



TRACTEBEL Engineering  
*GDF SUEZ*

# TAKING HYDRAULICS AND HYDROPOWER TO NEW HEIGHTS

Innovative and complete engineering solutions in Hydraulics and Hydropower



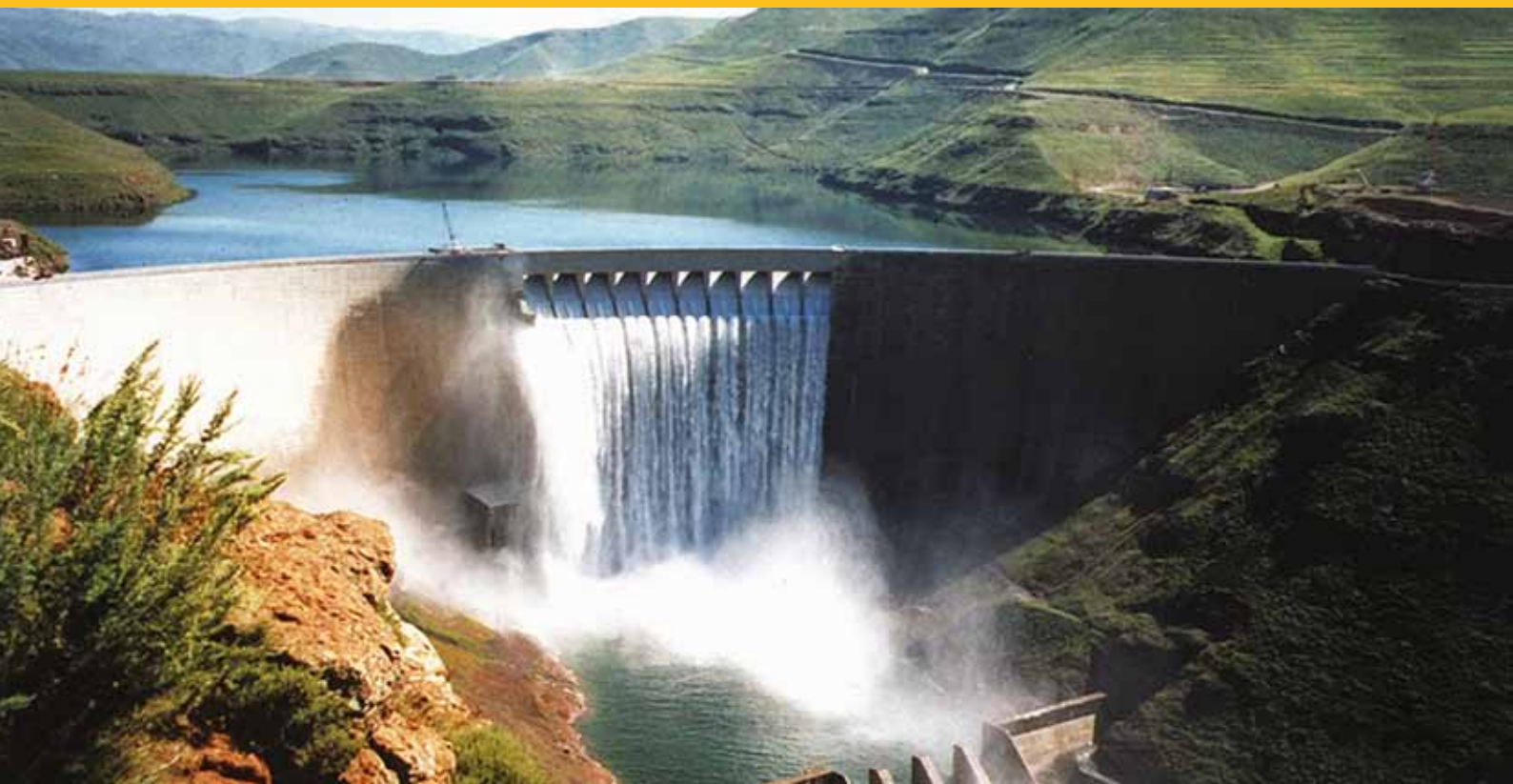
CHOOSE EXPERTS, FIND PARTNERS



COYNE ET BELLIER  
Ingénieurs Conseils

# A RELIABLE & EXPERIENCED PARTNER

Worldwide, an installed capacity of more than 1,000 GW supplies more than 3,500 TWh of hydroelectricity – accounting for approximately 20% of global power generation and about 88% of electricity produced from renewable sources. Yet this capacity is still rising as the need for Hydro-generated electricity continues to increase. This is especially true in countries with fast growing populations, where the need for water resources management and related water infrastructures is often also crucial. In such environments, having a partner with the global experience and know-how to provide focus and sound advice on your projects is essential.

