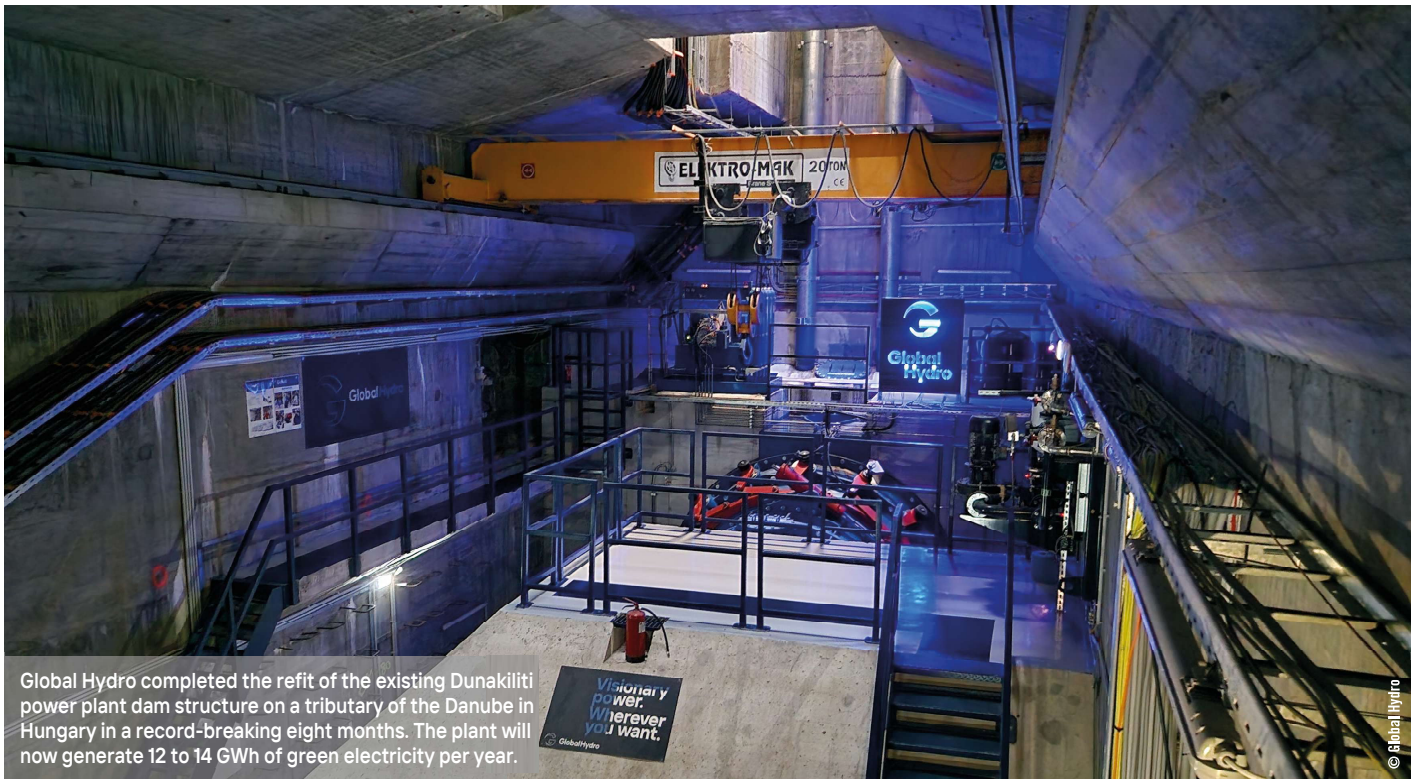

Global Hydro completed the refit of the existing Dunakiliti power plant dam structure on a tributary of the Danube in Hungary in a record-breaking eight months. The plant will now generate 12 to 14 GWh of green electricity per year.

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AUSTRIAN TURN-KEY SUPPLIER WINS RACE AGAINST THE CLOCK IN HUNGARY

Previously, since its construction in the 1980s, Hungary's Dunakiliti dam in the border region with Austria and Slovakia had remained unutilised in terms of hydropower. However, in the autumn of 2021 time was of the essence for the Hungarian operators as work commenced on the Danube canal power plant project. Success of the project depended on meeting the final deadline, as the power plant had to be hooked up to the grid and online by 30 June 2022. The Upper Austrian hydropower specialist Global Hydro was commissioned as the general contractor and had just eight months to complete all work. Ultimately, it was a race against the clock the renowned hydropower specialists were only able to win with logistical genius and immaculate cooperation with their partner companies. Since it was commissioned the Dunakiliti power plant has generated between 12 to 14 GWh of clean electricity per year..

