization services to improve plant efficiency.

Remote support for the on-site commissioning team by specialists of every discipline (e.g. process, control, machinery) giving access to the total Linde expertise.

Extensive safety procedures and safety training ensuring safe plant commissioning and operation.

# Designing processes – constructing plants.

Linde's Engineering Division continuously develops extensive process engineering know-how in the planning, project management and construction of turnkey industrial plants.

## The range of products comprises:

- Petrochemical plants
- LNG and natural gas processing plants
- Synthesis gas plants
- Hydrogen plants
- Gas processing plants
- Adsorption plants
- Air separation plants
- Cryogenic plants
- Biotechnological plants
- Furnaces for petrochemical plants and refineries

## Linde and its subsidiaries manufacture:

- Packaged units, cold boxes
- Coil-wound heat exchangers
- Plate-fin heat exchangers
- Cryogenic standard tanks
- Air heated vaporizers
- Spiral-welded aluminium pipes

More than 3,800 plants worldwide document the leading position of the Engineering Division in international plant construction.

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