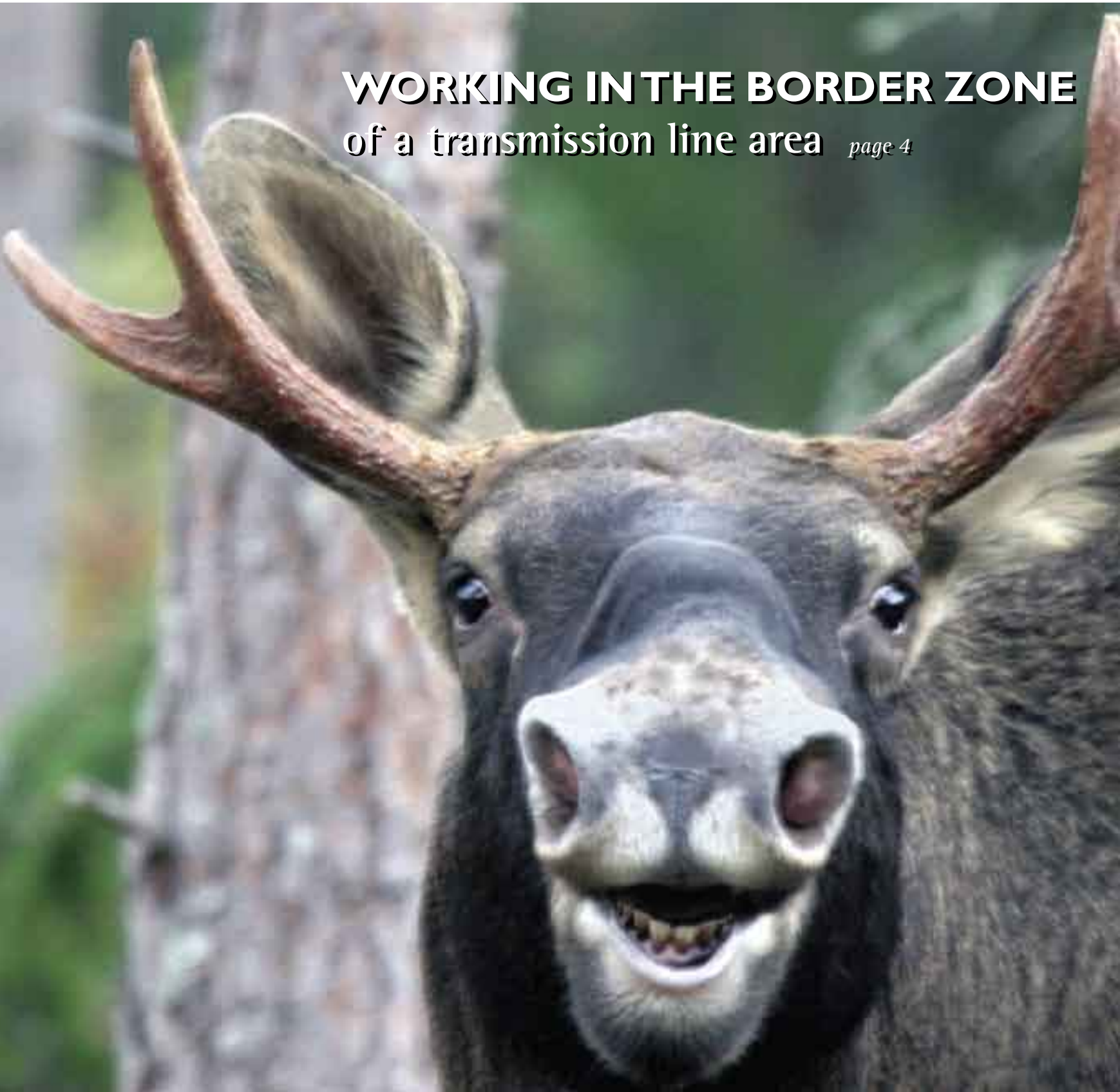
Corporate magazine
Fingrid Oyj
2/2006

FINGRID



WORKING IN THE BORDER ZONE
of a transmission line area *page 4*

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"Nordel's work to improve the functioning of the Nordic electricity market deserves all possible support," says Jukka Ruusunen, who will start as the President and CEO of Fingrid at the beginning of 2007. More about the thoughts of Jukka Ruusunen on pages 8 – 11.

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Summer and contacts

Timo Toivonen, Fingrid's President and CEO (third from the right), instructed Tarja Halonen, President of Finland, and her husband at Fingrid's stand at the Farmari exhibition in Hämeenlinna in 2002.

Our stand always provides an opportunity to learn about things such as routes of transmission lines. The photograph is from the Farmari exhibition in Tampere last summer.

This summer, Fingrid participated for the seventh time in the annual Farmari agricultural exhibition in Finland, which not only attracts people from the countryside but also an increasing number of townspeople. This summer the exhibition was arranged in Seinäjoki in Central Finland, attracting a total audience of 102,000.

At first, it may sound strange that the company responsible for the nation-wide electricity transmission grid is involved in an event such as Farmari. However, our experience shows that our presence is well justified in an event where we can meet thousands of representatives of our vital stakeholders: landowners and forest owners, members of various interest groups and associations, opinion leaders, and ordinary citizens.

