



RAMBOLL

HIGH EFFICIENCY POWER PLANTS

Ramboll's 30 years of in-depth expertise and practical experience as an adviser to major utilities shows that high efficiency is ensured by optimisation of technical parameters to the actual project.

Thermal power plants

Ramboll has designed and realised some of the most efficient and fuel flexible thermal power plants in the world, applying the most advanced Ultra Super Critical (USC) steam parameters and steam cycles. The plants are typically designed for coal, heavy fuel oil and/or natural gas.

Ramboll is generally providing designer and EPCM services including use of very advanced steam data and optimised processes resulting in an electrical efficiency well above 47 % – world class efficiency for USC power plants. Additionally, Ramboll has more than 15 years of experience with bio-conversion and co-firing of biomass of such USC coal fired units.

Our pool of specialists has personal experience of realising more than 10,000 MW of thermal power stations worldwide.

As a Ramboll customer you will benefit from our in-depth technical knowledge and innovative and structured methodology in combination with our practical operational experience, which has led to further increase of the operational efficien-

cy for some of the most advanced thermal power plants in the world.

CCGT plants

The Ramboll knowledge of CCGT plant concepts is both wide and deep. Ramboll is working together with the leading OEM (Original Equipment Manufacturer) to select the optimum gas turbine and steam process for ensuring the highest possible efficiency of CCGT plants. Ramboll has realised some of the most efficient and flexible CCGT power plants in the world to date. We are dealing with both relatively standardised CCGT projects and highly advanced CCGT projects.

Advanced CCGT projects are customised to fit specific requirements such as process steam supply for an industry, district heating supply or integration of a CCGT into an industrial process plant. Plants can be fuelled with refinery or gasification gasses for instance as a part of an Integrated Gasification Combined Cycle (IGCC) plant.

Our specialists have a combined working experience of realising more than 25,000 MW of CCGT plant capacities worldwide. Hence, Ramboll

can provide you with the option to realise your projects to budget – or even below – and achieve a project completion on time.

Our services comprise

- Complete in-house multidisciplinary engineering
- Site selection and feasibility studies
- Plant performance modelling and optimisation
- Tech-economic analysis
- Environmental Impact
- Assessment studies (EIA)
- Conceptual and detailed design
- Single EPC or multi contract
- EPCM consultancy, incl. tender specifications and evaluations and contract negotiations
- Owner's Engineer services
- Warranty engineer services and operational support.
- Lenders' engineer services.

For further information please visit www.ramboll.com/power or contact our Service Line Manager directly.

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HIGH EFFICIENCY POWER PLANT REFERENCES

1993-1998 NORDJYLLAND POWER STATION, DENMARK



Nordjylland Power Station Unit 3 is a 410 MW coal and oil fired unit commissioned in 1998.

USC steam data:

- High pressure steam: 290 bar and 582 °C
- Reheat steam: 80 / 23 bar and 580 / 580 °C
- Achieved >47 % efficiency.

The plant is equipped with double reheating resulting in an optimised design with regard to high efficiency and flexibility. The plant is equipped with desulphurization and deNOx catalyst and complies with the most strengthen environmental requirements.

Ramboll provided all engineering services and was in charge of project management, overall plant performance and the complete functioning of the plant.

This plant was after 9 years of operation still the world's most efficient coal fired plant (IEA).

2009-2011 ENECOGEN 870 MW CCGT, THE NETHERLANDS



Enecogen is a natural gas fired 870 MW CCGT located in Rotterdam and entered operation in 2011.

Data:

- Siemens SGT5-4000F gas turbine technology
- Two identical single shaft units
- High efficiency of 59.5 %

The plant has a high operational flexibility and its efficiency is due to advanced design and direct cooling. The plant is designed for 300 fast and reliable starts per year. Due to its location close to a LNG terminal the plant is designed to operate on fluctuating gas quality.

Ramboll acted as Owner Engineer for the investors Eneco and DONG Energy. Ramboll services included design review, shop expediting, supervision and plant testing.

The plant was completed before schedule and performance exceeded the guarantees.

2003-2010 MONGSTAD CHP PLANT, NORWAY



Mongstad CHP plant is a 280 MW plant located in Mongstad, Norway and started operation in 2010.

Data:

- Fuel mix of natural gas and refinery oil
- 2 gas turbines (130 MW each) from General Electric

The plant is integrated into the Statoil refinery process where it preheats crude oil, supplies steam and treats refinery gas. The plant separate hydrogen from the refinery gas before the gas is burned in the gas turbines. The plant is integrated into a carbon capture test center.

Ramboll acted as EPCM and performed all services from feasibility study and tendering until plant taking over.

The design of Mongstad plant is highly complex and demonstrates Ramboll's technical skills.