

The modernisation of steam turbine automation brought flexibility to production — Neve, Finland

In 2019, Fortum eNext and Valmet implemented an extensive modernisation of steam turbine automation for Neve (Napapiirin Energia ja Vesi Oy). The control and protection system was renewed completely and integrated into the plant's DCS system. This brought more flexibility to production, which enables participation in frequency support in the reserve market. The investment will therefore pay off quickly.



The modernisation of steam turbine automation brought flexibility to production

Neve is a multi-sector group of companies specialising in the arctic circular economy. Owned by the municipality of Rovaniemi, the group provides services for more than 60,000 local residents and hundreds of thousands of tourists in Rovaniemi and Lapland. Most of Neve's production consists of combined heat and electricity generation. Its most important power plant is the Suosiola back-pressure power plant (120 MW).

Neve has long been working systematically to improve the efficiency of the Suosiola plant. In 2018, it became evident that the original turbine automation from 1995 was nearing the end of its life cycle. Over the years, there had been turbine control and spare parts availability challenges, and also some equipment failures. When the root causes were analysed, it became clear that the turbine automation and some field equipment should be replaced, and that the flexibility and transparency of operation should be increased so that the plant could participate optimally in the electricity market, even in terms of reserves. The plant wanted to find a modern solution to replace the outdated turbine automation, because it was practically impossible to implement major changes to the old system.

In autumn 2018, Neve set out to find an operator to carry out a feasibility study on the modernisation of the turbine automation and the need to replace auxiliary equipment in connection with the same project. Fortum eNext was selected to carry out the feasibility study.

"In my opinion, the foundation for a successful project was laid during the feasibility study phase, which enabled us to further specify our goals. This ensured a good start for the project, which then progressed smoothly and was completed on schedule," says **Jukka Partanen**, Production Director at Neve.

The following aspects were examined thoroughly during the feasibility study phase: turbine control and protection, control methods, limiters, ramps, the scope of the necessary system reform, interfaces, and control principles for auxiliary equipment. In addition, needs for changes in the field were identified, the instrumentation and critical equipment replacements were reviewed, and field equipment and its specifications were examined, as well as how turbine automation could be integrated into existing systems.

"The more interested the key people of the plant are in the modernisation, the better the system will be. Neve was very actively involved throughout the project and presented suggestions for development. For example, the customer needs to determine their desired machine operation methods. Based on them, we can make recommendations and propose solutions," says **Toni Loivakari**, Senior Product Manager at Fortum.



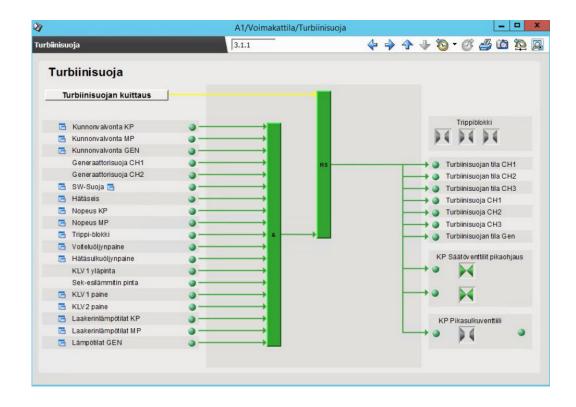
"I've been involved in a variety of projects, and this was a very well-managed project as a whole."

Henri Jokkala, Neve

Neve chose Valmet Automation as the supplier of the new system, as the plant was already using Valmet's systems. However, auxiliary equipment and the instrumentation of the turbine island often need to be renewed in connection with modernisation, which is why Neve wanted to assign the overall responsibility for the project to a single supplier.

"At first, we were planning to carry out the modernisation of automation directly with Valmet, but Fortum's broader mechanical expertise in turbine plants was crucial. We also knew that Fortum is a reliable partner because they had previously carried out turbine revisions and generator maintenance for us. It was important for us that the project was supported by a major player in case of any unexpected events," says **Henri Jokkala**, who worked as Electrical Automation Manager at Neve during the modernisation.

The plant needed an open turbine controller that can be examined when necessary. It was difficult to parameterise new features for the previous system, and very little support was available from the manufacturer. It had also been difficult to engage in open dialogue with some individual service providers on the needs for changes in automation.





