Corporate magazine
Fingrid Oyj **3/2014**

FINGRID

VALVE 2014
demonstrated the importance of practice
p. 4

Transmission grid and system security

▸The autumn VALVE 2014 exercise saw the completion of a black start at the Petäjäskoski hydropower plant. This picture was taken from the plant looking out over the lower course of the river. The autumn foliage was at its most beautiful during the exercise in September.

Corporate Magazine
Fingrid Oyj
17th volume
3/2014

EDITORIAL STAFF
Telephone: +358 (0)30 395 5267
Fax: +358 (0)30 395 5196
Postal address: P.O.Box 530, 00101 Helsinki
Street address: Läkkisepäntie 21, 00620 Helsinki
Editor-in-chief: Marjaana Kivioja
E-mail: marjaana.kivioja@fingrid.fi
Editorial board: Eija Eskelinen, Mikko Jalonen, Jonne Jäppinen, Reija Kuronen, Katja Lipponen, Petri Parviainen, Tiina Seppänen
Design by: Better Business Office Oy
English translation by:
Mester Translation House Ltd

Published by
Fingrid Oyj
www.fingrid.fi

Change of address:
reija.kuronen@fingrid.fi

Cover photograph: Fingrid's specialist Jani Pelvo led the VALVE 2014 exercise by VIRVE telephone from a management centre set up on Rovakaira's premises.
Photograph by: Kaisa Sirén

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

In this issue

Preparedness requires cooperation

This year, the number one theme at Fingrid has been continuity management. In many workshops and working groups, we have looked at how to act when different serious risks that impact main grid operations occur. The main grid should function and electricity flow under all circumstances. Data systems must be in good condition, information must be transmitted and human resources must be available. As a result of the continuity management project, operating plans and guidelines have been created for different risks, and at the same time a long list of development targets has been identified. The key objective of the project is to be able to act quickly in different situations: if a fire breaks out in an office, a serious disturbance may occur in the main grid or something else surprising may take place, which could not be originally identified. Operating models should be learned by heart so that, in a real-life situation, instructions do not have to be dug out from some file or from the depths of a computer.

Preparedness for disturbances in the system and planning for exceptional circumstances are coordinated and developed in Finland by the Power and District Heat Pool. The Pool is a largely voluntary cooperative body of authorities and power companies with almost 60 years of history behind it. The Pool's key operations are different training functions and joint exercises. It also guides and supports companies with regard to preparedness. Of projects carried out in recent years, we should mention ensuring the functioning of the water supply in power outages and pilot projects to safeguard the availability of fuel at service stations, as well as disturbance exercises. The Pool forms a natural forum in which different bodies can develop preparedness together and share their experiences. Fingrid plays a key role in the operations of the Power and District Heat Pool, as its chairman, secretary and the secretaries of the regional committees are all Fingrid employees.

In September in Rovaniemi, the Power and District Heat Pool held the major VALVE 2014 exercise in which the restoration of electricity was tested in a power outage covering the whole country. The preparation and implementation of the exercise was a major effort, in which representatives of many authorities and power companies participated. The exercise required a power outage in the Rovaniemi region as, without it, it would have been impossible to get a sufficiently reliable picture of how the restoration of electricity would work in reality. We spent a long time considering whether the outage could be carried out and how consumers would feel about it. In the end, we decided that we would carry it out, but that we would try to minimise inconvenience by all possible means.

The VALVE 2014 exercise demonstrated the strength of Finnish society: efficient cooperation. Different parties were very actively involved in the preparation and implementation of the exercise, for which warm thanks are due to all those who participated in the exercise and its preparation. People were openly informed about the event in good time, and the exercise received much publicity most of it positive, especially in the local media. The residents were very understanding about the power outage and prepared well for it.

Only by practising can we ensure the ability to operate in situations of serious disturbance. In the coming years, Fingrid will increase investment in different continuity management exercises and implement many improvement measures based on the VALVE 2014 exercise.

Reima Päivinen
is Fingrid's Senior Vice President responsible for power system operation.

When Rovaniemi went dark

The unique major disruption exercise organised in Rovaniemi provided valuable information on the functionality of the power system in the event of major disturbance on the main grid. The exercise also succeeded in developing cooperation between various players and provided the opportunity to practice information distribution concerning major disturbance.

TEXT SUVI ARTTI | **PHOTOGRAPHS** TIMO PYYKÖNEN, KAISA SIRÉN

Electricity outages often come as a shock. However, few people were surprised when the lights went off in Rovaniemi at 9:15 pm on Tuesday 23 September 2014. Rovaniemi residents had been made well aware of the carefully planned electricity outage.

The VALVE 2014 joint exercise between power companies and the authorities tested how electricity could be restored using hydropower from northern Finland in a situation wherein the main grid has collapsed and left the entire country without power. The disturbance exercise organised by the Power and District Heat Pool was the first of its kind in Finland and unprecedented in Europe. From a main grid perspective, the exercise dealt with a unique situation: a black start.

"Usually when disturbance affects electricity networks, electricity is available from the main grid. This time we simulated a situation in which the main grid is down and we are also unable to obtain electricity from Sweden," explains Fingrid's Control Room Manager **Arto Pahkin**, who acted as operative manager for the exercise. "We especially wanted to test the use of a disconnected area, known as an island. Previously we had only carried out theoretical calculations as to how to restore electricity using islands. In the exercise, we practiced creating islands →

▸ VALVE 2014

The Lapland Central Hospital, Suosiola power plant and healthcare centres in Tervola and on Sairaalakatu in Rovaniemi were all excluded from the VALVE 2014 exercise. The National Emergency Supply Agency, Power and District Heat Pool, Fingrid Oyj, Fortum Power & Heat Oy, Kemijoki Oy, Rovakaira Oy, Rovaniemen Energia Oy, Rovaniemen Verkko Oy and Tenergia Oy all participated in the exercise. The disturbance exercise was organised by the Power and District Heat Pool.

▸ Fingrid's Control Room Manager Arto Pahkin acted as operative manager for the exercise. Fingrid's communications officer Reija Kuronen also followed the situation from the management centre set up on Rovakaira's premises.

▸ At 9:15 pm the lights in the city went out with just one click of a mouse.

This is how the exercise progressed:

22 September 2014 | 5:00 pm

It's busy at the Rovaniemi Scandic hotel. In just over twenty-four hours, eighteen months of preparations will peak in an exercise unprecedented on a global scale.

"Even now we can say that this is a success. There are so many active players. The exercise has received plenty of media coverage and the topic has got people talking," says **Petri Nieminen**, Senior Adviser for Power Systems at NESA. He woke up at his home in Hausjärvi at four o'clock this morning, but nevertheless intends to go for a run in the crisp Rovaniemi evening air. Tomorrow is a big day.

23 September | 12 noon

Preparations are being made for the afternoon and evening at the management centre set up in energy company Rovakaira's facilities in the Rovaniemi city centre. Employees from Fingrid, Rovakaira, Rovaniemen Verkko Oy and Kemijoki Oy all know their tasks.

Each connection planned during the exercise is written on a command list consisting of over two hundred lines. The connections must be carried out in precisely the correct order.

Rovaniemi shops have seen the sale of torches rocket. Notices of shortened opening hours are found at shop checkouts and on restaurant doors. Housing associations remind residents that lifts will be out of order during the evening, and hotel staff are informing guests of the electricity outage.

23 September | 2:30 pm

At the management centre, twenty employees from various power companies are ready. Fingrid specialist **Jani Pelvo** initiates the exercise at 2:30 pm.

The exercise begins with the organisation of loads, or consumption, in the Petäjäskoski and Ossauskoski power plant areas and in Tervola. Loads are organised appropriately for the formation of an island. This will result in power outages in these areas before the actual black start and island formation. The first phase is to achieve a black start, which means the generation of starting electricity at the Petäjäskoski power plant. Enough energy is produced to start up the hydropower production machinery and increase consumption on the network in small steps. During the evening, the island will expand and be supplied only by hydropower from the Petäjäskoski, Valajaskoski and Ossauskoski power plants.

▸ The management centre closely monitored the behaviour of the island as consumption was increased.

and tested whether or not our calculations were correct."

The practical test fulfilled its task in providing information about the functionality of the power system which could not be obtained through simulations and calculations alone. "We knew that electrification using islands takes a long time. Now we know that it takes a lot longer than we thought. It took longer than anticipated to keep the frequency of the island stable and it was not possible to restore all loads to the disconnected area on the planned schedule," says Pahkin.

Use of islands put to the test

The idea of studying islands came about when disturbance caused an island to form in Rovaniemi in 2009. Once more load was connected, the island collapsed and caused a major power outage.

▸ Invited guests who came to follow the exercise visited the Petäjäskoski power plant before the evening's exercise.

▸ Black start

Power plants with a black start feature are able to start up on a non-energised grid without an external supply of electricity. With the help of this feature, we are able to restore voltage to the network in the event of major disturbance. There are several power plants in Finland with black-start capabilities. They have not however been used to practice running islands with weak network properties.

In addition, some of Fingrid's reserve power plants have black-start capabilities. If voltage is unavailable in Finland, attempts are primarily made to obtain it from Sweden's 400 kilovolt network.

"In localised outages which have occurred in recent years, electricity has always been restored via the main grid, never using islands. In cases of major disruption on the main grid, we've relied on our neighbours. The creation of islands within Finland would be one option for restoring energy to the main grid," says Arto Pahkin.

"There are corresponding islands in e.g. Tampere and Helsinki from which it would be possible to provide starting electricity. Northern hydropower plants however, play a key role in the security of electricity supply to Finland. Nuclear power plants, for example, cannot be connected to the main grid before the grid is sufficiently strong."

"The exercise provided us with lots of technical information we can use to improve our operations. We will study how the formation of an island could be sped up in the future based on obtained measurement data and analyses," says Pahkin. The possibility of a black start from Estonia will also be investigated.

The exercise also attracted international attention. **Mario d'Agostini** from FONES, the Swiss Federal Office for National Economic Supply, arrived in Rovaniemi to follow the exercise. "It's interesting to see a country which can carry out such an exercise. In Switzerland this wouldn't be possible. This was a lesson for us, too. The exercise demonstrated how challenging it is to balance increases in production and consumption in a situation like this."

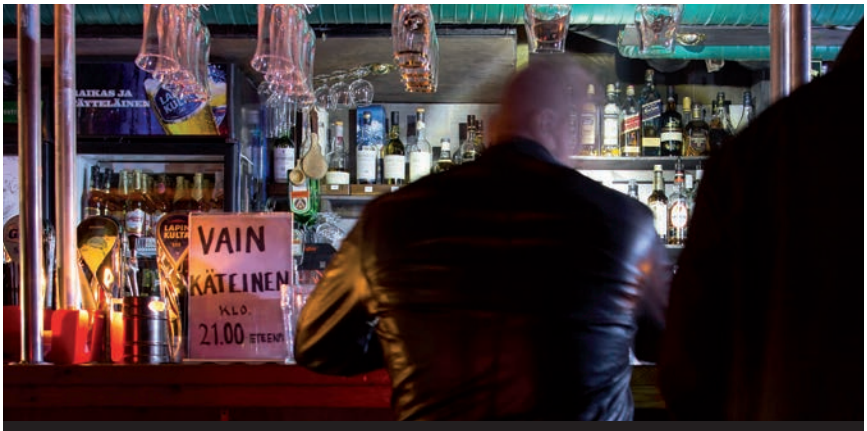
Peter Frost Andreasen from the Danish main grid company Energinet.dk followed the exercise with great interest. "Just the idea of an outage actually being implemented is interesting. At first I was sceptical of the exercise. Exercises never go as planned, and that's what happened here." Andreasen nevertheless admits that that is precisely the benefit of the exercise; had it only been carried out in theory, the results would have been different.