Dunakiliti is situated in the north-western border region of Hungary and owes its existence to the Danube. Alpine sediments accumulated here over thousands of years, forming and shaping the lowland landscape. Previously also known by its German name 'Frauendorf', over 100 years ago, it is a village on Hungary's largest island – the Szigetköz. This is completely enclosed on one side by the Mosoni arm of the Danube, also known as the Little Danube, and by several smaller branches of the main river. Dunakiliti in particular, and Szigetköz Island in general are considered to be idyllic natural environments and scenic gems, enjoying high protection status within the EU Natura 2000 conservation network. The region's picturesque landscape is exceptionally rich in flora and fauna, attracting increasing numbers of tourists every year – especially nature lovers, hikers, horse riders, cyclists, canoeists and paddlers.

A FUNCTIONAL SHIFT FOR THE WEIR

Internationally acclaimed for its magnificent floodplain landscape, Dunakiliti also enjoys broad recognition for the dam, built here within the framework of the Bös-Nagymaros reservoir system – a mammoth-scale project agreed as part of the Budapest Treaty between Czechoslovakia and Hungary in 1977, but never implemented to the extent originally planned. Work on the plant was halted in the late 1980s as Hungarian politicians expressed concerns about drinking water protection, fearing the Szigetköz floodplain forests could dry out. Nevertheless, since the massive six-span weir had already been completed, the Dunakiliti dam across the Danube Canal, or 'Little Danube' on the Hungarian side was retained. However, Hungary's withdrawal from the Bös-Nagymaros barrage project meant the dam operated by the North Transdanubian Water Administration ceased to play a role in the utilisation of hydropower between the two countries. Despite this, over the following decades it assumed an increasingly important water management function, especially for the irrigation of the surrounding floodplains. From the outset the intention was to integrate a hydroelectric power station set-up. So when the transverse structure was installed 40 years ago the planners intentionally left sufficient space in the first pillar on the left bank for subsequent installation. Although, technically speaking, only electromechanical components for a small-scale power plant

The commanding Dunakiliti dam in north-west Hungary was built in the mid-1980s. Planners included a room for the subsequent installation of a hydropower generation machine set.

would have been required to utilise the existing potential of the weir system – this wasn't to happen for several decades.

A PROJECT WITH A LONG LEAD TIME

In 2009, a public tender for the utilisation of the Dunakiliti dam's hydropower potential was announced, with several investors expressing interest. Ultimately, the contract was awarded to Future Hydro Vision Kft (FHV), a hydropower company owned by the well-known Hungarian hydropower operator Gusztáv Kapuváry, who also runs the Kenyary power plant on the River Rába. Kapuváry states several reasons project implementation progress was delayed by more than a decade. Alongside ecological, nature conservation and economic issues, there had also been questions about how water management in Szigetköz should be executed in the future.

Ultimately, the Dunakiliti power plant project proved Gusztáv Kapuváry was right to show staying power, as was Global Hydro – the company carrying out site work. Referring to the fact that the construction project had been put on hold more than once over a long period, Heinz-Peter Knass, Managing Director of Global Hydro explained: "We've been familiar with the project for a very longtime, and had developed the entire engineering infrastructure for the FHV operating consortium over ten years ago." The project finally got underway in autumn 2021, once the Upper Austrian hydropower specialists at Global Hydro had taken the project into their own hands as general contractors. Knass continues: "In October 2021, we made the decision with our partners to build the power plant ourselves, and commenced work immediately."

