Corporate magazine
Fingrid Oyj 1/2013

FINGRID

ELECTRICITY MARKET INTEGRATION MAKES HEADWAY

FINGRID
Corporate Magazine
Fingrid Oyj
16th volume
1/2013

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Cover photograph: A cable campaign of the EstLink 2 electricity transmission connection between Finland and Estonia was laid in the sea at Nikuviken in Porvoo at the end of November. Electricity transmissions to and from the Baltic countries will be strengthened significantly when the connection will be introduced in 2014. Photograph by Eija Eskelinen

Printed by Libris Oy, Helsinki
ISSN-L: 1456–2693
ISSN: 1456–2693 (Print)
ISSN: 2242-5985 (Online)

In this issue

EDITORIAL

AREA PRICE DIFFERENCES TO BE EXPECTED in the expanding electricity market

Electricity transmission congestions have imposed a considerable restriction to electricity trade in the past few years. The wholesale price of electricity in Finland has been much higher than in the other Nordic countries. Previously, we became accustomed to a situation where there were really no differences in the prices, especially as compared to Sweden. In 2012, however, the average difference was 4 to 5 euros per megawatt hour, and in some months it went up as high as over 10 euros. This is a new phenomenon and a peculiar trait in a situation where new transmission capacity between the two countries has just become available.

However, it is to be admitted that the additional capacity has not been fully accessible. Failures have plagued the two Fenno-Skan cable connections between Finland and Sweden. A ship's anchor, other technical faults, a fire at a substation and a system fault have incapacitated these connections. Fortunately, there are now two cables, and at least one of them usually works. However, it appears that direct current technology is quite vulnerable. The Nordic region features especially many HVDC submarine cables on an international scale, and they constitute a major risk factor in this market area.

The market situation itself also contributed to the scarcity of transmission capacity. Abundant supply of hydropower in Norway and Sweden resulted in a high demand for electricity imports to Finland. Imports from Russia have decreased considerably during the same period as a result of the capacity fees introduced in the Russian electricity market. Consequently, more electricity than ever before was imported to Finland from the west in 2012. The full transmission capacity was utilised all the time, and the capacity would probably not have been sufficient even if all the cables had remained intact.

It can be said that the Finnish market has faced a new situation where events in the neighbouring countries influence the market in Finland more than before. In addition to the situation in Russia, this is the result of the division of Sweden into four bidding areas and the Baltic countries joining the market. In the future, it will probably not be commonplace that the prices in Sweden and the Baltic countries, and also in Finland in-between them, would be uniform. The full transmission capacity is met easily at least on some border, and the area prices become divergent.

As a result of the transmission congestions on cross-border interconnectors, Fingrid has had the questionable pleasure to obtain so-called congestion income. In 2012, it amounted to a record-high figure of 44 million euros. Thanks to the regulation model applied, however, these funds do not go for example into the pockets of the shareholders, but Fingrid uses them for capital investments through which the transmission grid is upgraded to better meet the needs of the market.

Among Fingrid's recent or pending grid upgrades for the needs of the market are the recently-completed Fenno-Skan 2 cable, the EstLink 2 cable to Estonia to be completed next year, and the newly-launched 400 kilovolt transmission line project on the west coast of Finland, securing that Finland remains as a single price area in the electricity exchange. A third 400 kilovolt alternating current connection between Finland and northern Sweden is also included in Fingrid's plans, but a decision on its implementation still requires further contemplation. All in all, Fingrid will use much more money for the capital investments that benefit the market than what the company receives in congestion income.

Fingrid also endeavours to schedule the transmission outages required by maintenance and construction work so that the disadvantages on the market are minimised. However, it is difficult to foresee the market situation within the time span in which this work is planned and agreed. Wherever possible, work already agreed has been postponed to a point in time which better suits the market. This was the case twice in the past few months with maintenance work on the cross-border interconnectors in the north due to the damage in the Fenno-Skan cable. This is described in more detail on page 15.

Juha Kekkonen is Fingrid Oyj's Executive Vice President

With joint forces towards **THE EUROPEAN** electricity market

There is an objective to link the European electricity market together as early as 2014. The achievement of the world's largest electricity market will require that the relevant countries can extend their perspective beyond their national borders also with regard to security of supply.

Text by Suvi Artti | **Photographs by** Valtteri Kantanen, Jonna Monola, iStockphoto

"Market integration is a positive thing. The success story of the Nordic electricity market is a case in point of this," says Fingrid's President and CEO **Jukka Ruusunen**. Even though the year 2012 with its record-high precipitation levels will be remembered for the considerable electricity transmission congestions between Finland and Sweden, the Nordic electricity market in general worked very well, Jukka Ruusunen says.

The problems encountered last year were the sum of independent random events. Electricity imports from Russia collapsed, but still more electricity than ever before was imported into Finland and even more would have been imported had the full transmission capacity between Finland and Sweden been in use. There was abundant supply of hydropower and the market would have accommodated much more power from the west, but both Fenno-Skan connections were out of use due to failures for some part of the year.

This is why the price difference between Finland and Sweden grew very high at times: the price of electricity in Finland was lower than ever before, but in Sweden it was even cheaper. "If the rainfall had been normal, there would not have been so much price differences. The price differences are smaller when there is less rain – and the price of electricity is higher," Jukka Ruusunen points out.

On the February interview day, the bad news related to the Fenno-Skan connections follow each other: there has been a failure in the Fenno-Skan 1 connection in the preceding evening, and during the interview Jukka Ruusunen obtains further information by telephone. "That's the way of things, the same situation just goes on," he states. "Now we are finding out the cause of the fault." It later transpired that the fault was caused by a failure in the cable itself. By the time this magazine went to press, the repair work was in progress, and the goal was to bring the connection back on stream in April.

Cheap electricity from Sweden

The situation of last year indicated that there is a real need for large transmission capacity between Finland and Sweden. According to Jukka Ruusunen, the Finns have benefited from the integration of the Nordic electricity market. "The notion that Finland could be a country of inexpensive electricity through its own resources is incorrect. The consumers obtain cheap electricity from the effectively-functioning inter-Nordic electricity market."

He also wishes to correct the misconception that the integration of the European electricity market would automatically raise the price of electricity in the Nordic countries. "That is a chant that is constantly heard when electricity prices are discussed, but it is not necessarily true. You cannot draw conclusions of the future on the basis of the price level of today. The electricity production methods are the same everywhere, which is why there are no fundamental reasons for wholesale electricity being more expensive somewhere."

"Instead, taxation and for example the financing of subsidy schemes is a different matter. Fingrid has kept the grid fees at the lowest level in Europe, and this gives a competitive advantage to Finland."

Subsidies for renewables threaten the market

The biggest question shared by all countries now is how to secure the security of electricity supply as the electricity production architecture is changing. In order to attain the EU's climate policy objectives, energy from renewable energy sources is produced in many countries through substantial subsidies. Jukka Ruusunen says that producers of solar and wind power are in a special position *vis-à-vis* the traditional modes of production: they have the right to sell electricity whenever the wind blows or when it shines, but no obligations. There are no variable costs, so it is worthwhile selling electricity whenever possible.

Jukka Ruusunen thinks that the subsidised production of renewable energy, which has increased rapidly, already poses a threat to the functioning of the electricity market. He is looking forward to a change in the subsidy policy, because it is important to also retain sufficient conventional production capacity alongside renewable energy so that the security of supply is maintained.

"A sustainable balance between a reduction in carbon dioxide emissions, security of supply, and European competitiveness needs to be found in the energy policy. If electricity production is based solely on subsidies, there is no room for market mechanism, and the competitiveness of the European economies will decline. On the other hand, you cannot force anyone to produce electricity unless it takes place in a profitable business."

Costly German model

One worrying example mentioned by Jukka Ruusunen is Germany, where the subsidies for renewable energy become costly for the consumers. The wholesale price of electricity in Germany has even been negative at times, and still the subsidy mechanism has paid the full subsidy to the electricity producers. "The producers of renewable energy have no market responsibility in Germany. This costs millions of euros to the electricity users."

> "If electricity production is based solely on subsidies, there is no room for market mechanism, and the competitiveness of the European economies will decline."
> Jukka Ruusunen

Jukka Ruusunen says that European competitiveness cannot withstand the German model. A subtle change of approach should be made in the subsidy policy, and all means should be used to give renewable energy access to the market. For example in Germany, wind and solar power could start to be profitable even without subsidies.

Things are better in Finland: even though renewable energy production is subsidised, wind power producers have balance responsibility, in other words the →

"Renewable energy, security of supply and the electricity market should be advanced at the same time."

Risto Lindroos

producers are responsible for balancing their own production balance.

Fingrid's Corporate Adviser **Risto Lindroos** says that the investors' confidence is being tested, because the signals provided by the current market do not guarantee sufficient production capacity. He says that the problem with the policy applied to date has been one-sidedness: a certain volume of renewable energy at an annual level has been recorded in the objectives, but the fact that there has to be sufficient power in every hour and every moment has received less attention. "The power system is always an entity, and promoting just one thing at a time does not work in it. Renewable energy, security of supply and the electricity market should be advanced at the same time," Risto Lindroos sums up.

According to him, the energy industry is now waiting for a decision in principle of the direction in which the energy policy will be taken from 2020 onwards. The target is clear: carbon-free EU by 2050. It is now time to decide on the mechanisms through which that target can be reached.

"Demand response is one of the foremost new means for maintaining a balance between electricity consumption and production," says Jukka Ruusunen. "The situation in the Nordic countries is good in that we can use hydropower to adjust quite a lot of renewable energy. When we get more demand response, the situation will improve further." More information on demand response on page 16 of this magazine.

Perspective beyond national boundaries

In order to ensure the security of electricity supply, plans in different parts of Europe have emerged concerning the subsidising of electricity producers so that they would keep their production capacity available or make capital investments in additional capacity. The goal of this is to secure that there would be available capacity also when electricity production from wind and solar sources is not possible.

Risto Lindroos says that these capacity compensation methods involve problems. "All subsidies distort the market. If these mechanisms emerge, they can lead to a situation where it is not always possible to use that production which would be most affordable at any given time. The market is dispersed, and uniformity is compromised. In practice, security of supply can also suffer, even though the original objective of the capacity compensation system was to improve the security of supply."

Risto Lindroos hopes that the EU member states would adopt a perspective which extends beyond their national boundaries. "You should rely more on your neighbouring countries, broaden the viewpoint of security of supply, and upgrade the transmission connections. If the compensation

Capacity payments on the outskirts of Europe

Of the EU member states, capacity fees are already in use in Ireland, Spain, Italy, Bulgaria and Greece, and the introduction of some type of capacity mechanism is planned for example in the United Kingdom and France. The different methods applied in the member states are causing headache for those designing the single European electricity market. The European Commission has conducted an open consultation on the topic, and the results should be ready in 2013.

In a way, the strategic reserve applied in Finland and Sweden is a minimal version of the capacity compensation mechanism. However, the market impact of the strategic reserve is minimised, which is why it does not cut the price level in the market. "The strategic reserve is only applied when demand exceeds supply. In a way, it is an insurance policy for the finishing of power in the future," Risto Lindroos says.

The other extreme is a method where electricity sellers are forced to buy as much capacity as what they are selling to their customers at any given moment. According to Risto Lindroos, the Russian capacity remuneration mechanism is an example of a system which impacts negatively on the functioning of the market. This is indicated by the collapse in the amount of electricity imported from Russia to Finland.

mechanism is implemented incorrectly, the situation within a certain country may improve but get worse in the neighbouring countries."

If it is necessary to put capacity compensations into use, they should be designed so that the market effects are minimised, says Risto Lindroos.

First the Baltic Sea region, then the whole of Europe

The single electricity market of the European Union is right around the corner: the goal is to complete the market coupling within the EU by 2014. Alongside this, much work still needs to be carried out to reinforce and add to the electricity transmission connections between countries.

In the Baltic Sea region, the integration of the Baltic countries into the Nordic system has made good progress. Estonia and Lithuania have already joined Nord Pool Spot's trading system, and the next goal is to integrate the electricity market in Latvia. The transmission connections to the Baltic countries will be strengthened significantly when the EstLink 2 HVDC connection between Finland and Estonia, which is under construction, will be completed. The connection will be brought to commercial operation in early 2014.