National system for forwarding status updates

One important task of the VALVE exercise was to test a management system during major disturbance. A pre-agreed operating model and a joint connection plan, including transition to a back-up plan, worked excellently.

The exercise highlighted a key fault: there is need for a modern and standardised platform for status updates, through which power companies and authorities can forward on information to one another. The lack of such a platform was brought up in discussion several times during the exercise. CEO of NESA, **Ilkka Kananen**, was just one of many who finds the current model problematic, since various players use their own individual status update systems. Kananen believes the need for a joint platform has already been demonstrated during severe storms.

A management centre was set up on power company Rovakaira's premises for the duration of the exercise. In the event of real major disturbance on the main grid, the situation would be led from Fingrid's main grid control centre in Käpylä, Helsinki. Fingrid's President and CEO **Jukka Ruusunen** highlights Fingrid's central role in the event of major disruption. "We should immediately give an estimation of how long it should take to restore electricity all over →



▸ Restaurants were prepared for the electricity outage.

23 September | 7:00 pm

Fingrid's Communications Manager **Marjaana Kivioja** welcomes invited guests to follow the exercise in the Scandic conference room. It is attended by representatives from the city of Rovaniemi, rescue department, police and the media, as well as management personnel from participating companies.

The evening begins with a panel discussion themed "Are we ready for major disruption in Finland?". Participating in the panel are Chief Director of the Lapland AVI **Kaisa Ainasoja**, CEO of Rovaniemen Verkko Oy **Kristian Gullsten**, CEO of NESA **Ilkka Kananen**, Lapin Kansa's editor-in-chief **Antti Kokkonen,** Mayor of Rovaniemi **Esko Lotvonen**, COE of Kemijoki Oy **Tuomas Timonen** and Fingrid President and CEO **Jukka Ruusunen**.

23 September | 9:10 pm

The island has expanded to Rovaniemi. At the exercise management centre on Rovakaira's premises, Jani Pelvo speaks into his VIRVE phone: "You may carry out phase 26, lines 106 and 107, at 21:15, but not a minute earlier."

When the clock hits 9:15 pm, the lights go out in Rovaniemi. City residents have gathered on the banks of the Kemijoki River and at Ounasvaara to film the darkened city. The only spots of light in the darkness are car headlights and various advertisements, along with LED lampposts along the street. Candles flicker in the windows of a few houses.

In Rovaniemi care homes for the elderly, patient information systems are still up and running, in contrast to the situation during power outages in the summer and early autumn. It appears that work to improve systems has been a success. Hospital beds powered by electricity on the other hand, cannot be moved manually and instead remain in the position they were in before the power went out.

23 September | 10:00pm

According to the plan, electricity should be restored now at the latest, but the city remains dark. Outside of the exercise area, at Hotel Scandic, the lights are on and the projector is working, but the view from the window is pitch black. Everyone is waiting.

The electrification of the island is progressing much more slowly than expected. The management centre makes the decision to stop the exercise and move to the back-up plan. Rovaniemi is re-connected to the main grid. At 10:18 pm, two thirds of the blackout area is back on the grid and by 10:23 pm all of Rovaniemi has access to electricity.

Finland – not just to the main grid, but to restore power to homes."

During the exercise, Head of Preparedness at Lapland's rescue department **Ari Soppela** acted as a contact person at the Rovakaira management centre. He believes that a corresponding operating model would be good in the event of real disturbance.

"This was a good exercise in cooperation concerning information distribution with local electricity network companies. We could receive valuable information from the companies during real disruption," Soppela adds. Nevertheless, he points out that a real situation is not the same as an exercise planned in advance.

"How can we create connections to large and small network companies and to municipalities at equal speed during real disruption? There's room for improvement. In reality, disruption is highly likely to occur in connection with severe weather, such as a storm, in which case the rescue department will also have numerous other tasks to deal with," Soppela points out.

▸ A panel discussion dealt with the topic "Are we prepared if major disturbance hits Finland?".

Twitter and Facebook play important role

In addition to technical testing, the capacity for communication during disruption was also tested in Rovaniemi. When an outage occurs, people rapidly want information on the estimated duration of the outage. "Just the knowledge that something has happened is news," sums up **Antti Kokkonen**, editor-in-chief of the Lapin Kansa newspaper.

The organisation of the exercise alone has improved cooperation between power companies and the authorities. At the same time, however, we saw that communications must be improved and harmonised further.

Twitter, Facebook and other social media services have become a central communications channel. "Social media is undoubtedly a crisis communication tool for reaching large audiences," explains Fingrid's Communications Manager **Marjaana Kivioja**. On Twitter, the exercise was actively followed and discussed, with hundreds of tweets containing the hashtag #VALVE2014.

During the exercise, the Lapland rescue department also practised distributing information via social media. "In the morning, we updated our own Facebook page with information about the exercise and as the evening went on we provided additional information in the comments. The update was shared more than our usual Facebook updates. We also shared links to local electricity companies' online press releases," explains Ari Soppela. The Lapland rescue department was already familiar with the use of social media for distributing information because of real disturbance. "Social media is just one more opportunity for communication, and its significance is further highlighted during real situations," says Soppela.

Look after your neighbours

Just how dramatic the consequences of major disturbance can be depends on the season. Mayor of Rovaniemi **Esko Lotvonen** remembers the winter of 1999 when temperatures plunged to almost 40 degrees below zero for almost a week. "Major disruption in that sort of weather would have been catastrophic." CEO of Rovaniemen Verkko Oy **Kristian Gullsten** remembers that localised major disturbance wasn't too far away, as the peat trucks which supply Rovaniemen Energia with fuel would not start.

During the exercise, the City of Rovaniemi and the Lapland rescue department tested out their own preparedness. The City of Rovaniemi's Safety Director **Kari Tiermas** is pleased that the exercise was organised in Rovaniemi, despite it causing some inconvenience to residents.

"In many ways the exercise was a great success and significantly increased citizens' and the city's preparedness. Three quarters of the city, or just under 30,000 households, were affected by the exercise."

The Lapland rescue department's Head of Preparedness Ari Soppela also considered the exercise a success in reminding people to consider their own preparedness. "There are long traditions in Lapland of managing on your own, but in cities the situation is different, especially amongst young people."

According to Soppela, Lapland has highlighted the importance of shared responsibility. "Village communities have taken responsibility, and during storms, people look out for their neighbours. Hopefully the exercise encouraged more people to think this way." ■

▸ Island operation of power

Finland is part of the Nordic synchronised area, which means Finland does not normally have any electricity islands. They can occur during disturbance, however, or a conscious decision can be made to use islands for some other reason. In prolonged disturbance, attempts can be made to create islands using power plants which have remained operational during the disturbance but whose electricity production outside of the power plant has stopped.

Responsibility has been integrated into the core of business

Nowadays responsibility work is managed at Fingrid as part of finance and business development.

TEXT OUTI AIRAKSINEN | PHOTOGRAPH MATTI IMMONEN

It is by no means self-evident that an organisation understands the effects of corporate responsibility on a company's ability to create value for its stakeholders. Fingrid has wanted to make sure that corporate responsibility is at the core of its finance and business – an issue that is dealt with as part of the company's operations at a board and executive management level.

Responsibility work at Fingrid is headed by CFO **Jan Montell**.

"It's only natural for responsibility to be included in finance and business development, since strategy work, risk management, operational planning and financial affairs are all part of the perspective," explains Montell.

He finds the new model not only to be advanced, but clever in that responsibility is now present in all activities – whenever the organisation thinks about operations, strategy, risks and opportunities.

"Financial and responsibility issues have often been seen as opposing one another. It's easy to make the mistake of thinking that we can't afford to develop responsibility if it jeopardises important and stable finances. We can achieve a balance by always thinking of the two at the same time," Montell adds.

Interest groups value success

Attempts have been made to make responsibility work more visible.

"If responsibility is on executive management's agenda, it sends a message both inside and outside of the organisation as to how important we consider it to be. It also makes it mandatory for us to use time and money on responsibility," says Montell.

Responsibility is also one of Fingrid's values which, through investment, can have a positive effect on social acceptance.

"It's easy to say that you're truly responsible, but at the end of the day our interest groups evaluate how responsible our operations are. Impartiality and transparency are a couple of examples of what responsibility at Fingrid entails. We cannot simply pursue the interests of a single group," Montell says.

A recent interest group survey showed trust in Fingrid and revealed that respondents found the company's operations to be responsible. Indeed, Fingrid was also selected along with 11 other Finnish companies as a National Champion of the European Business Awards competition which evaluated corporate responsibility, excellence, innovation and best practices. The overall winner of the competition will be announced next year. ■

"Impact must be managed throughout the entire value chain"

Major issues relating to economic, social and ecological impact were first systematically defined at Fingrid in 2010. Since the operating environment has changed, the strategic connection of responsibility has strengthened and international reporting framework has been reformed, the decision was made to carry out a more thorough materiality assessment.

The first step in the three-phase process was to identify over one hundred potentially important issues relating to responsibility. Then issues in the list were prioritised by specialists in responsibility workshops and with a stakeholder survey. Finally, Fingrid's executive management group validated nine essential responsibility issues.

"The entire value chain was involved in the consideration and Fingrid's strategy was kept in mind throughout. The impact of operations have to be managed throughout the entire chain, not just in our own back garden," explains **Satu Vuorikoski**, development manager who coordinates responsibility work.

Responsibility workshops were attended by 40 specialists from all over the Fingrid organisation. The end result confirmed that the most essential responsibility issues are correctly identified in the company and that their management is monitored through targets and indicators.

"Of course, we also identified some areas where there was room for improvement and development procedures are now under way. I would like to take this opportunity to thank workshop participants and interest group survey respondents for their effort and views," says Vuorikoski. ■

Continuity management is day-to-day work

Fingrid's theme for this year is continuity management. During the year, the company has made action plans for seven threatening scenarios. One of the themes under investigation is cyber security.

TEXT MIRA MUURINEN | PHOTOGRAPH MATTI IMMONEN

"Many people might be lulled into a false sense of security that electricity will always be available," says Fingrid's corporate security manager **Vesa Syrjälä**. At Fingrid, continuity management is characterised by the company's social responsibility. Threats which affect Fingrid's basic operations can endanger the undisrupted availability of electricity and thereby can also endanger society.

"For example, major disruption resulting in a nationwide outage would cost society an estimated one hundred million euros per hour. If Fingrid were to stop investing in continuity management, the risk would spread to others," explains Syrjälä.

Universal instructions

Fingrid specified seven threat scenarios in connection with this year's continuity management project. The scenarios relate to threats which would extensively affect personnel, premises, information systems or property.

"We set out to investigate the consequences rather than the cause. The most important thing was to find out how we can restore critical operations as quickly as possible, rather than describe in detail every single threat we could imagine," explains Vesa Syrjälä.

For each scenario, a workgroup was appointed and began to work on instructions for preparedness. Forty people from various sectors in the company participated in the workgroups and in-house expertise was utilised widely. Each scenario was worked on for a year in four workshops, during which time threats and restoration criteria were determined, existing preparedness plans were mapped and the necessary tasks were clarified. Lastly, the information was gathered into instructions ready for use.

