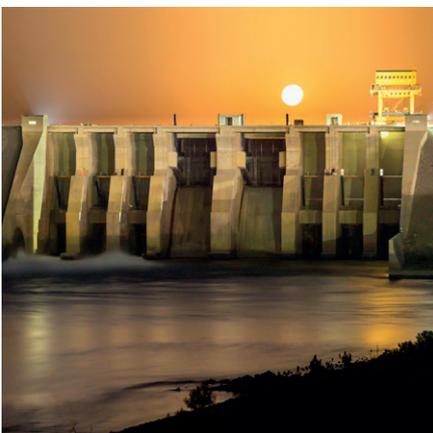


# HYDROPOWER AND WATER RESOURCES

*Shaping our world*



# Hydropower and Water Resources

The development, planning, design, and construction of hydropower as well as large-scale irrigation schemes and special hydraulic structures require multi-disciplinary engineering skills. Tractebel combines these skills which are necessary for the planning and implementation of complex hydropower and water resources projects. The know-how and expertise of our specialists are based on extensive experience gained during implementation of major projects throughout the world over several decades.

In providing such services, especially in the case of complex hydropower projects, the close coordination of multi-disciplinary tasks involving technical, ecological socio-economic, institutional and financial aspects is absolutely essential. A further important objective applied to all projects is the sustainable utilisation of the natural resources land and water.

We provide services for tender design and construction design for all types of hydraulic structures, not only traditional engineering design for owners, but also for suppliers and contractors within the framework of EPC and BOT contracts.

Our engineering services cover the entire project life from conception through design to construction and operation.

For the technical supervision of construction and erection, our engineers and experts apply their extensive experience to ensure that the works are completed according to the contract, emphasising on quality, budget and schedule.

Furthermore, Tractebel provides consulting services for all aspects of tendering, and award of construction contracts using various forms of contracts for all types of water resources and hydropower projects.

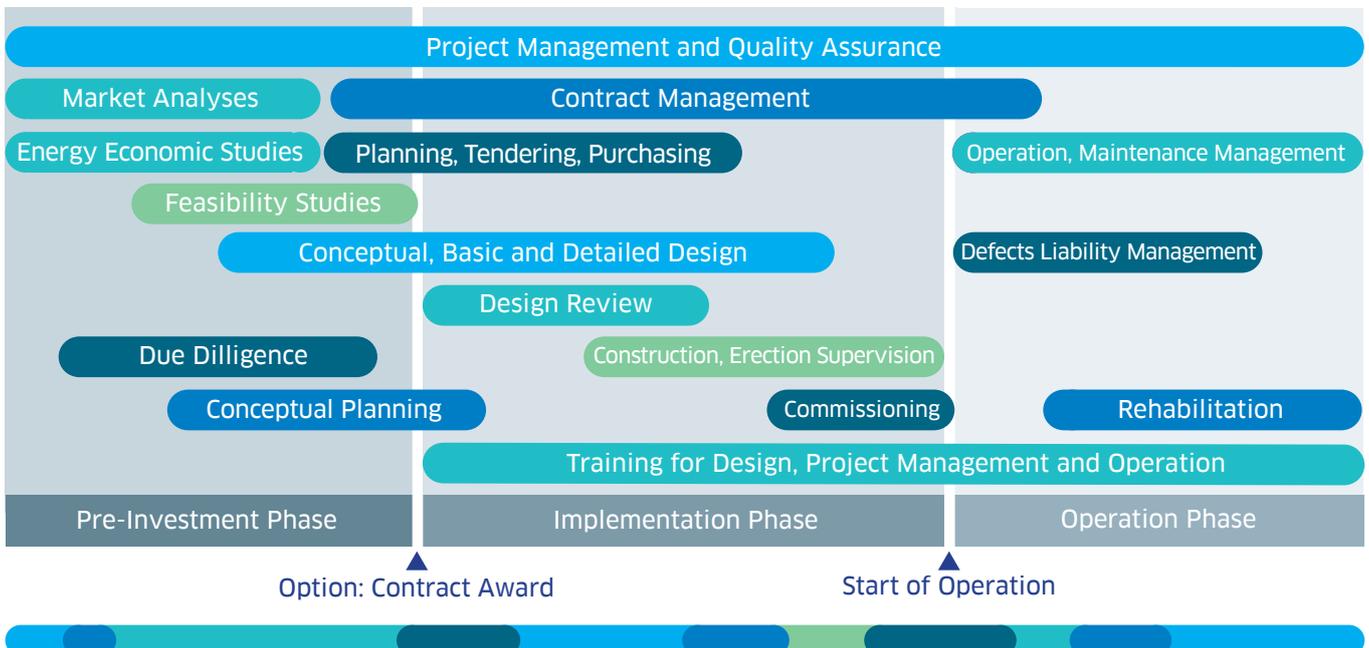
- Hydropower Planning
- Sustainable Water and Land Resources Development
- Geotechnical Engineering, Geology and Dams
- Hydropower and Hydraulic Structures Design

