WORLD CLASS CONSULTANCY
THERMAL POWER PLANTS
500 MW WOOD CHIPS FIRED POWER PLANT IN COPENHAGEN
The utility company HOFOR is planning a new 500 MW thermal CHP unit at the Amager Power Plant in Copenhagen, Denmark. The plant will be equipped with a CFB boiler (circulating fluidised bed), flue gas condensation, a steam turbine and new fuel storage and handling systems at the plant harbour. The main fuel of more than a million tons of wood chips per year will arrive by ship. COWI has been HOFOR’s engineering consultant since project start in 2013. The main contracts will be allocated in 2016 with commissioning expected in 2020.

A LEADING CONSULTANT IN THERMAL POWER PLANTS

Thermal power plants will continue to have an important role to play in a future with increasing use of combined heat and power production (CHP) and with electricity production from fluctuating renewable sources like wind and solar being introduced in the energy system. Efficient and updated thermal power plants are needed to achieve maximum economic and environmental benefits.

COWI is a large international multidisciplinary consultant with a worldwide staff of more than 6,000; with headquarters in Denmark and offices and operations in several countries worldwide. COWI Thermal Power is a team of experts ready to assist our clients in all phases of their projects, from feasibility studies and planning to implementation of new plants, and throughout the entire plant life. Based on many years’ experience in close cooperation with plant O&M organisations, COWI can offer assistance with plant modifications and retrofit, extension, major overhauls, condition based maintenance, and optimisation of operation.

We have comprehensive experience with Thermal Power Plants in sizes from 5 MWe to 650 MWe. We have assisted clients in numerous projects for coal, oil, gas and various biomass fuels, such as wood chips, wood pellets and straw. Many of these plants are designed as CHP.

COWI offers a unique range of specialists within planning and design, boilers and combustion, turbines and generators, district heating, corrosion and materials, chemical aspects, bulk handling, civil engineering, electrical equipment, plant control, process calculation and optimisation by use of Thermoflex etc. COWI specialists have wide international background from working on projects and with suppliers from around the globe.
Thermal power plants can be built for a variety of fossil fuels, e.g. coal, gas and oil. In addition, biomass fuels such as wood chips, wood pellets and straw can be utilised alone or in co-combustion with other fuels depending on local availability. COWI has experience from a number of projects with the use of all these fuels in different combinations.

Independent of fuel CHP is an attractive option when power plants are situated near cities with a district heating system or near industries with a heat demand. The overall energy efficiency is increased substantially and this reduces the climate change impact from fossil fuels. It furthermore improves the use of available biomass resources. All aspects of CHP in both production units and district heating distribution systems are part of COWI’s expertise.

The development of a Power Plant project is complex and requires careful preparation. The development of the project includes technical and economic feasibility studies, conceptual design and all necessary planning and environmental permits from the Authorities. This may take as much as 1-3 years depending on location, financing and procurement, so the initial costs can be quite high.

It is therefore of utmost importance to know the route to follow and the barriers and constraints that need to be managed so the result both meets all technical requirements and is financially viable.

COWI has comprehensive experience in the project development phase from a wide range of projects.

**PROJECT DEVELOPMENT**

**350 MW MULTI FUEL CHP PLANT IN COPENHAGEN**

The new Unit 1 at the Amager Power Plant in Copenhagen is designed as a multi-fuel plant. The unit can use coal, biomass and oil in a pulverised fuel boiler designed for 185 bar and 562°C steam. The high-pressure steam is supplied to a back-pressure turbine delivering 68 MW electricity and 250 MW heat for steam and water based district heating. The new boiler and steam turbine are installed in the original Unit 1 buildings from 1971. COWI was the main consultant responsible for all project phases including conceptual design, project management, procurement, and commissioning in 2010. To connect the pipes from the CHP plant to the district heating system in Copenhagen City, COWI designed a 4 km drilled tunnel with an inner diameter of 4.2 m under Copenhagen Harbour.
CO-FIRING OF WOOD AT NORDJYLLANDSVÆRKET, DENMARK

Unit 3 is a coal-fired plant at Nordjyllandsværket in Denmark, supplying 400 MW electricity and 490 MW district heating to the city of Aalborg. Unit 3 is a high-tech, double reheat boiler producing live steam at 580 °C/300 bar. For Vattenfall, COWI has investigated options to replace up to 40% of the fuel with wood chips or wood pellets. The project included the front-end engineering design (FEED) and tendering documents for the necessary equipment for wood fuel transportation, drying, milling and firing. The investment decision is pending.

PLANT MODIFICATIONS AND RETROFIT

A thermal power plant represents a sizeable, long-term investment. Changes in market conditions, technology, and environmental standards will occur during the life of the facility. A modification of the plant or the retrofit with new equipment may represent an economically attractive answer to the changed conditions. COWI has a long record of identifying and implementing this type of projects.

The economic incentives to reduce greenhouse gas emissions and to utilise local fuel resources can be exploited by partial or complete change of fuel from oil/coal/gas to biofuels. This calls for changes in fuel handling and storage facilities, fuel preparation and firing systems and perhaps modifications of flue gas treatment.

More rigorous flue gas emissions limits combined with emission taxes have made it necessary to improve flue gas cleaning with respect to filters, desulfurization and NOx reduction. COWI has experience from a number of projects where SCR NOx reduction was added to existing boilers.