"The aim of the project was to come up with universal instructions which can be applied to many different situations. The idea was to update existing plans, and entirely new instructions will only be drawn up if necessary."

When putting together the instructions, it was important to bear in mind that if a threat should occur, all Fingrid employees on site must be able to follow the instructions. "When the time comes to act, we mustn't be prevented from completing the action plan because we are missing a responsible person. Exceptional situations require exceptional procedures, which aren't necessarily in employees' job descriptions. At that point it's important to have good instructions," explains Syrjälä.

> "It´s important to continuosly develop technical and administrative defence and train personnel."

Another aim was to find areas for development which can be used to help improve preparedness and minimise the probability of threats occurring. Plenty of ideas for development were suggested.

"There are some wilder thoughts and big ideas, but also lots of suggestions which only require a change in operating method or personnel training," explains Syrjälä.

▸ Vesa Syrjälä and Jyrki Pennanen believe that continuity management should be part of day-to-day operational planning.

What if information systems go down?

One of the threats the project dealt with was related to cyber security. "We started with a total loss of all ICT systems," says Fingrid's information security manager **Jyrki Pennanen**. In a society which relies heavily on the electronic transmission of data, the thought of a situation in which data communications or systems, even computers and phones, would be unavailable is outrageous.

"At first, a lot of people felt as though if that kind of cyber threat came true, we wouldn't really be able to do anything besides give up. However, that's not an option for Fingrid, and instead the company has to find a way to take care of its tasks as quickly as possible."

Pennanen is satisfied that the scenario was challenging. "If it hadn't been so challenging, we wouldn't have been able to find out so much. The selected scenario required us to perceive an overall entity and to come up with a critical classification system, and the order of precedence for restoring operations was concretised in a really interesting way."

In the future, the significance of information systems to commerce and operations will only increase. A significant new change that Fingrid has begun to implement is the digitalisation of operations. "Roughly we can say that ICT is the third phase after manual and industrial operations. Through digitalisation, we can look for an entirely new way to utilise information technology and use it to obtain added value for our operations," says Pennanen.

At the same time, however, information security challenges are also increasing. "The world currently relies so heavily on computers that if a major threat actually occurs, we're in trouble." That's why it's important to continuously develop technical and administrative defence and train personnel.

"I'm really proud of how well we are able to take information security issues into account in projects and in our own work," says Pennanen.

According to Pennanen, cooperation concerning information security matters is at a good level in Finland, with thoughts being exchanged between e.g. Fingrid and other players critical to the security of supply. "In Finland, under the Finnish Communications Regulatory Authority we've achieved a situation in which we discuss problems and solutions and learn from them." This autumn the Finnish Communications Regulatory Authority awarded Fingrid with a prize for the promotion of electronic communications, and the company's information exchange operations relating to information security threats received special commendation.

Preparedness part of daily routine

Vesa Syrjälä and Jyrki Pennanen highlight that even though the continuity management project will come to an end in late 2014, preparing for threats is a permanent part of Fingrid's work. "Changes to the operating environment must be checked and selected scenarios must be evaluated critically. Something new can always crop up," Syrjälä points out.

Syrjälä and Pennanen believe the project to be a good wake-up call and eye-opener for the entire organisation.

"Many people who participated in the project said that threats to continuity earlier felt like a distant thought since the probability of the threat actually materialising is small. The project demonstrated that it's not only the occurrence of one major threat that can endanger continuity, but also the simultaneous occurrence of several minor threats can have the same effect," says Syrjälä.

"It's hard to say what the greatest threat is when it comes to cyber security. The most important thing is to think about how we can prevent various threats from actually occurring. Through the project, we've managed to form an overall picture. It's a brilliant start to developing continuity management," says Pennanen.

According to Syrjälä, the objective of the new continuity management plan is to make continuity management part of routine operational planning.

"Preparedness is at its best when it's included in guidelines for normal daily work. Continuity management shouldn't be a separate entity in itself, but instead has to be an integral part of each employee's day-to-day work." ■

PREDICTION KEEPS US POWERED

Outages in the electricity transmission network are planned well in advance in order for the outage's effects on the electricity markets to remain minimal, explains **Antti-Juhani Nikkilä**.

TEXT OUTI AIRAKSINEN | **PHOTOGRAPH** MATTI IMMONEN

Fingrid's operation planners have their work cut out for them when there are major construction projects under way on the grid at the same time as maintenance is carried out elsewhere. Outages must be planned and timed so that work can be carried out safely, operational security on the main grid is maintained and to prevent the work and outages from causing undesirable price spikes on the electricity markets.

Specialist Antti-Juhani Nikkilä sees his work as a jigsaw with live pieces.

"It's the dynamic situations which make this job interesting. It means I get to really challenge myself. When things change, you have to be able to find solutions, and quickly," says Nikkilä.

In practice, there are always outages somewhere on the main grid. In addition to routine maintenance, outages are needed when new grid is constructed. New cross-border connections which transfer electricity to and from neighbouring countries also increase the need for planning.

Even though computers take care of raw calculations, they are no substitute for the trained eye of a specialist.

"Computers can give us good answers as to whether or not there is overload somewhere on the network, but they can't yet tell us what that means with regard to the overall situation," Nikkilä says.

We can prepare for surprises

Even though Nikkilä had to leave his home region of Pirkanmaa once he graduated, he still feels lucky. Since arriving at Fingrid after completing an internship and diploma thesis, he has settled in well, even though his work tasks changed at the start of the year.

"I really enjoyed my old position working as a power system designer but I felt that now would be a good time to try out something different," he explains.

Previously, Nikkilä would monitor the power system's technical behaviour and plan and model the system, whereas now he has to react quickly to any changes in power system usage or if any disruption occurs on the grid.

"Both the market situation and power system operation conditions can change rapidly since we have several cross-border connections with various countries. We are constantly updating our own overview of outages and reacting to them if needed. Sometimes we have to be able to rework plans on the fly," says Nikkilä.

However, we can – and should – prepare for possible disruption in advance. Back-up plans are necessary especially in cases of long outages, which can occasionally last in excess of six months.

"We have to plan for what will happen if something else breaks during that time, and how we can then secure the supply of electricity in the transfer area. Sometimes surprises happen, but thanks to dimensioning and usage rules, we can prepare for surprises and we have operating models in place for them," he explains.

Electricity transmission can be secured through e.g. changes to connections, load transfers or making use of the existing grid to create temporary connections. It is also essential to schedule outages and maintenance procedures so that there is room for manoeuvre even if we fall behind schedule in some areas.

"Schedule changes are always seen in major projects. It's important that we're told in good time of the network-related needs that various parties will have. If we know well in advance what work will take place in a given area, we are able to reschedule outages if needed," says Nikkilä.

Cooperation is vital

On a rough level, outage planning can be carried out up to several years in

▸ "My work is a combination of several things I like to do; calculations, analysis and the versatile use of various tools. I get to solve lots of great problems," says Antti-Juhani Nikkilä, who works in transfer outage planning.

ANTTI-JUHANI NIKKILÄ

Age: 29

Education: M.Sc. (Eng.) in power engineering, Tampere University of Technology.

Career: Began work at Fingrid with an internship in 2008. After completing his thesis in 2010, he worked as a power system planning specialist. In early 2014 he moved to operation planning, e.g. planning outages.

Home and family: Born in Hämeenkyrö. Now lives in Järvenpää. In a relationship.

Hobbies: Fishing, tennis, piano and photography.

Motto: Let's get this solved!

advance. The closer we are to the present, the more accurate the plans are. Fingrid must also have information on outages planned by its customers in order to be able to form an overall view of the situation.

"It's important that customers are involved in transfer outage planning and forward on information to us as to what actions are planned for the electricity network in each area. In order to ensure operational reliability, we need to be able to see the big picture in advance," explains Nikkilä.

Good cooperation is needed especially in major construction projects, since they may require long outages affecting large sections of network.

"We have to put our heads together with our customers to think about how to use the network in the most reliable and efficient way possible. The core idea is that we try to find solutions in cooperation with all parties involved."

Operation specialists and designers visit the customer to discuss implementation and map perspectives.

"The end result is formed through deliberation; only after we've looked at things from a range of perspectives," says Nikkilä.

Schedules brought forward

In the future, customers must submit information on their own work and plans to the transmission system operator earlier on than they currently do. The aim is for Fingrid to be aware of all outages planned for the main grid over the upcoming year by the end of the current year.

According to Nikkilä, the act of bringing schedules forward is down to planned European network codes which would see future outages planned on a longer-term scale than they are currently.

"Although European network codes won't apply to all outages, important connections cannot be planned in isolation, and other network components must be taken into account. That's why we'll need information on other network activity earlier on," Nikkilä says.

So what does a designer get up to when he's not thinking about power networks?

"I like to fish in my free time. It's a nice way to relax and lose myself in my thoughts. If I'm alone, I like to row. When I'm with friends, we use a motorboat to fish," says Nikkilä. ■

▸ Info and discussion events about the NBS project have been organised at regular intervals. The picture above was taken at an event held in Helsinki in April.

One year to go before joint-Nordic imbalance settlement

The new joint-Nordic imbalance settlement model will be taken into use in Finland, Sweden and Norway during 2015 and 2016. "This is a sizeable project which will have an effect on each and every player in the electricity market industry," explains **Minnakaisa Ahonen**, project manager and CEO of the eSett company.

TEXT MIRA MUURINEN | **PHOTOGRAPH** MATTI IMMONEN

Electricity is a commodity which is very difficult, if not impossible, to store on a large scale. As such, the consumption and production of electricity must constantly be in balance. Balance management deals with maintaining this balance of power.

In practice, it's almost impossible for electricity market participants to accurately plan and balance their electricity production and consumption. This results in the formation of surplus or deficit. That's why each electricity market participant has to have an open supplier which balances its electricity balance. In such a balance hierarchy, open supply chains end with a balance responsible party, whose open supplier is the transmission system operator, Fingrid in Finland, (at the top of the hierarchy) and its imbalance power unit.

The transmission system operator is responsible for national balance management with adjustments ordered from e.g. balancing power markets. At the moment, it is still the transmission system operator's task to settle imbalances, known as imbalance settlement, between itself and market participants as well as between Finland and neighbouring countries. The NBS project will see this settlement become the task of eSett Oy, a new imbalance settlement company.

Imbalance settlement to be centralised

The aim of the NBS project is to harmonise imbalance settlement models between the three partner countries.

According to **Pasi Lintunen**, a member of the project group, the main principle of the imbalance settlement at a high level will remain the same: imbalances in production and consumption will be calculated separately just like they are now. "In 2009, the two balance model was harmonised in all Nordic countries, and it is still followed."

In the new model, reporting and imbalance settlement are centralised via eSett. In the future, the balance responsible party will make an imbalance settlement contract with a settlement company rather than a transmission system operator, and the settlement company will also invoice the balance responsible party for services relating to balance

Fact

The joint-Nordic balance settlement (NBS) project was launched in 2010. In connection with the project, the joint-Nordic imbalance settlement company eSett was set up in 2013 to take care of operative imbalance settlement in the Norwegian, Finnish and Swedish market balance areas. Due to Fingrid's efficient operating model, the decision was made to register the company in Finland.

The project's website can be found at www.nbs.coop. Materials such as the NBS Handbook are available for download from the site.

management, such as reserve energies.