Fortum favours open and flexible systems that reflect the situation better instead of systems with limited access, which is why cooperation with Valmet felt natural. It is important that the customer can engage in more detailed troubleshooting and implement changes independently if necessary. When the goal is to run the machine flexibly, the system provides the operator with plenty of information that helps them understand the limitations and why the turbine cannot be run in the desired area.

It was important for Neve to integrate turbine automation into the plant's main automation system so that it was easier to manage the power plant and optimise its operations as a whole.

"We wanted to assign overall responsibility to a player who could handle it. That's why we entered into an agreement with Fortum," says Jukka Partanen.

Six months is a short time in automation renewal

The competitive bidding process for the modernisation project was carried out in the late winter of 2019, and the agreement between the customer and the suppliers was signed in March. Milka Tilus, who worked as Lead Designer at Valmet at the time, joined the project, which was started immediately by placing an order for equipment.

The project progressed according to plan and was delivered in just six months, from signing the agreement to approval. Fortum had already studied the documentation and the plant during the feasibility study, which ensured a smooth start for the work.

"This can be said to be a minimum time for turbine automation modernisation projects, because they are complicated and involve a great deal of examination, planning and equipment purchases," says Toni Loivakari.

Extensive testing before start-up

The installation work was carried out in July, which is a peak season for revisions. The commissioning and site acceptance tests (SAT) began in August. The customer's factory acceptance tests (FAT) were carried out during the week following Midsummer, after Valmet's internal testing. The factory acceptance tests were followed by the site acceptance tests, after which the commissioning was completed, and the project was ready to be handed over. Employees from the plant participated in the factory acceptance testing in Tampere. Major surprises during the commissioning phase were avoided by careful testing.

"FAT is critical, and the schedule was tight. The equipment must be in place if something needs to be tested. In practice, testing is about functionality: checking that everything works as it should," Miika Tilus explains.

The first online run was carried out in mid-August. During the commissioning, the turbine's behaviour was closely monitored,



and the first load tests were run. The start-up was completed as planned, and the machine went live on the first attempt.

Various control valve positions were tested in the final stages of the project, but the valves were eventually installed in largely the same way as originally. Linearisation needed to be carried out during commissioning, but in practice, the opening order of the valves is the same as before the modernisation, and the slopes are very close to the original. Minor adjustments were made to the valves after the performance tests, and their balance is now well maintained in all settings.

The most significant challenges for Fortum were related to field installations.

"Surprises cannot be completely avoided when old and new are combined. It requires insight and experience to figure out solutions to problems. This project involved considerable instrumentation between new and old equipment, but we were able to overcome all the challenges," says Toni Loivakari.



"The modernisation of turbine automation enables participation in new products on the electricity market in circumstances where it is increasingly difficult to maintain a power balance."

Toni Loivakari, Fortum eNext

The modernisation brought flexibility to operation methods and increased opportunities to operate in the electricity market

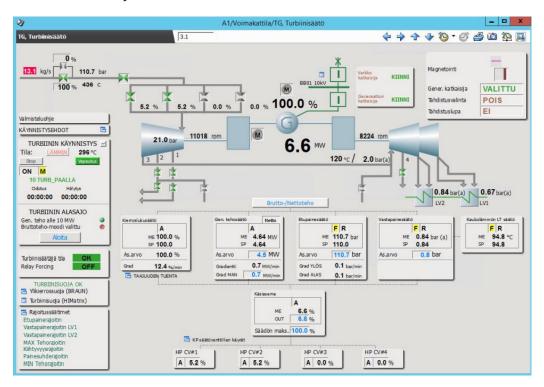
The electricity market has changed considerably in recent years, and even CHP plants need to increase production flexibility. They must be able to run turbines more efficiently in varying conditions. The turbine logic must be adjustable so that the plant can adapt to the prevailing production mode. In practice, this means that the minimum power should be as low as possible, the maximum power should be as high as possible, and the control speed should be maximal in relation to machine capability.

Were the goals for the assignment achieved?



"Yes, I would say they were. In future, each plant operating in the reserve market will have to develop its functionalities more flexibly. With the current set of controls, adjustments down and up, as well as frequency support, work very well. We have also achieved lower vibration levels," says Jukka Partanen.

