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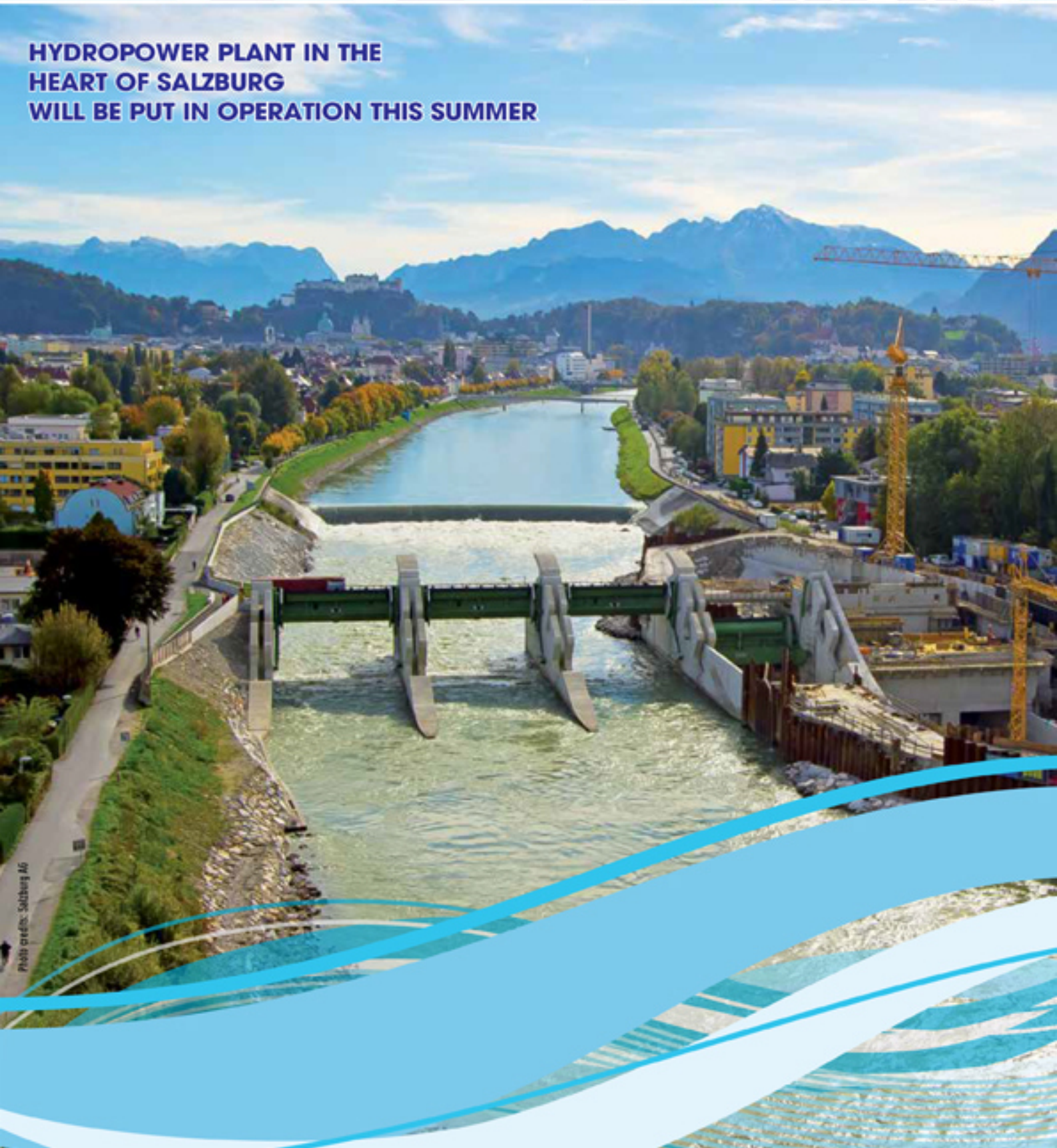
2013