"In addition to the integration of the Baltic region, the transmission connections between Finland and Russia are also important to Finland. Fingrid has an active role in promoting electricity trade between Finland and Russia. The purpose is to make it as efficient and transparent as possible, like any electricity trade. The next step is to begin electricity transmissions in both directions between the two countries at market terms, between several players," Jukka Ruusunen envisions. ■

New transparency regulation obliges the market participants

A new regulation on the transparency of the electricity market has been prepared within the EU. The regulation will oblige the transmission system operators, service providers and ENTSO-E to provide information increasingly transparently.

A group consisting of the experts of the member states has already approved the regulation, and after a transitional period it will become effective at the end of 2014.

The regulation will require ENTSO-E, the European Network of Transmission System Operators for Electricity, to publish the requisite information on the Internet. ENTSO-E is consequently preparing the gradual introduction of a new service, starting with the market information found currently on ENTSO-E's website. The project is comprehensive, and there will be a lot of work for the TSOs, their potential service providers and ENTSO-E. By virtue of the regulation, the market players are obliged to report the required information to the TSOs.

The Nordic TSOs have a long history of publishing transparent market information, so there will be no major changes to the Nordic rules. However, some changes will be made, such as the publication of hourly production information on generating units in excess of 100 megawatts with a delay of five days. Moreover, aggregated production data broken down by types of production will be published with an hour's delay. Changes concerning the TSOs include the forecasting of loads much farther into the future than now, more accurate reporting of congestions, publication of counter trade, shorter deadlines for information relating to balancing, and more accurate publication of reserves by types of reserves.

ENTSO-E's website will also be used for publishing interruptions in power plants and major loads, as required by REMIT.

REMIT regulation controls wholesale trade of electricity and natural gas

The provisions of the REMIT regulation governing electricity and natural gas market players are being prepared by ACER.

The EU regulation referred to as REMIT (Regulation on wholesale energy market integrity and transparency, 1227/2011) came into force in December 2011. The regulation prohibits, among other things, the abuse of insider information and market manipulation, and obliges the wholesale market participants to register, and report their transactions to the authorities.

The more detailed provisions pertaining to REMIT are currently being prepared by ACER, Agency for the Cooperation of Energy Regulators. The transactions and bids requiring registration are reported collectively through the market places, or in terms of individual contracts to ACER. ACER is currently defining the products that will be covered by monitoring under REMIT.

The publication of market information on interruptions in major (in excess of 100 MW) power plants and loads is defined to be compatible with both REMIT and the transparency regulation for electricity market information, which is being drawn up at the moment.

Electricity transmission **highway** on the West Coast

At the end of 2012, Fingrid made a capital investment decision concerning the biggest transmission line project in its history. The reinforcement of the connection between Hirvisuo in Kokkola and Pyhänselkä in Muhos is part of the development plan for the transmission grid in Ostrobothnia in Western Finland. This aged network with insufficient transmission capacity will be replaced with a more rugged connection.

Text by Suvi Artti | **Photograph by** Valtteri Kantanen

Additional capacity for the transmission of electricity in Ostrobothnia is needed because electricity consumption and production in the region are increasing. There are several pending wind power projects in the region, and a nuclear power plant is being planned in Pyhäjoki. The reinforcement of the network also serves the electricity market: when the transmission capacity between north and south is increased, it also contributes to Finland remaining as a single price area.

In order to guarantee the adequacy of transmission capacity and system security, the 220 kilovolt system along the entire west coast of Finland will be replaced by a 400 kilovolt system by 2016. A 400 kV line was constructed from Kristiinankaupunki to Kokkola in the early 1990s, but it has been operated at 220 kV until now. The 400 kV transmission line between Ulvila and Kristiinankaupunki will be completed in 2014.

The section between Kokkola and Oulu is in turn next. The timing of the project has been influenced by the fact that the 220 kV transformer substations built in Ostrobothnia in the 1970s will reach the end of their technical lifetime in the 2010s. In other words, some components should have been renewed in any case in the near future so as to maintain system security and safety.

"If a decision to keep the 220 kV voltage level had been made, several substations and transformers reaching the end of their service life should have been modernised," says **Antero Reilander**, Special Adviser in Fingrid's grid planning. Transformers which have been installed more recently will not be wasted, either, because they can be moved to Lapland and the Oulujoki river, where the 220 kV voltage will be retained.

About 100 kilometres of the Hirvisuo–Pyhänselkä line will be constructed with a 400 + 110 kV structure. Moreover, the remaining 220 kV lines will be converted to 110 kV, which will facilitate the connection of wind power capacity and distribution networks to Fingrid's grid.

Welcome, wind power!

Antero Reilander says that the coast of Northern Ostrobothnia is undergoing a wind power boom.

"The wind power potential in the region totals thousands of megawatts. If just 1,000 megawatts of the potential is realised, it is a big achievement. Land use and permit processes have slowed down the projects, but now things will definitely start moving. Wind power players talk about the ketchup bottle effect: when the blockage opens, there's no stopping the flow."

In order to facilitate the connection of wind power capacity to the grid, the first stage of the project, the new 110 kV connection between Hirvisuo and Kalajoki, will be brought to operation in 2015. It will be possible to increase the transmission capacity by means of small changes also after the actual project is complete. Transformers and transformer substations can be added to the grid, and wind power producers can connect to these.

"The change is so designed so that the grid can be upgraded in small steps. In the future, minor amendments can give a required volume of additional transmission capacity," says Antero Reilander.

At the right time

Thorough planning is an important part of a transmission line project – when the actual construction work begins, the planning process has been going on for years. The network plan for Ostrobothnia has been on the design engineers' agenda since the early 2000s, and it has been fine-tuned on several occasions.

"We brought the schedule forward two times so that the investment would take place exactly at the right time. Execution too late would hamper the →

"It will be possible to increase the trasmission capacity by means of small changes also after the actual project is complete."

Antero Reilander

HIRVISUO–PYHÄNSELKÄ 400 KV TRANSMISSION LINE PROJECT

TOTAL LENGTH OF TRANSMISSION LINE
212 kilometres

CONSISTS OF THREE PARTS:
1) Hirvisuo–Kalajoki, 2) Kalajoki–Siikajoki, 3) Siikajoki–Pyhänselkä

THE PROJECT ALSO INCLUDES:
Construction of Hirvisuo 400/110 kV transformer and series capacitor substation
Construction of Tuovila 400 kV substation
Expansion of Pyhänselkä 400 kV substation
Conversion of 220 kV lines in Ostrobothnia to 110 kV voltage

COMPLETED IN
2016

CONSTRUCTION COSTS
approx. 110 million euros

construction of new generation capacity and would not respond to the needs of increasing consumption. On the other hand, there is no point in carrying out a project too early, either," says Antero Reilander.

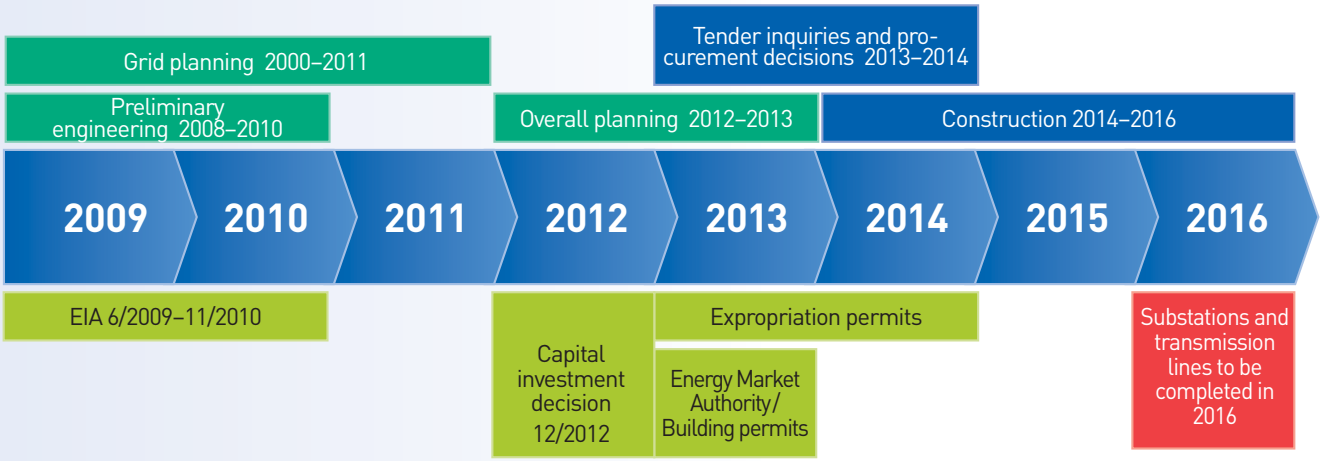
He describes the network planning process as collaboration, where several people work together to find the best solutions. Network designers simulate the loads in a network in a variety of situations, while the simulations of the electricity market experts ensure that the transmission capacity is adequate for the market.

Antero Reilander's role in the Hirvisuo–Pyhänselkä project has been to compile all the information together and to simulate the different solutions by means of computer: how the solutions would actually work, and at which points the network should be reinforced.

"We aim to find an outcome which is optimal to all. The issues that need to be taken into account comprise loads, new generation capacity, electricity market, and the ageing of the grid. The route of the line was chosen so that as many parties as possible will benefit."

"It is important to consider the system solutions well into the future and to find flexible solutions that do not exclude any developments in generation or loads. The goal is a grid that works no matter what happens."

From plans to execution



Construction launched in 2014

The general planning of the Hirvisuo–Pyhänselkä project is in progress, and some of the plans are already complete. Most of the landowners affected by the new power line areas have been contacted, and they have been offered an advance agreement of the use of land.

The Hirvisuo–Kalajoki section of the line has progressed to the expropriation permit phase. In this section, the transmission line will be built mostly in the right-of-way of a dismantled line. Only in the vicinity of the new Hirvisuo substation will the transmission line run in a completely new area. Transmission line construction will begin in 2014, and the Hirvisuo transformer substation is expected to be ready in 2016. The substation will be built in Kokkola, about 1.5 kilometres from the Ventusneva substation. The substation will have a series capacitor, which increases the transmission capacity considerably.

On the Kalajoki–Siikajoki section, the transmission line will be constructed in the right-of-way of a dismantled line. Between Siikajoki and Pyhänselkä, 52 kilometres of the power line will be built in a new right-of-way. The planning of the line route has paid particular attention to the environmental aspects. The EIA process of the project was awarded the Good EIA Award of the Finnish Association for Impact Assessment (FAIA) in 2011.

Customers involved in planning

Fingrid takes heed of the wishes of its customers in the planning of the sizeable transmission line project. "As an example, the solutions applied to the connections must be decided during general planning. For this reason, we kept close contacts with our customers throughout 2012. Discussions have been conducted of the changes to be made to the connections, and we have aimed to find the best solutions for every party," Antero Reilander says.

Well-functioning co-operation is also needed during the construction period. "We will face challenging transmission outage situations, which will call for careful outage planning. There are many customer networks in the area, and it is important to co-ordinate the outages so that there will be no overlapping outages in the customers' network." ■

KNOW THE TERMS

This column presents and defines terminology in the electricity transmission business and related fields.