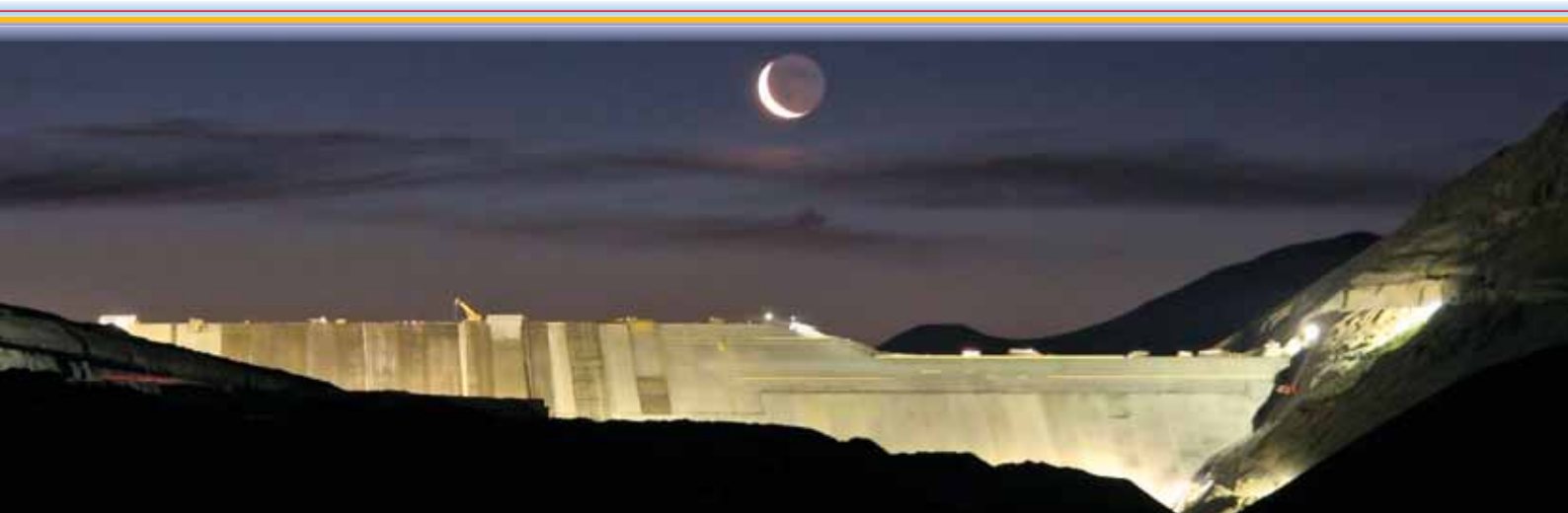


Katse Dam, Lesotho

Tractebel Engineering (GDF SUEZ) is one of the world's major engineering consultancies able to provide high level expertise, value added project management and consulting services in this specialised field. Today, we are well positioned to offer forward-thinking customers state-of-the-art services across the full spectrum and life-cycle of Hydraulic and Hydropower schemes. Our combined and extensive experience makes us your ideal partner for:

- Designing projects with due respect to local societies and the environment.
- Providing cost-effective design through a combination of international and local engineering resources.
- Controlling and mitigating project risks.
- Gathering traditional or innovative finance.

We believe in lasting partnerships. Our goal is to achieve sustainable energy and water resources solutions that meet both your requirements and the needs of the environment for a long time to come. This means we encourage a constant and open dialogue with you, to ensure a complete understanding of all your needs and constraints. Working closely with you, from project planning and technical economical feasibility studies to realisation and commissioning, we strive to deliver a high quality service, with limited risks and strict cost control, as your long term partner.



Kárahnjúkar, Iceland

# FROM COYNE ET BELLIER TO TRACTEBEL ENGINEERING LET OUR PAST EXPERIENCE LEAD YOUR FUTURE

Tractebel Engineering combines multinational and multidisciplinary expertise in Hydraulics and Hydropower project design and construction supervision to the benefit of customers in all regions of the globe. Our worldwide presence and proven expertise in this field allow us to bring tailor-made solutions to your specific project needs wherever they take us.

## EXPERTISE WITH HISTORY

Tractebel Engineering (France), acting in Hydraulics and Hydropower under the commercial name of Coyne et Bellier, is a major international player in Hydropower, Dams and multipurpose Water Resources and Infrastructure projects. Our **Coyne et Bellier** history dates back to 1947. Since then, more than 600 dams and 90 hydropower plants (30,000 MW) have been planned, designed and, the majority of them, built with our input in 70 countries in over 60 years.

