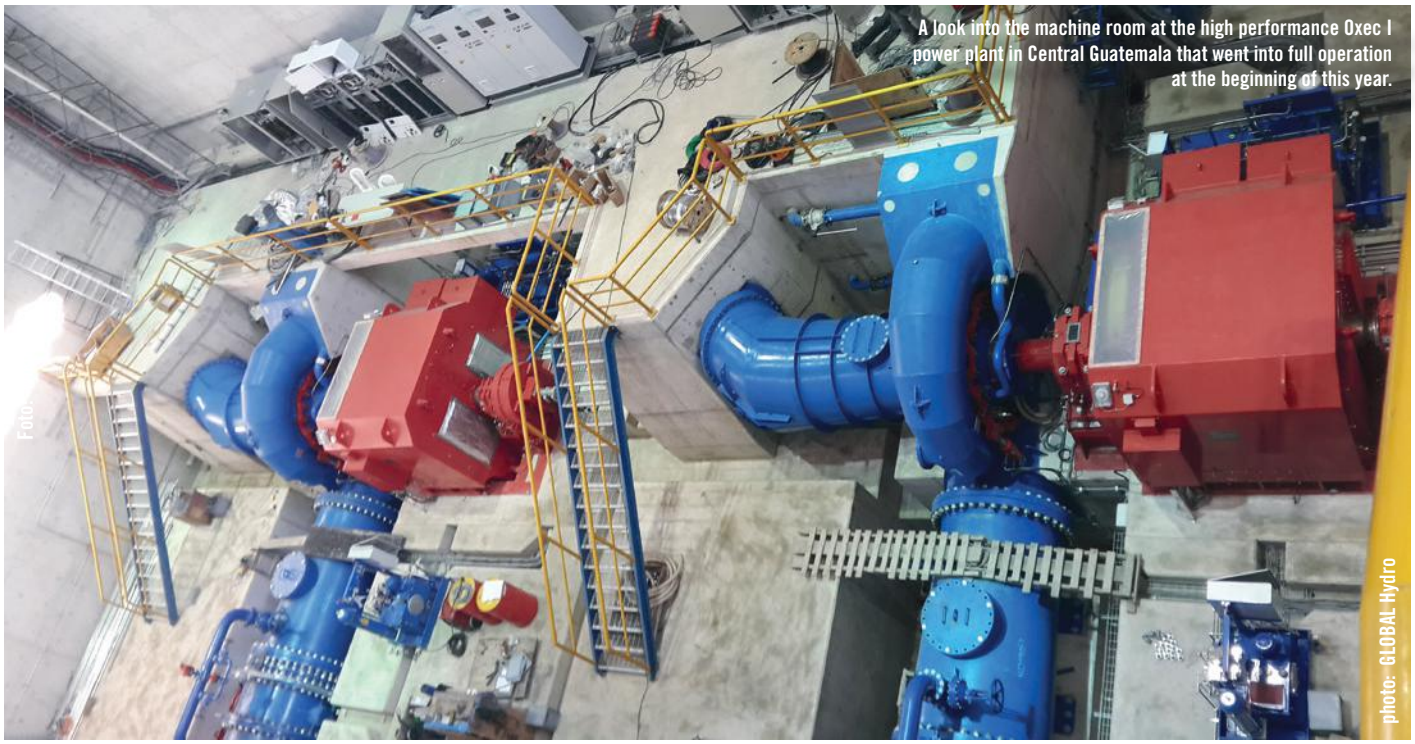

A look into the machine room at the high performance Oxec I power plant in Central Guatemala that went into full operation at the beginning of this year.

photo: GLOBAL Hydro

GLOBAL HYDRO EQUIPS A HIGH PRESSURE PLANT IN GUATEMALA WITH RECORD-BREAKING TURBINES

Expansion work is currently being carried out on hydroelectric capacity at the power plants in the heart of the high-precipitation highland area in Central Guatemala. Only recently, Energy Resources Capital Holding (ERC), the body contracting out the current work, was also responsible for ordering implementation of the Oxec I hydroelectric plant on the Oxec River around 150 kilometres away from the capital - Guatemala City. The operators ultimately chose to rely on Austrian hydroelectric expertise. The two identical Francis spiral turbines in the machine room were produced by the Upper Austrian hydroelectric specialists GLOBAL Hydro. Together they generate around 25.5 MW. They are the most powerful turbines ever to have been designed, manufactured and put into operation by these established turbine producers. In an average year Oxec I can be expected to feed around 100 GWh of clean energy into the mains grid.