P1

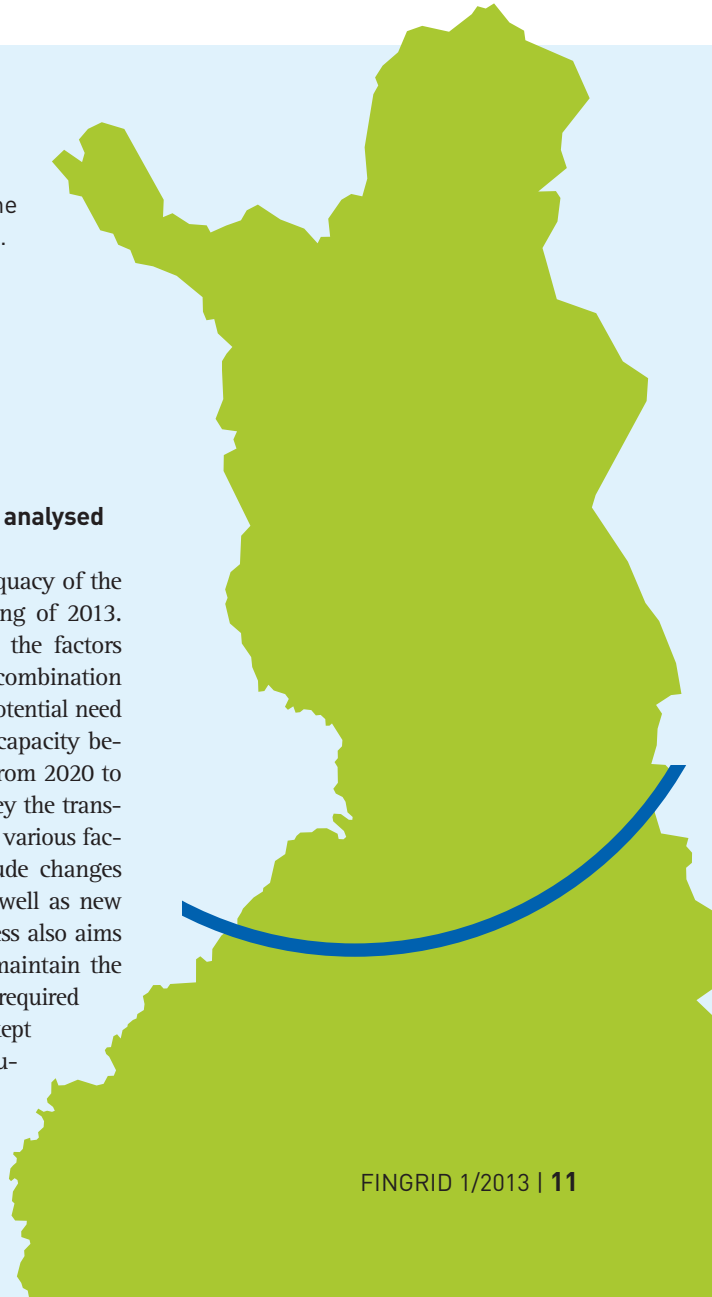
Text by Maarit Uusitalo

P1 related to system security is one of the quantities followed in the Finnish power system. P1 transmission refers to electricity transmission between north and south within Finland. The P1 section cuts Finland into two south of Oulu, approximately between Kokkola and Kajaani. The location of the intersection has been defined in the past on the basis of the measurement points of 400 and 220 kV grids.

P1 capacity means the transmission capacity available to north–south transmissions. At the moment, it consists of the total capacity of three 400 kV transmission lines and two 220 kV lines. The Hirvisuo–Pyhänselkä line to be built on the west coast of Finland will be part of the P1 capacity.

Adequacy of P1 capacity analysed

Fingrid is analysing the adequacy of the P1 capacity during the spring of 2013. The objective is to identify the factors which on their own or in combination with other factors trigger a potential need for additional transmission capacity between the north and south from 2020 to 2025. The analysis will survey the transmission needs resulting from various factors. Such factors can include changes in loads and generation as well as new cross-border lines. The process also aims to find solutions that can maintain the transmission capacity at the required level so that Finland can be kept as a single price area in the future, too. ■



PROS AND | CONS

weighed in system planning

The electricity transmission system is planned with a long perspective into the future. Various models are used for assessing the generation and consumption forecasts as well as the market benefits of new construction projects.

Text by Maarit Uusitalo | **Photograph by** iStockphoto

Capital investments in the transmission system are based on changes in electricity production and consumption in Finland and neighbouring areas. Fingrid assesses the market-based needs to reinforce the system by drawing up various scenarios and by analysing the transmission needs in these scenarios. The transmission system is built in stages based on long-term plans, and the capital investments are optimised with the renovation and maintenance management requirements.

The transmission needs and needs to reinforce the system are assessed well in advance. It is not in anyone's interests if the grid is reinforced prematurely or unnecessarily. Environmental studies and environmental impact assessments are conducted beforehand so that the actual construction project can be started quickly when necessary.

Planning in unison

Fingrid is responsible for the development of its own transmission system, and it carries system responsibility for the whole power system. This responsibility means capital investments in the grid to meet the electricity production and consumption requirements. The responsibility also means close co-operation with customers and parties connected to Fingrid's grid.

The load and generation changes in a few large geographical areas are reviewed thoroughly each year. This also ensures the adequacy of the regional networks.

Fingrid participates in joint system planning both on the European level and within the Baltic Sea region through ENTSO-E, the European Network of Transmission System Operators for Electricity. A more comprehensive electricity market area is emerging in the Baltic Sea region, while at the same time the traditional Nordic electricity market is integrating with the market areas in Continental Europe and the Baltic countries.

The market in the Baltic Sea region is anticipated by looking at the scenarios on the EU level. The first shared regional plan for the Baltic Sea region was released in 2012. The plan examines the requirements imposed by the expanding electricity market on the transmission network.

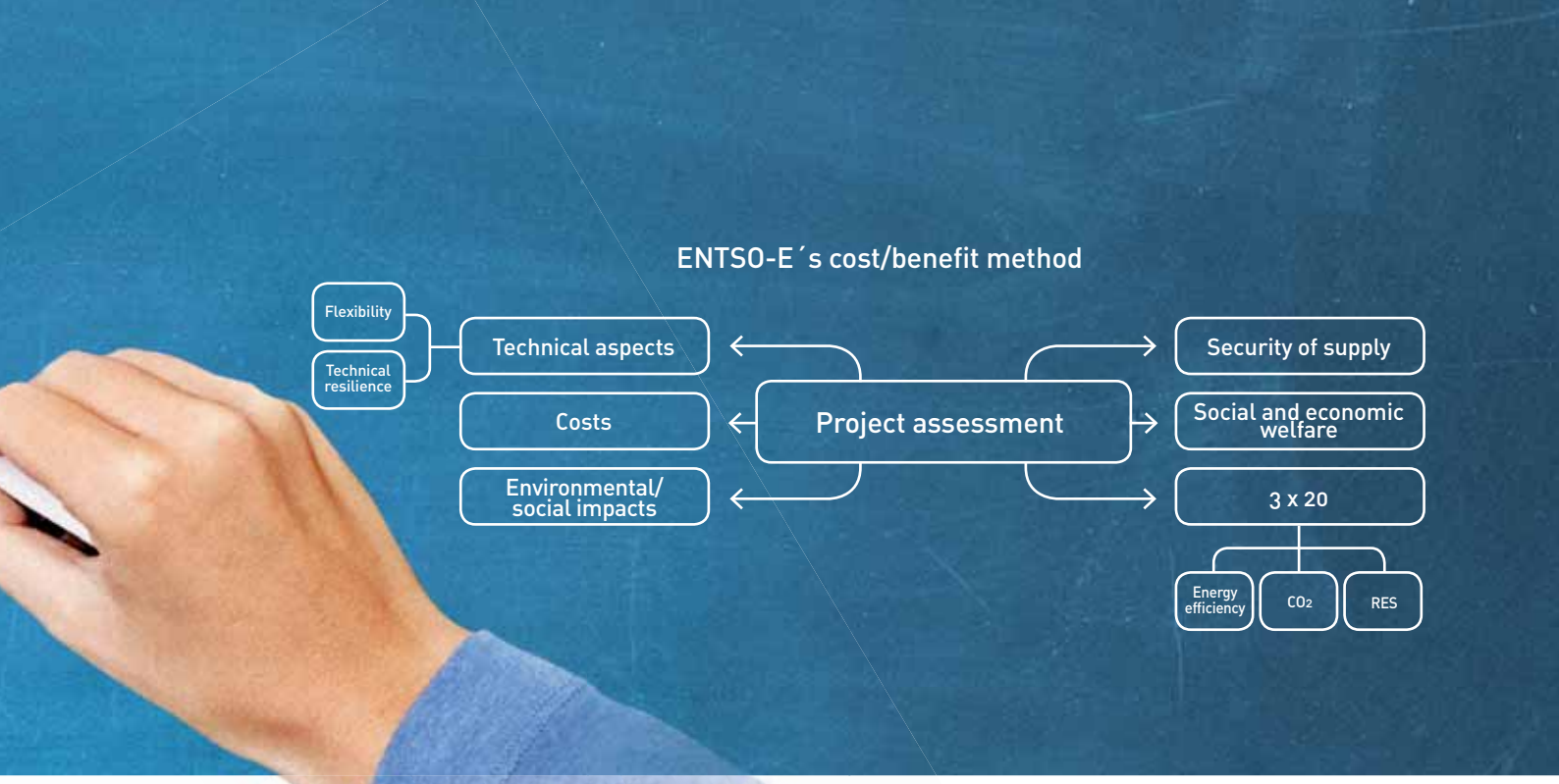
Projects carried out to promote the electricity market reduce the transmission congestions in the shared market area. The profitability of the projects is also assessed from the viewpoint of economic benefits. A new regional plan is already being prepared.

Cost/benefit analyses for cross-border lines

Various criteria are used to assess the advantages of the projects. Some of the projects are necessary because of system security. System security is guaranteed by keeping the power system in such a configuration that it will endure any individual fault at all targeted transmission volumes. Some of the projects are required so that new generation capacity or loads can be connected to the grid. There are also projects carried out due to developments in the systems of neighbouring countries. As an example, additional wind power capacity in Finland's neighbouring countries, but also increasing integration of the electricity market in the adjacent areas, will change the transmission needs in Finland, too.

The planning process assesses the impacts of a project on system security, security of supply, system losses, electricity market benefits, and the environment. The general acceptability and timing of the project are also estimated, and it is assessed how quickly the project can be executed. The costs are calculated and the different ways of implementation are figured out. The impacts on the environment must also be thought out. The benefits of the projects are always analysed from the point of view of corporate finances, too. This covers an assessment of the impacts on the company's proceeds and consequently on the accumulated tariffs.

The evaluation of the impacts on national economy covers the benefits gained by consumers and electricity producers, as well as congestion income and system losses. Modelling of the electricity



market is used to facilitate this process. The permanence of transmissions and congestion hours, which are needed so as to calculate the benefits, are found out by means of market simulations. The simulation tools aim to describe the functioning of the electricity market in different scenarios, which also reflect electricity consumption and production in specific hours or other time periods. As a result, the model shows the average electricity transmissions between various market areas and the price of electricity in different hours.

The electricity market benefits are usually only calculated for cross-border line projects or projects which influence cross-border transmission capacities. The goal is to keep Finland as a single price area, which is why market analyses within Finland are usually not carried out.

New European method

ENTSO-E has been preparing a common cost/benefit evaluation method, where the projects are assessed using several criteria, also other than electricity market benefits. The method describes two different ways of assessing the benefit gained by the electricity market parties. The method of assessing the total benefit gives assessments for each separate benefit indicator. The other method, assessment of savings in generation costs, evaluates the benefit of a network project exclusively as saved electricity production costs.

Neither method provides an assessment of the overall economic benefit or includes estimates of employment impacts, multiplicative effects, or other factors which are traditionally included in economic benefit.

Both of the described methods focus on the assessment of the benefits created in the electricity market. The benefit of the projects is obtained as the difference between two situations: one where the investment project is included and one where the project and its impact on the transmission capacity are excluded.

It is not always quite straightforward to estimate the loss impacts of grid construction projects. Grid construction projects add to the transmission capacity, which is why the system has higher transmission volumes after the reinforcement. As the transmission volumes increase, so do the losses, even though the volume of losses per transmitted energy would decrease. ENTSO-E's cost/benefit analysis aims to describe how the loss effects can be determined in a comparable way.

Some of the benefit criteria can only be assessed in terms of quality and some only in terms of financial aspects. The indicators are therefore presented with three-level colour coding, and any weighting of the different indicators is left to the stakeholders themselves. The method is used in the assessment of projects covered by the next European ten-year network development plan. Valuable experience of the application of the method will be obtained in this context. ■

BENEFITS AND COSTS ASSESSED IN THE METHOD

BENEFITS

- Improved security of supply, system security benefits
- Benefit to national economy, benefit to electricity market
- Integration of renewable energy sources
- Changes in system losses
- Changes in CO_2 emissions created in the system
- Technical resilience
- System flexibility

COSTS

- Total costs of project
- Social and environmental impacts

Construction work on the 400 kilovolt transmission line between Yllikkälä and Huutokoski was nearing completion in March.

Minimum disadvantage on the market as the goal in transmission outages

Fingrid's major capital investment programme and maintenance work on the transmission grid require electricity transmission outages, which occasionally influence the transmission capacity of the grid. The goal is to always schedule the outages so that their impacts on the electricity market are minimised.