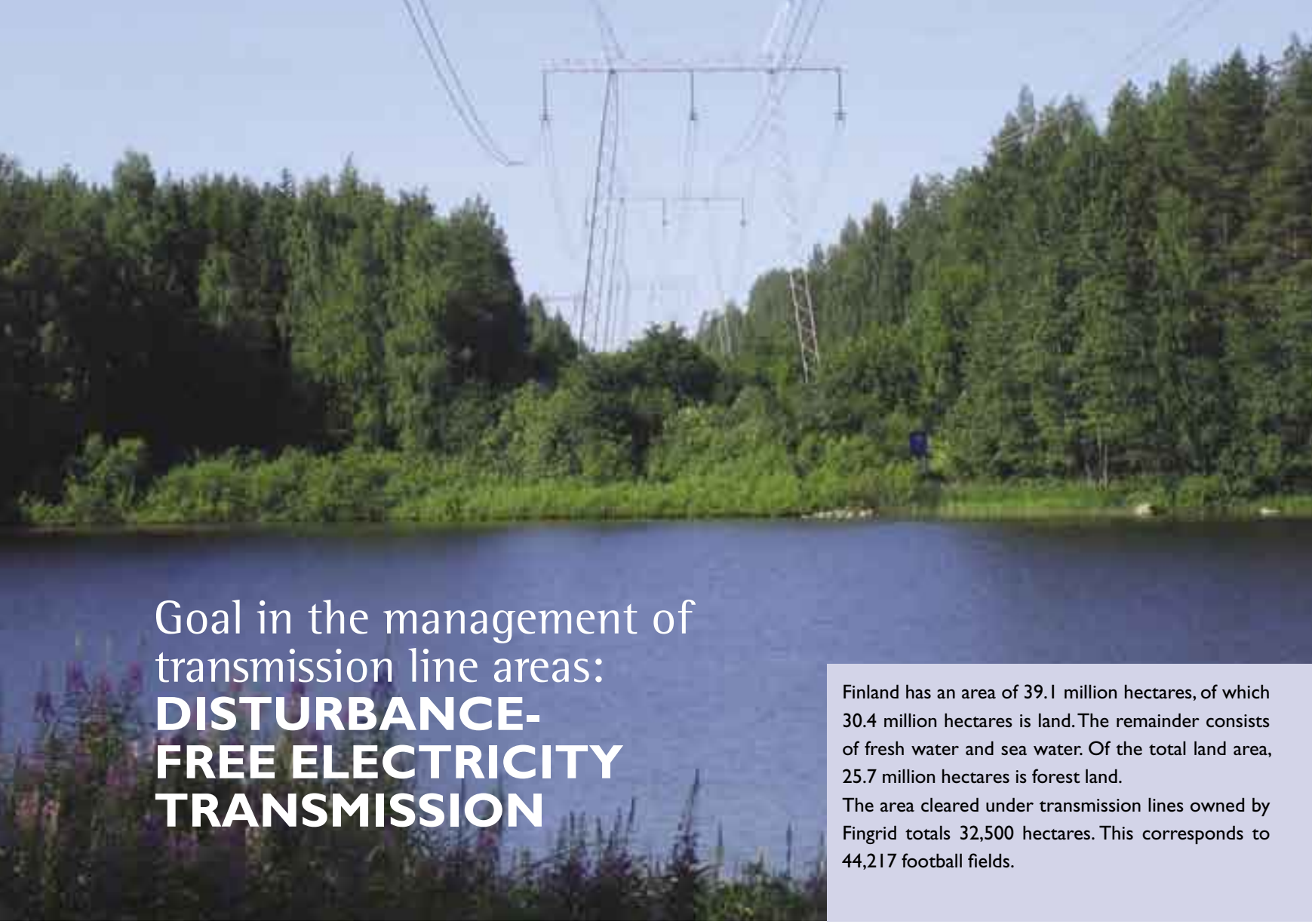
The 14,000 kilometres of transmission lines that Fingrid administers run in all parts of Finland to ensure that electricity is transmitted and that the lights are on in Finland. The main grid is part of our national property, and our company has a vital duty to keep it operational and in good condition.

Fingrid does not own the land, forest, field, marsh and water areas where the transmission lines run, but it has acquired a right of use to them through expropriation. The actual owners are thousands of private persons, corporations and associations; the very ones whom we met at Farmari. We wish to meet and listen to them, receive feedback, provide guidance and advice wherever necessary, and offer our expertise especially in many issues relating to transmission lines, working close to them, and our business in general.

The spectrum of these issues has turned out to be very wide. Among the more exotic questions presented to us include an inquiry about the operating principle of an electric chair!

Fingrid's vital duty is about caring – that is what we ultimately do. We forward energy, electricity, to wherever it is needed at any given moment. Participating in the Farmari exhibition represents caring of another kind – serving presence wherever knowledge and interaction are needed.

Leni Lustre-Pere is Fingrid Oyj's Communications Manager



Goal in the management of transmission line areas: **DISTURBANCE-FREE ELECTRICITY TRANSMISSION**

Finland has an area of 39.1 million hectares, of which 30.4 million hectares is land. The remainder consists of fresh water and sea water. Of the total land area, 25.7 million hectares is forest land.
The area cleared under transmission lines owned by Fingrid totals 32,500 hectares. This corresponds to 44,217 football fields.