## STRONG GLOBAL PRESENCE

Through Tractebel Engineering's other regional companies, we are present in key regions and countries with Hydraulic and Hydropower needs and interests; Africa, Latin America, Middle East, South East Asia, as well as in Europe.

## LIFETIME PRESENCE

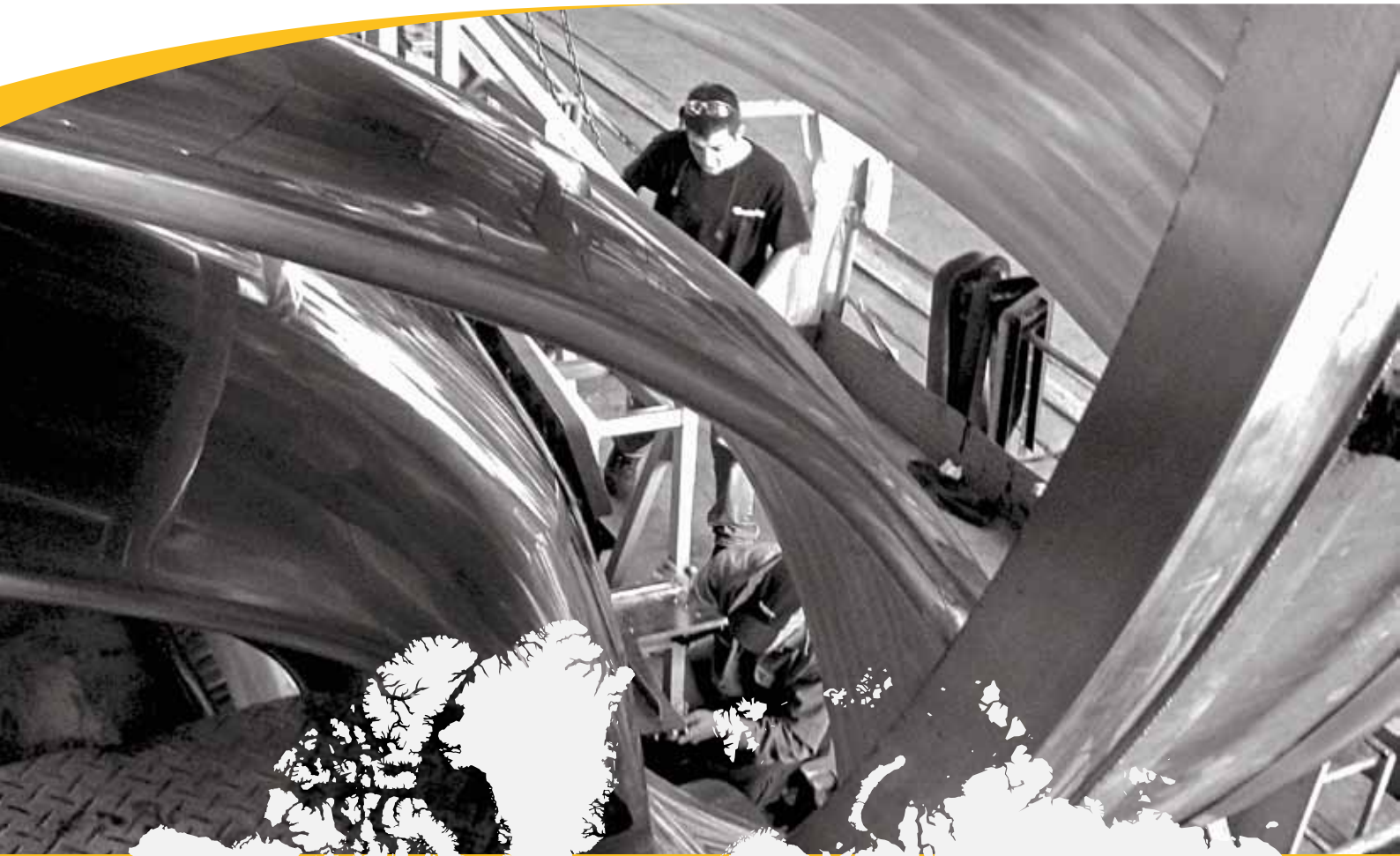
Any major hydro infrastructure has a considerable lifespan. You can rely on us all the way; from initial feasibility studies, siting, design and permitting, including the complex task of environmental study management, to construction, monitoring and rehabilitation. In every case, we're ready to help you to better manage your investment and mitigate risk.