Text by Arto Pahkin | **Photograph by** Johannes Wiehn

Disturbances in the high-voltage direct current connections to Finland in 2012 and 2013 have caused headache not only to the market parties but also to those planning and executing the transmission outages and to those heading maintenance and construction projects.

The planning of transmission outages is influenced by many factors. Firstly, it is difficult to forecast the volume of regional electricity production and loads at the time of the outage. Secondly, the outage arrangements necessitated by Fingrid's extensive construction programme are also considerable. The goal is to always minimise their impacts on system security. Additional challenges are brought by surprising and potentially long-term operation disturbances.

Cable fault postponed maintenance work on cross-border line

Several transmission outages, which influenced the cross-border transmission capacities, were carried out within Finland last year. The electricity market parties are always taken into account in such outages. As an example, the replacement of overhead earth wires on the Keminmaa–Svartby 400 kV cross-border line was originally scheduled for March this year, but the work has been postponed to a later date, because the transmission capacity between Finland and Sweden is limited by a concurrent fault in the Fenno-Skan 1 cable. A similar postponement was carried out last autumn at the Swedish end of the Fenno-Skan 1 connection due to a fire in the thyristor facility. The postponement of the maintenance work aims to mitigate the market effects caused by the cable fault.

The transmission outages are planned in co-operation with the other Nordic transmission system operators. The plans are drawn up with a perspective of a few years ahead. The goal is to adjust the transmission outage needs between the various Nordic countries so that the impacts on the market participants would be minimised and so that the agreed system security level could be retained in each country.

The transmission outages are adapted together within ENTSO-E's Nordic Outage Team. The TSOs have a shared Nordic Operational and Information System, which is used for managing the transmission outages affecting the cross-border transmission capacities. This co-operation will be developed further between the Nordic transmission system operators.

Significant outages must be communicated well in advance

In addition to enhanced co-operation, a European network code for system operation planning is being drawn up. The network code will require that significant transmission outages in the next year must be communicated to the transmission system operators by the late summer in the preceding year. The TSOs then evaluate the feasibility of the outages and propose changes where necessary. The final annual transmission outage plan would be ready towards the end of the preceding year. ■

Demand response provides new revenue opportunities

A large host of new players can participate in the balancing power and reserve markets in the next few years, when electric cars, for example, become more common. Development Manager **Jonne Jäppinen** is heading Fingrid's development project which aims to increase demand response in Finland.

Text by Outi Airaksinen
Photographs by Matti Immonen

WHO?

BORN in the late 1960s. Born and raised in Savo, moved to Espoo in adulthood.

EDUCATION B.Sc. in electric power engineering, B.Sc. in industrial engineering and management, MBA

CAREER Served in various system operation duties at Fingrid and its predecessors for about 20 years. Since the beginning of 2013 Development Manager for power system operation.

HOME AND FAMILY Single-family house in Nöykkiö in Espoo. We are a typical family in the area: parents, two children and a Volvo station wagon, although there are also some funnier vehicles. No golden retriever because of allergies, but my brother has one!

INTERESTS Downhill skiing, golf, gym, and as counterbalance a lot of sports-watching on the living room couch. Travelling with the family. Children's hobbies badminton and synchronised swimming have become familiar in the role of sponsor and driver.

MOTTO Things get done, despite or because of the attitude adopted from Savo...

"I need to be involved, even though it sometimes may get a bit too hectic. I want to do things hands on – where things are happening and where I can get to do something new," says Jonne Jäppinen, Development Manager for power system operation.

Jonne Jäppinen has been following the electricity market from a vanguard position for 20 years. He feels that it is now the right time to convert the visions embedded in smart grids into something tangible.

"It is not just a question of technology but also new business models – and how different companies can participate in the reserve market and balancing power market alongside Fingrid."

Since last autumn, the demand response project headed by Jonne Jäppinen has been finding partners and feasible business models, through which small and medium-sized enterprises could also draw benefits from demand response. In practice, this means earning money by providing Fingrid with reserves. The enterprises can achieve this by controlling their own electricity consumption.

"There has been demand response in electricity loads for about a decade in Finnish large-scale industries, such as the wood-processing, metal and chemical industries. However, we would like to increase the share of demand as a reserve and find new players – especially when energy-intensive industries seem to be diminishing in Finland."

Largely thanks to the new hourly energy meters, the electricity market is now also opening up quickly to small-scale electricity users.

Less generation elasticity

For Fingrid, increased demand response is a strategic project, which ultimately is about the functioning of the electricity market. The more inelastic electricity generation capacity – in other words generation that does not respond to changes in the demand or price of electricity – is built in Finland, the greater the need for costly balancing power and reserve power, if no elasticity is available in power consumption.

Nuclear power and for example wind and solar power, where the generation volumes depend on the weather rather than demand, are problematic forms of generation in terms of demand response. Jonne Jäppinen says that greater demand response would be by far the best and economically most sensible way to solve the equation.

"Fingrid currently has about 1,200 megawatts worth of its own and rented reserve power plants. Moreover, we have loads in large-scale energy-intensive industries, with these loads providing demand response. In the future, however, Finland must have the new nuclear power plant's worth of reserve power so that we can replace the necessary volume of power if the plant trips from the grid for some reason. Demand response can provide at least a partial solution to this."

Jonne Jäppinen hopes that the recently completed Forssa reserve power plant is absolutely the last new reserve power plant at least in the short term, because greater demand response would be a much more sensible option for the reserve power plants which stand idle. However, this requires a new mindset and examining new opportunities so that the resources could be utilised more extensively than before – not forgetting electricity users with small-scale consumption.

"Individual households still have it difficult to be involved in demand response, but all small and medium-sized enterprises using electricity could be active. Larger industrial enterprises probably still also have a lot of untapped potential and opportunities to increase demand response."

Batteries of electric cars as future energy reserves

When the price of electricity is determined by supply and demand, you can earn money in the market if you can sell electricity when the price is high, or if you can at least shift your consumption outside the price spikes. The savings can be considerable, because for example in the balancing power market in 2012, electricity during the most expensive hour cost as much as 40 times more than in the entire year on average.

In practice, demand response can concern temporary – perhaps only a few seconds in length – supply interruptions during extreme situations in the power system. Such interruptions are not necessarily noticed at all in real life.

"You can very well ask whether there is any point in constructing reserve power plants that stand idle, and whether consumption could yield even momentarily against compensation in cases where the supply interruption does not cause disadvantage to the electricity consumer. Such an interruption can take place as infrequently as once in 10 years."

According to Jonne Jäppinen, one very probable application of demand response would be electric cars, because their charging is hardly disturbed by short interruptions in the charging cycle.

Even though an electric car is still too costly an acquisition for many consumers, Jonne Jäppinen monitors the developments closely. The breakthrough of electric cars may actually be very close at least if the government follows Norway and Estonia and starts to subsidise electric cars. Electric motoring will not be impeded by a lack of infrastructure for charging the cars, because Finland is obliged by a proposed EU directive to build 7,000 public quick charging points for electric cars by 2020.

"We would like to increase the share of demand as a reserve and find new players."

It is quite possible that by then enterprises providing charging services will also make their loads available to Fingrid as a reserve against compensation. This should, at least in theory, lower the charging costs.

One of the visions for the future is to harness the batteries of electric cars to serve as energy reserves. If necessary, the batteries could provide power for use by the electricity market. "That requires a little more technology in the →

"When the price of electricity is determined by supply and demand, you can earn money in the market if you can sell electricity when the price is high, or if you can at least shift your consumption outside the price spikes."

Jonne Jäppinen

background, but in fact it is just another smart grid application," says Jonne Jäppinen.

The wind power intensive Denmark is already testing the utilisation of large batteries the size of a ship container as an intermediate storage when the power system cannot accommodate all wind power generated.

Even a small load can be valuable

Jonne Jäppinen says that even a small load is valuable if it can be controlled flexibly and quickly. Ideally, households with their smart homes also take part in demand response, but in practice individuals do not yet receive financial benefit from controlling their own consumption.

"I am really looking forward to taking advantage of timing my own electricity consumption outside the price spikes. It could be possible as soon as this year, but it all depends on the local distribution company," says Jonne Jäppinen.

The objective of Fingrid's demand response project is to identify and harness comprehensively the various reserves of electricity consumers, where the new technology offers opportunities. Reserves held by small and medium-sized businesses are also on the agenda. According to Jonne Jäppinen, such reserves can be found at least in manufacture and commerce.

"Taking part in demand response will require some initial investments from companies so that consumption can be controlled. In the long run, however, it is reflected in the profits. Large-scale consumption has a bigger potential for savings and more opportunities to participate in diverse markets."

In practice, Finland is at the forefront of developments. "Countries in Continental Europe are only contemplating whether to install hourly energy meters in the future. These meters are required by smart demand response. Such meters have already been installed in Finland," Jonne Jäppinen says.

Progress has been held up mainly by lack of information, because enterprises do not know how and with what types of loads they could be involved in demand response, and what is required of the relevant enterprises. The next stage in the demand response project is to provide information, for example on Fingrid's website. After that, the goal is to remove the obstacles that prevent new versatile loads from participating in demand response. This is carried out by critically reviewing the procedures and agreements honed over the years for the needs of large-scale enterprises.

Although there is sometimes a bit too much work, Jonne Jäppinen is confident. Things can be taken forward by discussing and by creating ideas and visions – and sometimes the pieces can fall into place when you are on the skiing track. ■

Pilot Juuso Pykälistö and maintenance management specialist Jarmo Lahtoniemi checking the flight plan before take-off. The ice removal tool made of a composite insulator is shown on the right.

Helicopter assisting the dropping of ice loads

Fingrid together with Helikopterikeskus Oy Helsinki has been developing a method for the dropping of ice loads from transmission lines by means of helicopter. The method tested in Eastern Finland has proved to be a cost-effective way of removing ice from the lines.

Text by Jarmo Lahtoniemi | **Photographs by** Mika Kasurinen

Massive ice loads on the overhead earth wires of transmission lines can cause transmission problems, and at worst they may even result in structural damage. Ice build-up has traditionally been monitored in conjunction with aerial inspections of power lines, and the ice loads have been dropped manually from the ground. The work has been slow and very difficult due to troublesome terrain conditions and in many cases considerable amount of snow.

The new method allows the dropping of ice loads during the inspection flight. The work is considerably faster when the ice load can be dropped as soon as it is detected. In an experiment carried out in January, the clearing of both overhead earth wires in a single span only took 1 to 5 minutes. In other words, in a short winter day a helicopter can drop the ice loads from the overhead earth wires in as many as 200 spans.

Because of being swift, the method is very cost-effective: based on initial experience, the method can save up to more than half of the costs of the dropping work. Additional savings will be gained as a result of improved quality of electricity. Correctly-timed dropping work can effectively prevent a situation which often leads to a disturbance, where the ice load makes the overhead earth wire sag to the level of the phase conductors or even below them.

The tool used in the new method is an ordinary 400 kilovolt composite insulator, whose stability has been improved by the addition of a separate weight. The insulator is taken into contact with the overhead earth wire beside the earth wire peak, and the insulator is then allowed to slide along the wire. There is a bearing in the insulator, which is why it begins to revolve as it is being pulled, and the silicon flanges in the insulator work like a circular saw, cutting even tough ice effectively from the surface of the overhead earth wire. Due to the insulating properties of the composite insulator, the work does not cause the risk of short circuit or earth fault. If necessary, the method can be applied to live phase conductors, too.

The new method prevents effectively the formation of a massive ice load. The work is safe, and electricity transmission disturbances caused by ice loads are significantly reduced. ■

Revised map service

Fingrid's open map service has been revised to be more user-friendly.

The map view of the service shows Fingrid's transmission grid, and it can be used for viewing various factors in the grid.

