



HYDROPOWER

Make your project a success



OVERVIEW

With over one hundred years of experience in the hydropower industry, Pöyry is one of the world's leading engineering companies.

About one fifth of the world's electricity is produced in hydropower stations. Thanks to its efficiency and sustainability, this kind of power generation is much valued on the international market. Although about 50,000 hydroelectric plants are in operation throughout the world – with a total capacity of the order of 750,000 MW – global hydropower resources are far from being fully developed.

Having been active in the hydropower industry since 1895, Pöyry can offer its clients wide national and international experience. Our responsibility over many years for the planning, study, design and construction supervision of hydroelectric schemes with a total capacity of more than 100,000 MW has made us one of the leading consulting engineers in the industry. Our highly qualified specialists

work together with our clients to develop tailor-made solutions of the highest standards.

The Hydropower business is part of the Energy Business Group of the independent Pöyry engineering company. It has two world-renowned competence centres – Pöyry Energy AG (formerly Electrowatt-Ekono Ltd.) and Pöyry Energy GmbH (formerly Verbundplan GmbH) – and many local offices worldwide.

The numerous companies forming the Pöyry Group provide an excellent network that we can call on for all our projects.

For a company with such a long-standing tradition, hydropower is not just business – it is a mission.



YOUR ADVANTAGES

Long-standing tradition

Having been active in hydropower engineering for over one hundred years, on numerous projects in all parts of the world, Pöyry has accumulated the expertise needed to provide its clients with services of the highest quality.

International activity

Our customer-oriented organisation is active in many countries; the Hydropower business alone has offices in Zurich, Salzburg, Vienna, Bangkok, New Delhi, Lima, Ankara, Brno, Tehran and Colombo. Together with selected partners, this network is the basis for efficient high-quality project work.

Experienced specialists

Pöyry employs nearly 300 hydropower specialists, all with a broad engineering education.

Our internal training programme allows younger engineers to benefit from the wide experience of their senior colleagues and ensures continuous know-how transfer in all aspects of our work.

Global network

The Pöyry Group as a whole provides an interdisciplinary network from which all its projects can benefit. In addition, the Hydropower business has design offices in Lima, Bangkok, New Delhi and Brno in which high-quality design work can be done cost-effectively and quickly.

Comprehensive services

We are a multidisciplinary company able to cover all stages of the development of a hydropower project, from initial conceptual planning and power market studies to feasibility studies, all stages of design, to construction support and supervision. Our services for the trainings of clients' personnel in design, operation and management of hydropower schemes are increasingly called on.



RESERVOIR STORAGE SCHEMES

Our services cover both technical and economic aspects for the design and construction of storage plants.

Besides ensuring the supply of mainly peak energy, reservoir storage schemes often also provide water for irrigation and industrial/domestic supply, as well as flood protection and recreational benefits. Pumped-storage schemes make an essential contribution to efficient and secure system generation and to meeting peak demand.

Since most storage plants are located in remote, often mountainous areas, their design and construction call for particular know-how and experience.

