

Desalination

Leading edge potable and process water solutions



Arrival of an evaporator for the Ras Laffan power and desalination plant, Qatar.

Mott MacDonald is a global multidisciplinary consultancy with a strong engineering base. With annual revenue of £1 billion, we combine the skills of over 14,000 staff with a presence in 140 countries.

As one of the world's leading consultants in desalination, we have been involved in the implementation of over 25% of global desalination capacity in the last 45 years. We have in-depth experience of all desalination processes, including the thermal processes associated with power production, stand-alone reverse osmosis (RO) plant and the emerging hybrid plant. As a leading innovator in this field, Mott MacDonald is at the forefront of reducing cost and improving quality in desalination.

Desalination technology

Desalination involves the removal of salts from a saline solution in order to produce potable water for drinking or water for industrial use. Desalination technology can be applied to seawater, brackish water and wastewater to produce potable drinking water and presents fewer health risks compared to water recycling technologies. It can also be used in other applications such as water reuse and other water sciences and technologies.

Two main processes are considered as desalination technology options:

- **Thermally driven process** Evaporation processes use thermal energy to produce distilled pure water from sea or brackish water. They rely on a phase change from liquid (in this case brine) to vapour. In these processes only the water molecules pass to the vapour phase leaving the other constituents behind. The two dominating systems that have evolved are multistage flash (MSF) and multiple effect distillation (MED).
- **Electrically driven process** In membrane processes such as RO, electrical energy is used to pump seawater or brackish water through a series of semi-permeable membranes to obtain a low salinity permeate as a product. They are based on the utilisation of membranes that allow the passage of water molecules only, excluding salts and other contaminants, which are discharged as a brine waste.

Markets of significant growth

In recent years there has been significant growth in desalination water and wastewater reuse markets. Mott MacDonald already plays a leading role in both these areas with considerable experience and expertise in the technology, commercial viability and project lifecycle.

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We offer a broad range of services, including:

- Conceptual design
- Construction and warranty supervision
- Contract review and negotiation
- Due diligence
- Ecosystem modelling
- Environmental impact assessments
- Feasibility and process studies
- Inspection and rehabilitation
- Operations/trouble shooting
- Operation and maintenance
- Performance specifications
- Performance testing and commissioning
- Plant optimisation
- Procurement management
- Project management
- Thermal/membrane/hybrid processes



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Shoaiba barge RO, Saudi Arabia. We were appointed owner's engineer by International Barges Company for Water Desalination (IBCWD).

Innovative solutions, market-leading experience

Desalination is becoming ever more important, driven by increasing demand and the scarcity of other water sources, allied to cost reductions achieved by technical advances. Our water treatment and desalination specialists are well versed in the latest water treatment technologies and are committed to providing innovative, efficient, sustainable and cost-effective solutions whilst minimising environmental impacts.

Our in-house software tools model and optimise thermal and membrane processes, groundwater/surface water/seawater feed systems and brine discharge systems, resulting in an efficient, environmentally acceptable water treatment project.

We provide a fully integrated service covering technical, commercial, regulatory and environmental aspects of desalination as well as combined power/desalination projects. Our expertise covers all desalination technologies, including MSF, MED and RO, as well as all the membrane processes used increasingly in reuse schemes, such as microfiltration (MF), ultrafiltration (UF) and nanofiltration (NF).

Strategy and solutions

Through our long involvement with desalination in regions where water shortages have been a constant challenge, we have honed our expertise in providing strategic, procurement, technical and regulatory advice.

Unlocking innovation and guaranteeing best value are crucial to us and we provide robust economic and environmental evaluation of the development alternatives. Through value engineering we identify optimal solutions based on whole-life cost analysis. Using qualitative and quantitative risk analysis we can predict reliability, failure rates, serviceability, maintainability and deterioration rates for assets.

Whether the project is publicly or privately funded, rehabilitation of an old plant or new developments, our rigorous approach will deliver a substantiated business case able to support an application for project financing.

We were owner's engineer for the Umm Al Nar combined cycle gas-fired power and water station in Abu Dhabi.





We were technical advisor for the Hidd independent water and power project (IWPP) in the Kingdom of Bahrain.



We provided owner's engineer services for Ras Laffan power and desalination plant in Qatar.

Optimising investments

Our services are geared towards optimising investment in new or existing assets. These include condition and rehabilitation surveys, performance analysis and plant economics, energy supply and water purchase agreements, environmental impact assessments, investment appraisal, due diligence, operation and maintenance agreements, plant design and specification, pumping plant and pipelines, risk assessment and site selection.

Delivering investment

Our contribution to the successful implementation of many of the world's most important desalination projects gives us a valuable insight into the allocation of risks and the associated commercial consequences. We are therefore well equipped to advise clients on procuring the best Engineering, Procurement and Construction (EPC), Build, Own, Operate (BOO) or alternative contract forms, and how to manage the supply chain.