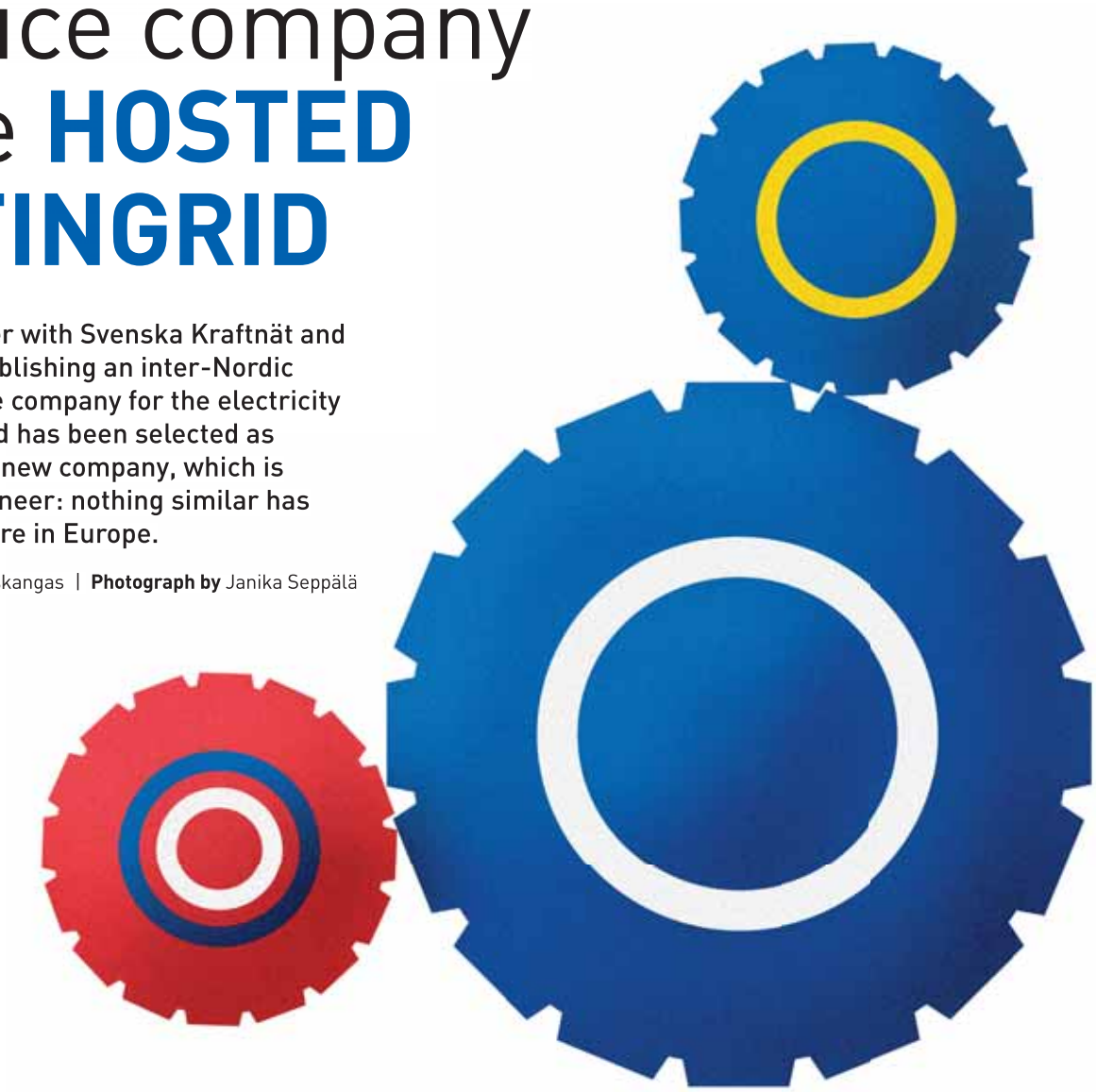
The service combines the submitting of feedback and contact requests, a possibility to view the grid projects, and indicating the location of operation disturbances and transmission outages in the grid.

The map service in Finnish can be accessed on our website from section Shortcuts, link Map service.

Nordic balance service company to be **HOSTED BY FINGRID**

Fingrid together with Svenska Kraftnät and Statnett is establishing an inter-Nordic balance service company for the electricity market. Finland has been selected as the base of the new company, which is becoming a pioneer: nothing similar has been done before in Europe.

Text by Maarit Kauniskangas | **Photograph by** Janika Seppälä



"Balance service together with Sweden and Norway will harmonise the practices and reduce the routines," says Project Manager **Minnakaisa Ahonen**, who has been heading the project at Fingrid. At present, the service is being prepared, and the project goes by the name Nordic Balance Settlement (NBS).

The goal is that in 2015, the balance settlement procedure will shift to a new company owned by the transmission system operators (TSOs) in Finland, Sweden and Norway. The other balance responsibility tasks, such as national balance management and the maintaining of the balancing power market, will remain the responsibility of the TSOs.

It was decided at the end of 2012 that the shared balance settlement service will be based in Finland. According to a report of an external consultant, the best place for the new company is Finland due to Fingrid's effective performance.

The principles of balance service have already been harmonised in the Nordic countries, although the practical ways to carry out the balance settlements are different in each country. Unified procedures will bring the inter-Nordic retail market of electricity one step closer. By simplifying the functions, the goal is to facilitate the access of electricity market players to a common market.

What will change?

"When the NBS service is up and running, the balance responsible parties operating in the electricity market no longer need to conclude separate imbalance settlement agreements with

"The balance responsible parties operating in the electricity market no longer need to conclude separate imbalance settlement agreements with the TSOs of Finland, Sweden and Norway."

Minnakaisa Ahonen

The NBS project group comprises Morten Torgalsbøen, Pasi Lintunen, Minnakaisa Ahonen and Mats Elmér.

the TSOs of Finland, Sweden and Norway. Instead, they sign a single agreement with NBS. The balance responsible parties will have common rules and standards. Bureaucracy will be reduced – and in the long term so will be the costs, even though there will be some additional costs initially when setting up the service," Minnakaisa Ahonen says.

Although the service will be centralised in Finland, the services are provided to the balance responsible parties in each country in their own language.

One major practical change concerns the data systems of the balance responsible parties and network companies. Among other things, a new message format is being planned in the messaging between these. "We will provide more information on the new format by the early summer," Minnakaisa Ahonen says.

Based at Fingrid

The NBS project was launched in 2010, when the TSOs in Finland, Sweden and Norway began the planning of a shared balance settlement service. The planning process has involved a reference group with representatives from network companies, electricity sellers, balance responsible parties, and a representative of the Energy Market Authority of each country. The group has received information about the service model and provided useful feedback. At the same time, the electricity market players have been able to prepare themselves for the change.

Now a specific company is being established for the NBS service. Other work in progress comprises the IT procurement and a handbook of how the balance settlements will be carried out in the future. Inter-Nordic balance settlement also calls for legislative changes in each country.

From the outset, the core persons of the project have comprised **Pasi Lintunen** from Finland, **Mats Elmér** from Sweden and **Morten Torgalsbøen** from Norway. The number of Fingrid employees involved in the project has grown as the project makes progress, since responsibility for the project is shifting to an increasing degree to Fingrid. For example personnel and legal matters, accounting and invoicing as well as IT support will be arranged by Fingrid in the future. However, the balance settlement is carried out locally in Sweden, Finland and Norway. Working outside Finland is possible thanks to electronic data transfer and reporting.

"Initially, the TSOs will offer their own balance settlement experts to the new company so that we can ensure proper skills and expertise also in the new company," Minnakaisa Ahonen says. ■

BALANCE SETTLEMENT ABC

BALANCE SETTLEMENT

- ascertains how much the volume of electricity procured and used in the preceding hour differs from that which had been estimated in advance
- determines in retrospect the volume of imbalance power (in megawatts hours): a party which has used more electricity than estimated must pay more for its electricity, and a party which has used less electricity than estimated receives a compensation.

BALANCE RESPONSIBLE PARTY

- an electricity market party which has signed a balance service agreement with the TSO
- estimates in advance how much it will produce and use electricity
- balances and settles its electricity balance with the TSO
- has access to the Nordic balancing power market
- must be available 24 hours a day and have adequate technical capabilities and credit worthiness.

INVOLVED IN NBS PROJECT:

- Project Manager: Minnakaisa Ahonen
- Steering group: Tania Pinzon, Pasi Aho, Tor Heiberg
- Project group: Pasi Lintunen, Mats Elmér, Morten Torgalsbøen
- Reference group: Niko Jauhiainen, Tom Backman, Daniel Nordgren, Sezgin Kadir, Margit Moen, Petter Sadøy, Suvi Lehtinen, Vidar Slettehaug, Anders Wallinder

"The substation to be constructed in Naantali will enable the connection of the future submarine cable from the Åland Islands to the Finnish grid."
Jari Tiusanen

New Naantalinsalmi substation TO ENSURE SYSTEM SECURITY

Fingrid will build a new 110 kilovolt substation in Naantali, enabling the connection of a new HVDC submarine cable connection from the Åland islands and a new power plant being planned in Naantali to Fingrid's grid.

Text by Antti Lagus | **Photographs by** Valtteri Kantanen and Jari Tiusanen

The existing switching station located in conjunction with the Naantali power plant is almost 50 years old and no longer meets the current system security requirements.

"The new substation is due to be completed in the spring of 2015. The transmission connection to the Åland Islands will be introduced at the end of the same year. The direct current converter station for the Åland Islands' submarine cable will be built next to the new substation," says Project Manager **Jari Tiusanen**.

He says that the project is not about the renewal of an existing substation but about a completely new station. The substation will be built under the existing 110 kilovolt lines less than a kilometre away from the old switching station. The goal is to utilise the existing lines and towers wherever possible. Provisions will also be made for a potential future 400 kilovolt power line.

Conventional structure

The new substation will allow the connection of a new multi-fuel power plant, which is planned in Naantali, to Fingrid's grid. Jari Tiusanen says that it also makes preparations for a rise in electricity consumption in the Turku region.

The switching station will be a conventional outdoor unit. The substation will have two main busbars and one transfer busbar. The project covers preliminarily 12 outgoing bays and a bus coupler circuit breaker. There are more than 100 similar 110 kilovolt switching facilities in Finland in Fingrid's ownership alone. The substation will not have a 400 kilovolt switching plant at this stage, but one has been taken into account in the space reservations.

Electricity transmissions between mainland Finland and the Åland Islands will constitute an interesting aspect at the new substation. Even though the submarine cable will be built to improve the system security of the power system on Åland, it also indirectly increases the technical transmission capacity between Central Sweden and mainland Finland in both directions by a maximum of 80 megawatts. ■

This is the site of Naantalinsalmi substation.

ÅLAND ISLANDS – a future electricity exporter?

Electricity production on the Åland Islands is on the increase. In the future, electricity can be imported from the Åland Islands to mainland Finland.

"Most of the electricity used on the Åland Islands is delivered from Sweden, but the share of local wind power is on the increase. In the future, there may be even more wind power, and the volume of surplus wind power can be significant at times. In these cases, the surplus can be transferred to Finland using the submarine cable," says Fingrid's Development Manager **Juha Hiekkala**.

New connection could level out the price differences

Despite the solid cross-border transmission connections, the price of electricity in Finland last year was often higher than in Sweden. Great price differences are a drawback in terms of the functioning of the market.

"The price differences were due to factors such as a good hydropower situation and problems in electricity transmission to Finland. The Fenno-Skan 2 HVDC connection was out of use because a ship's anchor damaged the cable, and a fire during the annual maintenance of Fenno-Skan 1 put this link out of order for a long time," Juha Hiekkala says.

Last year's problems were not relieved by electricity imports from Russia, as the price of Russian electricity was no longer competitive due to the capacity compensation introduced in Russia.

Market functioning can be improved by building more interconnectors between Finland and Sweden. A third AC connection to Northern Sweden has been planned for a long time, but no decision of its construction has been made.

"The transmission connection to the Åland Islands to be introduced in 2015 could add to the transmission capacity between Finland and Sweden and reduce the price differences," Juha Hiekkala says.

Too small to be a price area

Since the area of the Åland Islands is very small, it is not suitable as a price area of its own in Nord Pool Spot. Juha Hiekkala says that there should be another way in which electricity production and consumption on the Åland Islands could be separated from other electricity trade. The system should be able to take into account how much of the connections of the Åland Islands are available for increasing the transmission capacity between Finland and Sweden.

"This is a new kind of approach for Nord Pool Spot, but we believe that it can be managed. There will also be other similar cases when offshore wind parks are taken into use," Juha Hiekkala says.