As the transmission system operator, it is Fingrid's duty to keep the lights on in Finland. Being the owner of the transmission lines, Fingrid is to maintain the lines so that they are reliable and in good condition in accordance with electricity safety regulations.

TEXT BY Pasi Turunen PHOTOGRAPHS BY Juhani Eskelinen and Kuvapörssi

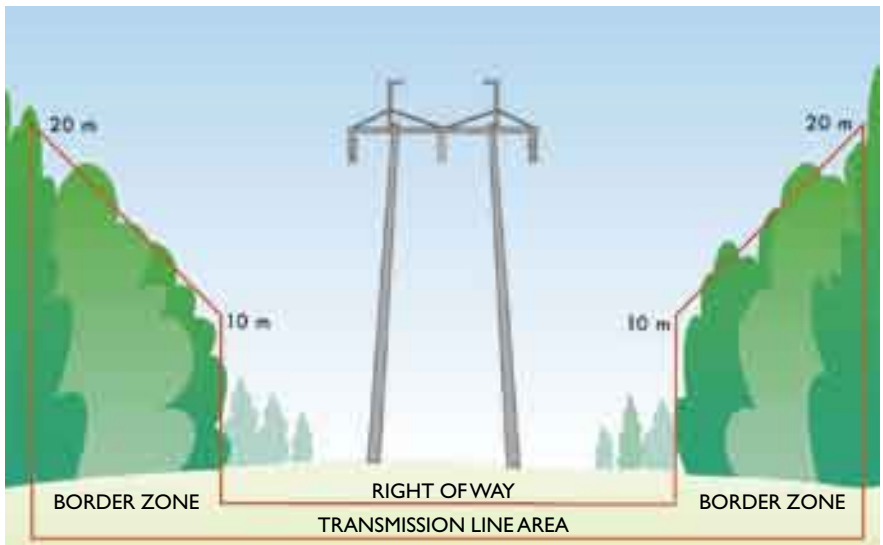
Fingrid does not own the land areas under the transmission lines nor the trees growing in the transmission line area, but these belong to the landowner. Fingrid has expropriated a limited right of use to the transmission line area. On this basis, the company has the right for example to use the transmission line area, clear the right of way, and manage long trees in the border zone.

The expropriation also contains a right to use roads and paths leading to the transmission line area. Separate 10-year service road agreements are signed with landowners concerning the use of private roads.

Why clearing?

Regular management of trees growing in the border zone of a transmission line area ensures that trees cannot fall on the lines, which would cause disturbances in electricity transmission.

The transmission lines are inspected for example in terms of vegetation every 1 to 3 years, either by walking in the area or from a helicopter. The costs of managing the transmission line areas constitute a major part of Fingrid's maintenance costs, and these costs also have a significant impact on the reliability of electricity transmission.



The width of the right of way for a 110 kV line is generally 26 - 30 metres.
The width of the right of way for a 220 kV line is generally 32 - 38 metres.
The width of the right of way for a 400 kV line is generally 36 - 42 metres.

The width of the border zone is almost always 10 metres.

In order to improve the reliability of electricity transmission and transmission lines, the rights of way are cleared in Southern Finland every 5 - 6 years and in other parts of Finland every 5 - 8 years. The trees in the border zone are felled at intervals of 14 - 25 years. Overlong trees in the border zone are felled, or the tops of such trees are cut by 2 - 5 metres using helicopter sawing.

In addition to fulfilling the electrical safety criteria, regular clearing also creates good conditions for multipurpose uses of the right of way. These areas can be used for purposes such as growing of Christmas trees, as a game field, for hunting, and for mushroom and berry picking. In the winter, a cleared right of way provides a good route for skiing tracks and snowmobile routes.

Regular clearing of the right of way resembles in some respects the traditional way in which meadows were managed in the past. It benefits degenerated plant and animal species. However, all uses of rights of way require a permit both from the landowner and Fingrid.

Rights of way are often good grounds for berry and mushroom picking.

Methods for management

The transmission line areas are cleared mechanically. In practice, this means manual clearing with a motorised handheld clearing saw or clearing with a special machine. Chemical prevention of new growth has never been used in Fingrid's transmission line areas.

The management of vegetation must be as environmentally acceptable as possible. This is why the total impacts of the methods employed are taken into account when developing existing and

A cleared right of way provides areas for example for snowmobile routes.

INFORMATION ON THE MANAGEMENT OF BORDER ZONE TREES IN TRANSMISSION LINE AREAS is available in a brochure published recently by Fingrid and at www.fingrid.fi (in Finnish and Swedish).

new methods. As a concept, the environment encompasses all living organisms and plants as well as factors influencing people, such as scenic and recreational values. The vegetation is always managed by professionals.

Manual clearing

Manual clearing of the transmission line area is nowadays considered as heavy work, which is why it is not very attractive. However, it has been found that manual clearing is best suited for delicate areas such as rocky surfaces, shores and close to trees with special scenic value. Manual clearing is also needed in conjunction with machine clearing, because machines cannot go for example close to tower structures.

Another advantage of manual clearing is that it enables selective clearing of the right of way. This aims to soften the scenery and to leave food plants favoured by game animals. Selective clearing also leaves more versatile vegetation in the right of way, which is more pleasing to the human eye.

Overall, manual clearing leaves a nicer-looking scenery and damages the ground surface less than machine clearing.