INTERNATIONAL HYDRO
FUTURE TECHNOLOGY

zek HYDRO

HYDROPOWER PLANT IN THE HEART OF SALZBURG WILL BE PUT IN OPERATION THIS SUMMER



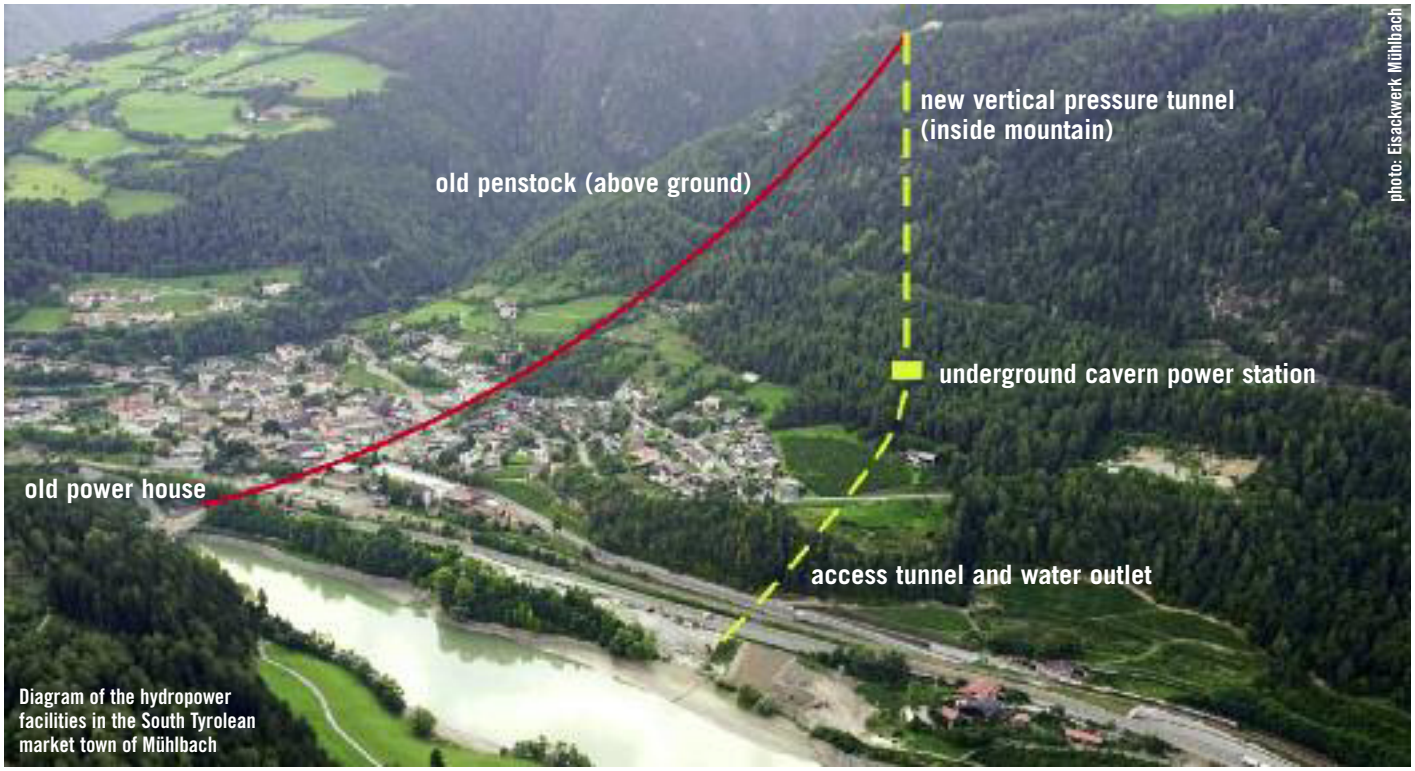


Diagram of the hydropower facilities in the South Tyrolean market town of Mühlbach

PRIVATE PIONEER PROJECT OPTIMISES POWER GENERATION FOR SOUTH TYROLEAN COMMUNITIES

In 2009 the permit for the almost century-old hydropower plant in the market town of Mühlbach was up for re-application. But it was not the region's big players of the energy supply industry that won the project at the head of the Pustertal, but two ambitious businessmen from Bozen. Their well-conceived, sustainable concept won the day – and the permit. Dr Karl Pichler and Hellmuth Frasnelli – who each hold a 37.25% stake in plant operator Eisackwerk Mühlbach GmbH – showed great determination and patience during the ensuing legal negotiations. In the end, their perseverance was rewarded with the successful startup of their innovative hydropower station in the autumn of 2012.

Built in the 1940s and 1950s, the double hydropower plant in the South Tyrolean Pustertal region was a local landmark of sorts, with its two penstocks running straight across the town of Mühlbach, much to the displeasure of the local population. For one thing, the humming of the turbines and generators in the nearby power house at the Mühlbach reservoir were clearly audible far and wide during the night. Also, the steely twin pipe, through which the waters were constantly gushing with an inside pressure of more than 60 bar, represented a considerable danger.

The route of the old penstock led straight through the town.

PRIVATE PROJECT APPLICANTS WIN OUT WITH INNOVATIVE CONCEPT

It was precisely these two rather unpleasant characteristics of the existing facilities that the two private project applicants decided to address with their new implementation concept. Deviating from the project designs of the competing energy suppliers, which called for an overground penstock to the old power station, the Eisackwerk Mühlbach GmbH proposed to install the motive water pipework under ground through a 430 m tunnel leading to a new cavern power plant inside the mountain. "One mustn't forget that the existing penstock pipes had been subjected to pressures of up to 62 bar for 60 and 70 years, respectively. Who knows what might have happened if the pipes had been damaged by falling rocks or something like that," says Hellmuth Frasnelli, commenting on the disaster hazard of open-air penstocks in the middle of an urban area. In intensive collaboration with the contracted planning offices of Studio G of Bruneck, project manager Dr Karl Pichler managed to develop the idea of using underground pipes into a workable project plan, which eventually won the full approval of the responsible officials during the contract awarding process.


photo: Eisackwerk Mühlbach

The intake at the Valser Bach stream was also fitted with the patented Coanda trash rack system by Wild Metal.


photo: Eisackwerk Mühlbach

The entrance portal of the 850 m access tunnel to the power plant cavern

UPHILL STRUGGLE FOR A PERMIT

But despite the decision, for Eisackwerk Mühlbach GmbH the project was far from being a done deal, as local authorities and political representatives kept criticizing the "radically innovative" character of the new concept. Until they finally were granted the required permission in November 2009, the two managing directors had to fight for approval all the way, including litigation in six cases against public offices and the provincial government. From the time when they submitted their planning documentation in 2005, the uphill struggle for the Pustertal power plant project went on for almost four years until all court cases were finally settled and the two innovators were granted permission for water power utilisation until 2040. With this hurdle cleared, they could concentrate fully on their ambitious power plant project for the Mühlbach region.

NEW INTAKE WITH PATENTED COANDA SYSTEM

The project plans called for the complete renewal of the existing (and still used) components of the motive water pipework in the upper section of the facilities. Renovation work began at the main intakes at the weir gates in Pfunders and Vals, which were completely renewed and fitted by Wild Metal of Ratschings with a new Grizzly trash rack. This patented intake system, which combines a Coanda screen with integrated protective rack, was installed in place of the original classic Tyrolean weirs. Gufler Metal of Moos in Passeier supplied and installed the other hydro steel structures for the project, including, among others, 26 barrier sluice gates with frame heights of up to 8 metres.

The granted permit also authorised an increase in the design flow rate for the two new machine units in the central control cavern. This allowed the project operators to draw water at the Pfunderer Bach intake at 2.3 m^3/sec (previously 2.0 m^3/sec) for their electricity generating purposes. At the Valser Bach intake, the flow rate was increased to 1.9 m^3/sec from previously 1.5 m^3/sec. At the same time, however, the residual water flow at both streams had to be increased as well in order to preserve the ecologic qualities of the outflow reaches. Also, the weir facilities at the Valser Bach had to be fitted with a fish pass, which was implemented by the Studio G planners of Bruneck in the form of a pool pass with cross-wall notches and submerged orifices.

