

## Project Report

### Frades II

The Frades II pumped-storage station will be located approximately 40 km north-east of Braga, in the northern region of Portugal. Frades II is constructed in a granite rock mass on the left bank of the Rabagão river, between the Venda Nova and Salamonde reservoirs and is an important addition to the eight plant Cávado-Rabagão-Homem cascade system in northwest Portugal.

Thanks to their variable speed, the pumped storage units of Frades II can adapt their number of revolutions continuously and take capacities from the grid in the range between 319 and 383 megawatts. Units with fixed speed do not provide this range – their pumping power is regulated with the aid of further units or plants. For the development of wind power, with its intermittent and not precisely predictable capacities, providing a flexible reserve plays a crucial role. In combination with variable speed pumped storage, wind power plants become more reliable and more profitable.

In early 2015 Frades II will be connected to the grid in order to support wind power in Portugal. The country's government plans to develop further 5.400 megawatts of wind power capacity.



„Frades II is a milestone in hydro power: variable speed technology supports direct grid control. In the era of renewable energies this is the new role pumped storage plants are playing. And Voith is setting the trend.”

Dr. Siegbert Etter, Executive Vice President Technology of Voith Hydro Holding



Above this, the asynchronous motor-generators can also be utilized for frequency stabilization of the grid. Line frequency variation must not exceed +/- 0,1 Hertz. The highly sensitive control systems react to grid variations within milliseconds, can tap the kinetic energy of the flywheel masses of the motor generators, and provide immediately energy to the grid, or respectively absorb energy from it. Facing variations in the grid, the motor generators react extremely fast and in the case of faults can compensate voltage loss accordingly – and thus enhance security of supply.

#### Type of pump-turbines Francis vertical, variable speed

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<b>Number of units</b>	2
<b>Nominal rated output per unit</b>	383 MW
<b>Rated speed</b>	364 rpm
<b>Rated net head</b>	414 m
<b>Runner diameter</b>	4.52 m
<b>Nominal rated flow</b>	100 m <sup>3</sup> /s
<b>Commissioning</b>	Spring 2015

#### Type of motor-generators asynchronous

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<b>Rated output</b>	419.5 MVA
<b>Rated input</b>	372 MW
<b>Rated power factor</b>	0.9
<b>Rated voltage</b>	21 kV
<b>Commissioning</b>	Spring 2015

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