- Contract Management, Cost and Schedule Control
- Electro-mechanical Equipment
- Geomatics
- Operation and Maintenance Services



We are certified according to DIN EN ISO 9001: 2015 and have been successfully re-certified until today.

## Services



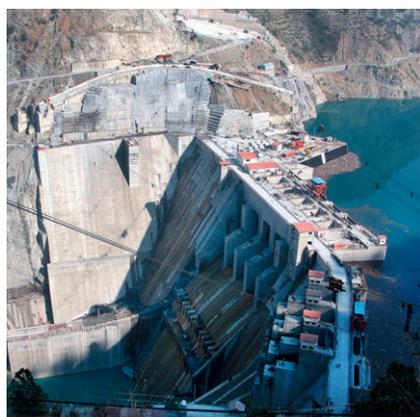
## Hydropower Planning

Investigating, planning and designing hydropower and multi-purpose schemes as the basis for investment decisions.

Developing and optimising power system expansion plans and advising during the decision-making process through to project implementation. Due diligence for privately financed hydropower schemes.

### Our Competencies:

- Feasibility Studies for Hydropower Schemes
- Due Diligence Assessments of Existing and Planned Hydropower Schemes
- Water Resources Planning and Management
- Power System Expansion Planning
- Hydropower Operating Rules
- Engineering Hydrology including Flow Forecasting
- Engineering Hydraulics of Complex Systems
- Hydraulic Model Tests



Baglihar Hydropower Project, India

## Sustainable Water and Land Resources Development

In many countries development of water and land resources is of key importance for their future. Studying the environmental and social impacts of major water resources projects and planning for the mitigation of adverse impacts and management is vital for project sustainability.

### Our Competencies:

- Planning of Multi-purpose Use of Water Resources
- Climate Change Adaption and Mitigation
- Integrated River Basin Development
- Groundwater Development
- Irrigation System Planning, Design and Modernisation, Performance Benchmarking
- Design and Optimisation of Surface and Subsurface Agricultural Drainage
- Flood Protection and Mitigation
- Environmental and Social Safeguards, Impact Assessments, Resettlement Planning
- Food Security Studies and Action Plans



Toshka Pumping Station, Egypt

## Geotechnical Engineering, Geology and Dams

Geological and geotechnical challenges are often very demanding when planning hydropower, water supply and irrigation projects, which require detailed geotechnical investigations before the start of the actual design. During planning and execution of the works continuous input by geological and geotechnical specialists is essential.

### Our Competencies:

- Planning, Supervision, and Evaluation of Geological Investigation Programmes, including lab and In-Situ Testing
- Preparation of Seismic Hazard Assessment Studies
- Identification of Quarries and Borrow Areas for Construction Materials
- Rockmass and Soil Classification
- Analysis of Groundwater Conditions
- Design and Engineering, Construction Supervision and Quality Control of Underground Structures (Caverns, Tunnels, Shafts), Foundations and Dams of all Types including relevant Geotechnical Instrumentation



Dam Complex of Upper Atbara, Sudan: foundation of the embankment dam

## Hydropower and Hydraulic Structures Design

Our services include investigating, planning and designing hydropower and multi-purpose schemes as the basis for investment and development decisions.

The engineering know-how of our experts is based on extensive experience gained during the implementation of major and complex hydropower projects worldwide. We attach great importance to the optimisation and harmonisation of the technical, economic, ecological, socio-economic and financial goals.

We prepare tender designs and construction designs for all types of hydraulic structures including structural engineering. These include river diversion schemes, gated and ungated spillways for reservoirs, powerhouses, any type of outlet works, as well as navigation locks and ship lifts for navigable waterways.



