

Seals the superlatives of shafts: VGH300S1/560

Split mechanical seals for high-performance storage pump

The Fragant power plant group located in the Möll valley of the Tauern mountains in Austria is operated by Kärntner Elektrizitäts AG (KELAG). It is the company's core for generating power and a mainstay for safe and reliable power supply in the federal province of Carinthia.

The power plant group consists of six large and several smaller alpine reservoirs, seven storage power plants and three run-of-the-river power plants. The total output is approx. 474 MW, which generates approx. 840 million kWh electricity each year.

During phases of low network utilization, the storage pump „Oschenik 1“ in the Innerfragant power plant delivers water to the Oscheniksee reservoir located at an altitude of 906 m. In case of high power demands, the water is used to cover peaks. Andritz Hydro, Graz, one of the leading suppliers of equipment for hydroelectric power generation, received an order from KELAG to renew the Oschenik 1 machine unit and replace the 1968 pump with a much more powerful and larger model.

New pump – greater efficiency

The Oschenik pump project included hydraulics, design, calculation, testing, production, assembly and commissioning. The operator's requirement was a considerable boost in efficiency which was to be achieved, for example, by increasing the flow rate by approx. 18 %. This was implemented by means of a horizontally split 6-stage storage pump.



The fully split mechanical seal VGH300 for a shaft diameter of 550 mm (21.65") being prepared for the test run.

Operating parameters

Pump:

Flow rate: 3.32 m³/s
 Manometric delivery head: 890 m
 Rotational speed: 750 min⁻¹
 Output: P_{max} < 34.5 MW
 Housing pressure test: 225 bar (3,843 PSI)
 Design for operation: Yearly 3,200 hrs. with approx. 274,000 start/stop cycles
 Expected service life: 75 years

Seal:

Shaft diameter: 550 mm (21.65")
 Temperature: +1 °C ... +35 °C
 (+34 °F ... +95 °F)
 Pressure, dynamic:
 p = 27 ... 42 bar (392 ... 609 PSI)
 Starting pressure: 23 bar (334 PSI)
 Pressure, static: max. 50 bar (725 PSI)
 Rotational speed: 750 min⁻¹
 Sliding velocity: v_g = 23 m/s (75 ft/s)

Fit for extremes: Split mechanical seal

Andritz Hydro commissioned EagleBurgmann to design, calculate, produce, test and assemble a mechanical seal on the drive and non-drive side of the pump shaft. The fully split seal of the HGH/VGH series was the right choice for this application.

Split mechanical seals for pumps are used where it is difficult to assemble the seal. The seals are designed as partial or full axial split which enables them to be mounted directly on the shaft of the completely installed pump. In the case of the semi-split EagleBurgmann HGH, the housing parts are split and the inner parts are not split during initial assembly. With the fully split EagleBurgmann VGH, all seal components are split. Both types of seals are in very reliable use in large pumps in a wide variety of water projects worldwide.

Complex FEM calculation

The mechanical seals for the Oschenik storage pump were redesigned on the basis of FEM calculations and optimized for the extremely dynamic and static pressures. The typical pressure operating limit of the VGH is 8 bar (116 PSI) for a diameter of 450 mm (17.72"). However, the requirement for the new storage pump was 50 bar (725 PSI) static with a diameter of 560 mm (22.05").

A particular challenge was to maintain the stability of the split seal housing and especially the metal-to-metal sealed coupling joint under the high pressure. This required the inclusion of structure mechanics (leakage, strength, screws, deformation at the joints, etc.) and sliding face design (lift-off behavior, leakage) in the complex calculations.

Test and commissioning

The seals were tested on the large test facility of EagleBurgmann at 27 ... 42 bar (392 ... 609 PSI) in dynamic operation at 750 min⁻¹ and static at 50 bar (725 PSI). The customer released the seals in March 2016.

Both seals were installed in December 2016 by EagleBurgmann installation engineers from Austria and Germany, and the pumps and seal system were put into operation in January 2017.



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The Innerfragant power plant is located 1,205 m above sea level. The Oschenik 1 pump draws water from the Haselstein reservoir (water level between 1,458 m and 1,471 m above sea level) and pumps it into the Oschenik reservoir (photo) with a water level between 2,245 m and 2,393 m.



During the installation: The 6-stage horizontally split Andritz pump of superlatives is over 6 m long and weighs 120 tons

Seal materials

Seal face and seat: Silicon carbide (Q2)
Metal parts: CrNi steel 1.4301 (F)
Seal supply system: Plan 32 (injection of clean fluid from an external source) and Plan 62 (quench on the atmosphere side)



Largest seal, cramped conditions: Installation of the two fully split mechanical seals on the pump shaft