Machine clearing

Machine clearing has an established position nowadays, and it is an effective clearing method for example on slopes beside roads. Machine clearing of rights of way commenced in small scale in Finland in the mid-1980s, but its use has not expanded outside local uses. In the future, machine clearing will likely also become more common in the management of transmission line areas because there will be fewer contractors who carry out manual clearing.

Machine clearing is clearly more efficient than manual clearing when the work areas are large and uniform and when the trees grow in thick groups and have a large diameter. Machine clearing can also be carried out at several levels. The end result depends on the machine operator's experience and machinery used.

It can be assumed that the working methods of machine clearing will be developed for example towards selective clearing. In this way, the end result can be a transmission line area with scenic uniformity, achieved in an efficient way.

Management of border zone trees

The felling and management of trees growing in the border zone are carried out as separate work. Only logging professionals are used for this work because of safety reasons. The tops of border zone trees can also be shortened by using a saw mounted on a helicopter. The helicopter contractor must possess an approval by aviation authorities for the equipment and method used. Helicopter sawing is used if only a small proportion of the border zone trees are too long.

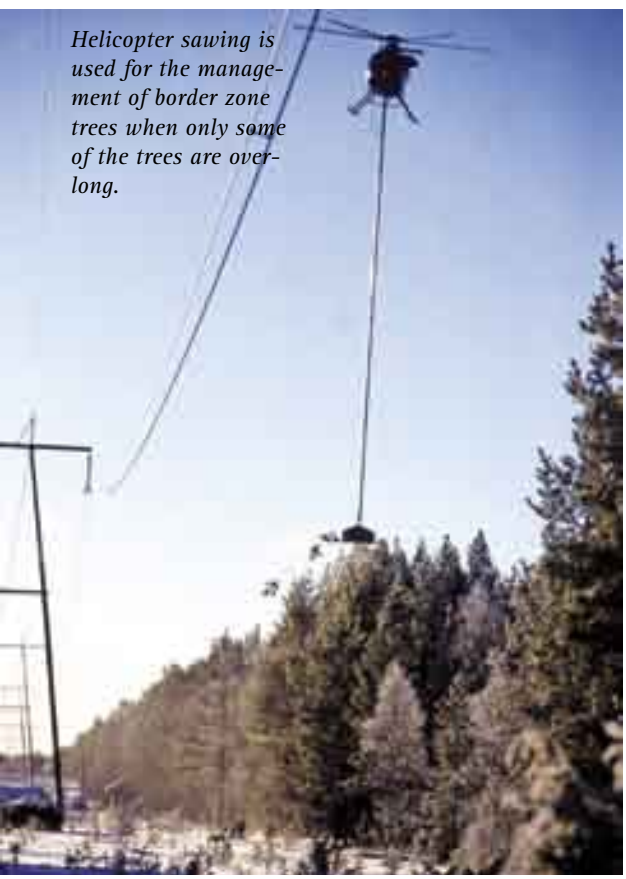
Timber owned by the landowner is an issue which is closely related to the management of border zone trees. Since the border zone is a band-like logging site containing a lot of trees with a small diameter, the harvesting costs are often high.

In many cases, the most sensible solution is total management where all trees are cut in the border zone, with the exception of trees which are clearly shorter than the limit height (see the diagram of the transmission line area on the previous page). In this case, Fingrid aims to arrange joint harvesting and sales of the border zone trees for example with the local association of

Safety distances from transmission lines		
Voltage level of transmission line	Minimum distance of machine and load under conductors	Minimum distance of machine and load at the sides of conductors
110 kV	3 metres	5 metres
220 kV	4 metres	5 metres
400 kV	5 metres	5 metres

forest owners. Fingrid also participates in the harvesting costs so that a buyer can be found for timber lots which can be harvested with reasonable costs and that the landowner obtains a reasonable price for standing timber.

If most of the border zone trees are overlong, it is often most sensible to cut all trees which fulfil the dimensions of industrial wood. The landowner's approval is absolutely always required for this.



Helicopter sawing is used for the management of border zone trees when only some of the trees are overlong.

Planning, execution and informing of clearing

The planning of clearing is based on the length of the clearing cycle. This cycle is determined by the geographical location, ground and structure of the line. In other words, the length of the clearing cycle is longer in Northern Finland than in Southern Finland. The objective of this is that new growth cannot grow too close to the line in any location during the clearing cycle.

A detailed plan, which is used as the clearing instruction, is always drawn up of the site cleared. The plan takes into account potential clearing agreement areas and scenic and other special features, such as shores, yards and nature preservation areas. The clearing of these is planned separately after a visit to the site. The goal is to manage as many of these areas as possible during a single clearing project, but separate clearing is also possible.

Manual clearing is primarily carried out during the growing season. Machine clearing also begins during the growing season but continues longer. Machine clearing must take into account external factors restricting working, such as thaw and depth of snow.

Clearing work is subjected to competitive bidding, and contractors capable of high-quality work are primarily selected for the work.

In densely populated areas, the detailed clearing plan is presented and reviewed together with the contact person of the municipality in question. Issues such as removal or chipping of clearing waste are agreed in the review. The clearing contracts are published on Fingrid's Internet pages at www.fingrid.fi.

