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STRAUB SOLUTION:  
**USING HYDROPOWER IN  
THE ILLWERKE POWER  
STATION TO PRODUCE  
ELECTRICITY**

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# KLÖSTERLE (AUSTRIA) HYDROELECTRIC POWER STATION STRAUB - PRESSURE LINE ON GEOLOGICALLY UNSTABLE TERRAIN

Hydropower is one of the most environmentally compatible ways of producing electricity and one of the most commonly used forms of renewable energy. By acting sustainably, hydropower is intended to be used as an environmentally compatible source of energy in the future also. The Klösterle power station uses the gradient between the two communities of Stuben and Danöfen. Continual bedrock movements within the gallery require flexible pipe connections to be used.



The STRAUB-OPEN-FLEX 4H 1670 mm used for installation and pressure test



A two-piece housing was used, allowing a subsequent installation without moving the pipes



Each spigot and bell socket is monitored using sensors

As the largest local energy provider, Vorarlberger Kraftwerke provides 370'000 people with a reliable power supply. The Vorarlberger Illwerke plants generate additional peak load power.

## THE CHALLENGE

The Alfenz River is dammed at 1'340 m above sea level and directed through the 5.1 km long Albona and Burtscha II tunnels to the Burtscha reservoir, which has a capacity of 6'900 m<sup>3</sup>. From this reservoir, the water is fed through a ductile iron pipeline to the Klösterle power station and then returned to the Alfenz River. All water pipelines are under ground. The installed power plant output of 16'000 kW provides an annual power generation of 60.5 m kWh.

The tunnel and pipeline were built in 1994. The PAM ductile pipeline is connected using spigot and bell sockets, rests on concrete bases, and is secured using brackets. The geological conditions are unstable and it became clear over time that the rock in the middle section of the

tunnel was sinking diagonally over a length of over 100 m. This movement was increasingly resulting in axial misalignment, angular deflection, and changes in axial length at the joints.

In view of these changes, Vorarlberger Kraftwerke commissioned local consultants to measure the movements and, based on their findings, design a solution that would accommodate them.

The survey determined a continuous increase in the pipeline length of 210 mm by 2008 and 870 mm by 2045 (refer to the diagram).

## Confined space in the tunnel

The engineers tested solutions involving flanged compensators as well as dual-gasket couplings to allow sliding. However, the settled area was more than 200 m along a very narrow passageway in the tunnel, meaning that only two people could transport the connectors. The weight of each component could therefore not exceed 50 kg. But the approaches proposed involved

heavy products that could not be dismantled, so that the tunnel would have had to be enlarged and the pipelines moved. Because of the very high costs and amount of time needed, Vorarlberger Kraftwerke sought other, more appropriate, solutions.

## THE SOLUTION

After the initial contact with the local consultants, STRAUB produced a first prototype featuring welded-on lugs. Installation of the pipe coupling in similarly confined conditions was also simulated and a successful pressure test was carried out.

The STRAUB-OPEN-FLEX 4 H 1'670.0 mm pipe coupling met all the criteria. It can accommodate changes in length of up to 200 mm, can compensate for up to 15 mm expansion and contraction, and can be dismantled into two halves. The weight of the individual components is under 50 kg, and the components can easily be installed by two people. The compactness of the components allows easy transportation inside the tunnel to the connection points. The hot dip galvanised pipe couplings, protected from corrosion by a special coating, were installed within hours, and no additional work was required to be done on site.

### Implementation of the project

A specialist team from STRAUB instructed the workers on site, demonstrating the installation of the first STRAUB-OPEN-FLEX and providing continuing support. Three workers were required to instal the couplings - one on each side of the pipe and a third on it.

All three pipes in the critical area were supported between the spigot and bell sockets and then cut twice. The gap between the pipe ends was



Coupling casing with triple corrosion protection coating: galvanised and dual epoxy painting



