

1. Power distribution and distributed generation - VELKO

2. What is integrated with DSM

DG

Energy storage

Smart grid technologies

3. What is the level of commercialization

Research project

Demonstration

Field test

Existing practice

4. Where to find more information?

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- [http://akseli.tekes.fi/opencms/opencms/OhjelmaPortaali/ohjelmat/DENSY/en/Closing\\_Seminar\\_2007.html](http://akseli.tekes.fi/opencms/opencms/OhjelmaPortaali/ohjelmat/DENSY/en/Closing_Seminar_2007.html) → Final Report

5. Objectives of the case

Frequency converters can be utilized in a hydropower plant as a control method alternative to using a variable blade angle turbine or a bank of fixed blade angle turbines that can be utilized in different combinations to have the head change as little as possible (two-point control). The overall economical feasibility of each of the options is determined by their investment and operating (maintenance) costs, and efficiency. The feasibility of each of the control methods (variable blade angle, two-point control, frequency converter) was studied.

6. Business rationale/model

7. Technologies used

8. Short description of the case

The frequency converter can be used to flexibly control the output power and thus the head of the power plant. The produced energy is metered hourly, and the producer is often credited based on an hourly-changing price. The price can be, for example, the hourly Nordpool spot price (or some fraction of it). This information is publicly available on the Nordpool WWW-site. Typically, in a small-scale hydroelectric plant, the power production has a significant impact on the head of the pool (pool volume is small) and vice versa. Therefore, it is possible to optimize the power production so that, as a basic

principle, the water is stored in the reservoir when the price is low, and released through the turbines when the price is higher. In the project, a simulation model of the behavior of the pool was created, and the effects of different optimization methods were compared.

9. Achieved/expected results (operational savings, CO<sub>2</sub>, efficiency enhancement)  
The income using the optimized combination was increased with 4 % compared to income using constant-head control. The difference is remarkable for the power plant owner and thus encourages to produce more energy when the demand is high.

10. Lessons learnt