The retailer will make a balance contract with the balance responsible party in the same way as before. Each transmission system operator is still responsible for balance settlement in their respective countries. In Finland, this is Fingrid.

Another clear change applies to the number of balance responsible parties. Currently, a single retailer has only been able to have one balance responsible party. The new model allows for several: a retailer can have different balance responsible parties for production and consumption, as well as for various metering grid areas.

Increased responsibility for distribution system operators

Open supply chains may remain the same after the move to the new imbalance settlement model, but the maintenance of their structures will become the task of the balance responsible parties. The settlement company, eSett, will not divide imbalance settlement at a market participant (retailer) level, but will instead carry out imbalance settlement by balance responsible party level. Imbalance settlement data is reported at market participant level and data will be aggregated for the balance responsible parties' imbalance settlement calculations.

The balance responsible party will maintain and update the structural information of its balance responsibilities and submit them to eSett. It is also the balance responsible party's task to report bilateral trades in eSett's balance settlement system.

From a distribution system operator's perspective, information to be reported will mainly be the same as before: measured consumption, profiled consumption, measured production and exchange measurement sums will all be reported to eSett. There will be some changes to practices, however, and these are set out in the project's NBS Handbook.

The reporting schedule will also change from 14 days to 12.5 days. Another scheduling change affects invoicing, which will change from a monthly cycle to weekly invoicing.

Reporting practices concerning exchange measurement sums between metering grid areas will also change. Unlike the current model wherein exchange measurement results are reported to Fingrid by measurement, in the new model these measurements are combined to form a sum which is reported to eSett. Distribution system operators can agree amongst themselves as to who is responsible for reporting.

In practice, the move to the new imbalance settlement model means an increase in responsibility for distribution system operators. Distribution system operators are more clearly responsible for balance settlement-related measurement data and its quality by metering grid area, since balance responsible parties no longer have the opportunity to check the accuracy of the information to the same extent as they do currently.

"This clarifies the responsibilities between distribution system operators, retailers and balance responsible parties. Agreement on exchange sum measurements will require increased distribution of responsibilities and negotiations with relevant parties," says Pasi Lintunen.

Joint-Nordic retail markets are making progress

"The NBS project received support from regulators in Finland, Sweden and Norway right from the start," explains Lintunen. The harmonisation of imbalance settlement is considered an important step towards fully-functioning joint-Nordic retail markets.

Thanks to the project, operating conditions for balance responsible parties will be as similar as possible regardless of the market balance area. This will lower the threshold for balance responsible parties to operate in several Nordic countries. At the same time, joint rules and standards will be created for the exchange of information.

Fair and shared imbalance settlement rules will facilitate entry onto the Finnish, Norwegian and Swedish electricity markets, which will also increase competition on the countries' electricity markets. In the long term, the project will also reduce the costs of imbalance settlement in the Nordic countries.

As the European integration of electricity markets progresses, the NBS project is leading the way. "If the Nordic countries can harmonise the principles of imbalance settlement, it will open up the opportunity for us to set an example to the rest of Europe," says Lintunen.

Complete in 2015

The NBS project has held national info days at regular intervals. "Events are organised often in order to keep the change threshold as low as possible," explains Minnakaisa Ahonen.

Changes brought about by the project are set out in detail in the handbook, which is freely available on the project's website. "The NBS Handbook is the most comprehensive channel for information. We also encourage people to send questions by e-mail or contact us by phone if they find anything unclear or ambiguous. We're happy to help and provide advice, and then add the information to the handbook to help others," says Ahonen.

The project has received a lot of questions recently, which Ahonen believes is a good sign. "The project's success is based on open discussion."

The new model will be taken into account in stages: first in Finland in November 2015, then in Sweden and in Norway in February next year. "In this way, help and advice will be available from all three parties if the implementation of the new model causes problems," explains Ahonen. ■

Transmission line moved out of way of new residential area

A seven kilometre stretch of Fingrid's transmission line was moved to a new line route in Oulu's Hiukkavaara. The move means the old line route will be available for residential and commercial construction. Some parts of the new transmission line are built on double circuit structures, where two 110 kilovolt lines run along the same towers.

TEXT SUVI ARTTI | **PHOTOGRAPH** TOMMI OLSSON

The request to move the line came from the City of Oulu. A residential area the size of a small town is due for completion in the former garrison area at Hiukkavaara. It was during the zoning stage that the decision was made to move the 110 kilovolt Pyhäkoski–Leväsuo transmission line out of the way.

Oulu contacted Fingrid in 2006. It began a long process in which time had to be set aside for project planning and redemption permit processing. "The line is on the City's land, so no private landowners were affected. The right to use the line area, however, must be determined according to the redemption process, and it took time for the matter to be processed by the Ministry of Employment and the Economy," explains Oulu's Head of Cartography **Eero Keski-Oja**.

Eventually, construction was given the go-ahead in early 2013. By the end of that year, the new section of line was complete and old lines had been disassembled.

Towers' service life is at least 50 years

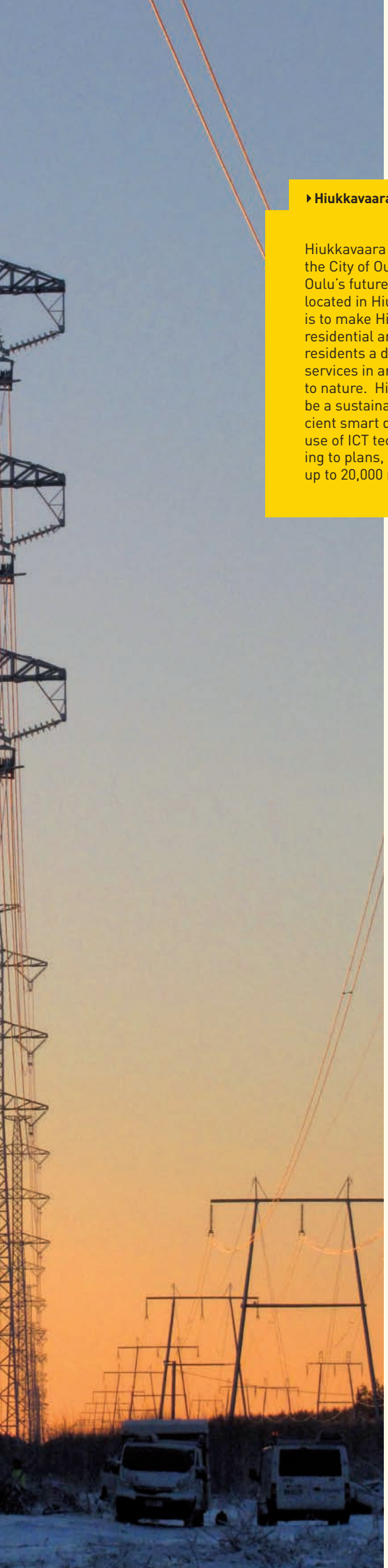
During the project, Fingrid's project manager changed twice. During the construction phase, **Tommi Olsson** acted as project manager and saw the project through to an approved decision. According to Olsson, the long-term timescale was visible during construction work.

"Over time, several plans had been made for the area, some overlapping. Sometimes other plans had been made for the transmission line site. As such, it took more time than average to deal with the numerous changes to the construction plans."

Just over half of the new line was constructed in the old Leväsuo–Nuottasaari line corridor. A few kilometres of entirely new line were constructed along Vaalantie road.

Facts

A new section of line spanning 7 kilometres was constructed from the Leväsuo substation in a southerly direction. A new double circuit line Leväsuo-Nuottasaari and Pyhäkoski-Leväsuo was constructed in the old Leväsuo–Nuottasaari line corridor. Three kilometres of entirely new line route were constructed along Vaalantie road. A total of 32 new towers were constructed, of which 25 are free-standing steel towers and 7 are guy rope towers. The line arrangements were ordered by the City of Oulu. Fingrid acted as builder for the project and Empower Oy was the contractor.



Hiukkavaara

Hiukkavaara is a growth area in the City of Oulu. The majority of Oulu's future construction will be located in Hiukkavaara. The aim is to make Hiukkavaara an urban residential area which offers its residents a diverse range of good services in an environment close to nature. Hiukkavaara strives to be a sustainable and energy-efficient smart district which makes use of ICT technologies. According to plans, the area could house up to 20,000 residents in 2035.

Existing transmission lines remained in use right until the end. The line which ran through the Hiukkavaara barracks area was dismantled once the new section of line was complete.

Old wooden towers were replaced with steel lattice towers, which have a significantly longer service life than their wooden counterparts. "The towers' planned service life is 50 years, but it will be longer than that before they need replacing," estimates Olsson.

Line arrangements saw the formation of a set of four transmission lines located close together, and according to Eero Keski-Oja, that was a cause for concern even as early on as in the general zoning phase. The number of line routes in Oulu will decrease after one of the four transmission lines is dismantled this year in connection with Poikkimaantie line arrangements. The disassembly of a second line is also planned. "Our aim is to reduce the number of line routes in general," explains Keski-Oja.

Residents sent feedback about the change in landscape. The new towers are taller than the old ones, and the location of the towers had changed, so the landscape in the old area did not remain the same. Trees also had to be felled.

On the other hand, the joint-tower section saves on space. "If you have two lines running along the same towers, the line route is narrower than it would be if each line had its own towers," Olsson points out.

An exceptionally large project

According to Tommi Olsson, transmission lines are rarely relocated. Modification work aims to take the needs of the initiator of the line change into account as much as possible. Modification clients are the public and private sector.

"There have been similar projects elsewhere in the country, but rarely so large. Last year we moved six towers in Lappeenranta and four in Vantaa, but this project saw 30 towers moved, and that's exceptional," says Olsson.

"When we receive a request to move a line, we listen to the customer's needs. We see what we can do and what technoeconomic and land use-related restrictions there are. Each place is its own unique entity."

Line arrangements are still ongoing in Oulu. Oulun Energia's and Fingrid's 110 kilovolt lines are also being moved to new double circuit towers in another project under way in the area between Hiukkavaara and Maikkula. The line arrangements made it possible to construct the Poikkimaantie bridge over the Oulujoki River without any restrictions set by transmission lines.

"In order to build the bridge, the nearby Oulun Energia line had to be moved. We noticed that we can carry out a second line project at the same time and move Fingrid's old Leväsuo–Nuottasaari line away from the residential area," explains Eero Keski-Oja. The project is in its final stretch and modification work on the 110 kilovolt lines between Kirkkokangas and Maikkula will be complete by the end of 2014.

A third line relocation project is planned for the Saarela district, but Keski-Oja says that zoning solutions are still needed before it can be implemented. ■

▸ Anu Huhtela and Juhani Ahonen from Fingrid hope that Fingrid's service providers will use the safety park to train their personnel. You can reserve a tour at the park through Ahonen or Huhtela.

Occupational safety training relies on power of experience

Visitors to the Pohjois-Suomen Turvapuisto safety park can learn first-hand about occupational safety in construction and industry in a genuine environment. Fingrid has its own training checkpoint in the park to remind people how to work safely near power lines.

TEXT SUVI ARTTI | **PHOTOGRAPH** MIKKO TÖRMÄNEN

▸ Facts

Pohjois-Suomen Turvapuisto is maintained by a non-profit association. The association's members include companies, associations and educational institutions who wish to invest in the development of occupational safety. Members can set up a training checkpoint in the park if they wish. There are currently around 70 members with around twenty checkpoints. Educational facilities are not charged a membership fee. The Oulu University of Applied Sciences and the Oulu Vocational College both use the park to train their students. It's also possible to obtain an occupational safety card at the park.