RAISE-BORING METHOD ENSURES PRECISION AND MANY BENEFITS

The main intakes are situated at different elevations: the Pfunders at 1,350 m above sea level, and Vals at 1,250 m.a.s.l. From there, the existing headrace tunnels lead to their respective pressure basins with surge tanks, which were completely refurbished as part of the overall renovation work.

From these points onwards, the two pipes now run in parallel, not over-ground downhill towards Mühlbach as previously, but through a vertical pressure shaft – which was excavated using the so-called raise boring method – towards the power house cavern inside the mountain.

"After 430 metres, the deviation of our pilot bore was only about 3 cm. For a 25 cm core bit, that is quite impressive", explains Dr Karl Pichler in commenting the high-precision work of the tunnel excavation team.

With the initial bore for the 2 penstocks and the breakthrough into the excavated cavern complete, new core bits with diameters of 1,5 m and 1.8 m, respectively, were fitted to the

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photo: Eisackwerk Mühlbach

The drive rig used for the vertical bores delivers 300 kilowatts of pure excavating power.


photo: Eisackwerk Mühlbach

Following the breakthrough into the power cavern, the core bit for raise boring is fitted.


photo: Eisackwerk Mühlbach

Next, the 12 m steel pressure pipes are carefully lowered into the tunnel.

flange pipe and raised while in rotation, thus creating the required shaft. With this drilling method, the excavated material simply drops to the ground, where it can be collected and removed quite easily. This allowed for a steady progress of around 20 m a day. Raise boring has other advantages as well: the machinery can be operated safely outside the mountain, and the method allows for higher excavation speeds at low operating effort.

NEW PENSTOCK DIMENSIONS

Once the excavation work for the pressure shafts was finished, the engineers went on to insert and install the new steel penstock pipes. The 12 m pipe sections were welded together near the shaft entrance and lowered carefully into the mountainous depth. When the last pipe sections were installed, the total weight carried by the hydraulic lift amounted to more than 200 tons. "Once the pipework was in place the two shafts were bricked up, so everything should be maintenance-free for the next hundred years, and that's that!", says Hellmuth Frasnelli emphatically, confirming the longevity of the steel penstock pipes.

During the planning stage for the new penstock runs, the extension of the previous pipe diameters was a key issue, as it was essential for boosting the capacity of the new plant. "The old penstock for the machinery in Vals was a combination of DN600 and DN700 pipes. For the new pipework we used DN1100 pipes throughout. This way, we were able to reduce the hydraulic loss significantly, which means a higher net head and higher energy output," explains DI (graduate engineer) Thomas Fiechter, project manager at hydropower specialist Troyer.

VISIONARY SOLUTION WITH STRUCTURALLY IDENTICAL TURBINES BY TROYER

Wherever the name Troyer is mentioned, one usually does not have to look far for the turbines by the renowned family-owned manufacturer of the South Tyrolean town of Sterzing. In the power house of the new Mühlbach hydropower facilities, two nearly identical four-jet Pelton turbines have replaced the original machinery, which remains in the old power house 700 m away. Describing the new turbines as "structurally identical" may sound slightly confusing at first, considering that they are not only designed for different design flow rates, but also work with different water heads: 622 m in the case of the Pfunders machine, and 487 m for the one in the Valsertal.

"But to keep things easy for the customer in terms of replacement parts, the machine in Pfunders is operated at 1,000 revolutions per minute, and its 'almost identical' twin in Vals at 750 rpm," reports Troyer's project manager Thomas Fiechter.


photo: Eisackwerk Mühlbach

The two private project operators Hellmuth Frasnelli and Dr Karl Pichler, and construction supervisor Walter Unteregelsbacher of Oberloser (left to right)

NEW HYDROPOWER PLANT GENERATES 20% MORE OUTPUT

Both of the high-grade, air-cooled synchronous generators were provided by Lloyd Dynamowerke of Bremen (Germany); they can achieve output efficiency levels of up to 98%. The operating heat of the generators is dissipated through a closed cooling system into the used motive water, which is carried into the Mühlbach reservoir by way of two concrete pipes installed at the bottom of the 850 m cavern access tunnel. As a result of the comprehensive modernisation, the output of the new facility is more than 20% higher, thanks to the increased design flow rate, the higher output efficiency, optimised partial-load behaviour of the new 4-jet turbines, and the improved, widened pipe hydraulics. In effect, these improvements translate into an increase in installed capacity from the old facility's 16 MW to 20.7 MW.


photo: Eisackwerk Mühlbach

Installers of Troyer are busy performing welding work on the water ring duct of the Pelton turbine in Pfunders.

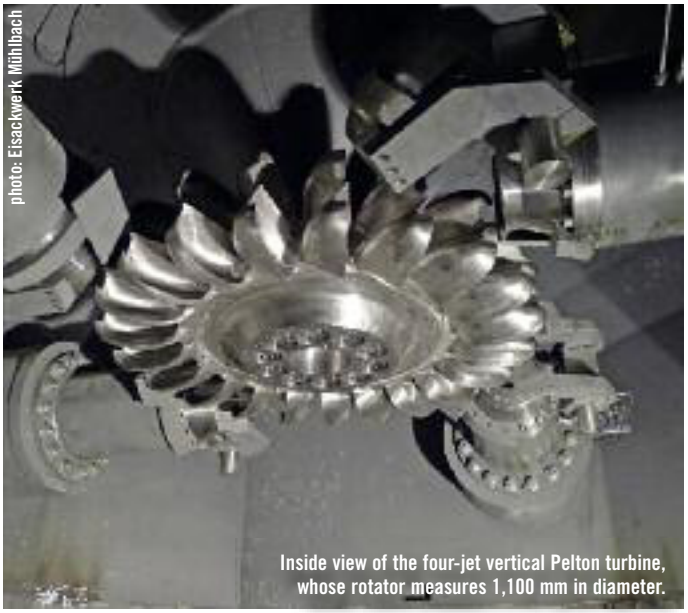


photo: Eisackwerk Mühlbach

Inside view of the four-jet vertical Pelton turbine, whose rotator measures 1,100 mm in diameter.