The technological development of modern process control systems is very fast. Usually the life of boiler, turbine etc. is longer than the technical or economical life of DCS and PLC systems. Supply of spare parts may become sparse or the cost of changes and improvements will be too high. COWI has experience with a number of projects ranging from change of control system for secondary systems to complete renewing of plant DCS system.
LIFE TIME EXTENSION

Thermal power plants are usually designed for 200,000 operating hours corresponding to 25-30 years of service. At this time it shall be decided whether the plant should continue operation as it is for a few more years or whether it is more favourable to invest in a life-time extension allowing 10-20 years of further operation. COWI has experience from a number of life-time extension studies.

The solid basis for a sound decision is the careful assessment of the condition of all major plant components from fuel reception to stack. The analysis of all available information on operating history and performance, maintenance history and reports, supplemented by interviews with key plant staff play an important part in this.

The evaluation of remaining life-time can be enhanced by special investigations and calculations for specific plant components. This includes metallurgical test and analysis of pressurized components such as boiler parts, piping and turbines, PD/Corona measurements of generators, analysis of transformer and lubrication oils etc.

A life-time extension study is also an opportunity to consider potential improvements of operating practice and / or efficiency by updating components and systems to today’s standard. This may include the upgrading with variable speed pumps and fans using frequency converter control.

LIFE TIME EXTENSION OF FYNSVÆRKET UNIT 7

The coal-fired power plant, Fynsværket Unit 7 can produce 362 MW electricity and 475 MW district heating in CHP mode or 410 MW electricity in condensing mode. The plant was originally commissioned in 1991 and refurbished in 2007 with a new SCR de-NOx plant and new DCS system. In 2014 Vattenfall initiated a life-time extension study that would allow the plant to remain until 2032. COWI performed the study including boiler, flue gas cleaning, turbine, high-pressure piping and electrical systems.
MAJOR OVERHAUL OF AMAGERVÆRKET UNIT 3 TURBINES
In 2011, Amagerværket started a program for major overhaul of the various sections of its Unit 3 turbine. The work began with the LP-section (low-pressure) of the main turbine and the feed water pump turbine. The work continued in 2013 with the IP-sections (intermediate-pressure) of the main turbine, and it will be finished in 2016 with the HP-turbine (high-pressure). COWI carried out planning, project management, procurement, and technical supervision for all phases of the program.

MAJOR OVERHAUL

Major overhaul of key components will be necessary a number of times during the life of the plant in order to maintain reliable operation and efficiency and reduce unscheduled outages.

The planning for a major overhaul begins with a close examination of the plant’s present condition. This determines the scope and time for the major overhaul, and the following detailed planning and preparation ensure that spare parts and competent personnel are available when needed.

For the plant owner it is essential to get the best possible offers from contractors with respect to both methodology, time, and costs. COWI has experience in specification for tendering of overhaul contracts and a long history of successful cooperation with plant operation and maintenance staff in the execution of the contracts.
OPERATION, MAINTENANCE AND OPTIMISATION

The large investment in a thermal power plant should be protected best possible. In addition, there may be close interest from the surrounding society with respect to reliable operation and environmental impacts. For both reasons, it is important to conduct operation and maintenance to a very high standard.

Efficient operation means the careful use of fuels and other consumables including in-house consumption of electricity. High availability requires strong focus on maintenance. Systematic preventive maintenance program follows suppliers’ component specifications and recommendations supplemented by continuous monitoring of key components.

Condition based maintenance uses intelligent measurements and assessments of several key data. These can include oil quality, differential pressure measurements, vibration readings, wall thicknesses, NDT (non-destructive testing), metallurgical analysis, etc. Against this background, maintenance and renewal of plant components happens exactly when needed.

COWI can offer in-depth support and analysis in all these areas based on many years’ experience from close cooperation with plant O&M organisations.

It is equally important that a thermal power plant is kept at the optimal efficiency in the daily operation, but it is a challenge to identify unnecessary energy losses from the process. Using long-time experience and advanced analysis tools COWI can offer performance-monitoring services, which will provide valuable input to the operation and maintenance of the plant.

OVERHAUL OF GENERATOR AT AMAGERVÆRKET UNIT 3

The coal-fired power plant, Amagerværket Unit 3 can produce 210 MW electricity and 320 MW district heating in CHP mode or 250 MW electricity in condensing mode. The plant was originally commissioned in 1989. In 2008 the rotor was removed during a major overhaul of the generator. This included inspections and tests and the replacement of the centering bolts in the rotor due to problems recorded on similar machines. COWI contributed with technical expertise during planning and inspection.
OUR SERVICES COVER:

PROJECT DEVELOPMENT
› Pre-feasibility and feasibility study
› Environmental Impact Assessment (EIA)
› Conceptual design and specification
› Technology evaluation
› BAT (Best Available Technology) assessment
› Procurement plan
› Technical, environmental and economic due diligence
› Statutory process
› Economy, finance and organisational set-up

DESIGN AND IMPLEMENTATION
› Design of mechanical, electrical, and civil works – at turnkey or detail level
› Pre-qualification
› Procurement including technical specification according to FIDIC and other international standards
› Bid evaluation and contract negotiation
› Progress monitoring
› Quality control including shop inspections
› Construction management and supervision
› Commissioning, including start-up, guarantee testing and handover

OPERATION AND MAINTENANCE
› Support during the guarantee period
› Optimisation of existing plants
› Support for operation and maintenance
› Education and training of operation and maintenance staff
› Planning of scheduled maintenance

SPECIAL CONSULTING SERVICES
› Handling, treatment and disposal of residual products
› Optimisation and improvement of monitoring and control instruments and systems (DCS/SCADA)
› Environmental management including ‘Green Reports’
› Life cycle and climate analyses
› Energy planning
› District heating and cooling systems

Visit our website for more detailed information and our references.