Learn more about the safety park at **pohjois-suomenturvapuisto.fi**

Pohjois-Suomen Turvapuisto opened in Oulu in April 2014 and its training checkpoints demonstrate accidents or close-call situations and show how the example task can be carried out safely.

By the end of September, over 2,000 visitors had been to the park, and the number is growing at an increasing rate. Project Manager **Olli Airaksinen** is satisfied. He says that visitor feedback has been positive. "People have almost without exception said that they would recommend the tour to others."

Many companies began to actively use the park right from the start. "Our member companies, such as Ruukki, for example, use the park systematically to train their employees," explains Airaksinen.

A group of visitors to the park are first shown a thought-provoking video, after which they are led around the park's checkpoints by a specialist guide. The tour usually takes a minimum of two hours.

"I hope that the demonstrative presentations really reach visitors and get them to think about their own occupational safety," says Airaksinen.

Fingrid's service providers welcome to attend training

At the joint checkpoint run by Fingrid and Oulun Energia there is a 12-metre tall 110 kilovolt wooden power line tower with normal insulation, wiring and marking equipment. There are similar, though significantly taller, towers all over Finland carrying power lines. The wooden towers are normally 14–22 metres tall and steel towers can reach a height of up to 80 metres. Oulun Energia, on the other hand, has staged a scenario in which a tree has fallen on a medium-voltage line.

Instructional signboards near Fingrid's tower briefly and concisely describe how to work safely near power lines. The safety park guide provides more in-depth instructions.

Checkpoints aim to remind visitors of safety distances and precautions when carrying out construction, excavation work and agricultural or forestry work near power lines. The signboards also contain instructions on what to do in the event of an accident.

"Machines collide with power line stay cables or other tower structures every year," says Fingrid's Regional Manager **Juhani Ahonen**. According to Ahonen, Fingrid's own service providers should also visit the park, since construction and maintenance work at power lines and substations is a "decathlon", including all phases from earthwork to wiring. There are occupational safety instructions for all of these phases at the safety park.

"When working in the vicinity of power lines, it's important to pay attention not only to the lines themselves, but also to tower structures and to the stay cables which anchor the tower to the ground," says Ahonen. ■

IN BRIEF

Maintenance contracts concluded – the present operators to continue

Fingrid has made procurement decisions on the basic maintenance of substations, power lines and its central warehouse for the period 2015–2017.

In the procurement, the share of quality points was 25%, which meant that quality was significant. In four work areas out of 14, quality points mattered to the extent that a supplier was chosen that was not the cheapest. Selected were the same operators that have also tended to these duties during the present contractual period. The contracts will be concluded by the end of November.

By work area, the following companies were chosen as providers of basic substation maintenance:

Eastern Finland	**VR Track Oy**
Southeast Finland	**Voimatel Oy**
Häme	**VR Track Oy**
Uusimaa	**Infratek Finland Oy**
Southwest Finland	**Empower PN Oy**
Western Finland	**Empower PN Oy**
Northern Ostrobothnia	**Infratek Finland Oy**
Lapland	**Caverion Industria Oy**

The total value of the procurement is approximately €14 million.

The contract terms and conditions have been amended in terms of, for example, safety, company responsibility requirements and the use of subcontractors and manpower.

Fingrid has also changed the requirements for its operator register. Suppliers must gain Fingrid's validation to perform work in different fields of expertise and are required to improve their self-supervision, among other things.

By work area, the following companies were chosen as providers of basic power line maintenance:

Häme-Uusimaa	**Eltel Networks Oy**
Southwest Finland	**Empower PN Oy**
Western Finland	**Empower PN Oy**
Eastern Finland	**Eltel Networks Oy**
Northern Ostrobothnia	**Eltel Networks Oy**
Lapland	**Eltel Networks Oy**

The total value of the procurement is approximately €6 million.

Additions have been made to the contract terms and conditions concerning responsibility requirements, the use of subcontractors and manpower and information security. The contract terms also carry specifications of, among other things, the performance and reporting of waste management and safety requirements.

Empower PN Oy has been selected to take care of the central warehouse for substation auxiliary equipment and spare parts situated in Hämeenlinna. The total value of the procurement is approximately €250,000.

Recognition as a promoter of electronic communications for Fingrid

The Finnish Communications Regulatory Authority (FICORA) has honoured Fingrid as a promoter of electronic communications, in recognition of the fact that the company ensures the security of its operations in an exemplary manner and is thus also improving national data security.

Fingrid was honoured for increasing information exchange related to information security threats. The award was also justified by the fact that, in its operations, the company has promoted the open discussion of information security deviations and has thus enabled the generation of up-to-date and actual situation pictures. In addition, Fingrid's operations have promoted the launch of FICORA's HAVARO monitoring system in new organisations.

The recognition for promoting electronic communications is awarded annually to a party that has promoted to a significant extent the development and spread of electronic communications in Finland.

Operational reliability Kainuu-style

Loiste is one of Finland's biggest electricity sellers. Loiste Sähköverkko Oy's operational manager Ismo Reinikka believes that good, regular maintenance work and active information distribution are of the utmost importance in customer work.

TEXT MIRA MUURINEN | PHOTOGRAPH MATTI IMMONEN

Operational reliability has always been an important part of Loiste Sähköverkko Oy's network strategy. "We've made regular investments in network renovation over a period of more than a decade," says Ismo Reinikka.

Loiste (previously known as E.ON-yhtiöt in Finland until 2013) is one of Finland's largest sellers of electricity and is active in all sectors of the energy industry. The company was previously owned by E.ON Nord Sverige AB but has been entirely Finnish-owned since the start of this year. The company owns electricity networks in Kainuu, Northern Ostrobothnia and in the Karhula industrial area in Kotka. It serves 200,000 customers in Finland.

The large company maintains operational reliability through regular network inspections. "Networks are inspected and maintained, and line routes are cleared at regular intervals. We have an efficient condition inspection and repair process whereby lines are toured at determined intervals and any possible faults are repaired," says Reinikka.

"We're also taking into use an operating method to maintain forests bordering on line routes. We agree on the removal of problematic trees outside of line routes with landowners, of course in such a way that the landowner is compensated for the felled trees."

Efficient operational reliability

Ismo Reinikka's career in the electricity industry began in Puolanka with a summer job as an electrical engineer, and later on as a substitute supervisor. His summer job quickly led him to other tasks. "In 1997, the MicroSCADA remote use project was launched in Kajaani's main office and I got to participate. And that's how I ended up here."

> "I hope for good customer cooperation from Fingrid, and that we can examine plans together. From my point of view this has been a real success."

▸ Ismo Reinikka was photographed out of his natural Kainuu habitat at the root of an old oak in the yard of Hämeenkylä Manor in Vantaa.

> "The greatest challenges to operational reliability will lie in communications and the related connections."

Later on, Reinikka worked as a control room technician and manager and now acts as usage manager heading a team of seven.

The Electricity Market Act which came into effect one year ago has tasked distribution network operators with new requirements for operational reliability on electricity networks. According to Reinikka, the change in legislation has not had any significant effect on Loiste's operations.

"The new law has meant that we've consolidated all our plans for operational reliability development into a single folder which we use to aid operations. With regard to practical work, we comply with an operating model which has proven itself to be effective concerning inspections, maintenance and upkeep."

The act's minimum times for electricity distribution outages during disturbance nevertheless require that some of the network be cabled in the near future.

"In zoned areas, outages may not last more than six hours. This means that lines have to be cabled. We're currently doing so, and it's coming along well," says Reinikka.

"However, we don't intend to cable all lines. In population centres and zoned areas, it's the best alternative, and the idea is to have all such lines cabled within the transition period set out in the Electricity Market Act. There is no need for cabling in rural areas, but it has been deemed worthwhile to relocate critical connections, such as lines between substations, to road-side locations. The importance of network automation is highlighted in rural areas."

Cabling helps with crown snow-load problems, which are a challenge almost every year in the Kainuu region.

"Over the years we've gained enough experience to be able to actively monitor the situation. We begin to remove frost from the lines as soon as it looks like crown snow-load will accumulate. We also make use of helicopters to pin-point problem areas. It's well worth acting in advance rather than waiting for faults to occur," says Reinikka.

Secure communications connections

Good maintenance can be seen directly in customer feedback. "Of course, the better our operational reliability is, the less complaints we receive," says Ismo Reinikka. From a customer work perspective, Reinikka believes the development of operational reliability means active communication with the customer.

"For example, we have an online service which each customer can use to see the current network status, fault history and planned outages. We are also developing a service which will allow customers to order information on possible disturbance and estimate duration by e-mail or text message."

Reinikka believes that the greatest challenges to operational reliability will lie in communications and the related connections. As extreme weather phenomena become more common and their destructive capabilities increase, so does the risk of widespread disturbance. This means that communications networks are at risk.

"Problems in communications networks can delay fault repair. In the future it will be especially important to think about how to secure critical points on the communications network."

Reinikka is in his third year of membership of Fingrid's Operational Committee. This year, he also hosted one meeting when the Operational Committee visited Loiste Sähköverkko Oy in Kajaani and learnt more about the company's operations centre.

With regard to the Operational Committee's operations, Reinikka believes that the opportunity to exchange experiences and give feedback is important. "Since I live in the north, I'm not actively in touch with members of the Operational Committee. In meetings I find it interesting to hear others talk of their experiences of disturbance, what led to the disturbance, and how they reacted. The Operational Committee is also a good place to comment on new plans, share your views and try to make a difference in operational reliability matters.

Reinikka believes cooperation with Fingrid has been good. "You can always reach someone in operations and they are always able to answer your question. I hope for good customer cooperation from Fingrid, and that we can examine plans together. From my point of view this has been a real success." ■

No empty seats on the Operations Committee

Fingrid's Operations Committee meetings are marked by active participation. Meetings are held four times a year and are attended by representatives from the company's various customer groups with thoughts and ideas for development exchanged in good spirits.

TEXT MIRA MUURINEN | PHOTOGRAPH MATTI IMMONEN

▸ Members of the Operations Committee, from left to right: Reima Päivinen, Jonne Jäppinen, Jukka Rajala, Teppo Härkönen, Mikael Heikkilä, Ismo Reinikka, Hannu Halminen, Teuvo Jouhten and Erkki Tiippana. Pekka Pollari is not shown.

The Operations Committee deals with questions relating to the management of operational reliability and offers new perspectives on the development of operating methods.

"The committee's most important task is to discuss topical issues and to share views. For Fingrid, the Operations Committee is an important channel for receiving feedback directly from the customer interface," explains the committee secretary, Development Manager **Jonne Jäppinen** from Fingrid.

Valued membership

The Operations Committee primarily convenes on Fingrid's premises in Käpylä, but this year it began to implement a practice whereby one meeting a year is held at a member's premises.

"The aim is to see things from the member's perspective. Visiting others' premises helps you to see what issues are most topical to them," explains Jonne Jäppinen. This year the Operations Committee visited Loiste Sähköverkko Oy in Kajaani.

Representatives from various customer groups are invited to act as members of the Operational Committee. Representatives of electricity producers and consumers, distribution network companies and industrial players are all involved.

