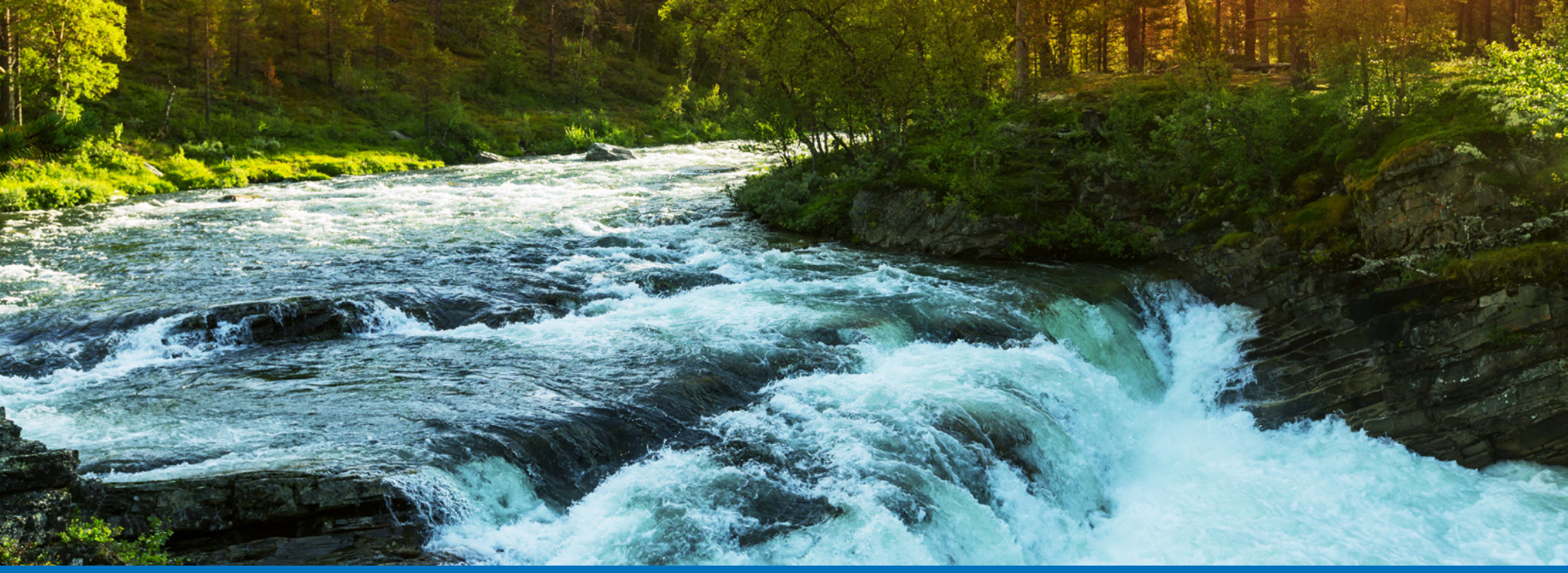


ENERGY IN THE RIVER
A Huge Potential for Growth in Output

Since flowing water, as a renewable energy source, doesn't fluctuate much – in contrast to wind or sun – it therefore fits extremely well into the energy grid landscape, with many hydroelectric power plants currently being modernized. These include the Böfinger Halde on the Danube River.

The generators inside the Böfinger Halde run-of-river power plant have been humming along smoothly since 1953. It is the most powerful of a total of eight hydropower plants operated by Stadtwerke Ulm/Neu-Ulm on the Danube, Iller and Blaukanal. Approximately half of the electricity that the municipal utility company obtains from water every year is generated here. It uses the natural gradient and the flow velocity of the Danube, as well as storing a certain amount of water. The difference in height between the upper and lower water, which is currently 7 meters, is what determines the amount of electricity that the operators can generate with this structure. As things stand today, the Böfinger Halde delivers up to 52 million kWh of electricity per year. After the weir system has been raised by 50 cm, as part of the ongoing modernisation program, an additional 4.4 million kWh per year, i.e. almost one tenth more, will be added to the electricity yield.

Safety is the top priority

Safety will remain the top priority around the dam even after the weir has been raised. Precise and reliable measuring equipment makes even the smallest change visible here. Because the amount of water in the Danube fluctuates over the seasons and even throughout the day, the current water levels and system data are continuously transmitted to the control centre to ensure smooth operation of the power plant. There, huge quantities of data are collected and evaluated. In addition, the technicians responsible for the hydropower facility carry out regular visual checks and on-site inspection rounds. One important piece of information for operating the power plant as efficiently as possible, is the water level directly in front of the inlet into the weir. The water should flow in a controlled manner and drain quickly, in order to optimize plant utilization and reduce the load on the structure. This is especially important in the event of flooding. If the level exceeds a certain threshold value, power generation begins to decline. At a certain point, the head becomes too low to drive the turbines: the power plant then has to be shut down.

Redundant technology

A dual redundancy measuring system helps predict the electricity yield reliably. It continuously records the water level in front of the intake structure before the water is fed into the headrace channel. The operating team working with deputy plant manager Jochen Schneider measures the same level twice here: at spatially separate locations, using two different measuring principles. One system can replace the other at any time should deviations or errors occur. This allows the technicians to rule out, with very high certainty, the possibility of both measuring instruments outputting the same error at the same time. To ensure comprehensive data acquisition and transmission at all times, they call up both measuring points at regular intervals from the control centre, even during normal monitoring mode.

The important measurement results are delivered contactlessly and continuously by an 80-GHz radar sensor, VEGAPULS 64.

