

Designing better solutions for power plants

From concept to construction



High-value engineering design

From conceptual, basic, front-end engineering to detailed design, we will help you optimise the design of your power plant.



Function and form

Conceptual design is the development of an outline technical solution and design that meets the requirements of the proposed project funding. It leads to the production of project functional specifications and generally involves a review and analysis of the client's requirements (both technical and economic), and the identification and selection of the most cost-effective technology and equipment to meet those needs.

We also help with tender evaluation, project planning, programming, cost engineering, supervision of construction and the commissioning of power generation projects.

The complete picture

Following project sanction, a **detailed design** is produced based on the basic/FEED design. This is used to develop a construction contract and equipment specifications, which are then used to procure every piece of equipment. Design is usually in a 3D environment, allowing a full appreciation of the process and enabling progress to be viewed as the detailed engineering advances.

A thorough plan

Basic design and front-end engineering design (FEED) develops the conceptual design in sufficient detail to enable the client to issue purchasing documentation for equipment and materials, and the overall project price can be established to a reasonable degree of accuracy. At this stage, we typically develop outline heat and mass balance, process flow, piping and instrumentation diagrams, electrical single lines, control system architectural/block, plot plans and general arrangements.

During this process, the conceptual design may be optimised and performance guarantees prepared using specialised software such as GateCycle, GT Pro and Thermoflex.

10 reasons to choose Mott MacDonald

1. Independent of thought

As an employee-owned management, engineering and development consultancy, we have the freedom and independence to find new ways to solve clients' problems, helping them to advance projects faster while mitigating technical, commercial and environmental risk.

2. Adding value

From the start of every project, we search for the opportunity to add value in our designs and outcomes. Our more than 16,000 staff are connected, sharing ideas and best practice to deliver projects with long-term value to our customers.

3. A winning team

We have won numerous technical excellence awards, including New Civil Engineer's Consultant of the Decade (2003–13). We are also a repeat winner of Infrastructure Journal's Global Technical Advisor of the Year.

4. Built-in resilience

We help clients guard against natural and human-made hazards, including extreme weather events and cyberattacks.

5. Global reach

Each of our offices around the world has in-depth knowledge and understanding of local conditions and practices. They are backed by our global resources, enabling us to offer our services across time zones and around the clock.

6. High-calibre input

A dedicated design centre with in-house capabilities and global resources to assist across the full project lifecycle. Our design teams are made up of specialists with world-class skills and expertise in engineering and building services. We have a full understanding of power technologies through regular engagement with original equipment manufacturers, and have familiarity and insight into the entire power project development chain.

7. Sustainability focus

We promote sustainability in all our projects. We strive to be ethically, environmentally and socially responsible, helping improve the quality of life today and sustaining resources for tomorrow's generation.

8. In-depth experience

We have been helping clients to design power generation schemes for more than 30 years. We bring global experience and best practice from the design of all types of power projects, ranging from 0.5MW to 500MW and above.

9. Digital by design

Digital design is faster, more efficient and of higher quality. We have developed processes, modules and tools to save our clients time and money on projects across the globe.

10. Broad capability

Our portfolio of services ranges from feasibility studies, technology and equipment selection, and basic and detailed design, to project planning and management, site supervision, performance testing and commissioning.



Project

Samra thermal power plant expansion

Location

Zarqa, Samra, Jordan

Client

METKA SA / Samra Electric Power Co

Expertise

Basic and detailed design

Design for arid, fuel scarce conditions

Energy and water efficient, and carbon savings

For the US\$150M expansion of Samra thermal power station in Jordan, we carried out basic and detailed engineering design to convert the existing plant from an open to a combined cycle gas turbine plant. Our role included design and site supervision of construction, start-up and commissioning of the 143MW add-on facilities.

The scarcity of water and limited fuel supply in Jordan were key factors which influenced our design. Our design team applied a value engineering process

to identify savings without compromising on quality or the construction schedule. We also ensured minimal disruption to existing operations during construction activities.

The quality of our design ensured work proceeded smoothly without the need for onsite modifications. The result is a more energy- and water-efficient plant, with reduced carbon emissions. At the same time, plant output is 7.7% higher than the guarantee condition. Savings have been passed on to Jordanian utility customers.

Cross-Atlantic recycling of generating units



Project
Audit and relocation of open cycle gas turbines, Kilroot power station

Location
Northern Ireland

Client
AES Kilroot Power

Expertise
Detailed design

Relocation of open cycle gas turbines

We carried out a technical audit of two Frame 6 open cycle gas turbine generators used originally in the Dominican Republic to see if they could be re-commissioned for the Kilroot power plant to help meet growing demand for peak load power generation in Northern Ireland.

Before being installed at Kilroot, the generators were first shipped from the Caribbean island to the Netherlands for modification. This involved the replacement of the existing gearbox to allow the

relocated units to operate at 50Hz instead of 60Hz. The design of foundations at Kilroot for the generators was a major challenge. Underground soil conditions were poor, so our engineers had to come up with a novel solution to design and install piling underneath the foundations to support the exhaust ductwork. There was also a tight schedule to complete work inside the operational power station, while old buildings, structures and underground tanks all had to be demolished, and the site cleared. The project was completed to a high technical standard in a short timeframe and within the client's budget.

Enhanced power capability for Bangladesh



163MW combined cycle power plant in 3D

Bangladesh is one of the world's poorest and most densely populated nations, with more than 160M inhabitants. Just 76% of households have access to an electricity supply, and even this is unreliable and prone to blackouts. The 163MW Kushiara combined cycle gas turbine (CCGT) plant now improves electrical supply, while enhancing local capabilities to match international standards.