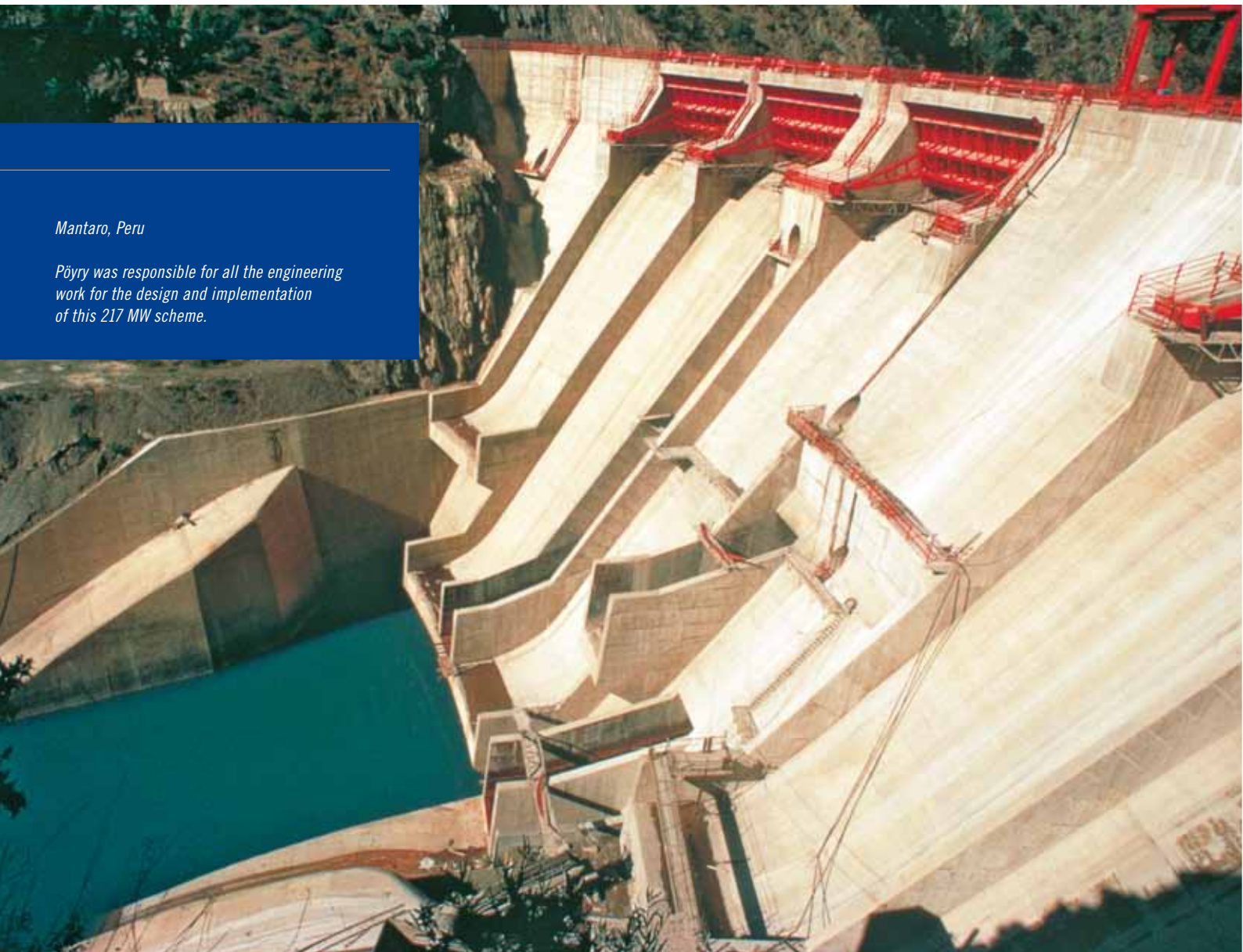
Hydropower schemes are complex and the planning and design of their components – high dams of many different types, large hydraulic structures, long tunnels and surface or underground power stations – call for wide-ranging expertise which can only be gained over many years.

In recent decades, our specialists have participated in the engineering of some of the largest hydropower storage schemes ever built, and the experience gained in this work makes Pöyry one of the world's leading consultancy companies in hydroelectric engineering.

For tunnelling and infrastructure work, the Business Area Hydropower can call upon specialists from our other Business Areas and thus generate added value for our clients. Management Consulting enables Pöyry to provide the economic expertise needed to determine solutions to all the many questions related to energy policies and financing. Only by combining technical and economic expertise, optimal and sustainable solutions for storage schemes can be developed.

Mantaro, Peru

Pöyry was responsible for all the engineering work for the design and implementation of this 217 MW scheme.



CORE COMPETENCIES

Dams

Our experience covers all types of concrete and embankment dams, including earthfill and rockfill dams with central cores or concrete facings and gravity and arch dams with conventional mass or roller-compacted concrete (RCC). For all dams also offer comprehensive geological and geo-technical services.