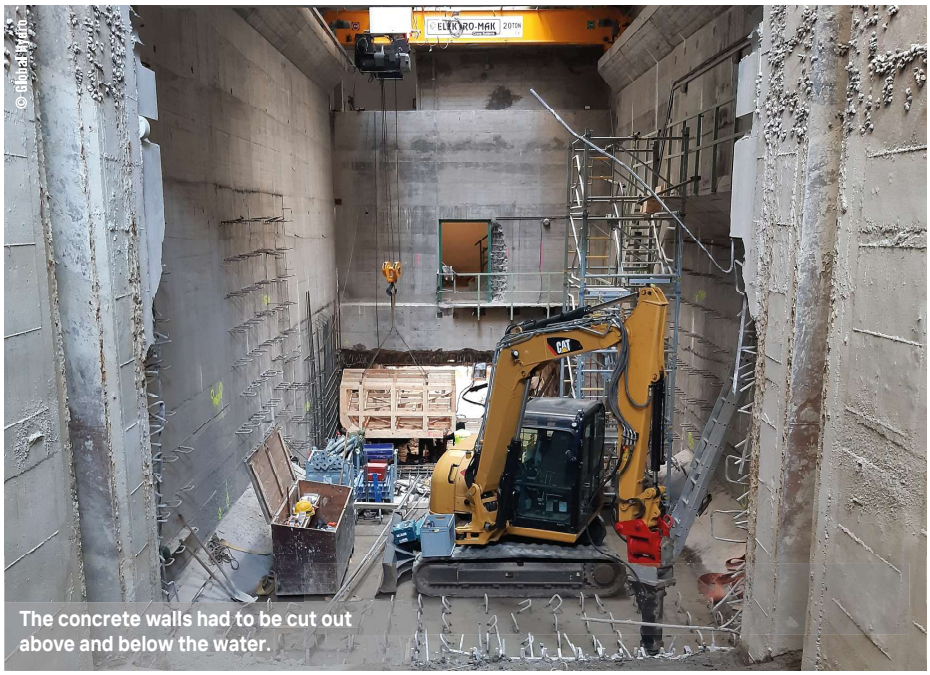
A RACE AGAINST TIME

A state subsidy, soon to expire, contractually guaranteed a special tariff – meaning rapid project completion was a matter of great urgency. Knass recalls: "At this point, the project operators still had a chance to benefit from the tariff regime; but only if the power plant went online by 30 June 2022. For us it meant the power plant had to be up and running within eight months. Otherwise, none of the original economic calculations would apply to the project, anymore. There was some justification in the belief held by some that this was a mission impossible." There were several reasons the seasoned hydropower specialists still believed they could meet the deadline: From day 1, under the leadership of Rainer Pühringer, the experienced project team had detailed and almost completed engineering plans to work from. Furthermore, they could completely depend on the other project partners who, like Global Hydro, operate under the F-Energies holding company umbrella. One partner was Hereschwerke, who offer a comprehensive range of electrical engineering services structures and buildings. Another trusted partner was Enso, a member of the Frizberg family conglomerate with broad and profound expertise, particularly in the structural realisation of power plants. Indeed, Global Hydro was able to draw on many years of experience in the implementation of numerous turnkey projects all around the world.

EXCELLENT DOVETAILING

The extremely tight schedule was the greatest challenge posed by the project. However, as project manager Rainer Pühringer recalls, "Obviously, the turbine hall had to be measured again in 3D, and the plans redrawn – but we benefitted greatly from having turbine designs that were more than 80 per cent complete. Precise coordination – internally, and with all external suppliers – was essential throughout the entire duration of the project. Fortunately, the project was assigned top priority within the company to ensure everything dovetailed perfectly." Pühringer explains that the success of the project hinged, above all, on close and highly-professional collaboration with Enso, the company responsible for planning, coordinating and implementing the construction measures.

This was confirmed by Enso's project manager and CTO Georg Schweighofer. Enso is committed to the ongoing



The concrete walls had to be cut out above and below the water.

Installation of machine components was meticulously planned by Enso's construction management specialists.

expansion of renewable energy use, and has a wealth of expertise in the field of hydropower plant construction. Georg Schweighofer points out that although the machine room in pillar 1 was basically ready for the installation of E&M, and ultimately just under 500 cubic metres of concrete were required, implementation involved some very complex construction: "Excellent cooperation with Global Hydro and the local developer enabled the power plant to be completed in a sensationally short period of time."

INLET OPTIMISATION

Over the decades since the original construction, enormous amounts of sediment had been deposited in the future intake and outlet areas of the power plant – in front of and behind the pillar.

Lifting the 20-tonne guide apparatus into position required incredible precision.

In order to dredge the intake clear, dam beams were inserted and a small excavator lifted down in extremely cramped conditions to expose the river bed. Georg Schweighofer recounts: "The two concrete walls that had sealed off the upstream and downstream sides the turbine chamber for the previous 40 years had to be cut away to protect the dam beams. In order to keep within the schedule, every task that could be carried out simultaneously – was carried out simultaneously."

Both partners managed a high degree of flexibility, despite the pressure of the deadline. When Global Hydro's experienced power plant planning engineers realised flow conditions in the inlet area required improvements, their solution was to extend the base of the pillar. Enso's CTO, an acknowledged hydropower expert himself, says, "CFD calculations were carried out and revealed significantly enhanced inlet conditions could be achieved with a pillar extension, which is why we chose this form of implementation."