In conjunction with the management of border zone trees, the owners of the relevant land areas are verified in the property data system of the National Survey of Finland. Landowners are always informed in writing of the management of border zone trees. The regional environmental centre is always contacted if clearing is carried out in an area with special scenic value or in an area preserved or protected by law, and the clearing of the site is always agreed separately with the environmental centre.

In accordance with Fingrid's principles for environmental management, vegetation in the transmission line is managed in a good manner in terms of the environment and nature. This can be achieved through thorough planning and fluent co-operation with the parties concerned.

Transmission line areas are part of forest nature in Finland, and ordinary people also come across them when moving in the forest. We can safely enjoy the natural environment with public rights when we are aware of the existence of transmission line areas and know their impacts.

"My career in the energy industry is equally as long as Fingrid's history. It includes significant reforms in this industry. There have not been two identical years in terms of the operating environment," Jukka Ruusunen says.

With a fishing rod in hand and

THOUGHTS IN THE GRID

Fingrid's future President and CEO Jukka Ruusunen spends his holidays in his summer home fishing and chopping wood. "With a fishing rod in hand, your thoughts become free. I think that this summer my thoughts will revolve around the Finnish main grid," he says when he is clearing his desk for the summer holiday at Fortum's head office in Espoo.

TEXT BY Maria Hallila PHOTOGRAPHS BY Jakke Nikkarinen and FutureImageBank

Jukka Ruusunen will become the head of Fingrid on 1 January 2007, but he will start his employment with the company in October. Until then, he will work as Vice President for Development in Fortum's Portfolio Management and Trading unit which is responsible for the optimisation of the company's Nordic power production, sales of produced electricity to electricity exchange Nord Pool, and for electricity derivatives and emissions trading.

The job description of Vice President for Development also involves a lot of supervision of interests. Much of this work concerns presenting views related to the development of the Nordic and European electricity market.

Jukka Ruusunen has also had an occasionally visible role in Finland as Fortum's spokesman when the media have wanted to hear the company's opinion about topical issues concerning the electricity market or emissions trading.

Expansion of electricity market brings added security

Before his summer holiday, Jukka Ruusunen has still a day's trip to Brussels, where the issue at hand is once again European electricity market integration. In the preparatory work for market integration, which has become increasingly important within the EU in recent years, he has been involved in assessing things and taking a stand on them from the viewpoint of power producers. In recent weeks, that point of view has started to change. "I notice that I am thinking about things more and more often from the perspective of the main grid, and the role of the grid has become more clearly visible in various contexts."

What Jukka Ruusunen considers as important - from both perspectives - is making sure that the Nordic views are heard on the forums which develop the European electricity market. "More and more of the rules are decided in Brussels, and the Nordic countries have much to give to Europe, because we can show what grid co-operation can be at its best. We are forerunners in that thinking which is now pursued by the Commission for the whole of Europe."

Based on experiences gained from Nordic co-operation, Jukka Ruusunen is convinced that expanding and advancing the integration of the electricity market is the best way in which to secure the availability of electricity and its reasonable price level.

"For decades, Finns have benefited significantly and in many ways from Nordic market co-operation. One recent example of these benefits is that thanks to imports of hydropower elec-

tricity, emissions trading did not raise the price of electricity last year as much as would have been the case if we had been alone."

According to Jukka Ruusunen, much has happened with regard to the EU's electricity market recently. Concrete examples of accelerated developments include new transmission connections which are under construction, for example a new cable connection constructed between Norway and Holland.

"Increased electricity transmission options will help the Nordic market for example in balancing electricity price variations caused by dry years. The more extensive our backing, the more secured we can feel," is how Jukka Ruusunen summarises his view of the advantages of market integration.

Fingrid knows its role and duties

Through his present job, Jukka Ruusunen has learned to know his new employer's business and also its way of operation. His knowledge and experiences of Fingrid have created an image of a strong expert company which is among the most progressive transmission system operators in Europe.

"Over the past decade, I have had the opportunity to follow Fingrid's phases quite closely, all the way from its establishment. This period also covers another decisive turning point in terms of our business in Finland: the Electricity Market Act became effective and the electricity market was liberalised. There have not been two identical years in terms of the operating environment," Jukka Ruusunen describes the changes in the energy industry.

In Fingrid's way of operation, he appreciates the fact that the company has defined its role and duties using grounds which are essential and correct in view of the market. "A transmission system operator needs to be independent, impartial and efficient. It must create good operating conditions for the commercial players and work constantly to improve these conditions further," Jukka Ruusunen describes the main points in Fingrid's model of operations.

According to him, the reliability of the transmission system operator is one of the cornerstones of co-operation and functioning of the electricity market. He also considers it important that Fingrid has always been an active listener and debater. "There is good dialogue in Finland between the transmission system operator and its customers. Fingrid is genuinely interested in the customer's views and development suggestions."

Jukka Ruusunen's present position as Vice President, Development, has many interfaces with Fingrid. "One of the foremost combining factors is an objective of expanding and advancing the Nordic and European electricity market co-operation," he says.

Showing direction is the foremost thing in leadership

Despite his accumulated knowledge and experiences of Fingrid, Jukka Ruusunen says that he will start in the company with a humble mind. "I am aware that I now have an outsider's view of many things, and that view may change as I get to see the things from the inside."