"This means that we receive feedback and ideas for development from as wide a sector as possible. We've also ensured that members represent the entire customer base in size and we have representatives of large and small players involved," says Jäppinen.

For customers, membership of the Operations Committee provides the opportunity to give Fingrid feedback on operations and to have an influence on the development of operations and operational reliability management.

"The committee's meetings aren't at all poorly attended. Seats are sold out, so to speak!" laughs Jäppinen. Some of the members change every two years. "There is some natural turnover as people change position or retire. Last time we had to draw lots whose turn it was to stand down and give their place to someone else."

Exchanging perspectives

According to Jonne Jäppinen, topics of discussion in the Operations Committee often follow the same basic structure. Topics relate to e.g. the use of the power system, disturbance and reserve power matters, outage planning and power balance management, as well as communications and cooperation between Fingrid and its customers. The power balance situation for the winter is always examined before the cold season.

The committee's work helps Fingrid to develop its operations in a customer-oriented way. "Committees are an important channel through which to obtain information and feedback from customers. We can use it to find out which questions are important to the customers. Issues are often presented in the committee before they are set in stone and made part of day-to-day work," says Jäppinen.

The committee is a place to exchange views and perspectives rather than a decision-making body. Jäppinen believes that this also has an influence on the atmosphere at the meetings. "Topics can be presented more freely than would be the case in contract negotiations or a decision-making event. There's simply an atmosphere of wanting to discuss topics and develop them together." ■

The aim of the HVDC team – uninterrupted interconnections

The significance of HVDC (high-voltage direct current) connections to the Finnish power supply has increased with the country being increasingly dependent on imported electricity. In order to improve the reliability of interconnections, Fingrid has established an HVDC team, which comprises the expertise of the whole organisation on the subject.

TEXT SUVI ARTTI | **PHOTOGRAPHS** ESKO KESKI-OJA

For a long time, Fenno-Skan 1 between Finland and Sweden, which was introduced in 1989, was the only HVDC connection between Finland and abroad. During the last eight years, three more connections have been built: Estlink 1 was introduced in 2006 (put under Fingrid ownership in 2013), Fenno-Skan 2 in 2011 and EstLink 2 in 2014.

The significance of HVDC connections to the Finnish electricity market is now greater than ever. Because the completion of the Olkiluoto 3 nuclear power plant has been delayed and the import of electricity from Russia has declined, Finland is increasingly reliant on imported power. The Fenno-Skan connections in particular are running hot with electricity being imported into Finland from Sweden.

"A disturbance in just one HVDC connection has a direct impact on the Finnish electricity market, similar to that of a large power plant dropping out of the grid, particularly if the connection is in the import direction as the Fenno-Skan connections have recently been," says **Harri Nurminen**, head of the HVDC Team.

▸ Members of the HVDC team Harri Nurminen, Patrik Lindblad, Anne Ventola and Jari Lehtimäki were photographed at the Rauma converter station during annual maintenance.

The team reinforces its expertise

In order to improve reliability, the 12-person HVDC Team contains personnel from different Fingrid units. The team's key function is to improve the reliability of the HVDC connections, which is also registered as a strategic project at company level. The project is divided into five subprojects, which improve reliability from different perspectives.

It is hoped that the team will strengthen HVDC expertise and also share knowledge inside the team. "An HVDC station is much more than just a normal substation. Whatever kind of disturbance it suffers, its investigation always requires more people," says **Patrik Lindblad**, a specialist in HVDC automation systems.

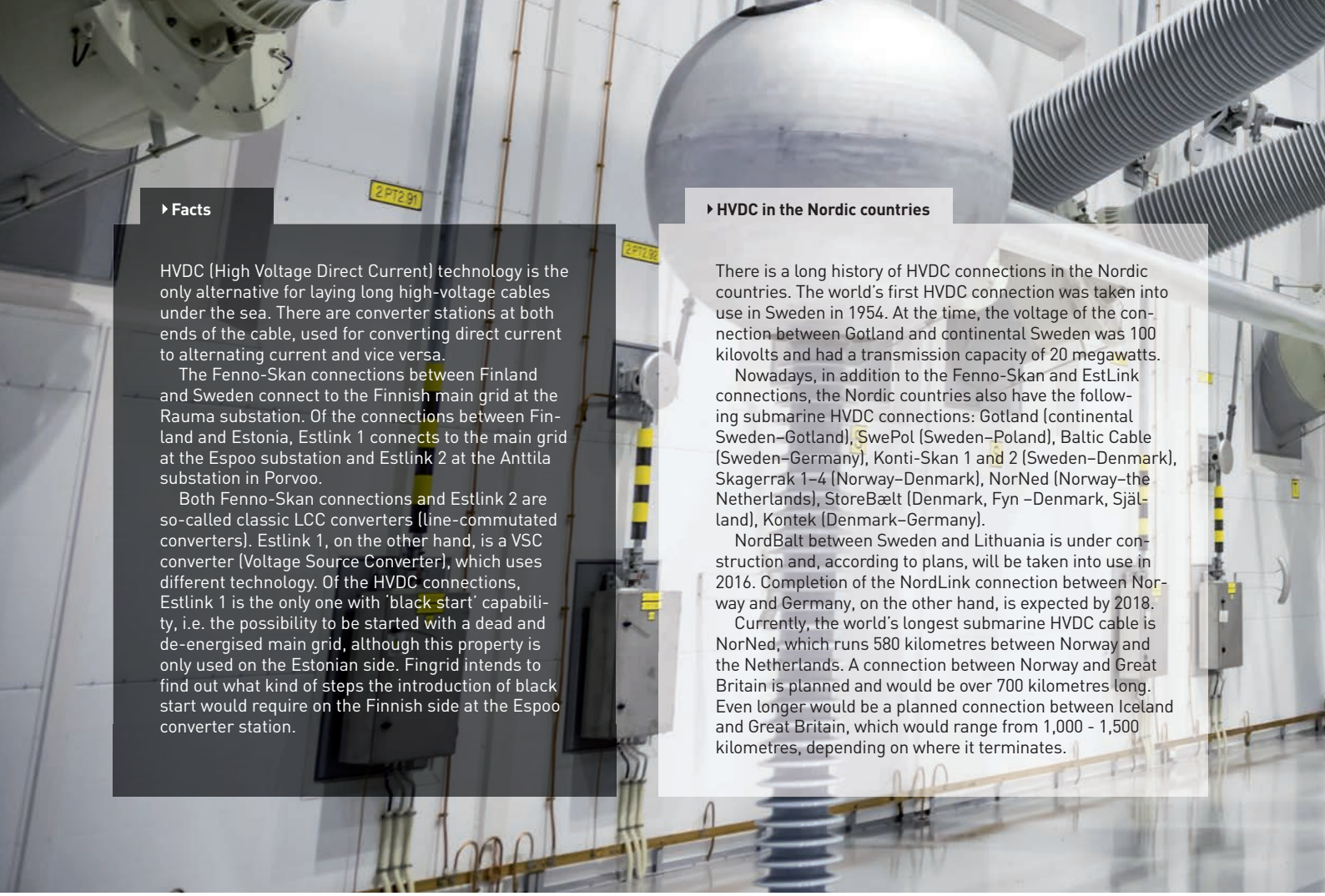
"We come from two different work areas and we verify our expertise by 'cross-training'. This is also necessary to ensure that we can stand in for each other during holidays, for example," says **Antti Puuska**, a specialist in local operations in the Uusimaa area. He acts as an operation specialist at the EstLink connections' converter stations in Espoo and Anttila.

Disturbances under control by solving problems

In the period between the beginning of 2012 and September 2014, Fenno-Skan 1 has experienced no fewer than 25 disturbances. Fenno-Skan 2 has suffered 18 disturbances and Estlink 1, 16.

According to Harri Nurminen, many of the disturbances in the Fenno-Skan connections have resulted from two types of problems: those concerning old transformers and those stemming from instabilities in the new automation system. The former type of problem has been solved, among other things, by renewing the Fenno-Skan 1 on-load tap-changer pressure relays, and the latter type should be resolved by a software update carried out in the autumn by ABB under warranty.

When examining a cable fault in spring 2013, the condition of the Fenno-Skan 1 cable was found to be degraded, and a condition study has just been carried out on the connection. "The cable's insulation has deteriorated prematurely. At 25 years old, the cable is only 'middle-aged'. For the time being, the connection is being used at a →



Facts

HVDC (High Voltage Direct Current) technology is the only alternative for laying long high-voltage cables under the sea. There are converter stations at both ends of the cable, used for converting direct current to alternating current and vice versa.

The Fenno-Skan connections between Finland and Sweden connect to the Finnish main grid at the Rauma substation. Of the connections between Finland and Estonia, Estlink 1 connects to the main grid at the Espoo substation and Estlink 2 at the Anttila substation in Porvoo.

Both Fenno-Skan connections and Estlink 2 are so-called classic LCC converters (line-commutated converters). Estlink 1, on the other hand, is a VSC converter (Voltage Source Converter), which uses different technology. Of the HVDC connections, Estlink 1 is the only one with 'black start' capability, i.e. the possibility to be started with a dead and de-energised main grid, although this property is only used on the Estonian side. Fingrid intends to find out what kind of steps the introduction of black start would require on the Finnish side at the Espoo converter station.

HVDC in the Nordic countries

There is a long history of HVDC connections in the Nordic countries. The world's first HVDC connection was taken into use in Sweden in 1954. At the time, the voltage of the connection between Gotland and continental Sweden was 100 kilovolts and had a transmission capacity of 20 megawatts.

Nowadays, in addition to the Fenno-Skan and EstLink connections, the Nordic countries also have the following submarine HVDC connections: Gotland (continental Sweden–Gotland), SwePol (Sweden–Poland), Baltic Cable (Sweden–Germany), Konti-Skan 1 and 2 (Sweden–Denmark), Skagerrak 1–4 (Norway–Denmark), NorNed (Norway–the Netherlands), StoreBælt (Denmark, Fyn –Denmark, Själland), Kontek (Denmark–Germany).

NordBalt between Sweden and Lithuania is under construction and, according to plans, will be taken into use in 2016. Completion of the NordLink connection between Norway and Germany, on the other hand, is expected by 2018.

Currently, the world's longest submarine HVDC cable is NorNed, which runs 580 kilometres between Norway and the Netherlands. A connection between Norway and Great Britain is planned and would be over 700 kilometres long. Even longer would be a planned connection between Iceland and Great Britain, which would range from 1,000 - 1,500 kilometres, depending on where it terminates.

reduced voltage, which limits the power to 400 MW. Possible remedial measures are being agreed together with Svenska Kraftnät," says **Janne Näsli**, a specialist in operations planning.

Teething troubles in the EstLink connections

The EstLink connections are both still new to Fingrid. According to Harri Nurminen, EstLink 2, which was completed early in 2014, is 'at its running-in stage', and the supplier of the connection is still remedying 'teething troubles'. In October, the earthing of the ground cable section return cable was improved at the Estonian end. Owing to a design fault, the earthing was defective, which caused two disturbances.

Estlink 1, on the other hand, has only been under the joint ownership of Fingrid and Estonia's main grid company, Elering, since the end of last year. Fingrid and Elering are currently planning supplementary system tests for the connection. "There are deficiencies in documentation and commissioning tests, which we have been unable to influence in the construction phase. It is partially unclear how the link and in particular its special controls will behave in a disturbance, and we want to get additional verifications about this," says Nurminen.