However, he is a little concerned that the arrangements for the Åland connection will not be overshadowed by the other arrangements undertaken by Nord Pool Spot. These other arrangements are related to the integration of the electricity markets in the Nordic countries and Continental Europe. ■

INFO

In the systems of Nord Pool Spot, which takes care of the Nordic electricity market, Sweden is divided into four bidding areas. Finland is a bidding area of its own. From the point of view of the functioning of the market, it is advantageous if the prices in the neighbouring countries do not differ much from each other. The neighbouring areas of Finland are Central Sweden, Northern Sweden and Estonia.

The primary transmission interconnectors between Finland and Sweden are the HVDC submarine connections Fenno-Skan 1 (550 megawatts) and Fenno-Skan 2 (800 megawatts), which was commissioned in the autumn of 2011. There is also an alternating current connection from Northern Sweden (1,500 megawatts).

The first field tower can be found at address Rantakulmantie 134, Hyvinkää.

Field tower erected **IN HYVINKÄÄ**

Fingrid's first field tower has been erected near the housing fair area of next summer in Hyvinkää. The tower is part of the transmission line project between Nurmijärvi, Hyvinkää and Hikiä in Southern Finland. The new tower has been designed to minimise the disadvantage inflicted on agriculture and to improve occupational safety.

Text by Tiina Miettinen | **Photographs by** Juhani Eskelinen

The foundation of the field tower consists of concrete sections joined together. The contractor in Hyvinkää is Eltel Networks Oy.

Agricultural machinery can be operated more freely near the new tower than in the vicinity of conventional guyed towers. Many agricultural machines can run between the legs of the tower, since the space under the tower is 7–10 metres in the longitudinal direction and 14 metres in the cross direction of the line. Protective structures surrounding the legs of the tower prevent potential collisions with the legs. The field tower is approximately the same height as a conventional 400 kilovolt tower: the crossarm rises to 31–35 metres.

The foundations of the field tower are composed of two prefabricated concrete sections joined together. Each part weighs 3 tonnes. The four-legged tower is anchored to the ground using foundations of 24 tonnes. Separate concreting work is not required, but the entire foundation is built as prefabricated constructions.

The field tower erected in Hyvinkää is the first of its kind. Others will soon follow, because such towers will also be used in the transmission line project between Ulvila and Kristiinankaupunki, which is under construction.

In the future, these towers will be used at Fingrid's all new 400 kilovolt line sites in field areas where the towers are applicable in terms of the terrain conditions. Typically, such areas cover 10 to 60 towers in a transmission line project. The field towers will primarily be used on new transmission lines, but they can also be erected on existing lines in conjunction with the replacement of a line or some its towers.

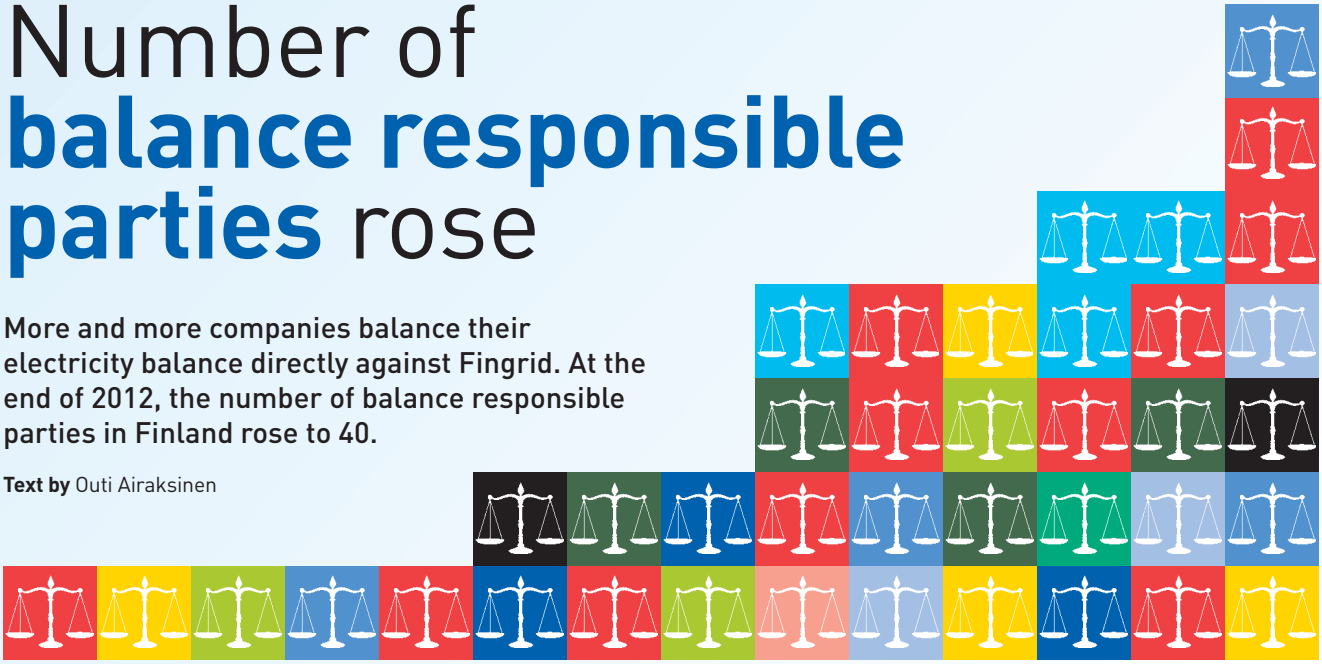
Award-winning tower

The field tower model has been devised in co-operation with design agency Muotohiomo Oy. The tower was granted the Fennia Prize 2012 Grand Prix in industrial design last June. The jury commended Fingrid for the use of design in an innovative and open-minded manner as part of an indispensable infrastructure. The award-winning tower model is gaining a "little brother", because Fingrid has been designing a similar structure for 110 kilovolt transmission lines. ■

Number of **balance responsible parties** rose

More and more companies balance their electricity balance directly against Fingrid. At the end of 2012, the number of balance responsible parties in Finland rose to 40.

Text by Outi Airaksinen



Fingrid has managed the nationwide balance service in Finland by law for more than ten years now. In balance service, companies which have applied for the position of a balance responsible party do the balancing by matching their electricity procurement with their consumption. This is done by selling or purchasing imbalance power to or from Fingrid.

The open electricity supplier of these balance responsible parties is Fingrid, to whom the balance responsible parties report their electricity supplies, deficit and surplus. Fingrid is committed to buying and selling imbalance power as necessary.

As many as 12 companies started as new balance responsible parties in Finland in early December, when PVO-Pool Oy, which was previously in charge of the open electricity supply of the companies, changed its operations.

The new balance responsible parties are: Energia Myynti Suomi Oy, Stora Enso Oyj, Metsä Board Oyj, Kemira Oyj, Pori Energia, Yara Suomi Oy, Ruukki Metals Oy, PVO Power Management Oy, Oy Perhonjoki Ab, Oulun Energia, Kokkolan Energia and Etelä-Suomen Voima Oy. In all, there are now 40 balance responsible parties in Finland, which take care of their imbalance power matters directly with Fingrid.

"It would be quite possible that there would only be one or two balance responsible parties, and the other electricity market players would work under them. However, this raises the question of whether the market would function effectively and whether the players would no longer be independent," says Fingrid's Balance Service Manager **Pasi Aho**.

There are now about equally as many balance responsible parties in Finland and Sweden. Instead, in Norway almost all electricity market parties balance their electricity balance directly against the transmission system operator.

"Due to the necessary data systems and requirements concerning 24-hour reporting, it is not necessarily worthwhile for all companies to serve as balance responsible parties. A balance responsible party accumulates costs, and it may be more affordable to do some things in co-operation with others," Pasi Aho says.

Equal conditions for all

In practice, the balance responsible parties represent the foremost players in the electricity market in Finland, such as electricity production and sales companies as well as energy-intensive industries. Some of the companies provide an open supply of electricity to their own customers or shareholders. There are also some foreign companies engaged in the sales of electricity.

"The balance responsible parties are currently a rather heterogeneous group, because the companies must organise the open supply of electricity in some manner anyway. Fingrid provides this service at public conditions which are the same for all without the companies having to look for quotations from various sources," Pasi Aho says.

A company wishing to become a balance responsible party signs a balance service agreement with Fingrid. The agreement requires from the balance responsible parties issues such as a guarantee, 24/7 accessibility, and electronic exchange of information concerning reporting.

"We impose certain requirements, and if you can fulfil them, you can become a balance responsible party. In this way, a player can become more independent of the other players and gain direct access to the balancing power market, among other things," Pasi Aho says.

A balance responsible party also has access to Fingrid's balance settlement services. Correspondingly, the company must provide Fingrid with a continuous process of balance settlement, on the basis of which the imbalance power is invoiced. A role as a balance responsible party also gives the companies access to the forefront of information, because Fingrid invites the balance responsible parties for example to various seminars and customer events. ■

"Enhanced transparency improves the efforts"

Etelä-Suomen Voima Oy owned by 15 local electricity companies made a decision last spring to apply for a position as a balance responsible party with Fingrid, if this would not cause a significant increase in costs.

"We wanted to make the supply chain lower. From the perspective of our shareholders, there were previously two intermediaries, but now we have direct contacts with Fingrid, the highest level in Finland. This has expedited certain processes and considerably improved transparency, which in turn will help us in our quest to lower the costs," says Development Director **Kimmo Tyni** of Etelä-Suomen Voima.

Etelä-Suomen Voima Oy balances the electricity balances of six of its shareholders. Previously, the counterparty in the sales and purchase of imbalance power was PVO-Pool Oy, but the business was streamlined as of the beginning of December. As the balance responsible party, Etelä-Suomen Voima primarily makes sure that money moves at the right time and to the right place, because the company has outsourced imbalance management and shared balance settlements to Empower Oy.

"Our shareholders have no resources of their own for imbalance management and balance settlement. We have made the system primarily to reduce bureaucracy, but it also benefits us in view of costs, because the scheme offers economies of scale," says Kimmo Tyni.

The electricity deficit and surplus problems of the six companies are mainly dealt with using mutual arrangements between the companies, which means that the need for actual balance service is smaller. Based on a few months' experience, Kimmo Tyni is satisfied with Fingrid's balance service.

"Everything has worked just like we think it should. Our initial intention was to introduce the service in early 2013, but the amendment of the terms of PVO-Pool's open electricity supply expedited the transition. Still, we knew well in advance what is required from us so that we can become a balance responsible party. The process was easy and smooth in every way," says Kimmo Tyni.

"It all worked just like we planned"

Ruukki Metals Oy, a subsidiary of Rautaruukki Oyj, became a new balance responsible party with Fingrid last December when its electricity procurement and balance arrangements through PVO-Pool changed.

"The change as compared to the previous situation has been minor despite our new role. It mainly meant the signing of agreements and giving of guarantees to Fingrid. The actual work continues same as before – we buy and sell imbalance power even if the counterparty is now different," says Energy Manager **Mikko Lepistö** of Rautaruukki.

Ruukki's annual electricity consumption is 1.2 terawatt hours, which represents about 1.5 per cent of the total electricity consumption in Finland. The company produces itself approximately 40 per cent of the electricity it consumes, because the blast furnace gas and coke oven gas generated in its processes at the Raahe steel mill are utilised as a fuel at the power plant.

According to Mikko Lepistö, Fingrid's balance service works exactly as the company had thought. "The change-over has not had a significant cost impact. Instead, we are concerned about the transmission connections between electricity price areas. A failure in a cable between Finland and Sweden may result in significant costs to us."

"The goal should be to avoid price differences through every means available and to repair the faults as quickly as possible. Last year, the area price difference between Finland and Sweden was 5.44 euros per megawatt hour, and through the spot prices this price difference affects the price of all Finnish electricity – including imbalance power."

"Same rules for all facilitate the operations"

Like many other PVO-Pool's shareholders, the wood-processing company Stora Enso Oyj started as a balance responsible party with Fingrid at the beginning of December.

"As far as electricity consumption is concerned, we are now involved in Fingrid's balance service, but on the production side we continue with the former approach. The change was due to the rearrangements in electricity procurement within Pohjolan Voima," says **Jukka Mikkonen**, Vice President, Energy, of Stora Enso Oyj Energy Services.