## A PASSION FOR SOLUTIONS

We are engineers who thrive on the work we do. It's a matter of pride and pleasure for our teams to rise to the complex technical, social and environmental challenges faced in this sector in order to deliver the innovative solutions required to meet your needs. With expert skills, experience and knowledge on our side – tell us what you want to achieve and, together, we'll find a way.



# YOUR GLOBAL PARTNER IN HYDRAULICS AND HYDROPOWER



○ Countries with implemented & on-going projects

## THE POWER OF TRACTEBEL ENGINEERING GROUP

Tractebel Engineering, an established engineering consultancy with global reach, offers the services of 3,300 people including multidisciplinary experts and consultants present on all continents.

Tractebel Engineering is also part of one of the world's leading energy producers. Its presence and high level involvement in Hydropower projects on a global scale has extended our experience and provides us with invaluable feedback and operational studies; an added value that we pass on directly to you.

# A PARTNER THAT GOES WITH THE FLOW

Hydraulics and Hydropower is a mature high-growth business with many varied social and economically attractive opportunities for investment. Team up with us for your next venture. Understanding your ambitions, we'll provide the engineering input you need, and more, at every stage of your project.

## A BROAD RANGE OF COMPETENCES

Complementing our broad range of consulting services designed to see your project through from start to commissioning, you can call on us for **Owner's Engineering, Project Management** or **Lender's Engineering**. Our services range from feasibility analysis, basic and detailed design, contracting, site supervision and follow-up, operation and maintenance.

## DUE DILIGENCE

We offer due diligence services to our customers, including validation of conformance, estimated schedule and cost, construction requirements and cost, permit and environmental assessments.

## RISK ANALYSIS

Analysing the risk associated with the project is a priority undertaken by Tractebel Engineering to ensure your project's success. The financial, economical, timing and execution risk are assessed and the proper mitigation scenario's are studied and prepared.

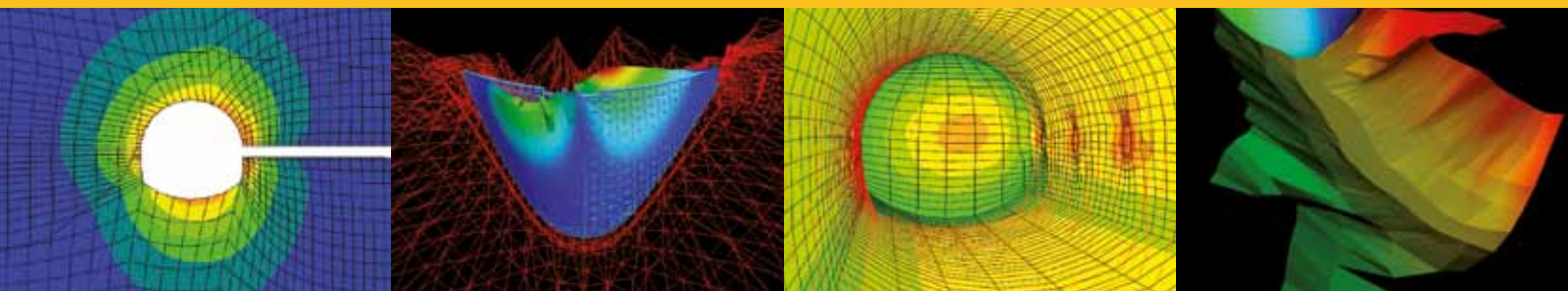
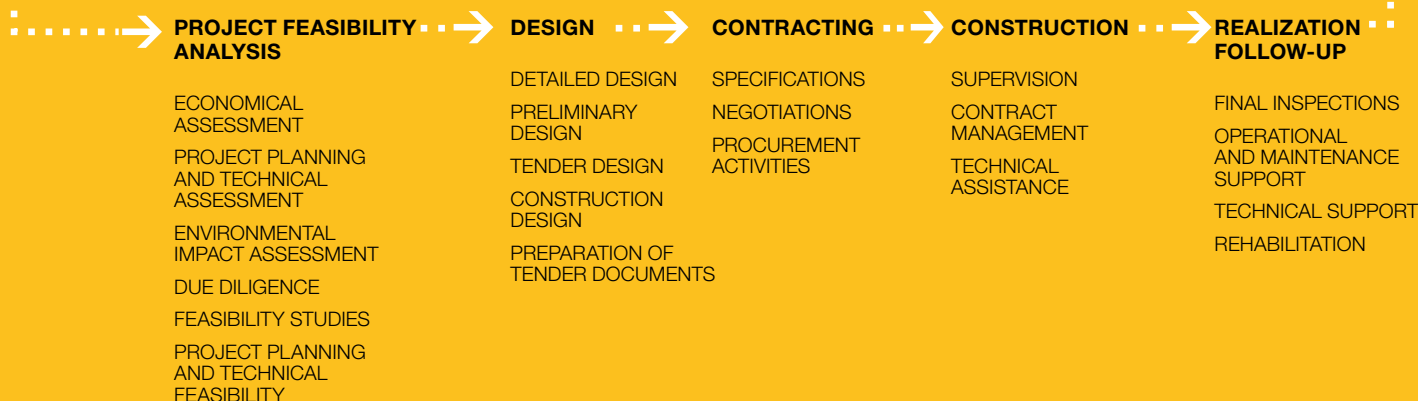
## SUSTAINABLE DESIGN