For Estlink 1, in the past couple of years disturbances have been caused by problems in the cooling system, among other things. In the annual June service, modifications were made to the cooling pipes, so such disturbances as these at least should not happen again. According to Harri Nurminen, the problems with the cooling system were registered as being the responsibility the previous owner, which was also liable for the costs of the modification work.

Quick repair of cable fault

One of the ongoing development projects is aiming at speeding up the submarine cable repair process. Repairing a cable fault is a multi-stage process, which usually lasts for months. From a perspective of the electricity market, each day costs money, so Fingrid wants to do all it can to speed up the repair process.

"Before a fault can be repaired, it must be located and repair contracts concluded. Our aim is for agreement templates to be ready and the whole process planned in advance," says **Jussi Rantanen**, a specialist in HVDC cables.

The first stage of the repair is to locate the fault. "By using a cable fault finder, we can from the shore establish the distance of the fault location from the cable terminal and the location of the fault under the sea can be discovered using map information. A fault caused by an external factor such as a ship's anchor is easier to locate exactly than an internal cable fault. Divers or remote-controlled submersibles can help in the exact positioning of the fault. Acoustic and electro-magnetic sound locators can also be used," explains Rantanen.

As soon as we establish that we are dealing with a cable fault, we begin to make contracts with repair companies. Concluding contracts can easily take four weeks. After that, how quickly the fault can be repaired depends on the availability of a repair vessel.

Weather conditions also affect the progress of the repair. A diver first breaks the cable and its faulty section is removed. Once the repair vessel has arrived, both broken ends of the cable

HVDC Team

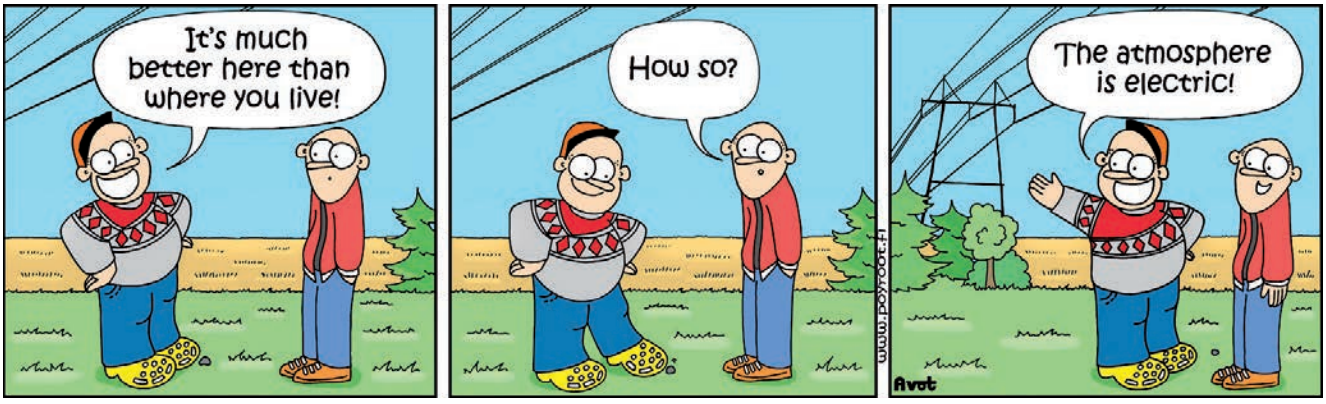
Fingrid's HVDC Team combines the expertise of HVDC connections throughout the organisation. The special field of Team Leader, **Harri Nurminen**, is HVDC substations. **Janne Nästi** acts as a specialist in operations planning, and **Patrik Lindblad** and **Jari Lehtimäki** as automation system specialists. **Kimmo Nepola** is in charge of the series capacitors and SVC (Static Var Compensator) and **Jussi Rantanen**, HVDC cables.
The team also includes local Fingrid specialists from Southwest Finland (Fenno-Skan connections from Rauma) and from Uusimaa (EstLink connections from Espoo and Anttila). Protection-telecommunications expert **Pekka Lepistö**, substation specialist **Anne Ventola** and local operations specialist **Tomi Mantela** are responsible for Fenno-Skan. **Kari Lundahl**, **Jarkko Hautala** and **Antti Puuska** take care of the corresponding functions for the EstLink connections.

are lifted in turn onto the vessel and a reserve cable is fitted in place of the faulty section.

Jussi Rantanen and Harri Nurminen remember that a fault in the Fenno-Skan 1 cable in spring 2013 was repaired in two months, which can be considered as quick. Then the fault was at Rihtniemi at a depth of about 10 metres.

Rantanen says that, depending on the location, fault repair entails different challenges. "When the fault is near the shore, the repair vessel must be small enough. However, the cable weighs so much that a very small vessel will not cope. In the open sea, on the other hand, a larger vessel can be used but the cable is deep down and the wind can hinder repair work." ■

Lines over Ostrobothnia



Hoping for ice coverage all winter long

In autumn, hydropower companies carefully follow weather forecasts and the drop in water temperature. In an ideal winter, rivers freeze over quickly and prevent the formation of frazil ice dams which prevent the flow of water and cause water levels to rise.

TEXT SUVI ARTTI | PHOTOGRAPH KEMIJOKI OY

"Our goal is to have good ice cover on the plants' upper pools and over the entire river so that we can produce quality balancing power throughout the winter. Of course, local residents also hope for strong ice," says Kemijoki Oy's operations centre manager **Erkki Nuortio**.

When the water temperature approaches zero, production is steered to help the formation of ice by diverting water evenly over parts of the river which show signs of ice formation. "We monitor the drop in water temperature at all power plants. Freezing only occurs when the water temperature is below 0.1 degree above zero, and as theory tells us, water only turns to ice at 0 degrees," explains Nuortio.

Frazil ice dams a problem for power plants

There are good conditions for the formation of ice cover when supercooled water molecules on the surface of the water gently "collide" with one another, forming ice crystals. These crystals form ice cover. If no protective ice forms over it due to strong currents, cold weather can cause water to supercool further below surface level. This forms frazil ice which, due to turbulence, can be carried to the bottom of the water body and adhere to the bed there. In a downstream current, the frazil ice may also rise to the underside of the ice cover, forming a slushy mass of ice crystals which can span hectares and grow up to several metres in thickness. The frazil ice then begins to dam the flow of the river and increase the water level upstream.

"Favourable conditions for frazil ice formation are especially found below the surface at old rapids. When supercooled water crystallises onto rocks, a dam begins to form from the bottom up and the flow of the river is slowed," explains Erkki Nuortio. "Other areas susceptible to frazil ice are stream pools downstream from rapids where eddies occur, meaning that the frazil ice can rise and adhere to the underside of the ice cover.

The frazil ice leads to drop losses and in turn causes power and energy loss. "During a bad frazil ice season, we can lose up to six metres of drop height along the entire Kemijoki power plant chain. A difficult winter can decrease production by an amount equivalent to the annual production of a small power plant. That's the reason good ice coverage over the entire water system with no frazil ice is an important annual goal for Kemijoki Oy," explains Nuortio.

Frazil ice can also cause problems if it accumulates on the power plant's water screens, or inflow grates. "If super-

Facts

Kemijoki Oy owns 20 hydropower plants. Of these, 16 are located in the Kemijoki waterway system, two in Lieksanjoki and two in Kymijoki. All eight power plants in the main channel of the Kemijoki River are among Finland's ten largest hydropower plants.

cooled water enters the screen, it crystallises, adheres and glazes over the metal surfaces of the screen upon collision. An entire wall of ice can build up very rapidly in the water in front of the hydropower plant equipment. One autumn we had to stop all machinery at the Taivalkoski plant because frazil ice formed on the screens. The equipment's screens were blocked and all the water bypassed the hatch.

At the mercy of nature

Kemijoki Oy has used a frazil ice radar for a few years. At Kirkonjyrhämä in Rovaniemi, a radar was installed at a depth of 10 metres to detect ice crystals in the water. When the signal emitted by the radar hits the ice, it reflects back information on the amount of frazil ice and any possible ice cover. The radar helps to monitor the situation, but the hydropower company is no less at the mercy of nature than anyone else.

According to Erkki Nuortio, the formation of ice cover only takes one to two weeks in a good year. Some years, however, it can take two months to form. Sharp fluctuations in temperature complicate matters. "The worst thing is when there's a warmer, rainy period after sub-zero temperatures and snow. That can cause small floods even in autumn, and the ice cover doesn't stay on the river bed and instead descends as ice floes," says Nuortio.

Last year was a good year concerning frazil ice. "There was strong ice on the Kemijoki River, and Rovaniemi hosted the Winter Swimming World Championships. "The winter before that, though, was difficult. We just couldn't get the ice cover to form. A frazil ice dam about four metres deep formed at the Jätkänkynttilä bridge and was over a kilometre in length. There was only a tiny crack between the dams through which the water could flow."

Return to day operation

Once ice coverage has formed, the hydropower plant gradually returns to day operation, which means it begins to produce balancing power. "At night we primarily keep flows small and production is low to correspond with consumption. During this time, the water levels rise in the plant pool above the power plant. Consumption increases in the morning when people get up and begin to go to work, and hydropower reacts to the change in consumption. Production is increased and the plants' upper water levels begin to decrease again," explains Erkki Nuortio.

The ice cover is also involved in the daily routine; it rises and falls according to flow. The hydropower plant powers on despite freezing winter weather. In spring the snowmelt water is stored in "Finland's largest batteries", Lokka, Porttipahta, Kemijärvi and Olkkajärvi. But that's a whole different story. ■

IN BRIEF

Replacement for the 'Iron Lady' under construction

The Hikiä–Forssa power line project started in January 2014 is progressing

In the project, the power line between Hausjärvi, Hikiä and Forssa is being renewed and the old towers are being replaced with steel ones. The line being replaced is part of the Rautarouva (Iron Lady) line built in the 1920s.

The power line work is located in the areas of Hausjärvi, Riihimäki, Janakkala, Loppi, Tammela and Forssa. In place of the line coming down, combined 400 and 110 kV steel towers will be erected to make the use of land more efficient. Field towers will also be erected for the line, which will enable the safer use of farming and work machinery right at the foot of the towers.

The Hikiä-Forssa power line joins the main grid at the Forssa substation, where expansion and refurbishment work is ongoing. The power line project will be completed by the end of 2016.

Test use of mobile applications under way at Fingrid construction sites

A new mobile application is being piloted at four of Fingrid's investment construction sites. The solution includes different applications to improve site occupational safety, project management and local monitoring.

The application solution is referred to as T3 reporting, and it is being developed in cooperation with Integround Oy. T3 reporting includes MVR-FGR measurements (which measure occupational safety levels), electronic construction site diaries, notifications concerning dangerous situations, notifications of accidents, management review forms and an application to manage the sites' most important documents.

T3 reporting is a browser-based application which can be used on smart phones, tablets and computers regardless of operating system. It is being piloted at substation projects in Lavianvuori and Kangasala and in the Tikinmaa-Lavianvuori and Hirvisuo-Kalajoki power line projects.

▸ More news at **fingrid.fi**

New main grid contract steers the use of reactive power

The main grid contract due to come into effect in 2016 will redefine the principles of reactive power. Principles will become somewhat stricter as a result of the change, but will also balance out.

"Work on new reactive power principles has been carried out in cooperation with customers right from the start, since the new principles must also be in line with customers' reactive power principles," explains **Pertti Kuronen**, Fingrid´s leading customer and grid planning specialist.