Stora Enso consumes 5.5 to 6 terawatt hours of electricity per year in Finland. Of this, more than half is produced by its own mills. Being a large-scale electricity user, co-operation with Fingrid was familiar to Stora Enso from earlier contexts.

"We have dealings with Fingrid in issues such as electricity transmission, so balance service with Fingrid was a sensible solution for us," Jukka Mikkonen says.

Taking the matters into the company's own hands has gone quite well, because many of the tasks associated with balance service and the contents of balance settlement were already familiar issues for the company from the period when the counterparty was PVO-Pool. However, the change required matters such as reviewing the functions and conditions necessitated by the role as a balance responsible party.

"We had to learn some new things, but this was facilitated by the fact that the agreement and the conditions are clear. When the rules are the same for everyone, the actual operations are easier."

Grid ABC

This article series deals with the main operating principles, equipment units and components in the main grid. The articles published in the series previously can be viewed on our website at www.fingrid.fi.

Cross-border transmission connections between Russia and Finland

Electricity has been imported to Finland from Russia since the 1960s. At present, the total import capacity is 1,500 megawatts. Most of the electricity from Russia is imported via the 400 kilovolt connections from Vyborg in Russia. The next step is to shift to two-way transmission of electricity between the two countries.

Text by Pertti Kuronen | **Photograph by** Johannes Wiehn

Electricity imports from Russia to Finland have traditionally had an important role in Finnish electricity supply. At their height, the imports have almost corresponded to the annual hydropower production volume in Finland.

Transmission of electricity between the two countries started in the 1960s. Enso-Gutzeit launched electricity imports from Svetogorsk in the Soviet Union to Imatra in Finland, using its own 110 kilovolt transmission line, in 1961. The import capacity at that time was 25 megawatts. Hydropower units corresponding to the import capacity were connected beyond the Imatra–Svetogorsk transmission line, and the plants were connected to the Finnish transmission grid. A similar mode of operation still continues.

In Ivalo in northern Lapland, local electricity production was supplemented by connecting it to the Russian grid using a 35 kilovolt line in 1965. This took place from Kaitakoski, which is one of the hydropower plants on river Paatsjoki. A 110 kilovolt line across the border was completed in 1975, and it was extended to Ivalo in 1981.

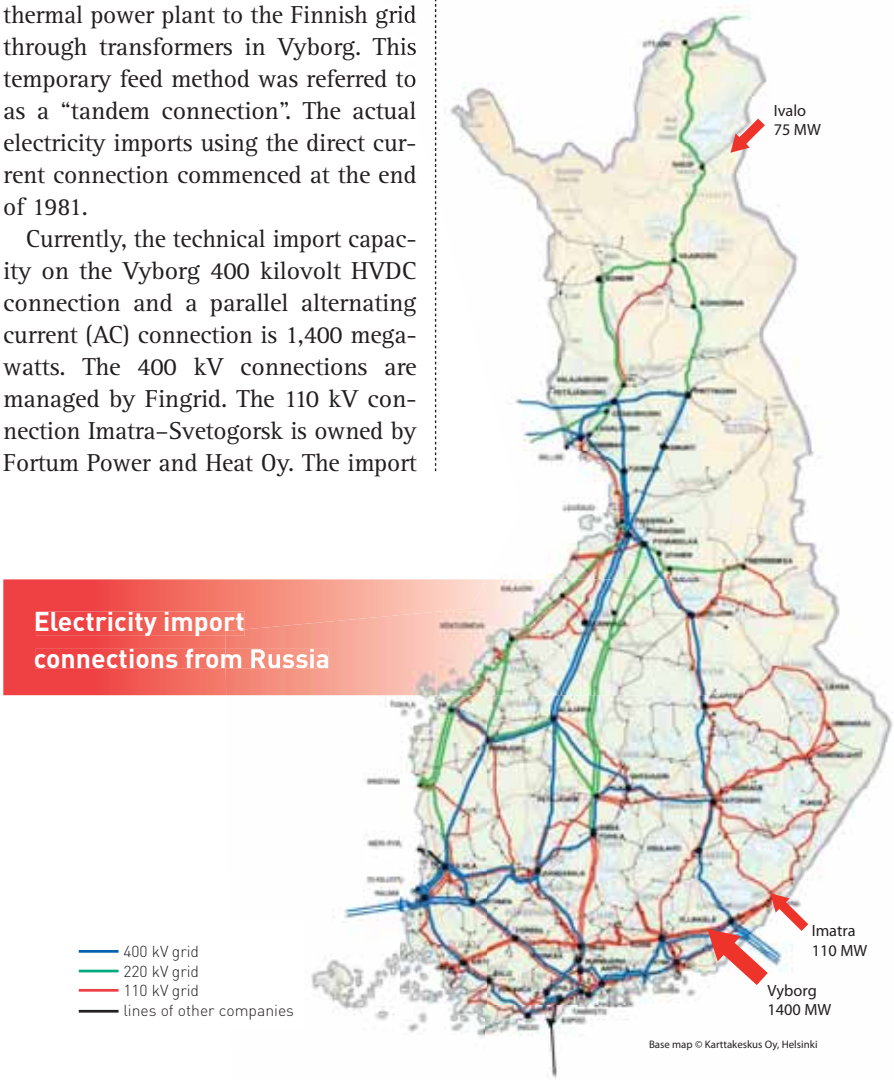
Ivalo was connected to the Russian grid until 2000, when the Ivalo 220/110 kilovolt substation was connected permanently to the 220 kilovolt power line from Vajukoski in Kemijoki to Varangerbotn in Northern Norway. This line had been completed in 1988. Earlier, the 220 kilovolt line had served as a backup connection for Ivalo.

Electricity imports from Russia have continued and are still continuing by connecting Russian generating machinery, which corresponds to the import capacity, to the Finnish grid via the Ivalo Kaitakoski 110 kilovolt transmission line.

An agreement on the construction of the Vyborg high-voltage direct current (HVDC) converter station was signed with the Russian party in 1975. Imports of electricity via Vyborg began in 1980, initially at a power of 300 megawatts by connecting the Kirishin thermal power plant to the Finnish grid through transformers in Vyborg. This temporary feed method was referred to as a "tandem connection". The actual electricity imports using the direct current connection commenced at the end of 1981.

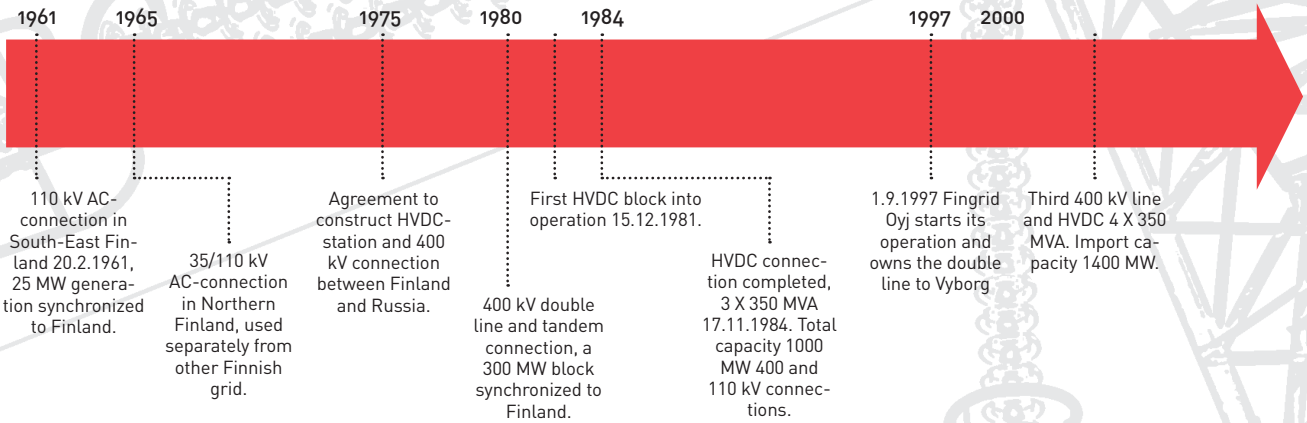
Currently, the technical import capacity on the Vyborg 400 kilovolt HVDC connection and a parallel alternating current (AC) connection is 1,400 megawatts. The 400 kV connections are managed by Fingrid. The 110 kV connection Imatra–Svetogorsk is owned by Fortum Power and Heat Oy. The import capacity of the connection is about 110 megawatts. The 110 kilovolt connection Ivalo–Kaitakoski in Lapland is owned by Inergia Oy, and its import capacity is about 75 megawatts.

The Vyborg transmission link consists of two parts: an HVDC and an AC connection. The HVDC connection consists of four HVDC blocks, each →



Electricity import connections from Russia

Development of transmission connections between Finland and Russia



with a nominal power of 350 MVA. The maximum commercial imports through these total 900 megawatts, and another 100 megawatts have been reserved as a technical reserve. The technical capacity is hence 1,000 megawatts.

Alongside the HVDC connection, there is an AC connection through which one power plant (3 x 150 MW) at the north-western plant located near St Petersburg is connected to the Finnish grid. In other words, the total technical capacity is approx. 1,400 megawatts, and the commercial imports are 1,300 megawatts.

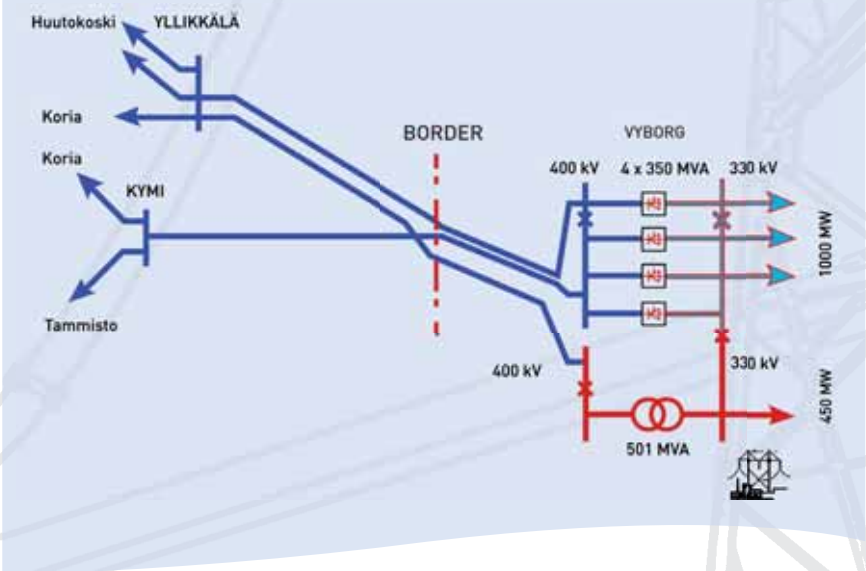
In Russia, three 330 kV lines run to Vyborg. Three of these feed the converter station and one is connected via a 330/400 kV transformer to the Yllikkälä 400 kV substation in Finland. Of the other two 400 kV transmission lines running to Finland, one is connected to the Yllikkälä substation and the other to the Kymi substation. These arrangements have maintained the reliability of the connection itself and ensured the system security of the Finnish power system during potential disorders.

Why is such a back-to-back HVDC link needed in Vyborg? Why are the lines not connected directly together? The Russian power system is quite extensive, and the Nordic power system is also relatively large. Managing the power transmissions on an individual transmission connection between two large power systems is difficult, if not impossible, especially when there are differences in the power control principles as well as operation and design criteria of the power systems. An HVDC connection eliminates these differences between the power systems, and the power of the connection settles to the desired, set value. It could be said that the HVDC connection combines both technical and commercial power transmission.

The Russian cross-border transmission connections have traditionally been used for the import of electricity to Finland. The Vyborg back-to-back HVDC link was originally constructed only in view of imports, and the exports of electricity to Russia are not possible without modifications. The conversion of one HVDC block to two-way transmissions has been planned with the Russian parties. The goal is to implement the necessary changes and to agree on the commercial terms so that the two-way operation of the connection could be launched in 2014 at a power of 350 megawatts.

Over time, when transmission connections must be renewed due to ageing, two-way transmission of electricity will be introduced as a natural development. ■

Electricity import connections from Russia



TLT-Building Oy selected as the contractor for the Hovinpaikka–Kontiolahti transmission line

Fingrid signed a contract with TLT-Building Oy on the construction of the Hovinpaikka–Kontiolahti 110 kilovolt transmission line on 14 February 2013. The line will replace the existing line built in the 1950s.