Power waterways

The power waterways are a key part of any high-head hydropower scheme. Tunnels, vertical and inclined shafts, surface penstocks and underground pressure shafts, surge tanks as well as tunnel driving and underground structures are amongst our core competencies. Tunnel linings, rock mechanics investigations as well as transient calculations are analysed using the most advanced methods.

Hydraulic structures

Hydraulic structures such as the various types of power intakes, spillways as well as medium- and low-level outlets, with all corresponding gates and valves, are part of our specific know-how.

Powerhouse

We are specialised in the design of surface and underground powerhouses, and can provide all corresponding civil and electromechanical design services for all project phases.

Mechanical equipment

Pöyry has many years' experience in the engineering of electrical and mechanical equipment, in particular turbines and pump turbines, generators and transformers, as well as hydromechanical equipment such as gates, valves of all types, steel linings, penstocks and cranes.

Plant operation concepts

Precise analysis of operating procedures is of particular importance for storage schemes. With the help of advanced reservoir simulation and electricity price models etc., we can develop optimal rules for plant operation to meet all conditions.



Deriner Dam and Hydropower Plant, Turkey

Services: Feasibility study, final design, supervision during construction, progress and quality control, inspection and control of electro-mechanical equipment, assistance during commissioning and technical management of the project

Technical data: 249 m high double curvature dam, 700 m crest length, four Francis turbines with a total installed capacity of 670 MW, 2118 GWh annual energy production



Nam Ngum 2 Dam and Hydropower Plant, Lao PDR

Services: Feasibility study, Environmental Impact Assessment, project upgrade studies, outline design and tender documents, supervision of erection and commissioning of electro-mechanical, hydro-mechanical equipment and transmission line works

Technical data: 185 m concrete faced rockfill dam (CFRD), three Francis turbines with a total installed capacity of 615 MW, 2218 GWh annual energy production



Limberg II Pump Storage Plant, Austria

Services: Approval design, tender documents, guideline design, detailed design, coordination of civil construction and HEM erection, site supervision, project management, scheduling

Technical data: Two reversible Francis turbines, 480 MW installed capacity, 1300 GWh annual energy production



Tsankov Kamak Reservoir Storage Scheme, Bulgaria

Services: Financial setup, joint implementation, review of final design, organization, scheduling and coordination, guideline design, detailed design, geological survey, site office services

Technical data: 125 m double curvature arch dam, installed capacity of 80 MW and a small turbine with 1,3 MW for providing of ecological flow, 185 GWh annual energy production

RUN-OF-RIVER SCHEMES

Our specialists can provide economical and optimised designs as well as efficient construction phases for new schemes and rehabilitation work.

Run-of-river schemes make an important contribution to meeting base load electricity requirements. Often constructed in the bed of a large river, run-of-river schemes not only generate electricity, but also provide flood protection and contribute to the development of tourism. Design criteria for them have always to be consistent with prevailing ecological standards.

The often-competing requirements of energy production, flood protection, bed load and sediment transport and ecology, have been optimised for many run-of-river schemes; in this way, the design of new projects could be perfected and the operation of existing schemes improved. For such studies, Pöyry can call on specialists with comprehensive expertise not only of the design of new hydropower plants but also the rehabilitation of many large,