In contrast to other provinces in Guatemala, the centrally situated 'Departamento Alta Verapaz' is usually blessed with plentiful rainfall. There are numerous rivers throughout the region. The area forms a transitional geographical and climatic zone between the cooler climes of the highlands in the South-West, and the warm and humid lowlands in the East and the North. For quite a while now the conditions in the region have been exploited for the hydroelectric generation of power, as was underlined by the expansion of the four Renace power plants that altogether show a total power capacity of 310 MW.

The works feed water overcomes the 110 m height difference in 220 m of high pressure steel piping on the way to the turbines.

photo: GLOBAL Hydro

Not very far away the ERC project developers had their eyes on another very promising hydropower site – the Oxec River, which joins up with the Cahabon River further downstream. This, in turn, heads off toward the Caribbean coast. "Based on hydrological data from the Instituto Nacional de Electrificatión, or INDE for short, the hydrologists and engineers at ERS developed a concept for the construction of the power plant several years ago", explained Jose Gonzalez, who was closely involved with the entire management of the overall construction project, and whose father presides over the ERC board.

COMPLEX GEOLOGICAL SITUATION

The main challenges posed by the implementation of this project were the mountainous


The 5.50 m concrete channel snakes across the mountainous landscape for a distance of around 5 km.

photo: Solel Boneh

topography of the region combined with the complex geological conditions faced at the site of the power station. The building contract was awarded to an Israeli company, Solel Boneh International (SBI). Jose Gonzalez explained that the company had profound knowledge in the field of building hydroelectric power stations. Ultimately, this expertise turned out to be absolutely vital for the creation of innovative solutions in the face of landslide proneness, due to extreme rainfall, and because of the general dangers of earthquakes. One such solution was the installation of a w-shaped, inverted siphon in the tail race works water. This shortened the overall headrace channel and directed the water away from the slopes most prone to landslides. Nevertheless, nature still took its course. "During the construction phase we were surprised by an immense landslide that cost us six months", Jose Gonzalez remembered.

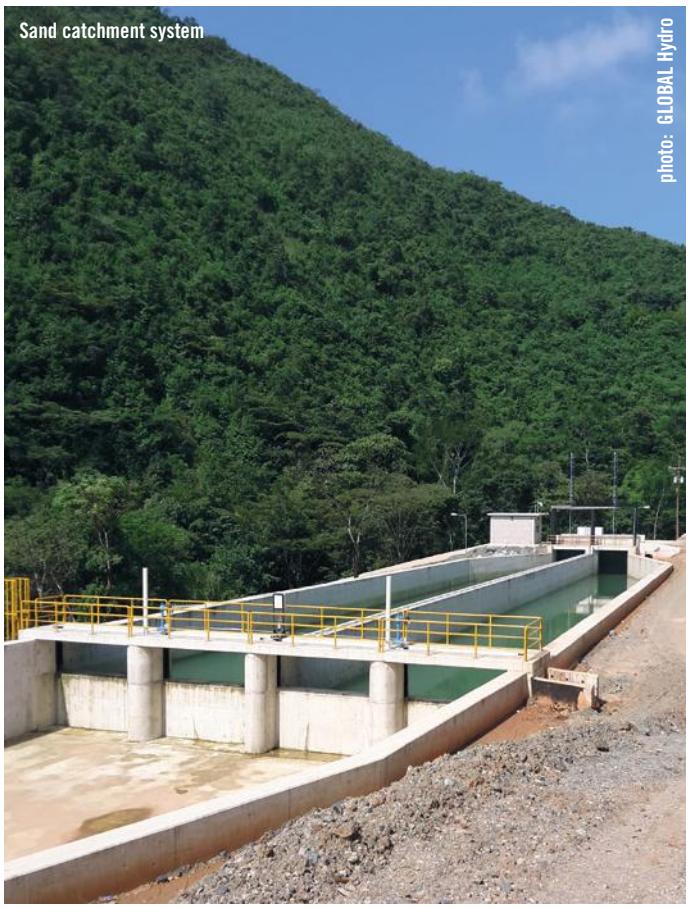
Sand catchment system

photo: GLOBAL Hydro

"The remoteness of the site is a general challenge. Simply accessing the site on poorly constructed roads in this mountainous area takes around eight hours from the capital city. So precise planning is vital and there is little room for error." Logistical coordination on site was also an issue of key importance. At peak times there were up to 800 workers on the various sites around the power station at the same time. Building work commenced in May 2013 and it took a total of more than two-and-a-half years before the power plant was finally able to produce electricity in October of last year. At the end of November both of the machine sets were already operating at full capacity.