COOPERATION WITH PARTNERS

While construction work continued on site, Global Hydro was under immense time pressure to manufacture the turbine and organise the remaining scope of delivery. This also included the generator, gearbox, auxiliary equipment, transformer and control system. "The role played by the sheer dimensions of the turbine in project implementation shouldn't be underestimated. Machine size was taken to the limit to maximise exploitation of the hydrological conditions. Rainer Pühringer outlines the challenges involved in lifting a Kaplan S-type turbine with a diameter of 3.15m into place: "Heavy machine components like the 20-tonne guide runner were lifted into place using the weir system's overhead travelling crane. It was such a squeeze that we had to scrape away a few centimetres of the roof-side access turbine room opening to lift in the apparatus without damaging it." In fact, one blade even had to be removed and then bolted back into place when lifting in the four-bladed turbine runner.

As the general contractor, Global Hydro was also responsible for implementation of the custom-built hydraulic steelwork equipment manufactured by the western Austrian specialists. Rainer Pühringer expands:

A double-regulated 2-MW Global Hydro Kaplan S turbine was installed according to plan.

"In addition to the dam beams and the intake screen, the hydraulic steelwork contractor also supplied a new screen cleaning machine that was then integrated into the higher-level

Technical Data

- Hydraulic head: 4.3 m (max. 5.3 m)
- Expansion water volume: 54 m^3/s
- Turbine: Kaplan S turbine
- Manufacturer: Global Hydro
- Bottleneck capacity: 2.036 MW (max. 2.561 MW)
- Speed: 120 rpm
- Number of runner blades: 4
- Runner diameter Ø: 3,150 mm
- Weight of runner: 20 tonnes
- Generator: Synchronous (water-cooled)
- Speed: 750 rpm
- Hydraulic steel construction & RRM: Künz
- Construction work: Enso GmbH
- Control technology: HerosControl (Global Hydro Digital Solutions)
- Electrical engineering: Global Hydro / Hereschwerke GmbH
- General contractor: Global Hydro Energy GmbH
- Energy generation capacity: 12 - 14 GWh
- Commissioning: 27 June 2022

Lack of space meant one wing had to be removed to lift the 4-wing runner into place.

HerosControl control system by our control technology experts." The project managers praised the quality of the cooperation with the sister company Hereschwerke, responsible for the implementation of the entire electrical engineering side. Hereschwerke's many years of experience were required for cabling and installing the entire set of switch and control cabinets. "In view of the tight schedule for project completion, complete reliance on a partner from within our corporate group for electrical engineering services was a major advantage", says Pühringer.

COMPLETED ON SCHEDULE

The modern Global Hydro Kaplan S turbine is designed to discharge a water volume of 54m3/s. The machine drives a water-cooled generator via a vertical shaft in the gearbox to achieve a nominal output of 2.036 MW from a nominal head of 4.3 metres. The 4-blade runner rotates at a speed of 120 revolutions per minute. This translates to 750 rpm via the gearbox and enables the power plant to supply around 12 – 14 GWh of clean electricity to the 22kV grid in an average year; in turn corresponding to the average annual consumption of 5,500 to 6,000 Hungarian households.

However, the fact the power plant runs economically at all is primarily due to the fact that the general contractor Global Hydro, and their partner businesses, managed to hook the plant up to the grid on schedule. Plant commissioning was completed on 27 June 2022, just three days prior to expiry of the deadline for the lucrative subsidised tariff. It's a magnificent technical and logistical feat of which Global Hydro Managing Director Heinz-Peter Knass is particularly proud: "The whole project was a race against the clock. This amazing achievement was only possible with the state-of-the-art technology and expertise the employees and partners involved were able to provide."

SUCCESSFUL GROUP-LOOP SOLUTION

Global Hydro Managing Director Heinz-Peter Knass believes Dunakiliti provides a promising model for future projects, especially in terms of the interaction within the extended group of companies that included Enso and Hereschwerke. The combined expertise of the three companies enables projects to be managed all the way from evaluation and analysis through to final operation. "On a worldwide scale we identified some great potential for investors to benefit from the turn-key optimisation of small hydropower plants", announces Knass. "Contractors often lack the technical expertise for hydropower-specific optimisation. That's where we come in, offering holistic solutions that save time and money." He points out that, in this context, the European trend toward realising 'downsizing potential' and building as compactly as possible also needs to be implemented elsewhere. Experience and expertise enable him to see that delays and increases in costs for small hydropower projects are often due to the numerous inter-business contact points between construction, planning and operation companies. The group-loop model is expected to enable Global Hydro and its partners to minimise the number of information bridges, and make projects leaner and more economical overall. It's this reduction in complexity and costs that has increased the interest of professional investors in this business model.