For large projects anywhere in the world, we are able to assimilate and integrate our knowledge of the world's different cultures, languages and climates, as well as technological know-how, to propose sustainable development designs that respect social and natural environments and manage any new risks to greatest possible extent.

## NUMERICAL MODELLING

It's always been our scientific policy to take advantage of technological developments that benefit our clients' projects. Over the last 30 years, advancements in computer power and analysis software have made it possible for us to develop superior modelling skills. Today, we can combine advanced computer capabilities with leading analysis software to produce a step change that allows our engineers to use numerical modelling at all stages of your Hydraulic or Hydropower Plant design. Our design teams will apply their state-of-the-art numerical modelling experience as an integral part of the full engineering design process, with the ultimate goal of ensuring innovative designs of the highest quality and reliability possible.

## MULTIDISCIPLINARY EXPERTISE FOR EVERY STAGE OF YOUR HYDRAULICS OR HYDROPOWER PROJECT



Numerical modelling



# DAMS



Potrerillos in Argentina

For more than 60 years, Coyne et Bellier has been at the forefront of many of the world's most important Hydraulics projects and has widely contributed to the global development of Dams, either for Water Resources or for Sustainable Energy. We are ready to turn this experience to your advantage.

## A COMPLETE DESIGN PROCESS

Our design process is a continuous succession of steps geared to the successful outcome of your project. Starting with conceptual design, taking into account all constraints, and pre-feasibility studies, we will analyse your best options and define the main characteristics with early assessment of the environmental risks and technical-economic feasibility of the proposed site and dam. This will later be refined through definitive studies to confirm the project feasibility and define dimensions, lay-out and all engineering works and equipment, leading to the drawing up of technical specifications and preparation of contracts, permit requests and detailed design reviews necessary to start construction.

## DAM REALISATION

Our experience in carrying out feasibility studies, or detailed design, as well as construction supervision extends to high dams of all types: Arch Dams, Concrete Gravity Dams including RCC Dams (Roller Compacted Concrete), Rockfill Dams like CFRD (Concrete Faced

Rockfill Dams) and Earthfill Dams. Most of the dams designed by Coyne et Bellier have also gone on to be constructed under our supervision whatever the type of construction contract.

## SOME DAM REFERENCES

- **Arch Dams:** **Karun IV** (232m) in Iran, **Tekeze** (187m) in Ethiopia, **Berke** (201m) in Turkey.
- **RCC Dams:** **Beni Haroun** (120m) in Algeria, **Gibe III** (240m) in Ethiopia, **Tha Dan** (110m) in Thailand.
- **Embankment Dams and CFRD:** **Mazar** (190m) in Ecuador, **Setif** (88m) in Algeria, **Kárahnjúkar** (190m) in Iceland, **Machadinho** (125m) in Brazil.
- **Earthfill Dams:** **Bougous** (87m) in Algeria, **Grand Maison** (160m) in France, **Potrerillos** (116m) in Argentina.



Mazar in Ecuador



Gibe III in Ethiopia

# HYDROPOWER PLANTS



Boguchanskaya in Russia

As the call for cleaner energy generation grows ever louder, so the real beauty of Hydropower comes to the fore as a renewable energy source with high generation capacities. Coyne et Bellier has designed more than 100 Hydropower Plants worldwide of which one third have a capacity higher than 500 MW.

## FULL SCOPE CONSULTING

We provide an entire scope of consulting services geared to the realisation of new Hydropower Plants. From the first site reconnaissance to the start-up and initial operation and maintenance management of Hydropower Plants (underground or outdoor) we have the advanced expertise to help you achieve your Hydropower ambitions. Utilisation of **Pump Storage Plants** (PSP), as an effective energy storage solution, is on the increase worldwide. We can design sophisticated hydraulic circuits and electro-mechanical equipment to achieve your pumped storage project.