RECORD-LENTH UNDERGROUND HIGH-VOLTAGE CABLE

To be able to feed the expected annual energy output of 100 million kWh into the grid, Troyer – which also supplied the entire medium-voltage and protection technology – transported the transformer from the old power house at the Mühlbach reservoir to its new destination at the entrance to the cavern access tunnel. The transformer station located there, together with another, smaller transformer, now convert the generators' 15,000 V output power to 132,000 V before it is carried via a 800 m underground high-voltage cable to the transmission line at the old power house.

Troyer kept the old power station operational until 2012, when it was finally time to switch over to the machinery at the new Mühlbach cavern power plant.

SOUTH TYROLEAN VALUE CHAIN

When the second machine was connected to the grid on November 16, 2012, the two project organisers could finally breathe a huge sigh of relief, take a step back and look at their achievement with a certain sense of pride. "We made a conscious decision to award all project contracts to South Tyrolean firms," says Hellmuth Frasnelli, thus confirming the essentially regional character of the entire project. Of the 26 million euros that he and his business partner Karl Pichler invested into the project, they provided 20% themselves, the remaining 80% were contributed by Unit Credit Leasing, with an expected amortisation period of 18 years.

But there is another thing the two private operators want the locals to profit from: Eisackwerk GmbH intends to grant 50% discounts, for up to 1,800 kWh per year, to all households in the Mühlbach community that have 3.3 kW mains connections. In case this is not possible for legal reasons, the operators intend to donate an equivalent amount to charitable causes in the region.

This generous offer is the final highlight that underscores this ambitious and thoroughly successful model project in the South Tyrolean energy supply industry.

Technical data:

- Total flow rate: 4.2 m^3/s
- Gross head: 487 m ; 622 m
- Turbines: 2 x vertical Pelton
- Manufacturer: Troyer
- Generator: 2 x Synchronous
- Manufacturer: Lloyd Dynamowerke
- Installed capacity: 20.7 MW
- Annual production: 100 GWh

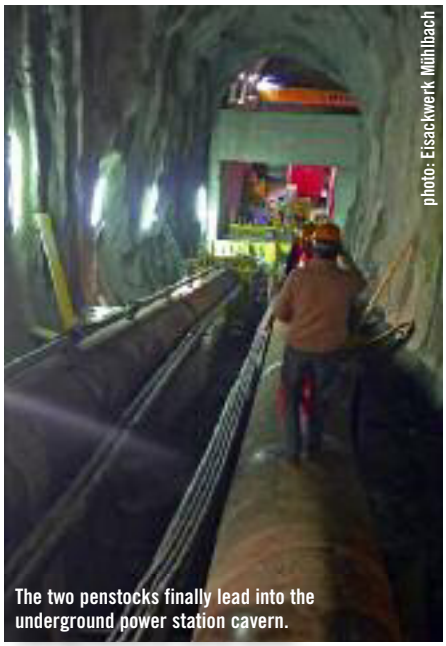


photo: Eisackwerk Mühlbach

The two penstocks finally lead into the underground power station cavern.


photo: zek

The two LDW synchronous generators in the underground cavern after start-up of the Mühlbach power station

GRIZZLY MODULE SYSTEM: TREND-SETTING WATER CATCHMENT TECHNOLOGY

The new operator of the Mühlbach hydropower plant, Eisackwerk Mühlbach GmbH, hired Wild Metal, a company based in South Tyrol, Italy, to supply and install the entire hydraulic steel engineering components in the course of the modification works of the plant. Grizzly rake modules for water intakes turned out to be the ideal solution for an efficient and low-maintenance discharge of process water. This system, patented by Wild Metal, combines an integrated protective rack with a Coanda screen and skims off the smallest sediments and debris. The water catchment on the Pfundererbach Creek is equipped with a Grizzly 2300, which is the largest Grizzly module ever used in power plants.


The new Grizzly rake at the water intake Valser Bach

photo: Wild Metall

Adapting the water catchment to state-of-the-art technology was an important stage of the modification project of the Mühlbach power plant. This is why the operators decided on a new and highly efficient rack cleaner system, which guarantees the highest screen capacity and the lowest maintenance requirements: the Grizzly by Wild Metal. Its patented catchment concept, which is constantly revisited by the manufacturer based in Ratschings, South Tyrol, combines a robust, hot dip galvanized protective screen with a Coanda screen placed underneath it.

To significantly increase the functionality of the catchment on the Valser Bach Creek, its existing structures were adapted by installing 14.5 elements of the Grizzly rake modules. The water catchment on the Pfundererbach Creek is a clearly larger version with 18 integrated modules of the Grizzly 2300. With a breadth of 20 meters it is the largest water catchment with a Coanda system in the Alpine region. It is designed for a guaranteed capacity of 3,000 liters per second. The extra-strong protective rack was designed to divert even a heavy bed load of a few tons safely over the catchment during high water periods.

MINIMIZING CONSTRUCTION COSTS WITH THE GRIZZLY SYSTEM

The patented Grizzly rack module is a truly innovative development by Wild Metal. The basic technical improvements in comparison to a Tyrolean weir are the shorter gap spacing of the Coanda screen and the integrated protective rack. The gap spacing of the Coanda screens used at the catchment of the Mühlbach power plant is 0.5 mm. This means that only particles with a grain diameter of less than 0.3 mm can enter the process water system. Consequently the grit chamber is smaller in dimension and in that way saves construction costs. Pine needles, leaves, twigs and other debris is washed over the catchment and floats off. The design of the module offers an extraordinarily simple and quick installation. Another characteristic of the Grizzly rack is its low height. Together with the newest development of coarse rack bars expanding towards the bottom, it represents the most maintenance-friendly rack cleaner system for water catchments currently available in the hydropower market.