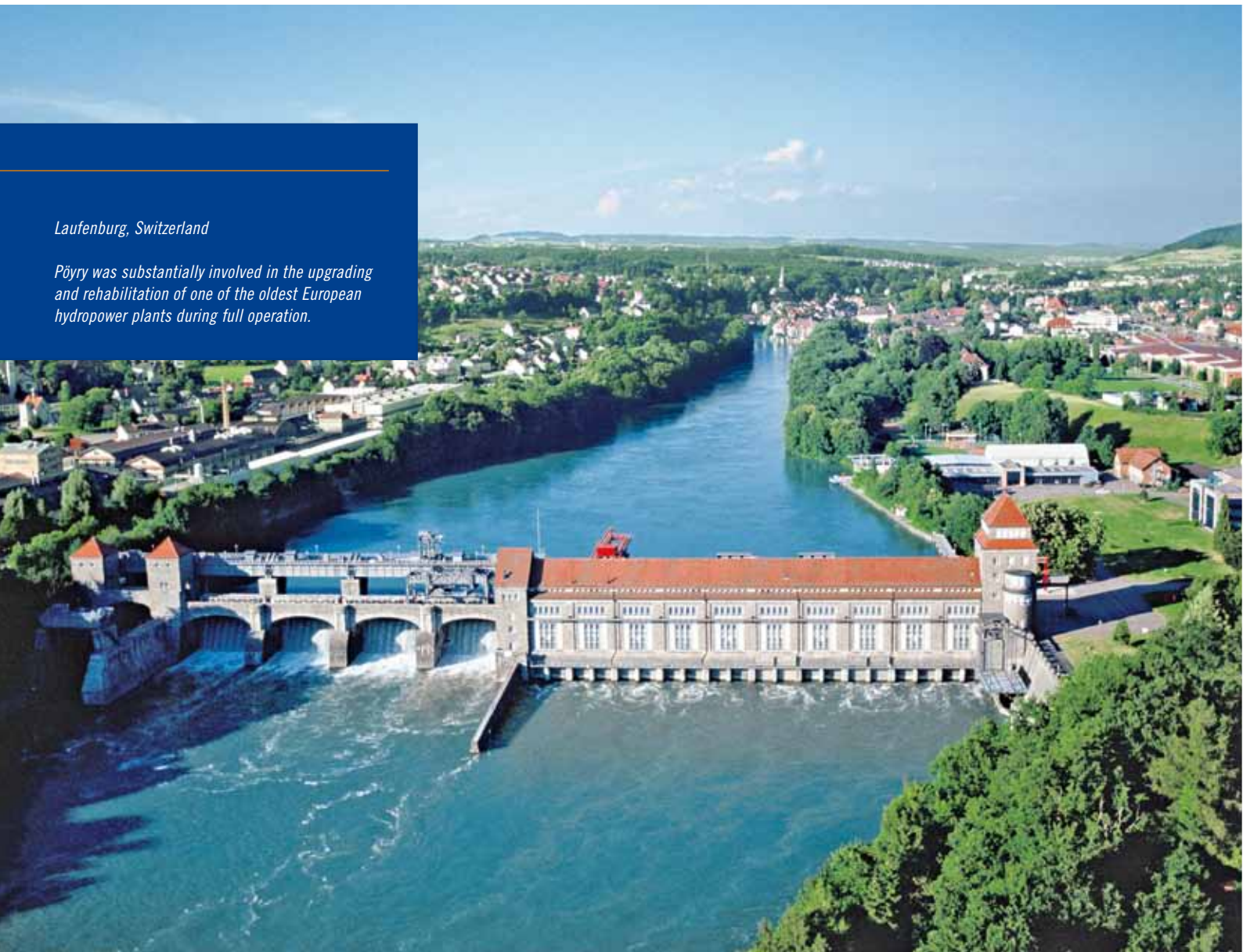
long-established run-of-river schemes.

The design and construction of various schemes with bulb turbines on the river Danube in Austria for example have been progressively optimised over several decades. The know-how gained in such projects is now available for the design of run-of-river plants all over the world.

The complex structures for run-of-river plants, especially on large rivers, require the development of carefully planned, staged construction procedures – in particular for river diversion – based on full analysis of hydrological and logistic restrictions. Limited working space and dewatering of deep excavations, flooding risks and the possible need for controlled flooding of parts of the site during high water make the optimal planning of such construction work a particular challenge, for which our specialists have much experience.

Laufenburg, Switzerland

Pöyry was substantially involved in the upgrading and rehabilitation of one of the oldest European hydropower plants during full operation.



CORE COMPETENCIES

Spillway structures

Our engineers specialised in the design of hydraulic and steelwork structures have the expertise necessary for the design of all kinds of spillway structures. Often situated on navigable rivers, run-of-river schemes have to be equipped with navigation locks, in the planning and design of which we have wide experience.