Our plant design for Kushiara CCGT was achieved through industry collaboration. It seamlessly integrates with GE's 115MW Frame 9E gas turbine, dualpressure heat recovery steam generator and 65MW steam-turbine generator. We also brought together more than 50 separate balance of plant vendor contracts, including an extensive number of design interfaces, into the detailed design and 3D model. We were able to advance construction by performing much of the balance of plant civil design based on our own historical information database and expertise in lieu of actual plant and equipment details. The civil design took into account the availability of suitable materials and construction competency in Bangladesh, as well as changing owner requirements. We applied value engineering plant optimisation, while maintaining compliance to international standards.

Project
Kushiara combined cycle power plant

Location
Fenchuganj, Bangladesh

Client
Kushiara Power Company Ltd (KPCL)

Expertise
Basic and detailed engineering, 3D modelling, procurement assistance, site support for testing and commissioning

Rewiring south London

Project
Asset replacement scheme

Location
UK

Client
Laing O'Rourke for the National Grid

Expertise
Design management, detailed design, 3D modelling

Designing with carbon in mind
Constructing this new 400kV gas-insulated substation is extremely challenging when the site is severely constrained and located in a highly congested part of south-west London. It is also the first National Grid project to include in the tender a weighting of 5% specifically for carbon.

Main contractor Laing O'Rourke has used digital engineering to address

the space and crowding issues, and to deliver an efficient, safe and cost-effective solution, which also achieves significant carbon savings.

We supported the company to develop a 3D model of the substation, with the help of other contractors, including GE and SGB-SMIT. Our model helped everyone to understand the layout, interactions and constraints of the site, develop the designs

and communicate risks to construction, operation and maintenance teams. A common data environment was established to share information with more than 20 suppliers and 157 individual users. We were responsible for the associated design and BIM co-ordination in line with Laing O'Rourke protocols.

Laing O'Rourke and its partners are on track to deliver a 23% carbon reduction compared with previous similar projects.



Reducing waste for city council

Energy from 132,000t of waste

Our client contracted with a UK local authority to design, build and operate a facility to treat 'black sack' waste from households across the borough. All non-recyclable and non-compostable material was to be used as fuel for an advanced thermal treatment plant, which transforms the material into a gas. Combustion of the gas generates steam to create electricity in a turbine. The facility involves heating waste to extreme temperatures for greater efficiency.

We provided detailed design services for the energy-from-waste plant. Our services covered mechanical, electrical, process, control and instrumentation, piping using a 3D model, planning and engineering management.

The plant features three different technologies – mechanical treatment, a biogas plant and a waste gasification facility. The complex will handle up to 132,000t of waste per year, with the biogas plant and the gasifier treating 32,000t and 93,600t, respectively. The complex has an electrical capacity of 7.7MW, exporting about 5.7MW to the grid.

Project
Local authority energy-from-waste plant

Location
UK

Client
Energos

Expertise
Detailed design



First live-line working in Africa

Project

Upgrading Johannesburg's power lines

Location

Johannesburg, South Africa

Client

City Power

Expertise

Line design, assessment, engineering studies

Upgrading power lines over 400km

Our client wanted to increase the power transfer of its 50-year-old, 88kV network in Johannesburg. It ruled out installing new transmission lines as impractical, while it was unrealistic to suspend electricity supplies in the city while work was carried out. The only solution was to install new conductors under live-line conditions.

As the designer of the original transmission infrastructure in the city, we retained the design drawings for the towers and were able to come up with a workable live-line working solution. First, we assessed the condition of the lines, tower insulators and footings, access road and facilities. This was followed by line design, conductor selection and general engineering studies.

The project, the first of its type in Africa, involved replacing 400km of conductor under energised conditions, requiring the protection of engineers from the 88,000 volts passing through the line. This was achieved by using live-line buckets, with the operatives in suits with stainless steel woven into the material, effectively providing each engineer with their own Faraday cage. Operatives use a wand to bond to the live conductor before attaching a clamp from the bucket to the conductor. They are then at the same potential as the wire and can work on it safely.



Project

Al Zour South III combined cycle power plant – add-on project

Location

Az Zour, Kuwait

Client

Ministry of Electricity & Water (MEW) / Shandong Electric Power Construction Corporation III (SEPCO III)

Expertise

Basic and detailed engineering, 3D modelling, procurement assistance

Saving project costs in Kuwait

Conversion to a 270MW CCGT power plant

Kuwait wants to double its generation capacity by 2025 to meet an anticipated peak demand of 25GW. SEPCO III was commissioned to convert a power plant consisting of two Siemens SGT5-4000F open cycle gas turbines into a new combined cycle gas turbine (CCGT) plant. The aim is to increase plant efficiency and reduce environmental impact. The conversion design was based on two BHI dual-pressure heat recovery steam generators and one Siemens 270MW condensing steam-turbine generator.

We optimised the plant's performance using GateCycle thermodynamic modelling software and ran continuous collaborative iterations. Our design had to account

for degraded gas turbine performance and consider all extreme load case variables – such as local temperature and relative humidity, power output, configuration of the turbines, fuel supply and power augmentation – and achieve a gross efficiency of 54%.

Using our secure digital collaborative environment, we integrated up to 100 separate balance of plant vendor contracts, including an extensive number of design interfaces, into the detailed design and 3D model.

Our optimised plant layout in a tightly constrained brownfield site was crucial to saving the client up to US\$10M on project costs.

Opening opportunities with connected thinking.

Talk to us:
power@mottmac.com

mottmac.com