*Naga Hammadi Barrage, Egypt: radial gate flap open*

For the structural design most sophisticated FEM-software packages are applied to achieve optimised engineering design-solution.

The specific constraints of each project will often require the development of individual technical solutions related to river engineering, flood protection and control, and pumping systems.

### Our Competencies:

- High Head Plants
- Low Head Plants
- Pumped-Storage Plants
- Power Plant Rehabilitation
- Surface and Underground Powerhouses
- River Diversion Schemes
- Tunnels and Shafts
- Spillways and Weirs
- Outlet Works
- Pump Stations
- Navigation Locks
- Ship Lifts
- River Training
- Flood Protection



*Laúca Hydropower Project, Angola: dam and power intake*

## Contract Management and Cost Control

The tasks related to contract management include: establishing the contractual and financial framework for the project, developing all tender and contract documentation for diverse types of projects (conventional construction, design-build and EPC, operation and maintenance, private concession), managing the prequalification and tendering processes, negotiations and award of contracts, and the complete management of all contractual issues arising throughout the duration of the respective contract.

### Our Competencies:

- Preparation and Finalisation of Contractual Documents
- Administration of Procurement
- Management of Contracts
- Quality Assurance
- Time Scheduling and Risk Management
- Budgeting and Cost Control
- Claim Management, Mitigation and Resolution of Disputes
- Commissioning

## Electro-mechanical Equipment

We plan, design and assist in the contracting for the manufacture and installation of hydromechanical, mechanical and electrical equipment for hydropower plants and other hydraulic structures. We supervise the entire process including factory acceptance tests, handling and installation on site, testing, quality control and commissioning. In addition we have extensive experience in the rehabilitation and upgrading of existing plants.

### Our Competencies:

- Hydraulic Turbines and Governors
- Pumps and Pump-Turbines
- Generators, Transformers
- Balance of Plant
- Rehabilitation and Upgrading of Plant Equipment
- Model Tests of Hydraulic Machinery
- Cranes, Hoisting Equipment, Elevators
- Steel Liners and Penstocks
- Hydraulic Gates and Valves
- Navigation Locks



Vianden Pumped-Storage Plant, Luxembourg: generator rotor

## Geomatics

Geomatics play a major role in hydropower, land and water resources development as well as other major infrastructure projects. Our worldwide projects require a wide range of approaches to the utilisation of different types of spatial information. To meet these needs experts with various qualifications offer expertise in engineering surveying, geodesy, geographical information systems, remote sensing, land administration and cadastral survey.

### Our Competencies:

- Geographical Information Systems (GIS) and Remote Sensing
- Hydrological GIS Applications
- Flood Risk Mapping and Natural Disaster Assessment
- Land Administration and Cadastral Survey
- Photogrammetry, Cartography, Bathymetry
- Surveying Engineering and Underground Surveys
- Geodetic Structure Monitoring



Merowe Dam, Sudan

## Operations, Maintenance and Training

We provide training and support for the permanent operation and maintenance staff of hydropower and water resources facilities including, for example: general and specific operation activities, inspection and surveillance of the facilities, maintenance and repair programmes and procedures. We develop and optimise reservoir operating rules for the effective use of water resources, and design instrumentation systems and monitoring programmes.

### Our Competencies:

- Operation and Maintenance Support
- Training of Operation & Maintenance Personnel
- Maintenance Schedules
- Management Information Systems
- Document Management and Reporting
- Safety Reports/Instrumentation
- Optimisation of Reservoir Operation
- General Training in Water Resources Engineering
- Capacity Building

# We are Tractebel

Tractebel provides a full range of engineering and advisory services throughout the life cycle of its clients' projects, including design and project management. As one of the world's leading engineering and advisory companies and with more than 150 years of experience, it's our mission to actively shape the world of tomorrow. With about 5,000 experts and presence in more than 70 countries, we are able to offer our customers multidisciplinary solutions in energy, water and urban.

Since December 2014, Tractebel Engineering GmbH (former Lahmeyer International) belongs to Tractebel and thus is part of the international ENGIE group headquartered in Paris. Tractebel (Brussels, Belgium) and Tractebel Engineering GmbH (Bad Vilbel near Frankfurt, Germany) cooperate on numerous international projects as one company.

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