According to him, one of the biggest future challenges is related to leadership in an organisation which works under the pressure of increasingly strict efficiency requirements. "Constant development of results and efficiency is the means to success. It is the management's duty to make sure that the company focuses on the right things and that work is organised so that such focus is enabled."

Jukka Ruusunen describes himself as a coaching leader. "I want to give people responsibility and show the direction towards which we are heading. Instead, it is not my style to specify each and every detail," he says.

According to him, showing direction is the most important task of a leader. "People must know where we are heading. And when they know the direction, I want to trust my organisation. It is the

people who ultimately take care of the business."

A good team spirit and working as a team are important values for Jukka Ruusunen, who has served as the coach of a junior football team for ten years.

Jukka Ruusunen has a degree of Doctor of Technology. Before his present job, he worked for example as a professor and assistant professor at the Helsinki University of Technology and Helsinki School of Economics.

"I am interested in people, I consider discussion as important, and I also like to teach," he says. These were obviously the main criteria when he was elected teacher of the year at the Helsinki University of Technology in 1994.

"Logistics manager" in free time

Even though Jukka Ruusunen's actual work changes in the autumn, his other tasks remain unchanged. In his private life, he characterises himself as the logistics manager in his family. In practice, this means organising and attending to transport so that the four children of the family get to their interests in the evenings: three of them to football field and one to figure skating training. "Family life is very educating," he says with a laughter.

Whatever free time he has beside transport duties, Jukka Ruusunen likes to spend in the natural environment, jogging, reading, and fishing in the summer.

Pehr-Olof Lindh (on the right) showing Tuomo Kouti (on the left) and Timo Kiiveri how to use a pair of compasses in navigation.

Seabed survey of the expansion of Fenno-Skan link completed

CABLE ROUTE PUT ON MAP

The project for expanding the Fenno-Skan cable link between Sweden and Finland reached one of the most important initial stages in the early summer, when the seabed survey of the cable route was completed. The designers now have an exact map of the seabed along the route of the cable. In conjunction with the survey, samples were also taken along the route so that the composition of the seabed can be analysed.

TEXT BY Leni Lustre-Pere PHOTOGRAPHS BY Tuomo Kouti

Timo Kiiveri, Fingrid's Project Manager, characterises the seabed survey as a very important stage in the cable project. "The survey makes it possible to choose an as even seabed for the route of the cable as possible. And when we know the exact length of the route, we can request bids of the cable and its laying," Timo Kiiveri says.

Survey responded to the main questions

The seabed can be viewed in great detail, metre by metre, thanks to the survey and analyses.

"Various research methods can be used for finding out what the route contains: whether there are any wrecked ships, how deep the route runs, and how

Data provided by various measuring instruments were monitored constantly during the survey.

steep and high the irregularities at the seabed are," Timo Kiiveri says.

Samples taken in conjunction with the survey will be analysed for the composition of the seabed, which has an impact on issues such as the water permit and dredging.

"The width of the surveyed area is 300 metres, and the optimum route is selected for the cable over this area. The survey also reveals all crossings such as other cables and pipes."

The digital route mapped in the survey will also be used during the laying of the cable.

Cable to be laid in 2010

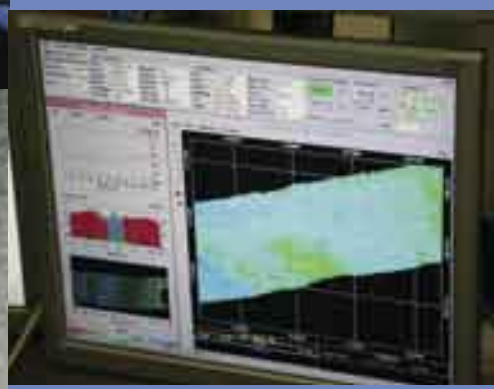
The seabed survey for the expansion of the Fenno-Skan cable started in May, and the results started to be ready in July. The survey was carried out by the Swedish company Marin Mätteknik Ab.

"The open sea was surveyed using the 56-metre m/v Franklin, which ran the route several times and scanned the seabed using various instruments. A smaller vessel was used in shallow coastal waters," Timo Kiiveri says.

The survey went smoothly and as

Nils Ingvarsson, project manager of Marin Mätteknik, describing the progress of the survey in the saloon of the m/v Franklin. Persons from the left: Pehr-Olof Lindh, Timo Kiiveri, Nils Ingvarsson, Kari Suni, reporter of newspaper Satakunnan Kansa, and Ulf Martinsson, consultant of Vattenfall Power Consultant hired by Fingrid.

A shipwreck at the seabed revealed by a side scan sonar.



A multi-beam echo sounder provides an exact map of the depths of the seabed. With other information obtained, this data can be used for choosing an optimum route for the cable.

planned. "However, at the very beginning we had a small accident when the vessel touched bottom right after departure in Swedish waters. Luckily, there were no serious consequences."

The concrete conclusion of the expansion project, the laying of the cable from Rihtniemi in Rauma, Finland, to Dannebo in Sweden will take place in the summer of 2010, but, according to Timo Kiiveri, much will happen in the project before that.

"The actual manufacture of the cable will take about 18 months, because we will need 200 kilometres of it."

According to Timo Kiiveri, potential cable manufacturers have already been investigated, and their capacity situation has caused some concern to the project team and also a potential schedule risk. "Cable factories seem to have a good market situation, because in some of them, the capacity has been reserved until the beginning of 2009. In our project, the cable can only be laid in the summer, so our schedule is fixed in that respect and requires a timely delivery," Timo Kiiveri says.