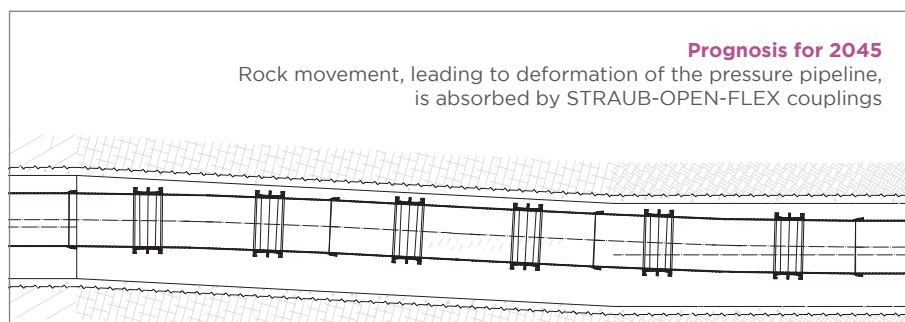
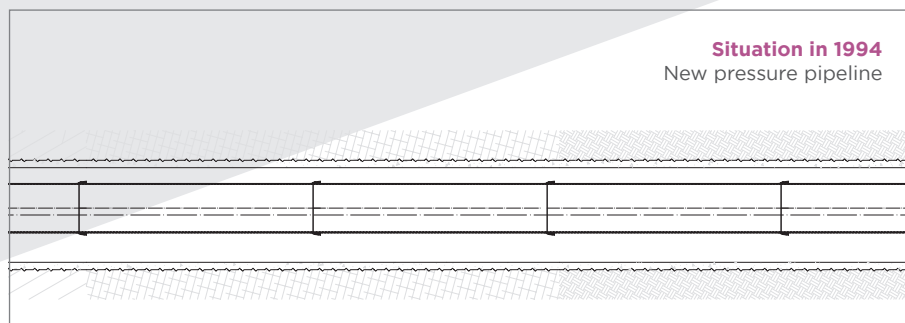
STRAUB specialist at work

approx. 30 mm at the beginning. The cut surfaces were sealed by applying a corrosion protection agent. First, the 200 mm wide steel strip insert was placed around the pipe and the sealing sleeve placed on top of it. Then the two halves of the casing were placed over the sleeve from the top and bottom, and the closures tightened using the torque wrench. The position of the coupling was marked on the perimeter of the pipe around the casing.

All six pipe couplings were installed within one day, allowing the pressure tests on the installed couplings to be carried out without delay.

### On-going monitoring of movement

By continually monitoring the markings, engineers can determine when the movement within the coupling has reached 15 mm. At that point the locking bolts are undone and the sealing sleeve lifted far enough for the sealing lips to move back to the starting position. This can be repeated until the full range of 200 mm is exhausted, when the next coupling can be brought into play.

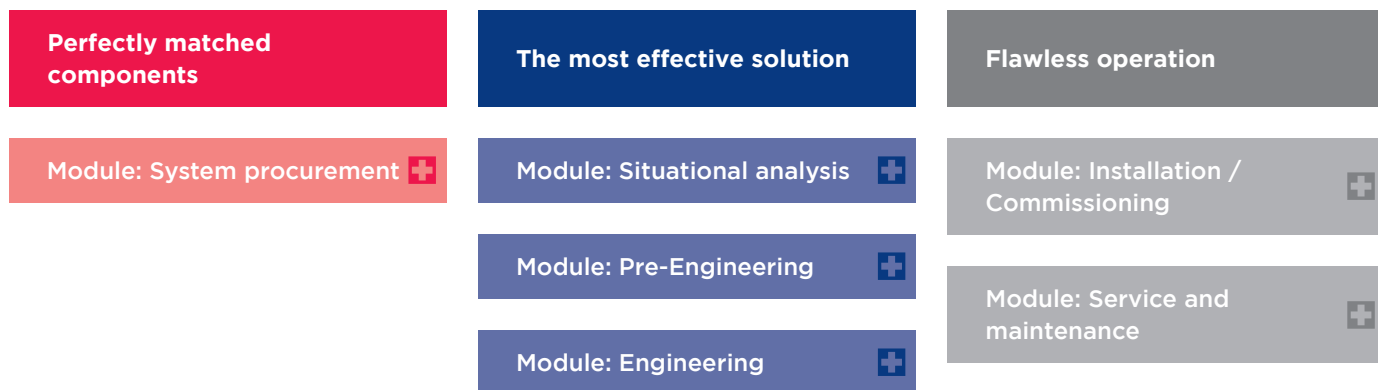


Comparison of the tunnel situation in 1994 and prognosis for 2045

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The result: The right pipe system solution with significant added value for you.



For more information on the modules, please visit [www.straub.ch](http://www.straub.ch)