## EXPERTISE FOR PLANT REFURBISHMENT

Our support service record reflects our commitment to helping you achieve the best possible operational results for your Hydropower assets. Our studies contribute to the increased efficiency of Hydropower Plants and the cost-effective refurbishment and optimisation of existing ones, including environmental protection.

## QUALITY CONTROL

Quality inspection and contract management of manufacturing of Hydro electro-mechanical equipment is also a key factor to optimal performance. We have experts who are highly experienced in this domain. Today these experts are located in Brazil, Argentina, France, Belgium, India, and China and can be mobilised to your plant, anywhere in the world to provide you with a top quality service.

## SOME HYDROPOWER REFERENCES

- **New Plants:** **Theun Hinboun** (280 MW) in Laos, **Jirau** (3,300 MW), **Ita** (1,450 MW), **Machadinho** (1,140 MW) in Brazil, **Tocoma** (2,160 MW) in Venezuela, **Berke** (510 MW) in Turkey, **Boguchanskaya** (3,000 MW) in Russia, **Manantali** (200 MW) in Mali.
- **PSP:** **Abdel Moumen** (400 MW) in Morocco, **Tehri** (1,000 MW) in India, **Coo Trois Ponts** (PSP - 1,140 MW) in Belgium.
- **Rehabilitation:** **Guri** (10,000 MW) in Venezuela, **Nangbeto** (65 MW) in Togo/Benin, **Andekaleka** (68 MW) in Madagascar.



# WATER TRANSFER AND WATER WAYS



Panama Canal Extension in Panama

Many governments are faced with the problem of population growth in semi-arid areas requiring innovative solutions for the delivery of water to those regions. In other countries, waterways are increasingly being regenerated or created as transport routes. Our Company is active developing projects of water transfer and water ways. Our experience in both fields can contribute to a number of unique solutions.

## MULTIDISCIPLINARY SKILLS FOR LARGE INFRASTRUCTURE PROJECTS

The transfer of water from one area to another is a complex issue involving environmental and social issues and requiring complex infrastructure design. Our expertise accumulated on major references is invaluable in these situations.

## INTERNATIONAL KNOW-HOW

Such projects are often driven at governmental level and as water, as a commodity, does not always respect borders, project development often requires the cooperation of several different authorities and agreement between governments. We often also find ourselves working with renowned institutions like the World Bank or with Basin Authorities. As a result, our experts are often called on, not only to present and explain project concepts, but to help to negotiate the way forward for such schemes.

## A PASSION FOR INNOVATION

Few water transfer projects are straightforward but as engineers we are excited by the challenges and opportunities for innovation that they present. As a result in recent years we have been involved in some of the world's most ambitious and forward thinking water management schemes. We will approach your project with the same kind of enthusiasm and creativity.

## SOME REFERENCES

- **Gurara Water Transfer** in Nigeria, **Red Sea-Dead Sea Water Conveyance Project** (Israel, Jordan, Palestinian Authority), **Seine Nord Canal** in France, **Panama Canal Extension** in Panama, **Lesotho Highlands Water Transfer** in Lesotho, South Africa.