The length of the new line section is approx. 30.5 kilometres. The contract covers the construction of a new line between Hovinpaikka and Kontiolahti primarily in the right-of-way of an old line which will be dismantled. The contract also includes modification work on the Kontiolahti–Puhos line and the rerouting of the line to Pamilo so that a Puhos–Pamilo line is established.

The line section covered by the contract is part of the Varkaus–Kontiolahti line. When the whole line is completed, there will be a new line between Huutokoski and Kontiolahti. The project is part of the grid development plan for the Savo-Karelia region, bringing more transmission capacity to North Karelia and improving system security.

The value of the contract is approx. 4.5 million euros. The work will begin with foundation work in the summer of 2013. The line will be ready no later than 20 May 2015.

Shown in the photograph in the front row from the left are Managing Director Vesa Nurmi of TLT-Building Oy, and Fingrid's Executive Vice President Kari Kuusela and Senior Vice President Jussi Jyrinsalo. In the back row from left: Managing Director Eero Hakala of TLT-Energy Oy, and Project Manager Ritva Hauvonen and Construction Manager Keijo Välimaa of Fingrid.

Photograph by Olli Häkämies

Results of customer survey

Fingrid's overall grade in the 2012 customer survey was 8.38. The grade fell slightly from the previous year. This was mainly due to the tariff increases and transmission congestions.

Fingrid arranged the annual survey of its performance towards the end of 2012. The survey form was sent to Fingrid's grid service and balance service customers, electricity market parties, service providers, regulators, and industrial organisations.

A total of 212 stakeholder representatives replied to the survey, i.e. 50 per cent of those who received the survey form. Fingrid's general grade among all respondents was 8.38 on a scale from 4 to 10, and among grid customers slightly higher, 8.47.

The general grade decreased slightly from the previous year, when it was 8.42. This was mainly due to the tariff increases and transmission congestions. However, the grade given by the relevant stakeholders for both the electricity market services 8.32 (8.25 last year) and the grid services 8.71 (8.60) went up. Only the average grade given by the balance service customers came down, to 8.43 (8.71). Based on the survey, the customers wish more co-operation and personal meetings.

Open house on Valentine's Day

Photographs by Juhani Eskelinen

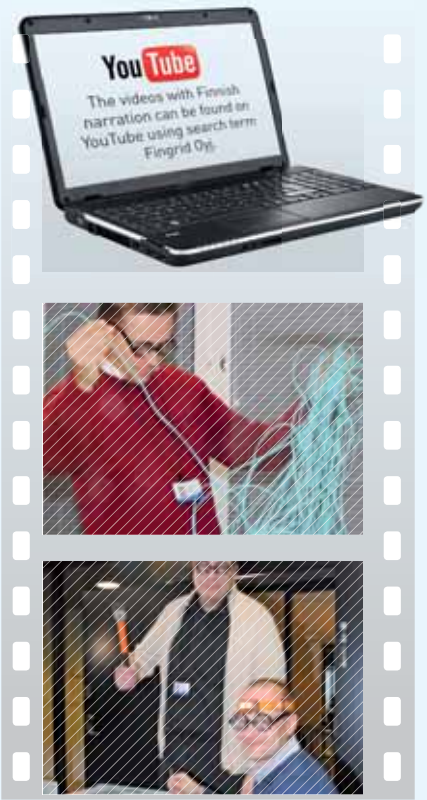
The housewarming party of Fingrid's new head office was held in Käpylä in Helsinki on Valentine's Day 14 February. The guests were given a guided tour of the new premises. Video presentations of Fingrid's office and Main Grid Control Centre were also released in the event.

Koop Arponen's ensemble Flute of Shame provided the guests with entertainment.

Katrina Klinge-Sonninen and Juha Kekkonen receiving the visitors.

Fingrid's presentation videos on YouTube

Fingrid has released two new presentation videos: "Talo täynnä virtaa" shows Fingrid's operations and people in the new facilities, and "Kantaverkkokeskus" describes the Main Grid Control Centre, showing how the Finnish power system is monitored day and night.



To see, you need to stop

The results of surveys conducted of the world of work in recent years do not make very pleasant reading. The meaningfulness of work has been coming down for a long time. Work imposes a greater and greater mental burden. You can sleep off physical exertion over the weekend, but your head is active at all times, so it is not easy to push job matters to the background. Haste and deadlines also represent everyday features for many.

How can we retain our creativity in the midst of stress? We could use innovation to come up with new ways of working to avoid the haste. Overwhelmed by a negative mood, we perceive a smaller and smaller slice of the world, and we cannot focus on the essential.

What adds to a positive attitude and the skill of calming down? In one study, an attempt to achieve this was made by asking the test subjects to record the daily positive events and emotions and by learning meditation skills. First, they thought of positive thoughts of themselves, then of their near ones, and finally even of the difficult people at the workplace. After nine weeks of this, the test subjects' personal strength and creativity had increased, they could receive support from their colleagues better than before, their satisfaction at life had increased, and they were even less susceptible to illness. The US Marine Corps is also testing the same approach with the new recruits.

We and our daily planners are like the overgrown park that was thinned out in our neighbourhood last summer. The leaves of the trees that were left standing were at a high altitude, and the bare trees did not look very attractive. However, the gardener assured that the landscape will look nice in five years. He also said that the thinning severely disturbs the life of shrub snails. They can no longer crawl among the bushes and raise all-devouring offspring, because the sun and wind can penetrate the underbrush.

The logging of the park prompted me to reflect on the state of my own head (this opportunity was also due to my ankle which I sprained while jogging). The ankle was operated on, so I had to go on sick leave, because I could not walk with the special shoe that kept my foot in a stable position. As I had to start clearing my planner, I noticed that it had become overgrown, quite on its own. It was completely short of void, which would help me to see far and give room to breathe.

I went to the cottage to pass some time. When I got out for the first time, I noticed a stone in the yard. The stone had become covered with bright green moss in the shape of a heart. It had not appeared there during the two weeks of my sick leave; it was just that I had been too busy to see it before.

To see, you need to stop, but a positive attitude also gives perception and enables new ideas. Emotions also tend to be transmitted from one person to another, even over the telephone. If you come to

work feeling annoyed, it is transmitted instantly to your co-workers by means of the mirror neurons in our brains. Customers will experience that they obtain service of better quality when the person attending to customer service is in a good mood.

This is why managers and supervisors should pay particular attention to the creation of a positive atmosphere. A neutral approach is not sufficient, because in many cases it is interpreted as a negative emotion. All members of the workplace community can create a cycle of positivity through their own action: by thanking, commending, and by describing the highlights of their work.

Creativity requires calming down and positive emotions – and not even money. ■

Marja-Liisa Manka, M.Soc.Sc., Ph.D., has served as a professor in work welfare at the University of Tampere since 2004. Before that, she worked as an entrepreneur, head of further education centre, and as training manager at Saarioinen Oy, among others. In 2011, she was elected the social scientist of the year and an advocate of good world of work. She has also written books on the topic, most recently "Työnilo" (2012).

Fingrid's annual review and financial statements 2012: **Profit improved significantly**

The financial statements of the Fingrid Group for 2012 were published in February. Fingrid's profit was improved by the increase of 30 per cent in the grid tariffs and by the congestion income on the border between Finland and Sweden resulting from the major area price differences. On the other hand, the Russian cross-border transmission income and inter-TSO compensations in the European market place decreased considerably because the electricity imports from Russia came down.

"Among the costs, especially the costs of reserves which safeguard the system security of the transmission system increased on 2011. The maintenance management costs were raised by the repair of a fault in the Fenno-Skan 2 cable," says Fingrid's President & CEO **Jukka Ruusunen**.

Net borrowing by the company grew due to its sizeable capital investment programme. During 2012, Fingrid issued a public bond valued at 300 million euros and with a maturity of 12 years under the company's International Medium Term Note Programme.

Fingrid's capital expenditure in the transmission system totalled 139 million euros. Fingrid had several ongoing capital investment projects for ensuring system security and the adequacy of transmission capacity in the future.

The system security of the transmission grid was excellent after two poorer years. The number of disturbances in the grid was at the average level, but the disadvantage inflicted on the customers and society as a result of the disturbances was very small.

The year was exceptional in the electricity market. There was very abundant supply of Nordic hydropower throughout the year, which clearly brought down the price level in the wholesale market. However, the Finnish market did not benefit fully from the inexpensive hydropower. One of the two submarine cables between Finland and Sweden was out of order for much of the year, which is why the full transmission capacity between Finland and Sweden could not be utilised. As a result, a record-high amount of congestion income, 88 million euros, was created on the border between Finland and Sweden.

Fingrid's annual review and financial statements are available on the Internet at www.fingrid.fi (under Investors). Printed publications can be requested from Fingrid's communications.

Electricity Museum Elektra shedding light on the origins of energy

Exhibition "Energiaa vesipyörästä fuusioon" on energy is opening at Electricity Museum Elektra in the summer of 2013.

Our energy consumption has been increasing steadily in recent decades, and the growth seems to continue. At the same time, we aim to decrease the burden on the atmosphere and develop new energy production technologies. Where are we going in energy issues, and how have we arranged our energy supply so far? These are among the questions to which an energy exhibition at Electricity Museum Elektra in Hämeenlinna in the summer of 2013 is seeking answers. The exhibition will be expanded further in 2014.

The main focus in the exhibition is on electricity and its central role in contemporary energy supply. The exhibition visitors can try out for example a copy of the world's first electric generator, and get to know new trends in energy production – not forgetting private power generation. The exhibition presents the wide spectrum of energy consumption and examines how society as a whole and each one of us can conserve energy. Should we build our homes with better insulation, or maybe we should start using hydrogen cars? Should we simply give up buying new things? Could we produce our own electricity from wind and solar sources? There are many interesting things to see and try out for people of all ages.

Fingrid Oyj sponsors Electricity Museum Elektra. More information about the museum at www.elektra.fi

Text by Ville Nyman

ENERGIAA vesipyörästä fuusioon

Two-way electricity trade between Finland and Russia being prepared

Fingrid and the Russian grid parties FGC UES and SO UPS as well as the Russian NP Market Council are preparing a trading model for two-way electricity trade between Finland and Russia and analysing its technical conditions.

At present, electricity transmission on the 400 kilovolt cross-border interconnectors is only possible from Russia to Finland. In two-way trade, one of the four HVDC links from Vyborg (capacity 350 megawatts) would be used for transmitting electricity from Finland to Russia. Two-way trade is expected to be possible from the beginning of 2014. The starting date depends on the results of the technical analyses and testing and on the completion of the related procedures.

GRID QUIZ

Competition to the readers of Fingrid Magazine

Answer the below questions and send your reply by fax (number +358 (0)30 395 5196) or mail to Fingrid no later than 31 May 2013. Address: Fingrid Oyj, PL 530, 00101 HELSINKI, FINLAND. Mark the envelope with "Verkkovisa". Among all those who have given right answers, we will give five men's leather wallets as prizes by drawing lots. The answers to the questions can be found in the articles of this magazine.

1. In what year will the European electricity market be linked together according to the plans?
- 2014
- 2015
- 2016

2. By virtue of the proposed EU directive, how many public charging points for electric cars should Finland have by 2020?
- 2,500
- 5,000
- 7,000

3. When the development project for the grid in Ostrobothnia will be completed, between which towns will the 400 kilovolt ring network run?
- Kokkola and Oulu
- Kristiinankaupunki and Oulu
- Pori and Oulu

4. Where has the first field tower been erected?
- Nurmijärvi
- Hyvinkää
- Forssa

5. The acronym NBS stands for:
- Northern Balance Statement
- Nordic Balance Settlement
- National Bidding System

6. How many balance responsible parties are there in Finland?
- 12
- 26
- 40

7. What is the name of the exhibition opening at Electricity Museum Elektra in the summer of 2013?
- Sähköä tuulesta ja auringosta
- Energiaa vesipyörästä fuusioon
- Hiilivoimaa ja hiilihydraatteja

Winners of prizes of the Grid Quiz in the previous Fingrid magazine (3/2012): Arto Köykkä, Muhos; Dins Merirands, Riika, Latvia; Sirkka Saviniemi, Hämeenlinna; Martti Uppala, Rovaniemi; Tommi Valli, Seinäjoki.

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