Joint project by neighbouring countries

The expansion of the Fenno-Skan sea cable link will be implemented jointly by Fingrid and Svenska Kraftnät, the transmission system operators in Finland and Sweden, respectively. They will share the ownership and capital expenditure costs - some 230 million euros - of the 800 megawatt cable.

The expansion will add to the electricity transmission capacity between Finland and Sweden by approx. 40 per cent and connect the Nordic electricity market even closer together.

Fingrid in benchmarking

Seeking BEST PRACTICES and verifying efficiency

Throughout its history, Fingrid has participated actively and successfully in international benchmarking in the electricity transmission industry. In this way, the company aims to find new, more efficient procedures and development issues and to ascertain its efficiency level in relation to other transmission system operators.

TEXT BY Jukka Metsälä PHOTOGRAPHS BY Juhani Eskelinen

Fingrid has participated in benchmarking studies which examine the quality and efficiency of grid maintenance at intervals of two years since 1995. Measuring the performance of grid operation also has traditions of a decade at Fingrid, and workplace atmosphere has been surveyed annually. The company has also taken part in some other individual comparisons.

In benchmarking which examines Fingrid's overall operations, efficiency is composed of the efficiencies of various functions. Depending on the benchmarking study, the functions studied can comprise for example maintenance of transmission lines and substations, grid operation, administration and support functions, and scope and development of grid.

In studies examining the efficiency of the main functions, all input and output of the participant relating to the grid business are considered. In this way, for example the costs and capital expenditure compiled for the study correspond to the participant's figures which have been reported externally. So far, there have been three benchmarking studies of Fingrid's overall operations since 1999.

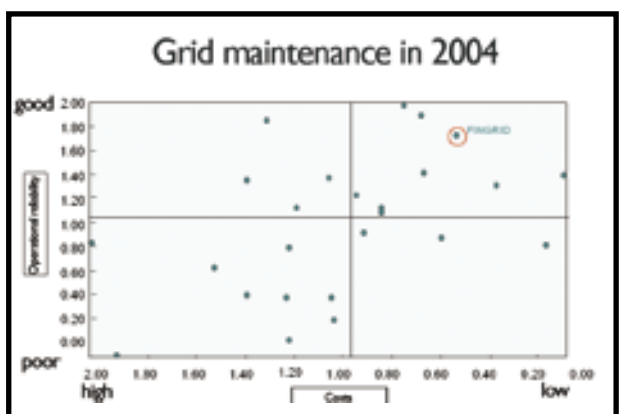
Benchmarking concerning a certain sector, such as grid maintenance, grid operation or workplace atmosphere, enables detailed comparisons and analysis and finding best practices.

Fingrid in the top league internationally

Fingrid has participated in benchmarking with transmission system operators operating in various parts of the world. The number of participants has ranged between 10 and 25.

The more participants, the more extensive the comparison material used in benchmarking, but on the other hand it is more laborious to match the initial data because the participants are highly different. However, a high number of participants and their differing operating environments may provide an opportunity for finding new, even surprising practices and applying them in one's own operations.

Almost without exception, Fingrid has been among the top three in all sectors in its benchmark group. The studies have been a source for many best practices which Fingrid has taken into use.



Includes the maintenance of substations and transmission lines.

Based on results from international benchmarking concerning the maintenance of the transmission grid in 2004, Fingrid was again in the top league.

Fingrid is already applying many of the best practices which were found in the most recent benchmarking studies. The results of the studies have indicated that performance has become more efficient both within Fingrid and in the business in general internationally.

Fingrid's good success in benchmarking stems from the history of the electricity transmission business in Finland and from Fingrid's operational efficiency. The energy business has always been a highly competitive and cost-conscious business in Finland. This has been in the interests of an energy-intensive industry which knows the energy business. Grid operation was separated within power companies at an early stage in international electricity market development, as a result of which competitive bidding and focus on the core business brought considerable savings.

A single grid operator was established in Finland, and it was imposed a concrete objective of operational efficiency at the outset. Fingrid's efficiency is the result of factors such as successful outsourcing, solid expertise as a service customer, efficient data systems, and constant improvement and monitoring of efficiency. Cost and quality consciousness is guaranteed by competent personnel, and expert owners and expert customers.

Benchmarking also in the future

This year, there are five benchmarking studies going on within Fingrid. Two of these focus on examining the efficiency of the main processes of transmission system operation and three on analysing a certain sector. Two of these studies are new for Fingrid.

In the future, too, Fingrid will be actively involved in benchmarking to seek best practices, to apply them within the company, and to measure its performance against transmission system operators in other countries.

The goal is to find suitable models for the comparison of transmission system operation and to develop the existing methods. In 2007, a representative of Fingrid will be on the control group of the International Transmission Operations and Maintenance Study (ITOMS), where the control group is composed of the representatives of the various continents.

In strategy literature, *benchmarking* is defined as a process for identifying, learning and applying best practices and procedures.

Measuring and developing performance have an important role in business development. This is why benchmarking is a widely used management tool in various businesses.

Benchmarking can be carried out individually or in co-operation with others. It can concern a wide variety of issues such as various functions, costs, products or strategy.