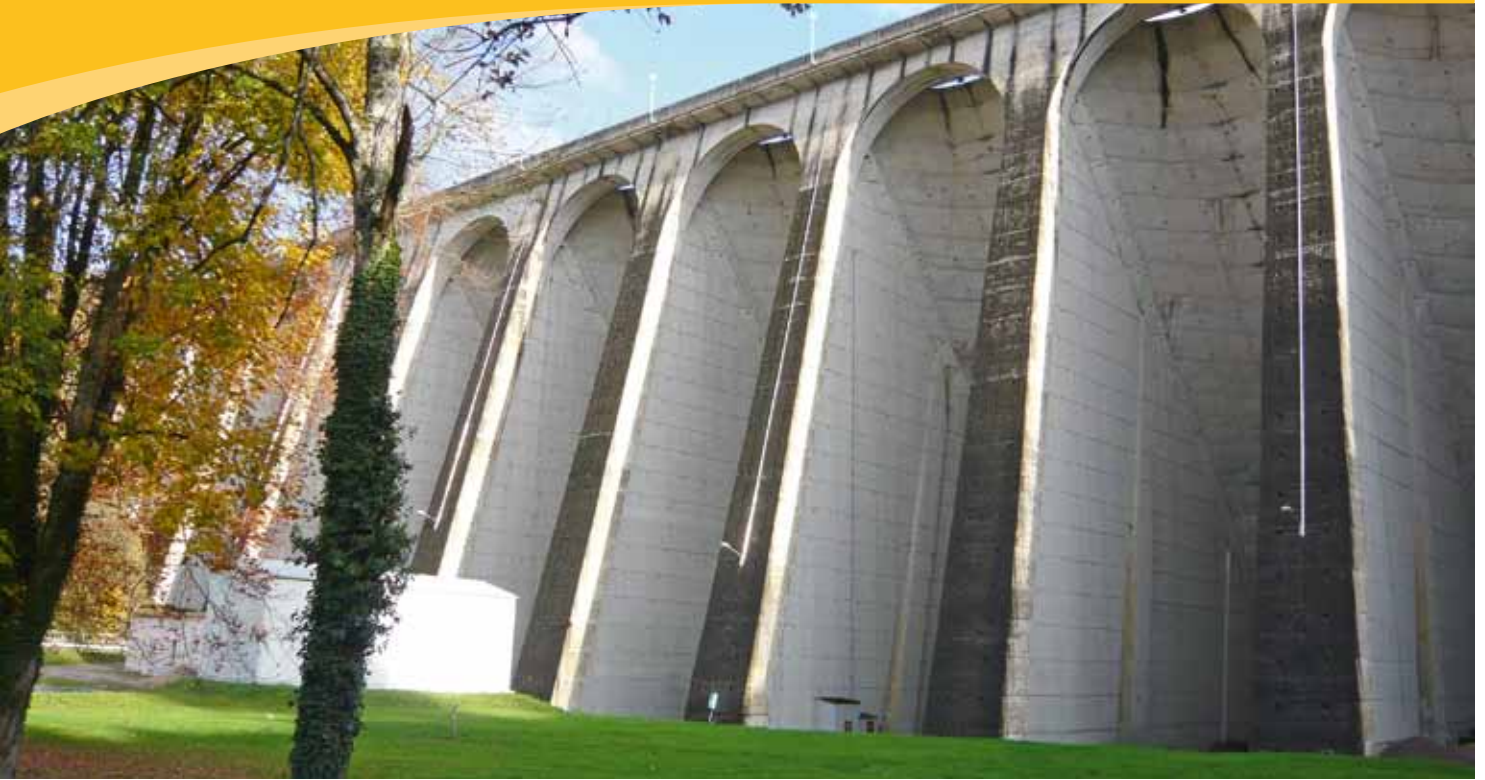
Canal Seine-Nord, France



Irrigation in Gurara, Nigeria



# REHABILITATION



Pannecière in France

There are 45,000 large Dams in operation in the world. These Dams represent an important heritage and need constant monitoring and evaluation, and where needed, rehabilitation, to ensure they stand the test of time. We have equally long standing experience in this field.

## WELL-GROUNDED EXPERTISE

The monitoring, evaluation and rehabilitation of Dams and Hydropower Plants does not fall into the category of regulations or standards. Nor is it a matter of process. It is fully reliant on an engineer's judgment and his full conviction, based on the synthesis of different observations and evaluations. Our engineers have the experience to carry out such missions, taking into account: the general aspect of the Dam, its foundation, its appurtenant works; deep analysis and evaluation of documentation available and comparison of this information with on site observations such as the evolution of measurements provided by monitoring equipment. Special testing and analyses of the works are conducted on site or in laboratories to ensure the security of your investment.

## REHABILITATION STUDIES AND REPAIR

This field covers a wide range of activities and studies require a vast number of specialist skills in all project phases; from geological and geotechnical studies to structural computer analyses, hydrological and hydraulic studies and technical knowledge of hydro mechanical equipment. Our customers know they can rely on us to provide the

expert teams to fulfil this important task. As a result, a large portion of our activity is devoted to the monitoring, maintenance, inspection, renovation or consolidation of operating works of different ages – each project consolidating our experience and contributing to future studies.

## SOME REFERENCES

- **Shiroro, Kainji, Jebba** in Nigeria, **Kariba** in Zambia/Zimbabwe, **Nangbeto** in Togo- Benin, **Pannecière** in France.

# GEOTECHNICS AND UNDERGROUND WORKS



Dul Hasti in India

Underground Works are strongly linked to Hydraulic and Hydropower projects and a high level of technical expertise is required to face the wide variety of geological and geotechnical situations that can impact your scheme.

## THE HEART OF OUR EXPERTISE

Geological investigation is core to all the work we do. We have accumulated a long experience over the last 60 years designing hundreds of kilometres of tunnels and underground chambers of all types and sizes worldwide, of which over 250 km are currently in operation. Our design teams bring together complementary specialists of the highest level - civil engineers, geologists, geotechnics engineers and engineering software specialists who bring their expertise to every stage of the design process in which they may be required. As a result, your project will be carefully tailored to reduce technical risks and to ensure that its layout is adapted to site conditions.