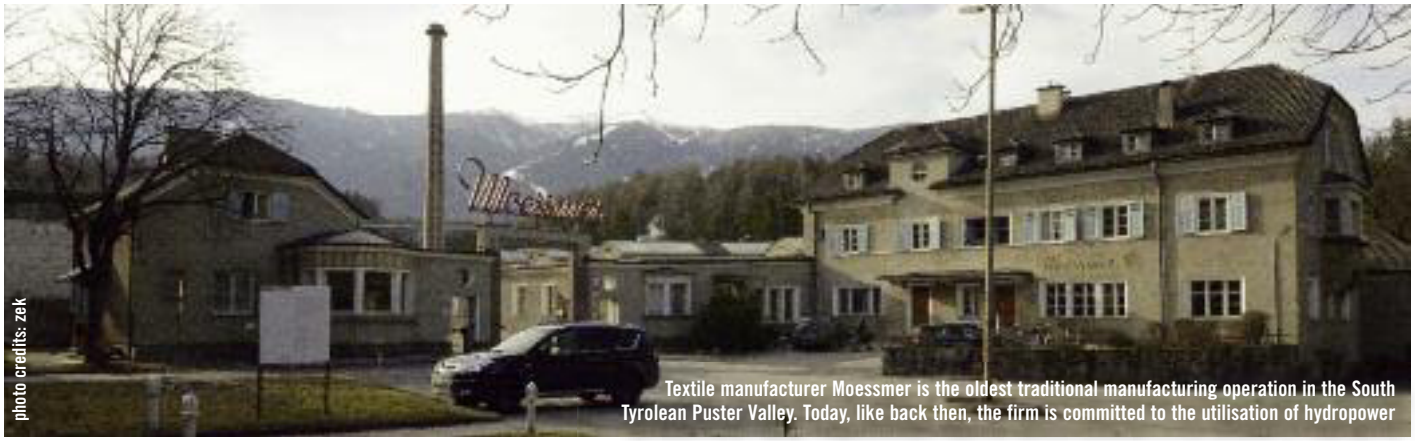


photo credits: zek

Textile manufacturer Moessmer is the oldest traditional manufacturing operation in the South Tyrolean Puster Valley. Today, like back then, the firm is committed to the utilisation of hydropower

OLDEST INDUSTRIAL OPERATION OF THE PUSTER VALLEY OPENS NEW CHAPTER IN HYDROPOWER UTILISATION

As it did in the past, textile manufacturer Moessmer of Bruneck is committed to the use of hydropower. As the oldest industrial operation in the Puster Valley, the firm's tradition-steeped history goes back more than 100 years. Over the last few months the current facilities were subjected to a comprehensive modernisation process, fitting them with the latest technical equipment. Thanks to a newly granted permit, the existing solution with two machines from the early 1980s was able to be updated to a GHE-PIT turbine solution with considerably higher output. The conversion on the premises of the textile factory turned out to be a complex challenge both for the planners and the construction engineers. In the end, they were able to keep within schedule. As a result, clean electricity has been generated on the Moessmer textile factory grounds since the end of last year.

They count designer fashion labels such as Prada, Armani, Dolce & Gabbana or Louis Vuitton among their clientele. Superior quality, produced with sustainable manufacturing processes that reflect a successful symbiosis of tradition and modern style, has long been the hallmark of fabrics by Moessmer, one of the very few textile manufacturers in the Alps that still covers the entire production process from wool to top-quality fabric. Production has been up and running in Bruneck since 1894, making the factory the Puster Valley's very first industrial operation – and a highly successful one to boot, as Moessmer was already appointed supplier to the Austrian imperial court by the turn of the century. The brand quickly took root and was destined for further success, despite the turmoil of the two world wars, turbulent market developments and changes in ownership.

What remained was the backbone of the firm's manufacturing power: the hydropower, which the owners still rely on as they did back then. "The reason why the factory was established here in Bruneck in the 1890s can be found in Rienz. They used the force of the moving waters to drive the mechanical equipment by means of transmissions. Years later, in 1923, the first power station was built, which provided around 220 kW," says Dr Josef Zingerle, Head of Controlling at Moessmer. The start of the factory's independent electricity generation was a milestone in the firm's history, as Zingerle explains. "In the early 1980s the power station was completely refurbished. They installed two Kaplan turbines, which were still in operation until June last year." What was to follow was a new chapter in the history of hydropower generation at Moessmer.

PROBLEMS WITH HIGHER WATER VOLUMES

In 2010 the permit for the Moessmer power station expired, and to get the much needed extension called for swift action. The idea was to come up with a new concept in order to be able to accommodate new, future requirements as well as the changed basic conditions. These concern primarily the operation of the "Bruneck" upstream plant, which was constructed back in the late 1950s. Says Zingerle, "Until 2002 or 2033, the water was usually available to our turbines around the clock. But from then on, the operator adjusted the production to the economic electricity rates at the Energy Exchange. This means that the motive water began arriving at irregular peaks. On the one hand, our turbines were not designed to handle the higher water volumes, which means that quite a bit of the water remained unused. On the other hand, the two machine units were unable to react quickly to the constant changes.

If you consider that at low levels the water often wasn't available for more than three or four hours at a time, while the turbines took about thirty or forty minutes to synchronise for parallel grid operation, you can imagine that the whole operation wasn't always running very efficiently at all."

ONE GHE-PIT TURBINE TO REPLACE TWO KAPLAN ONES

In practice, this means that the design flow rate of previously 18,300 l/s would have to be adjusted to that of the upstream plant, which was 22,000 l/s. Besides, it was also necessary to find the machine solution that would provide the best outcome in terms of technology, economy and ecology. After intensive deliberations and research on various possible arrangements on the part of the owner and contracted planning office Studio G of Bruneck, the final decision came out in favour of a Kaplan-Pit turbine, which owes its name to the term for a shaft with an open top. Its excellent controllability and superior efficiency, combined with its low space requirements, were the most convincing arguments that sealed the decision in favour of this machine version.