SPECIAL SIPHON SYSTEMS

Basically, the Oxec I power station is a high pressure plant with a small storage basin in the form of a 24 m dam. The storage volume generated is sufficient to operate both machines at full capacity for 4 hours, meaning the power station can also deal with maximum load situations when required. A sand catcher system was installed after the water intake section from which the sediment-free works water is routed to an open concrete gravity channel of around 5 km in length and a width of 5.50 m. On this journey the water passes two siphon systems. The gradient of the channel allows a drop of 0.40 m per kilometre. Ultimately, the concrete channel feeds the works water to a pressurised all-steel pipe feed system. The water is forced down these 225 m DN3150 pipes to the two machines in the power house.

The cornerstone of the system is formed by two identical Francis spiral turbines, designed, manufactured, delivered and put into operation by the Austrian hydroelectric specialists Global Hydro Energy GMBH, who were contracted with provision and installation of all the water-to-wire-equipment.


photo: GLOBAL Hydro

Each of the two identical Francis spiral turbines has a nominal power output of 12.5 MW. They are the most powerful machines ever to have been provided by the immensely experienced hydropower specialists at GLOBAL Hydro.

A HEART MADE IN AUSTRIA

Each of the turbines was set up to deal with an increased flow of 12.5 m^3/s and a net head of 110 m. This allows each of the Francis spiral turbines to reach a nominal output of 12.5 MW. They are the most powerful machines GLOBAL Hydro has ever produced. With a nominal rev count of 514 rpm each machine transfers the energy to a synchronous generator manufactured by INDAR of Spain.

"The design of the turbines has been optimally tailored to the local hydrological conditions. The dry and rainy seasons are extreme in this region. During the dry season the flow of usable water can fall to 4 to 6 m^3/s, while in the rainy season it is not uncommon to deal with water volumes of 60 to 70 m^3/s. The relative proximity to the Caribbean Ocean means that tropical storms and hurricanes are no rare occurrence", commented Jose Gonzalez, explaining the general environmental conditions.

The power station operators ERC stated several reasons for choosing the services of the Austrian hydroelectric specialists. "We had a very good feeling about working with GLOBAL Hydro right from the start. They had already installed and started up machines in Guatemala and those machines made a very positive impression. We also toured the manufacturing facility, so we were certain the very best machines and materials would be used", recounted another ERC representative. "I would also recommend GLOBAL Hydro because of the high degree of responsibility they showed throughout the entire implementation of the project."

OXEC II IS READY TO GO

The ERC operator group is made up of a total of seven private partners. The successful commissioning of Oxec I is already the second leap forward achieved in hydroelectrics in Guatemala. The next step forward is now imminent. Work on the Oxec II plant, which when in operation will show an installed capacity of 60 MW, is now about to commence. The new chain of power plants should go into operation in 2018 and is expected to offer around 85 MW of new hydropower capacity for the 'land of eternal spring' – as the most populous nation in Central America is known.

On the one hand, the Upper Austrian hydropower experts see the successful 'mission' in Guatemala as another important reference for potential customers on the hydropower market. On the other, it marked the crossing of the 12 MW boundary, thus was a milestone in the company's own development. The achievement provided impressive proof that the company has yet to reach the limits of its own potential.


photo: GLOBAL Hydro

The new power plant is expected to produce 96 GWh per year.

Technical Data

- Flow Rate: 25 m^3/s
- Net Head: 110.0 m
- Turbines: Francis-Spiralturbines horizontal
- Numbers: 2 pc.
- Manufacturer: GLOBAL Hydro
- Runner Diameter Ø: 1,233 mm
- Nominal Speed: 514 Upm
- Nominal Output: 12,531 kW $_{each}$
- Generator: synchronous
- Manufacturer: Indar
- Dam Height: 24 m
- Open Gravity Channel: L: 5 km W: 5.50 m
- Penstock: L: 225 m Ø DN1,270
- Material: Steel
- Total average capacity: 96 GWh