Head pond and bed load aspects

The groundwater regime and the bed load balance are a particular challenge for all run-of-river schemes. The detailed analysis and solution of this problem is part of Pöry's tradition. In addition, we benefit from many years of experience in the design of fish passes, sealing concepts and environmental studies.

Excavation concepts

Pöry undertakes optimised construction management analyses with precisely optimised planning phases, which allow costs to be reduced, considering safety aspects.

Powerhouse

We can provide comprehensive designs for powerhouses, taking fully into account the suppliers' precise details of all equipment, in order to ensure ease of construction, minimum construction time and sustainable operation over many years.

Mechanical equipment

We are specialised in developing innovative solutions such as matrix and Straflo turbines as well as in the optimisation of new and existing designs and the refinement of equipment layout for such power stations.

Operational concepts

The optimal concept with regard to the design discharge, efficiency, operational reliability and subsequent inspection needs can only be determined on the basis of long experience. As a former operator of many hydropower stations, Pöry has accumulated the knowledge and expertise needed for such studies.



Rheinfelden Run-of-River Plant, Switzerland

Services: Study of existing scheme, environmental study, assistance during concession agreement negotiations, feasibility study, optimization study, tender and contractual documents, detailed design of the powerhouse
 Technical data: Run-of-River hydropower plant, four Bulb turbines with 100 MW installed capacity, and a small Kaplan turbine with 2 MW capacity, 600 GWh annual energy production

Laja Run-of-River Plant, Chile

Services: Basic design, tender design, detailed design and HEM interface of the power plant
 Technical data: Run-of-River low-head hydropower scheme with spillway structure and two Bulb turbines generating 35 MW at 250 m³/s and 16 m head, 166 GWh annual energy production

Lehen Run-of-River Plant, Austria

Services: Comparison of alternatives, basic design, structural pre-dimensioning, approval design, participation in authorities procedures, tender design, hydraulic calculations, geological investigations, detailed design, commissioning
 Technical data: Run-of-River hydropower plant, two Kaplan-pit turbines (2 x 6.85 MW) with horizontal shaft, runner diameter of 4.00 m, 81 GWh annual energy production

Xajaburi Run-of-River Plant, Lao PDR

Services: Review of major project documents, regular site visits, review of project construction progress, financial status, environmental compliance
 Technical data: 30 m high weir, 5000 m³/s powerhouse discharge, 7 + 1 Kaplan turbines with 1,285 MW installed capacity, 7405 GWh annual energy production

ELECTROMECHANICS

We perform the complete design and implementation work for the rehabilitation and construction of electromechanical schemes.

We are specialised in the design and specification of the complete electromechanical and operational equipment required in hydropower plants, from water to wire. Our services comprise the planning and design of electrical power generation and transmission schemes, instrumentation for control and automation, security and communication systems, earthing, lightning and overvoltage protection, all for new projects as well as for the rehabilitation and upgrading of existing plants.

For the power transmission and distribution industry, we are the preferred partner for the design and implementation of high- and medium-voltage substations, overhead transmission lines and cable feeders as well as entire transmission and distribution networks.

In today's liberalised energy markets, we advise our clients on the introduction of energy management systems and IT solutions for the optimisation of their business processes.

One of our special fields of interest is the rehabilitation of existing power plants. We can offer the whole range of services for condition analyses and assessments, including the identification and evaluation of optimisation potentials such as the improvement of availability, reliability and efficiency.

Consulting services for the technical and economic optimisation of operation and maintenance procedures, as well as for the operation of schemes for power suppliers and industrial enterprises with their own power generation capacity, complete our range of services.

Aschach, Austria

Pöyry was responsible for the detailed design, the installation and the commissioning of the rehabilitation of the 220 kV substation.



CORE COMPETENCIES

Turbine-generator units

We are specialised in transforming hydraulic energy into electricity. Our expertise covers all performance classes and comprises turbines, generators, excitation systems, generator protection and monitoring systems. Besides the design and specification, we undertake error analyses, commissioning and acceptance tests.