Protection against flotsam and ice

The robust sensor is encased in a specially manufactured, stilling tube that provides additional mechanical protection against flotsam or other "events". "During floods, huge tree trunks drift past, blocking the rake below the measuring point," says Schneider, explaining the stresses to which the measurement technology is exposed. And last but not least, the tube structure also offers protection from animal visitors. "During the breeding season, swans expend a lot of energy and fly around at high speeds – sometimes colliding with unexpected objects!" he recalls from experience. And because in the winter, deep snow and ice is almost always expected on the Danube in the Böfinger Halde area, the protective tube can even be heated if necessary. Measurement errors caused by ice sheets are thus a thing of the past.

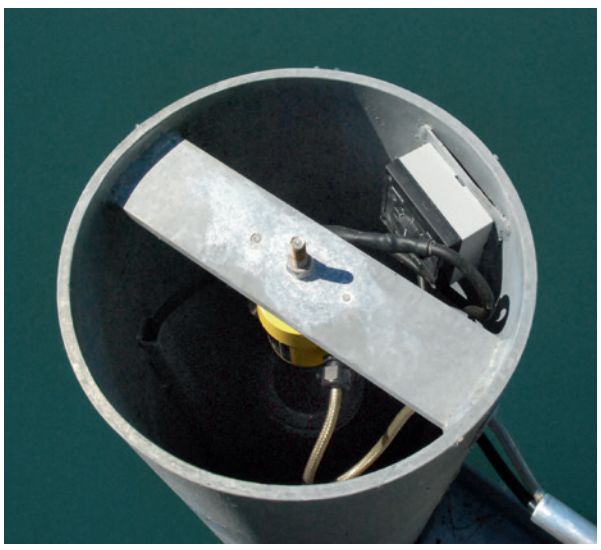
Long-term stable all-rounder

A few metres downstream, a VEGAWELL 52 immersible pressure probe measures the level a second time. With its wear-free ceramic measuring cell, it is an extremely long-term stable all-rounder for water applications and requires little effort on the part of the maintenance team. VEGAWELL 52 optimises and improves not only the accuracy of the measurement results, but also the costs of level monitoring at the weir.

Measured values with long-term value

Apart from providing information for the everyday operation of the plant, the data on the water levels form the basis for hydrological changes that directly affect stakeholders in the waterway. The values are used in a variety of ways, be it to plan the expansion or deconstruction of the river course or to regulate the barrages.

River navigation and local residents also depend on this information, for scheduling trips on the basis of current fairway conditions and taking protective measures against high water in good time.



Flotsam is no problem here: A sturdy pipe provides additional mechanical protection for the level measurement system.

Full hydropower ahead

By 2030, Germany wants to supply almost half of its total electricity requirements from renewable energy sources. Hydropower will play an important role in this. According to the Federal Ministry of Economics and Energy, its potential in Germany is largely exhausted. However, since hydropower flows continuously day and night and can be regulated at a moment's notice, existing facilities are being modernized as much as possible and made more efficient. Without any support at all from the 'Renewable Energy Sources Act' in Germany, hydropower technology, with its high economic efficiency performs amazingly well in the face of unequal competition and helps reduce the load on the grid infrastructure by providing constant output.

Like a big waste filter: the water that gets caught on the screen is returned to the Danube via a special channel.

Located a short distance the inlet structure, a VEGAWELL 52 suspension pressure transmitter provides redundancy with a second measurement, complementing that of VEGAPULS 64.

An international comparison

Despite its undeniable advantages, hydropower accounts for only a very small percentage, just over 3.5 %, of the total electricity generated in Germany. And among renewable energy sources, it accounts for only 10% of the total. In this respect, Austria and Switzerland paint a completely different picture: hydropower is the most important source of electricity in those countries, accounting for well over 50% in each. And worldwide, despite a downward trend, water still generates more than two thirds of the total electricity supply. This discrepancy between Germany and other countries is due to its different topology: "Hydropower is extremely demanding," says Jochen Schneider, getting to the heart of the matter. "The impoundment depth and the water fall height must have certain values for the yield to be profitable. My colleagues in Austria work on a completely different scale. Damming heights of 70 meters and more are common there."

Modernise – but thoughtfully

Besides simply raising the water level, the modernization of the Böfinger Halde includes measures to avoid ecological damage. Drainage pipes and drawdown wells have been installed to prevent the groundwater level from rising. To provide a way for fish to swim around the power plant, a natural stream has been created instead of a fish ladder. "Nature has quickly recaptured this new environment on its own," explains Schneider, "and given the landscape aesthetic appeal here at the water's edge. People have identified with it and begun using it enthusiastically as a local recreation area." The turbines and generators in the Böfinger Halde power plant will thus continue to spin for a long time to come. And the noise they make is a sign that everything is running smoothly. Interestingly, the turbine manufacturer intends to use the noise in the near future to improve plant availability. He is working on an acoustic monitoring system that can detect any deviation of the noise from the normal state. The idea is to use that information to deduce when the ideal time for replacing mechanical parts has come.

How a hydropower plant works

Hydropower plants normally supply electricity continuously – day and night, whether it's stormy or calm. Basically, they still work exactly the same way as the proverbial "clattering waterwheel mill on the rushing brook."

The power of the flowing water is increased by a weir system with multiple sluice gates. Damming up the river water creates or increases the height difference. The higher this so-called drop height, the greater the efficiency. On rivers that only have a small downhill gradient, what is lacking in height can be compensated by correspondingly larger flow rates.

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