Where to obtain such a machine was decided rather quickly when the contract was put up for tender early last year. It was decided to award the contract for the electromechanical equipment to Upper Austrian hydropower engineering specialist GHE (Global Hydro Energy), which also enjoys an excellent reputation as an expert in Kaplan-Pit turbines.

photo credits: zek

To protect it against cavitations, the new machine unit has been lowered in elevation by 3.1 m. Picture: engine and generator

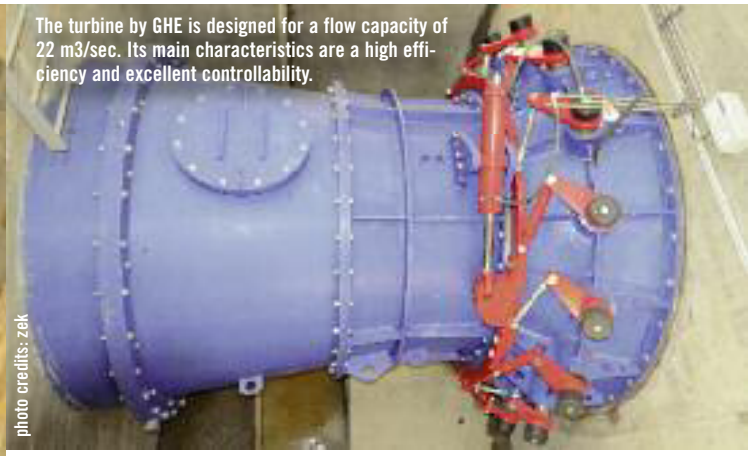
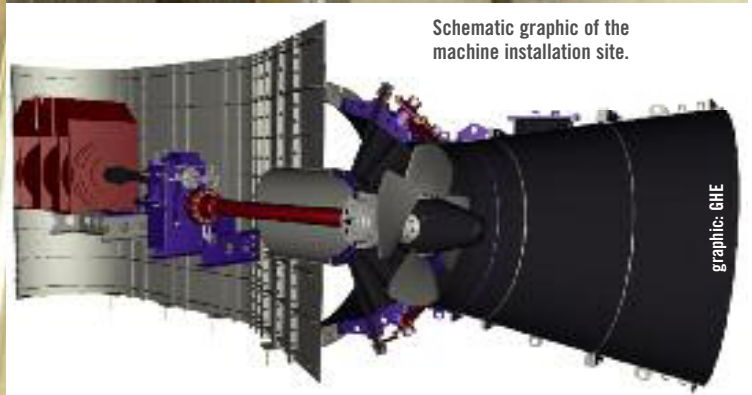


photo credits: zek

The turbine by GHE is designed for a flow capacity of 22 m3/sec. Its main characteristics are a high efficiency and excellent controllability.



graphic: GHE

Schematic graphic of the machine installation site.

"We had had excellent collaboration experience with GHE in the past, so we were confident that they were up for it. Where quality was concerned we really had a lot of confidence. On the other hand, however, it was also extremely important for us to have a partner that would be able to deliver just in time – and demonstrate handshake qualities at the same time. In both respects, GHE has fully lived up to our expectations," as Studio G's panning team confirms.

HIGH-SPEED CONSTRUCTION PROJECT

Especially the time schedule represented a central criterion for getting the new power plant up and running. After all – as in many other Italian hydropower construction projects that year – the main goal in terms of time was to complete the entire modification and reactivation before the year was out. It was a tough challenge, considering that the plans called for particularly sensitive constructional measures – and that while the textile manufacturing operation had to be kept running. Once the new permit was obtained (this one will be valid until 2040), the earth was broken and the project kicked off in late June last year. The old machine units were dismantled, the old power house was knocked down, and preparations for the actual civil engineering work were begun. The contracted building firms saw themselves up against a very tight schedule from the very start.

After all, the existing facilities had two machine units installed, which had required the construction of two separate tailraces, which were around 170 m apart. "Due to the difference in altitude between the tailraces the overall efficiency of the facility was not quite optimal, especially since the larger ones of the two machines – the one whose tailrace was further upstream – also had a lower gross head. So the obvious thing to do was to use the lower tailrace for the newly installed turbine,"explain the planners of Studio G. "In effect, this means that the higher one of the existing tailraces had to be brought down, while the lower one had to be expanded and adapted to the 22 m3/sec water flow."

SPECIAL CIVIL ENGINEERING MEETS JET GROUTING

The expansion pushed the planners and construction specialists to their very limits, Due to the static conditions and restricted space conditions, the cross-section of the tailrace could be expanded only by lowering, but not by widening. To ensure a properly safe extension of the outer walls down to the required depth, the team decided to use a method known as "jet grouting" – a special engineering method that allows for setting up underground concrete structures by means of a high-pressure injection technique. During the procedure, an injection pipe is inserted into the ground. Once the proper depth is reached, a mineral compound is squirted in at extremely high pressures of up to 600 bar, which binds to the soil to form a solid concrete body. The rotating motion when the pipe is lifted out creates a concrete cylinder. Placed next to each other, these can be used to form regular underground walls without the need to dig up the soil. There are many advantages to this construction method: for one thing, it allows for the use of small machines, which can work even under very restricted spatial conditions; what is more, the 'jet stream method', as it is also known, has both a static and sealing function, which was particularly important for the Moessmer hydropower project. As a result, not only could the side walls be stabilised with a solid foundation, but the construction pit could be sealed more densely as well. Especially the latter was of critical importance for the subsequent construction of the new power house. "By the time we could start building the power house, we were 11 m below ground-water level. Here, again, we used jet grouting to create a sealed construction pit. It all worked very well," recall the Studio G engineers.

The base plate for the tailrace was also constructed by jet grouting. The concrete base, which is now situated around 4 m lower, was therefore prepared underground, with the soil above it being removed only later on.