Whether we are part of a contracting alliance or serving as owner's engineer, we provide innovative conceptual and detailed design and our appreciation of strategic issues can bring significant whole-life cost savings without jeopardising the completion schedule.

Throughout construction we have the capability to provide our clients with a comprehensive contract management, supervision and commissioning service, assistance with site management, specialist monitoring and auditing.

Our track record

Our track record encompasses some of the world's largest MSF and MED plants and many RO plants, including more than 30 in the Middle East.

- **Ras Laffan Power and Desalination Plant, Qatar** We provided owner's engineer services involving design review, construction supervision, works inspections, testing and commissioning services for the development of a 1025MW power and 60 million imperial gallons per day (MIGD) (272 600m³/d) MSF desalination plant, comprising three gas turbines, two back pressure steam turbines and four 15MIGD MSF distillers.
- **Ras Abu Fontas B2 Power and Desalination Plant, Qatar** After successfully engineering Ras Abu Fontas A power and water station in Qatar, we were appointed owner's engineer for the B station. The 608MW plant comprises five gas turbine generators with heat recovery boilers supplying steam to five MSF distillers, providing a desalination output of 33MIGD (150,000m³/d). Our responsibilities include the detailed design review, approval and supervision at site.
- **Shuweihat S1, UAE** Since 2001, Mott MacDonald has acted as technical advisor to the lenders of this \$1.6 billion 1500MW CCGT power and 100MIGD (454,350m³/d) MSF desalination plant, which has been operating since 2004. Operational monitoring includes regular site visits and advice on technical issues, maintenance, operations, insurance, and budget. At the time of its inception this project was the largest independent power and desalination scheme in the world.

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- **Adelaide RO desalination plant, Australia** We provided technical studies and investigations, as well as concept design, preparation of specifications and tender documentation for the provision of a 60MIGD (272,600m³/d) desalination plant and drinking water transfer pumping system.
- **JAFZA utility project, UAE** Jebel Ali Free Zone Area (JAFZA) is located in a new development area in Dubai Neighbourhoods. The project included a desalination plant based on membrane technology (22MIGD/100,000m³/d), a membrane bioreactor (MBR) sewage treatment plant (25MIGD/112,000m³/d) and a polishing plant (18MIGD/81,000m³/d) designed to process the sewage effluent to feed the district cooling system. We supported the tender process and completed a technical evaluation of the bids.
- **Palm Jumeirah desalination plant, UAE** Situated in a new luxury residential area of Dubai, this plant was designed and developed with state-of-the-art solutions, combining high performance with a small footprint. The desalination plant comprises ultrafiltration (UF) pre-treatment followed by RO. We reviewed the detailed engineering and supervised site activities of two identical desalination plants, each with a capacity of 12MIGD (55,000m³/d).
- **Umm Al Nar, UAE** We were owner's engineer for the 1550MW and 113,600m³/d MSF Umm Al Nar combined cycle gas-fired power and water station in Abu Dhabi. The £500 million plant has a total desalinated water capacity of 430,000m³/d.
- **Ras Azzour, Saudi Arabia** As owner's engineer for Sumitomo, we provided technical support associated with the development of the largest desalination plant as well as the largest hybrid plant in the world, comprising 75% MSF (750,000m³/d) and 25% RO (250,000m³/d). Our services culminated in the successful proposal submission by Sumitomo to the Saudi Government.
- **Al Dur, Bahrain** We completed a tendering process for the power and desalination plant at this site. Our current role is as technical advisor to EWA (Electricity and Water Authority) for the 1234MW power and 48MIGD (218,200m³/d) RO desalination plant.
- **Shoaiba Phase II Desalination and Power, Saudi Arabia** We were appointed as owner's engineer by Saline Water Conversion Corporation (SWCC). Our role included project management, design review, site supervision and commissioning for five boiler/steam turbines producing 500MW plus ten multi-stage flash desalination units producing 100MIGD(455 000 m³/d).
- **Rabigh, Saudi Arabia** As owner's engineer for this 360MW, 37MIGD (168,200m³/d) RO plant, we completed a design review for the Rabigh Arabian Water & Electricity Company. We monitored construction and supervised commissioning until startup. The plant is the first commercial scale 3-pass RO plant in the world.
- **Hidd power and desalination plant, Kingdom of Bahrain** We were technical advisor for this independent water and power project (IWPP), which extended the existing 136,260m³/d MSF desalination capacity by 272,800m³/d using MED. This was the first time that MED was employed on an IWPP.
- **Shoaiba barge RO, Saudi Arabia** We were appointed owner's engineer by International Barges Company for Water Desalination (IBCWD) to provide detailed engineering services for an innovative off-shore desalination plant. The two barges incorporate UF and RO technology to provide 5% of Jeddah's drinking water. Each of the barge-mounted RO desalination plants has a capacity of 5.7MIGD (25,000m³/d), expandable to 6.6MIGD (30,000m³/d).

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