Auxiliary systems

Pöyry carries out design work for all types of auxiliary systems such as generation for plant power supply, emergency systems, cooling systems for generators and transformers, fire protection and extinguishing systems, heating, ventilation, air conditioning (HVAC) as well as earthing and lightning concepts.

Substations

Substations for power plants, transmission and distribution networks are part of our expert knowledge. We can offer services for all voltage levels – from medium to high and extra-high voltage.

Instrumentation and control

Thanks to many years of operational experience in co-operation with plant operators and to our excellent supplier knowledge, we are the preferred partner for maintenance and diagnostic systems, water supply control, automatic operation, turbine governors, voltage regulators, protection systems, instrumentation and substation control, etc.

Transmission and distribution

Besides the technical design and the construction/erection support, we offer comprehensive services for transmission and distribution networks. These include master planning, network analysis, calculations and evaluation, as well as communication systems related to power transmission.

Rehabilitation services

Our specialities include condition assessment, rehabilitation and performance upgrading of existing schemes. Our specialists have gained excellent expertise in these fields through their work on many international projects.



Flumenthal Rehabilitation of the Hydropower Plant, Switzerland

Services for the rehabilitation of the electrical systems: Technical specifications, tender documents, tender evaluation, checking of suppliers' documents, workshop inspections, supervision of installation and commissioning

Technical data: Three Kaplan turbines with a total installed capacity of 23.7 MW; rehabilitation works covered the 4.25 kV equipment, auxiliary installations, control equipment, protection systems

Thurfeld Innovative Hydropower Plant, Switzerland

Services: Revision of concession project, basic and final design, tendering, detailed design, site supervision, shop inspections, commissioning

Technical data: Run-of-river hydropower plant with an innovative concept. The two bulb turbines and generators (2 x 0.8 MW) are installed in a movable steel casing to allow bedload transport during plant operation, and to optimize turbine efficiency. The weir consists of Obermeyer pneumatically operated spillway gates

Ashta Two Run-of-River Plants, Albania

Services: Consulting services in the pre-construction stage, technical reports and drawings for permits, tender documents, assessment of cost of civil works and HEM equipment, evaluation of offers, overall project schedule, connection to the grid, execution design, structural and hydraulic analysis, HEM interface coordination, site supervision

Technical data: Ashta 1: 45 Hydromatrix-TG-units with 20 MW installed capacity, annual energy production of 97 GWh; Ashta 2: 45 Hydromatrix-TG-units with 29 MW installed capacity, annual energy production: 133 GWh

Rucatayo Run-of-River Plant for Power Generation, Chile

Services: Integration of main equipment for power generation, engineering support to electromechanical supplier, detailed design of electrical and mechanical auxiliary systems, elaboration of specifications for procurement of auxiliary equipment

Technical data: A single Kaplan turbine will be installed in a surface powerhouse. The available gross head of 34 m with a design discharge of about 200 m³/s allows to generate 56 MW

SPECIALISED SERVICES

Dam monitoring, earthquake safety analyses, environmental consulting and other special services complete our package.

Our engineers have wide experience of the state-of-the-art technological, hydraulic and hydrological design procedures and can provide decision support at all levels. Pöyry makes use of the most up-to-date databases, information systems and mathematical models able to simulate and analyse processes in the environment.

We offer our clients single-source solutions and can thus ensure reliability and excellent value for money. Energy and climate protection consulting as well as river management, flood protection and monitoring of structures are also part of our expertise.

As an internationally recognised engineering consultant, staff of Pöyry also serve as technical arbitrators. Our large environmental department can undertake full envi-

ronmental impact assessments for hydropower projects, including socio-economic surveys, investigations of flora and fauna and the planning of resettlement schemes where these are unavoidable.

Besides traditional design work, the long-term quality assurance of schemes has been one of our core competencies over many years. Furthermore, our many specialists can undertake the safety monitoring and analysis of complex structures, in particular dams.