INNOVATION IN HYDRO-STEEL ENGINEERING

The next construction steps required the intake channel to be adjusted top the new conditions along a 28 m stretch. This was done by gradual-

ly reducing its cross-section as it approaches the turbine. One question arose in connection with the design of the power house: due to the lower elevation of the installation site for the new machine, the engineers dispensed with the usual roof construction. Instead, the Studio G engineers planned a concrete ceiling just above the edge of the terrain. For mounting and maintenance purposes, a 6 m x 4 m, double slidable steel cover was placed onto the insert opening, which can be shifted very easily by hand. This solution was implemented by South Tyrolean steelwork engineering specialist Wild Metal, which had been awarded the contract for all steel construction and hydraulic steelwork engineering for the project. Their task gave the steelwork engineers from Ratschings the opportunity to prove yet again their reputation for being extremely inventive and resourceful. Numerous designs were constructed in three dimensions by Wild's in-house construction department and quickly issued to the manufacturing department and partner firms. Highlights of their engineering ingenuity include the turbine pit, which is 8.5 m long and 3.6 m wide, as well as the reinforcing ring, which measures 4 m in diameter and whose contact surface with the guide vane assembly was engineered to an extreme level of precision. For the sluice gate at the intake, which has a width of 8.2 m and height of 3 m, the hydraulic cylinders were arranged so that they hardly reach above the sluice body. The downstream gate was anchored so deeply that the corresponding 10 m frame also remains almost fully hidden. A pressure-tight, cylindrical access shaft with hydraulically optimised bottom (also by Wild) was inserted into the suction pipe. The construction was complemented by some made-to-measure covers, as well as the railing and access ladders for the pit and turbine shaft, and the creatively designed spiral staircase, which provides access to the central level. An indoor crane – a special construction by Wild Metal – allows for controlling the guide vane system, which measures 3.6 m in diameter, in a space with only 4.7 m head clearance. The space between the twin crane car and ceiling is only 5 cm.

UNBUREAUCRATIC SUPPORT

Technically, the lowering of the tailrace and the construction of the power house posed the greatest challenges for everyone involved – especially since the entire project had to be completed within a few short months. With the actual starting shot to the project being fired in late June of last year, the engineers could begin with the installation of the machine in late autumn – exactly as planned. This alone is reason enough for the engineers of Studio G to commend the contracted firms and the owner for their commitment: "Both representatives of the owner, Dr Niedermair and Dr Zingerle, were often at the construction site, and they contributed very actively to the project. We also commend the contracted firms for keeping the schedule the way they did, and for their competent way of handling the project."

A rather important issue for the construction part of the project arose in connection with the intake. The plans called for the newly build power plant contributing to the electricity grid of the Bruneck Public Utilities. That raised the


Jet grouting preparations are under way.
photo credits: Studio G


Everything's ready for jet grouting. This involves a concrete suspension being injected into the soil by means of a thin pipe.
photo credits: Studio G


The suction pipe form work is finished, as is the pit casing by Wild Metal.
photo credits: GHE

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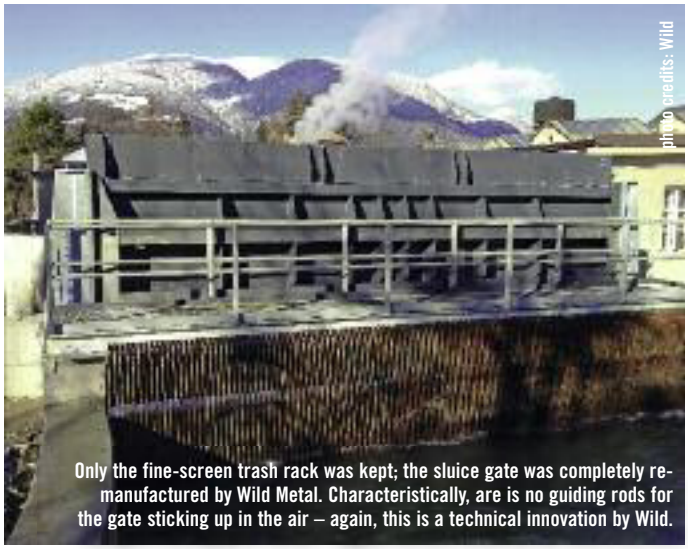


photo credits: Wild

Only the fine-screen trash rack was kept; the sluice gate was completely re-manufactured by Wild Metal. Characteristically, are is no guiding rods for the gate sticking up in the air – again, this is a technical innovation by Wild.


photo credits: zek

The indoor crane, which was specially constructed by Wild, allows for lifting the 3.6 m guide vane assembly in a restricted space with only 4.7 m head clearance.

question of whether it would be possible to get the grid hookup up and running within such a short time. "We were very happy to see that the Public Utilities people were very helpful and unbureaucratic. As a result, we were able to start up operations right on time," say the Studio G engineers.

SLOW RUNNER WITH CONVINCING QUALITIES

Full of suspense, the owner and planners awaited the premiere 'performance' of the new turbine, which was lowered by 3.1 m to protect it against cavitations. The Pit-Kaplan turbine has several benefits for this type of application. Apart from its modest space requirements, it provides higher full-load efficiency in arrangements with a low head than vertical Kaplan turbines. Also, this type of turbine is usually highly reliable. Besides all that, it also provides easy access for maintenance, repair and inspection purposes. To top it off, the fast, efficient control of this turbine makes it the ideal choice for applications like the Moessmer project. All these quality features are packed into the Pit-Kaplan turbines by GHE. Hundreds of reference facilities all over the world testify to their popularity.

Compared to the previously installed turbines, the new one is a real 'slow runner', whose rotor moves at a very moderate 190 rpm. A spur wheel gearing transmits the rotational speed to 750 rpm. This arrangement was well calculated: after all, the intermediary gearing reduces the efficiency loss to only around 1 per cent. This is a record number – and a great argument in favour of the spur wheel gearings by Eisenbeiss, which are specifically designed for Pit-Kaplan turbines. At 750 rpm, the turbine drives the generator (manufactured by Hitzinger), which is designed for a rated output of 1,500 kVA. The turbine's capacity at a net head of 6.70 m and maximum design flow rate of 22 m3/sec is 1,353 kW – a value that can hardly be achieved during the winter season, when the water levels are low.