"Modernisation has enabled participation in modern electricity trading in a new way. Participation in the frequency-controlled reserve market is no longer limited by outdated turbine automation," says Henri Jokkala.



Modernisation pays off

Automation is a complicated investment for many operators. It is difficult to justify the modernisation of an old but functioning system, because the payback time is not easy to calculate. Modernisation is often postponed, because its benefits are not fully understood. However, when a plant actively serves as reserve for or sells electricity to the grid manager, a payback time can be calculated for automation, regardless of the scope of the investment.

The integration of turbine control and protection into the plant's operational automation, along with field equipment renewal, makes the plant's operations more transparent for its operating personnel, and it also makes maintenance work easier for example in potential fault situations. The faster and more precise turbine control and frequency support, which was implemented during the project, will bring significant cost savings for the plant in the future in areas such as increased competence, spare parts, and reporting and system support.



"In this case, it was useful to integrate the turbine automation system into the plant's DCS, because the plant already had the engineering and operating levels in place. This significantly reduces the customer's costs and makes operation and maintenance easier, because all the equipment is from the same manufacturer," Toni Loivakari points out.

Operators can adjust and optimise the process independently, which was previously impossible because of interfaces created by separate logics. According to Henri Jokkala, the plant has been able to meet every challenge arising from the market after the modernisation, and participation has no longer been limited by the technical properties of turbine automation. The fully integrated modernised turbine automation will also enable participation in 15-minute balance clearance periods in the future.

Good cooperation with the customer and the suppliers was highlighted during the project

The whole project was completed on schedule and as budgeted. The system and the implementation were in line with the assignment, and there were no major surprises. Some of the features were determined during the project.

"We were unable to take everything into account during the project specification phase, and some needs were not discovered until the project was underway. However, Fortum and Valmet as its subcontractor were able to meet all needs for changes in an excellent manner. We were also able to implement the frequency-controlled reserve optimally. In the process, we discovered all the currently available opportunities," Henri Jokkala explains.

Toni Loivakari, Senior Product Manager at Fortum eNext, agrees with the others on the importance of dialogue:

"We enjoyed good discussion among all the parties throughout the project. The customer presented many suggestions and ideas about what should be done, and what they expected in terms of the result. This is extremely important, and even a prerequisite for project success, because the customer naturally knows their operational needs and challenges best. Our job is to provide the customer with the best solutions."

"Fortum creates added value through its strong understanding of turbine and generator equipment. We have in-depth expertise in rotating main equipment, and the know-how on how to optimise the performance and respond to new operating needs."

Toni Loivakari, Fortum eNext



Customer

Neve (Napapiirin Energia ja Vesi Oy), Finland

Location

Rovaniemi; services include e.g. electricity transmission, water supply and district heat production

- Power plant: Suosiola combined heat and power plant (CHP), Rovaniemi
- Fuel: Local recycled wood, industrial side streams, forest chips and peat (less than 20%). The site also has a steam boiler (40 MW) and an oil boiler (50 MW) in case of fault situations.
- Power: 120 MW
- Equipment: Turbine (ABB STAL HP16 and MP10) and generator (ABB GBA 1250 LD, nominal power 34 MW)
- System to be replaced: ABB Advant Controller 110

The customer's challenges

Solution provided by Fortum eNext

Benefits for the customer

- The plant's original turbine automation had reached the end of its life cycle.
- The flexibility and transparency of operations needed to be increased so that the plant could participate optimally in the electricity market, even in terms of reserves.
- Auxiliary
 equipment and the
 instrumentation of the
 turbine island are often
 renewed in connection
 with modernisation.

- turbine automation was implemented in close cooperation with Valmet, a system supplier and equipment manufacturer.
- The control and protection system was renewed completely and integrated into the plant's DCS system.
- Overall responsibility for the project enabled functionality to be optimised as a whole and new operational needs to be implemented flexibly during the project.
- A strong understanding of the mechanics of turbine and generator equipment.

- The modernisation of automation brought more flexibility to production, which enables participation in frequency support in the reserve market.
- Integrating turbine control and protection systems into the plant's automation system makes operation and maintenance easier and increases transparency in the rotating equipment, supporting timely decisions.
- The investment will therefore pay off quickly.



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