Optimisation of the operation of existing hydro stations is also one of our specialities; using the latest instrumentation, such as thermodynamic efficiency measuring devices, and providing detailed advice on operational improvements, we can create added value for our clients, the plant operators.

Pamir, Tajikistan

Pöyry was responsible for the rehabilitation and upgrade as well as for a detailed environmental impact assessment study of this 28 MW scheme situated at almost 4000 m altitude.



CORE COMPETENCIES

Dam monitoring

Over more than 50 years, we have monitored many dams all over the world and have evaluated their structural behaviour through stress and deformation analyses. For these analyses, we compare deformations from geodetic surveys and instrument measurements with calculated design values. Furthermore, we use regression analyses, neural networks and calibrated finite element models for the monitoring of dams.

Hydraulic cascade simulation

By means of hydraulic simulations using the latest software, we can optimise operating patterns and prepare schedules at 15-minute intervals based on boundary value analyses, for cascades of hydropower stations.

Hydrology and flood protection

We develop hydrological and hydraulic models able to analyse both surface and ground water as well as flood protection and emergency concepts for our clients.

Earthquake safety of dams

Pöyry has carried out seismic analyses for numerous large arch, gravity and embankment dams in earthquake-prone regions such as Iran, Turkey, Northern India. For new dams, we can analyse the behaviour of the structures under seismic loading and prepare seismic-resistant designs. For existing dams, perhaps designed using outdated seismic criteria or dynamic analysis methods, we can make earthquake safety assessments and design reviews.

Turbine efficiency measurements

Pöyry can provide all technical measuring equipment needed for thermodynamic efficiency measurements of Francis and Pelton turbines. The method used is based on the measurement of temperature differences to determine the power losses.

Environmental consulting

Our experts cover all areas of energy consulting, from environmental impact assessment studies to compliance procedures and relevant studies for climate protection.



Daugava Dam Safety Project, Latvia

Services: Dam break analysis, site investigations, soil-structure modelling, design and supervision of repair work for bituminous joints, hydro-geological modelling, risk assessment (FMEA), emergency action plan, general management and co-ordination for design and supervision of the works for securing the safety of the dams

Technical data: Plavinas: 55 m embankment dam, 855 MW; Kegums: 25 m embankment dam, 68+192 MW; Riga: 30 m dam, 402 MW

Climate Change Impact Study Danube River, Germany & Austria

Services: Water balance modelling of the whole upper Danube basin, historic runoff simulation 1887 to 2007, simulation of climate change scenarios for the periods 2020-2050 and 2070-2100, assessment of impact on hydropower and navigation; uncertainty analysis

Technical data: Semi-distributed water balance model for 100,000 km², consideration of glaciers and large reservoirs, ensemble modelling approach by use of 23 regional climate models for IPCC A1B emission scenario

La Confluencia Hydroelectric Power Plant, Chile

Services: Tender design, basic design

Technical data: Hydropower scheme with an off-river reservoir, 20 km tunnels (pressure and free-flow tunnels, pressure shaft, high pressure tunnel and a power house). Two main intakes and five secondary intakes collect water from two valleys. An off-river reservoir with a daily storage capacity of 1.2 mio m³ is located close to the Tinguiririca main intake. The power-house is designed for a design flow of 52.5 m³/s. The two francis turbines have a total capacity of 160 MW

Environmental and Social Impact Assessment Meme'vele, Cameroon

Services: The SIA included an analysis of the socioeconomic impacts of the dam, the electricity lines and the construction works, as well as a public consultation, health analysis, infrastructure analysis and analysis of the potential impact on opportunist migration, and gender and minority issues for 14 villages around the project area. The EIA covers all environmental aspects: hydrology, fauna, flora, forest, GIS, water quality, etc.

Technical data: Hydropower plant: 450 m³/s, reservoir: 1450 ha

Pöyry has nearly 370 hydropower specialists in offices in Zurich, Salzburg, Vienna, Bangkok, New Delhi, Lima, Ankara, Brno, Tehran, Colombo and on numerous construction sites worldwide.



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