QUICK REATCION TO CHANGING WATER VOLUMES

More significant, however, is the rated medium output as referenced to a medium design flow rate of 11 m3/sec. Under these conditions, the two old turbines generated around 308 kW and 324 kW, respectively. By comparison, the rated medium output of the new turbine is now 832 kW. This sharp increase has several reasons: "One reason, of course, lies in the fact that the tailrace of the larger of the two machines was further upstream, which means it had a lower gross head. The new turbine now has the gross head of the lower one of the two machines.

Another reason can be found in the excellent hydraulic design of the GHE turbine, which achieves very high efficiency levels to start with. However, there is another factor that comes into play where the overall efficiency of the facility is concerned: the new machine offers very good control qualities, reacts quickly to changing water volumes, and syn-

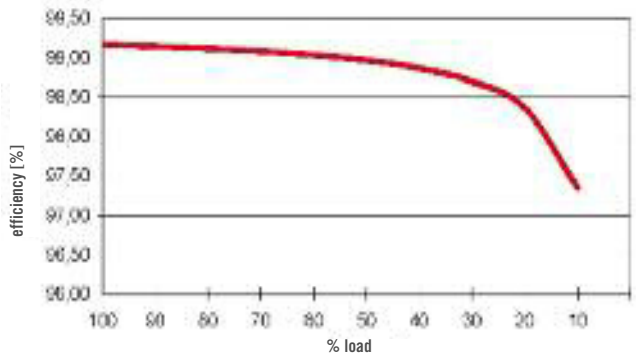
99 per cent efficiency with spur wheel gearings for Pit-Kaplan turbines

Slowly moving Kaplan turbines often make it impossible to transmit the relatively low rotational speed of the turbine to the faster speed of a generator. In these cases, the operator needs to consider carefully the difference (loss) in efficiency by the introduction of a transmission gearing between the two components.

In view of the special design of the Pit turbines, the gearings used to increase the rotational speed must meet very specific requirements. Besides requiring a compact construction to fit into the turbine shaft, they also need a smooth transfer of the turbine drive to the gearing. The additionally required high efficiency for such gearings require specialised solutions. Gearings by long-standing Upper Austrian-based manufacturer Eisenbeiss of Enns are designed specifically for this purpose and have been proven in numerous installations all over the world.

Developed specifically for pit turbines, these gears are of robust, compact design and are approximately 99% efficient. This is achieved by means of a double helical toothing optimized for this particular application, low-friction bearings and an optimum lubrication regime. In conjunction with a gear system support halfway along the shaft, a cleverly constructed ribbing transfers the forces from the turbine straight to the foundation. As a result, flexural stresses in the housing are avoided, and excellent tooth meshing is guaranteed even at maximum load.

Austrian-based spur wheel gearing specialist Eisenbeiss has developed gearings that meet the specific requirements of Pit-Kaplan turbines. Thanks to their special double helical toothing and high-grade design, they achieve efficiency levels of up to 99 per cent.



Efficiency performance of the Eisenbeiss spur wheel gearings depending on the load of the turbine. [graphic: Eisenbeiss]

chronises within a very short time for parallel grid operation. This process, which used to take between thirty and forty minutes, now usually takes less than sixty seconds. With frequently changing water volumes, this is a key criterium," say the planners of Studio G.
The turbine control assembly was also provided by GHE. It is based on the highly proven, custom configurable HEROS control unit, which offers a characteristically high level of operating convenience.

ADAPTATION OF THE INTAKE CONSTRUCTION

The start of regular operation of the facilities went ahead on schedule last December. Since then, the power station has been working reliably, its high efficiency rates confirming to the operator that they made the right decision – even if the machine has been running mostly on partial load, due to the seasonal water conditions. "After the necessary adjustments, the new machine unit is now living up to all our expectations. What helped shape our decision to go with GHE was the assurance of a guaranteed service over the next years. We will soon see how the output will change during the water melting season. The overall annual production depends essentially on the prouction of the upstream station," explains Dr. Zingerle. Even if the heart of the facility is already pumping at a healthy beat, the overall project "Moessmer Power Station" is not quite finished yet. The to-do list still has a few as yet unfinished items on it, including the renewal and adaptation of the intake construction, which is situated around 250 m above the power station. The main objective there is to implement the ecological regulations and high-water safety standards, Studio G will once again play a leading role in making it all happen.

PERFECT SYNERGY BETWEEN TRADITION AND NEW TECHNOLOGY

The managers of the renowned textile manufacturer can consider their reconstruction project a true success – and with good reason: as planned, the reconstruction work, which involved clearing some complex administrative hurdles, was completed in record time. It was only around six months that the factory had to make do without its own hydro-powered electricity supply. Now, the path has been cleared towards a reliable, efficient operation until the current permit expires, i.e. 2040.
As 120 years ago, when the first water usage permit was granted for the manufacturing location in Bruneck, hydropower is still a part of the Moessmer operations that no one would want to do without. And what would fit the mission of the Puster Valley's oldest industrial enterprise better than hydropower – the epitome of traditional and modernity in perfect unity. Just like the textile factory itself.

Technical Data

- Flow Rate: 22 m³/s
- Turbine: Pit Kaplan turbine
- Turbine Output: 1'353 kW
- Rotation speed: 190 rpm
- Generator: Synchronous generator
- Rotation speed Generator: 750 rpm
- Gear: spur gear (Eisenbeiss)
- Net Head: 6.70 m
- Manufacturer: GHE
- Number of blades: 4
- Runner diameter: 2050 mm
- Manufacturer: Hitzinger
- Output: 1'500 kVA
- gear ratio: 1 : 3.947

GLOBAL HYDROENERGY

Everyone involved in the project approached the renovation of the Moessmer power station with great dedication and enthusiasm: DI Adolf Dengg (Studio G), Dr Josef Zingerle (Moessmer), Philipp Meindl (GHE) and Ing. Thomas Eder (GHE).

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