## CONSTRUCTION METHODS AND MONITORING

The choice of the right construction methods and planning is essential for optimum success in underground engineering. Our engineers pay very special attention to the technical and financial management of the works, optimisation of excavation and support methods, installation of monitoring equipment and interpretation of the data obtained, control of costs and lead-times.

## SOME REFERENCES

- **Head Race Tunnel:** Dul Hasti in India, **Gibe III** and **Tekeze** in Ethiopia.
- **Water Transfer Tunnels:** **Potrerrillos** in Argentina, **Los Olmos** in Peru, **Katse** in Lesotho, **Kárahnjúkar** in Iceland.



Gibe III Ethiopia



Manantali in Mali



# ENVIRONMENTAL & SOCIAL IMPACTS MITIGATION

While water, power and transport infrastructures are intended to improve living conditions, new projects impact and alter natural and social environments. Regulations dictate that environmental and social impacts must be addressed, but we also believe, as project designers, that mitigating or limiting any negative effects to the best of our ability is all part of the job.



## REAL TIME - REAL COVERAGE

The survival of ecosystems and the stability of human societies are governed by mechanisms and balances that must be incorporated in the design criteria. This calls for many disciplines over and above our design and construction services. Specialised studies of the ecology, socio-economics and the control of construction disturbances are vital and we have dedicated and specialist teams on the ground expert at managing environmental matters through every project phase. Both the immediate project site and the surrounding region are covered by our studies and the combined effects of any other planned structures are also assessed to give our customers the full picture.

## ADDRESSING KEY ISSUES

- **Physical aspects** concern river flow and sediment transportation, the possibility of landslides, the risk of earthquakes and noise pollution.
- **Biological aspects** are linked to the flora and fauna, water quality and health.
- **Socio-economic aspects** concern the possible need for re-settlement and the associated development plans, relocation of communication infrastructures, protection of the historical and archaeological heritage.

The variety of issues that our teams examine in their environmental assessments reflects the diversity of world geography. Our teams have the mobility and flexibility to respond to this world. Your ESIA report will be unique; concerned with the description of a specific set of natural and social conditions pertaining to your specific project.

## TAKING CARE OF EVERY CARE

One unresolved issue can impact the future of your project. For this reason, our studies examine every possible horizon and we go to great lengths to ensure that responsible action is taken to resolve or mitigate identified issues. Our approach ensures the local population take part in the planning process, however diverse or changeable their views. Our goal at all times is that all issues are sensitively approached and that solutions or recommendations respect both our customers' needs and those of the environment.

## SOME REFERENCES

- **Ban Mai Hydropower Project** in Vietnam, the **Red Sea-Dead Sea Water Conveyance Project** (Israel, Jordan, Palestinian Authority), **Fomi Dam** in Guinea, **Tekeze** and **Gojeb Hydro Power Projects** in Ethiopia, **Berke** in Turkey, **Bogushanskaya Dam** and **HPP** in Russia, **Kaleta HPP** in Guinea.

# WHERE WE ARE

## TRACTEBEL ENGINEERING (FRANCE)

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## REGIONAL COMPANIES

BRAZIL, CHILE, CZECH REPUBLIC, INDIA, ITALY, PANAMA, POLAND, ROMANIA,  
THAILAND, UNITED ARAB EMIRATES

## AFFILIATES OF TRACTEBEL ENGINEERING (FRANCE)

**Coyne et Bellier El Djazair**  
ALGERIA - Alger

**Coyne Ve Bellier Müh. Müş. Ltd.Şti**  
TURKEY - Ankara

**Coyne et Bellier Nigeria**  
NIGERIA - Abuja

**Coyne et Bellier Swaziland**  
SWAZILAND - Ezulwini

**Tractebel Engineering Monaco S.A.R.L.**  
MONACO - Monaco

# TRACTEBEL ENGINEERING TODAY

[www.tractebel-engineering-gdfsuez.com](http://www.tractebel-engineering-gdfsuez.com)

One of Europe's major engineering consultancies, Tractebel Engineering is part of GDF SUEZ, an industrial group with the financial strength to address the challenges of the future. With approximately 3,300 people in 20 countries, we offer life-cycle engineering solutions for power, nuclear, gas, industry and infrastructure clients. Services include a full range of engineering assignments: Architect Engineer, Owner's Engineer and Consulting Engineer. Our customers are private and public companies, as well as national and international institutions.

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