"Reactive power services are a part of grid services rather than a new sales product. It is the joint objective of all parties to be able to manage reactive power in a sensible manner so that we don't have to charge for it."

Monitoring carried out at connection points

In accordance with the current grid contract, Fingrid monitors reactive power consumption by distribution network companies and electricity producers and consumers both by connection point and by monitoring area. Customers also have the opportunity to monitor the use of reactive power hour-by-hour via the extranet service in Fingrid's invoicing measurement and balance settlement system. If reactive power limits exceed the limit set for them in a given monitoring area, Fingrid has the right to charge the connection point holder which caused the excess.

"In the current model it's proven very difficult to show where possible problems in the reactive power area come from. Whose fault is it if limits in the area are exceeded but there are several connection points owned by

GRID A B C

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.

WHAT IS REACTIVE POWER?

Reactive power is needed for the regulation of voltages in the transmission grid, among other things. However, reactive power should not be transmitted in the grid since reactive power transmission increases losses.

Power flowing through an AC network can be divided into two components – active power and reactive power. Active power flows from generators to loads and can perform work at loads. Reactive power flows between electric and magnetic fields as the current and voltage alternate in a sinusoidal way, and does not perform work at loads. The AC network and the majority of devices connected to the network require both active and reactive power to function.

In an AC circuit, energy is temporarily stored in inductive and capacitive components. Inductive components store energy in their magnetic field. Purely inductive components are often referred to as coils. If voltage is placed across a coil, its magnetic field begins to increase and it takes a certain period of time for the current flowing through the coil to reach its full value. In other words, the current flowing through the coil lags behind its voltage. As such, **coils consume reactive power.**

Capacitive components, on the other hand, store energy in their electric field. Purely capacitive components are often referred to as capacitors. If current is driven through a capacitor, its electric field begins to increase and it takes a certain period of time for the voltage across the capacitor to reach its full value. In this case, the current flowing through the capacitor leads the voltage. As such, **capacitors produce reactive power.**

Reactive power in the transmission grid

It is not reasonable to transmit reactive power over long distances in the electric grid, since reactive power transmission increases the losses of lines and transformers and reduces the transmission capacity of active power. Often, it is sensible to produce the necessary reactive power close to

Current reactive power tariffs

Reactive power limits exceeded:
EUR 3,000/MVAr
(exceeding the reactive power window)

Reactive power:
EUR 10 /MVArh (of delivered and received energy in the area exceeding the reactive power window)

different players in the same monitoring area?" asks Pertti Kuronen.

Kuronen says that in practice no-one has been charged for exceeded limits. Recently however, an increase in reactive power introduced on the grid has been observed whereas previously it was more common for reactive power to be consumed. One reason for this is an increase in cabling in the regional and distribution network.

The new grid contract will introduce a solution since invoicing for reactive power by connection point will begin through measurements and monitoring. A reactive power window will be determined for each connection point and the use of reactive power and introduction of reactive power onto the network must remain within these limits.

"Balance will increase if each player is responsible for its own reactive power window," explains Kuronen.

Obligation-based reactive power reserves

Reactive power reserves are used to support the system voltage during faults or disturbance at power plants or in the power system. All electricity producers who are connected to the power system and who act in accordance with the power system technical requirements set out by the Electricity Market Act automatically participate in the maintenance of reserves.

In line with the current grid contract, producers connected to the main grid are reimbursed for maintaining reactive power reserves. In the new system, this maintenance will become obligation-based.

"There are no clear, fair grounds for the reimbursement. If production capacity corresponds to requirements, reserve maintenance will not cause significant additional costs for producers. In practice, all electricity production plants in Finland already participate in the maintenance of a reactive power reserve," explains Pertti Kuronen.

Preliminary tariffs to be announced at the turn of the year

The aim is to examine reactive power pricing principles this year. These principles will take into account the procurement and maintenance costs of compensation devices, losses caused by the transmission of reactive power and the value of transmission capacity taken up by the transmission of reactive power.

"The new price is likely to be lower than the current tariff," Kuronen says.

The amount of reimbursement paid for reactive power in the future will be clarified at the turn of the year. "This means that customers have a year to prepare for the change before the new grid contract comes into effect. We have also discussed a transition period for the new contract with customers. If a customer needs to make investments in order to carry out the new principles, a year might not be enough time," says Kuronen.

"It's essential to include reactive power management in a network development plan made in cooperation with Fingrid, for example, in order to see what a realistic time for the implementation of compensation could be. We will discuss this in more detail with customers during the autumn and coming winter." ■

TEXT MIRA MUURINEN

the location, where it is needed. In addition, reactive power has a significant effect on grid voltages. Since reactive power and voltage are local quantities, the production or consumption of reactive power at a certain area in the grid has an effect on the voltages in the same area.

The required amount of reactive power in the transmission grid varies according to e.g. load level of the grid. For example, transmission line reactances cause reactive power losses, which increase as the load current on the line increases. On the other hand, lines produce reactive power in their ground capacitances and the amount of the reactive power depends solely on the voltage level, and is not affected by the load current.

Since the variation of the loading conditions in the transmission grid is very large, the variation of voltages at substations would also be large if the need for reactive power was not compensated. The goal of the regulation of the transmission grid's voltages and reactive power is to keep the voltages within permitted limits in all operating conditions. Normally, the grid voltages begin to fall and the need for reactive power increases as load increases, and vice versa.

Grid voltages can be increased by producing reactive power. Reactive power can be produced using e.g. shunt capacitors or overexcited synchronous generators. Correspondingly, **voltage can be reduced by consuming reactive power.** Reactive power can be consumed using e.g. a reactor (coil) or underexcited synchronous generator. Occasionally, special devices are used for reactive power compensation, such as a static var compensator (SVC). ■

TEXT JANNE SEPPÄNEN

MONITORING RESPONSIBILITY

In this column, representatives of Fingrid's interest group companies write about responsibility.

Why is the government also **interested in responsibility?**

In September, the Ministry of Employment and the Economy made a proposal to the Government about the national implementation of UN Guiding Principles on Business and Human Rights. These principles deal with the State's duty to protect and the responsibility of companies to respect human rights, as well as remedial measures. The decision was made to begin national implementation based on the proposal presented, but why are such programmes needed? Many may ponder on, for example, the responsibility of the energy industry that as long as power comes out of electrical sockets at a reasonable price, everything is all right.

LINDA PIIRTO
The author is in charge of the preparation of social responsibility policy at the Ministry of Employment and the Economy.

For the State, the duty to protect human rights means many different measures aimed at ensuring that, within its jurisdiction, human rights are respected, including in business. At the same time, the State must ensure that, if infringements do, however, occur, they are dealt with and any damage caused is rectified.

In practice, the State's means to take care of this obligation are divided into three groups: legislation and its implementation, means of legal protection and the identification of all the functions by which the State deals directly with companies. In the latter case, the State may, through its own activity, ensure that responsibility issues are taken into account. Opportunities for this can be found, for example, in public procurement, public financial institutions and state ownership steering.

Of these, responsible public procurement has been particularly emphasised at the Ministry of Employment and the Economy. Last year, the ministry published a guide to socially responsible procurement, which explains how issues of responsibility can be taken into account at each stage of procurement from planning to the actual contract period. In connection with the different stages of the procurement process, examples of units carrying out public procurement gathered from all over Finland are presented, in which these possibilities have already been tried out in practice.

Procurement units like Fingrid have also been pleasingly quick to experiment with taking responsibility into account in public procurement. The procurement units have, for example, set contractual conditions for the contract period, which require the employment of young people, the disabled or long-term unemployed or the observance of occupational and human rights in goods or food production taking place abroad. There are also positive experiences of involving customers as early as the procurement planning stage. Other ways of taking advantage of social perspectives are suitability conditions concerning the supplier, minimum requirements for the object of procurement, for example in relation to accessibility and, with certain preconditions, also bid comparison principles.

So there is indeed a selection of ways to promote responsibility. Perhaps a greater challenge in Finland is the fact that our society is so developed and many things can be expected to happen almost automatically. For us, when we plug an appliance into the grid we do not usually have to think about whether there will be power, whether the main grid towers are still standing or whether the grid has been built of materials safe for the consumer or for the company's personnel. The same process of taking things for granted can be applied to most of the goods and services that we use every day.

Perhaps here, both the public and private sectors still have a possible opportunity: we could tell others more often what we are doing, why we are doing it and what we hope to achieve by it. That way, we could show that responsibility means the choices that we make every day, by which we aspire to a society that is predictable in a good way. ■

GRID QUIZ

Answer the questions below and send your reply by fax (number +358 (0)30 395 5196) or mail to Fingrid no later than 31 January 2015. Address: Fingrid Oyj, PL 530, 00101 HELSINKI, FINLAND. Mark the envelope with "Grid Quiz". Participants have the chance to win 3 mixes of three spices each. Answers to the questions can be found in this issue.

1. What was tested in the VALVE 2014 exercise?

- The possibility of acquiring starting electricity from the Swedish 400 kV grid.
- The capability of the main grid to transmit electricity in a situation where the hydropower plants in northern Finland are unavailable.
- Restoring electricity to the main grid using hydropower from northern Finland in a situation where the main grid has collapsed and left the entire country without power.

2. When will the joint-Nordic balance settlement be taken into use in Finland?

- November 2015
- March 2016
- November 2016

3. What is the name of the VALVE 2014 exercise an abbreviation for?

- Valtakunnallinen vesivoimaharjoitus (national hydropower exercise)
- Valot verkkoon (light to the grid)
- Valveilla ympäri vuorokauden (Awake around the clock)

4. In which year was the first HVDC connection in Finland, Fenno-Skan 1, taken into use?

- 1975
- 1989
- 1996

5. The longest submarine HVDC connection in the world, at the moment, is between which countries?

- Iceland and Great Britain
- Norway and Great Britain
- Norway and the Netherlands

6. Where is the Pohjois-Suomen Turvapuisto safety park located?

- In Oulu
- In Rovaniemi
- In Kemi

7. How is frazil ice formed in a river?

- In very low temperatures, the ice cover becomes so thick that it reaches the riverbed.
- Water supercools below the surface layer and adheres to the riverbed or under the ice cover.
- The water surface rises so high that snow on the banks is mixed into the water.

Prizes for the previous Grid Quiz (2/2014) have been sent to the following winners who answered correctly: Seija Lohikoski, Espoo; Joni Parkkinen, Toijala; Sami Rinne, Helsinki.

FINGRID OYJ

P.O. Box 530, FI-00101 Helsinki • Tel. +358 30 395 5000 • Fax +358 30 395 5196 • www.fingrid.fi

Helsinki
Läkkisepäntie 21
FI-00620 Helsinki
Finland
Tel. +358 30 395 5000
Fax +358 30 395 5196

Hämeenlinna
Valvomotie 11
FI-13110 Hämeenlinna
Finland
Tel. +358 30 395 5000
Fax +358 30 395 5336

Oulu
Lentokatu 2
FI-90460 Oulunsalo
Finland
Tel. +358 30 395 5000
Fax + 358 30 395 5711

Petäjävesi
Sähkötie 24
FI-41900 Petäjävesi
Finland
Tel. +358 30 395 5000
Fax +358 30 395 5524

Varkaus
Wredenkatu 2
FI-78250 Varkaus
Finland
Tel. +358 30 395 5000
Fax +358 30 395 5611