The goal in benchmarking is to verify efficiency at certain input/output ratios. In the studies where Fingrid has been involved, the input has comprised resources, such as costs and working hours, and output has included the duties and results of the transmission system operator, such as the scope and structure of the grid, geographical conditions, volumes of electricity transmitted, and number of customers.

After a comparison of key figures, the studies have sought factors among each participant's procedures which have an impact on efficiency or inefficiency.

Carrying out benchmarking is almost always challenging. The foremost challenges include harmonising the benchmark group and finding the right and homogeneous data among the participants.

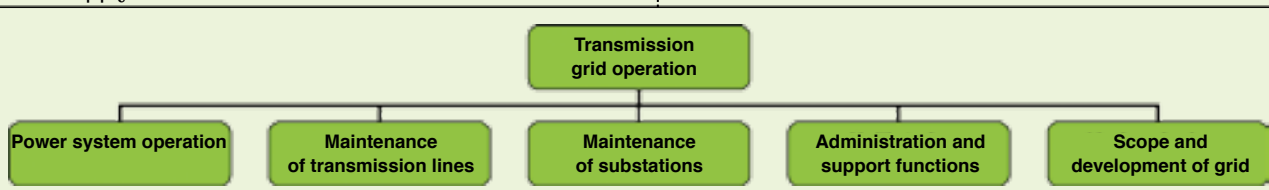
There are several benchmarking models developed for various purposes. It may be laborious just to find the right model and apply it.

The essential thing in benchmarking is that the reliability of the model and of the data compiled is assessed in every stage of the study. When repeating a single benchmarking method, the reliability of the results grows.

Fingrid's benchmarking projects are made more challenging by the fact that benchmarking is carried out almost every time in a different country and between participants which operate in different types of operating environments. The data compiled for the studies differ from the data reported by the participants in other contexts, which also poses challenges to the compilation of data. Moreover, the nature and depth of the benchmarking study set their own requirements for the accuracy of the data compiled. Fingrid has developed reporting to also correspond to benchmarking needs.

Fingrid has participated in benchmarking studies and their development together with transmission system operators in many countries and with consultants. It is important to develop the comparison models jointly so that the special features of each participant can be considered.

However, there are many country-specific special features, and compromises are often called for in the harmonisation of the benchmark group. Consultants have been responsible for the functioning and development of the benchmarking models, for compiling the right data, and for analysing and presenting the results.



The functions studied in benchmarking can include for example maintenance of substations and transmission lines, grid operation, administration and support functions, and scope and development of the grid.

Photograph by Gorilla Oy

Nordel's chairmanship and secretariat to Finland

Nordel, the co-operation organisation of the Nordic transmission system operators, held its annual meeting in Fiskebäckskil, an old fishermen's village on the west coast of Sweden, on 13 June 2006. In accordance with Nordel's rules, the two-year chairmanship of Sweden came to an end at this meeting and was taken over by Fingrid for the next two years. Fingrid's Executive Vice President Juha Kekkonen started as Nordel's Chairman.

TEXT BY Erkki Stam

Nordel's chairmanship was transferred to Finland at a challenging phase in the development of the Nordic electricity market. In recent years, Nordel has drawn up several reports and initiatives to improve the functioning of the Nordic market. The Nordic energy ministers have supported the initiatives made. Many of the initiatives must also be put into practice during Finland's chairmanship.

In view of the electricity market, the foremost initiative is the harmonisation of the pricing of balance power in the Nordic countries. This harmonisation is a basic condition for the development of a Nordic end user market. Nordel's proposal is presently being commented on by the market parties, and conclusions are expected by the end of this year. Another objective is to expand the Elbas market, which is related to balance management, to Norway and Jutland in Denmark.

In grid operation, the ongoing analyses include the co-ordination of procurement of reserves needed for disturbances in the power system. There will also be focus on mutual information exchange between the transmission system operators and on training of personnel.

The biggest challenge during the early part of Finland's chairmanship is to create shared principles for the management of transmission congestions. The development programme for the Nordic grid is part of this management over a long term. The next development programme will be completed during Finland's chairmanship.

The Nordic electricity market has been an example for other European countries. Retaining the pioneer status calls for the constant development of efforts and rules within Nordel.

Nordel's secretariat was also transferred to Fingrid in line with the chairmanship. **Erkki Stam** will serve as Nordel's Secretary supported by **Anders Lundberg**. The assistant is **Anneli Fagerlund**.

Some 20 Fingrid employees participate in the various committees and task forces of Nordel.

MOST UP-TO-DATE TECHNOLOGY to secure Fingrid's telephone systems

Several significant reforms have been carried out in Fingrid's telephone systems during the past year. The most up-to-date technology now ensures that the communications will work reliably and without jamming also during exceptional situations.

TEXT BY Ari Silfverberg PHOTOGRAPHS BY Eija Eskelinen and FutureImageBank

Telephone communications continue to have a significant role for Fingrid. The operation of the main grid is remote-controlled, but control taking place over the telephone is a crucial safety factor for example during switching when people are working on the lines or at substations.

Reduced need for in-house telephone network

There were many reasons why Fingrid originally had a separate telephone network of its own. There were no available telephone subscriptions and connecting lines for remote traffic in the general telephone network, the networks could jam up, and the telephone calls were expensive. Moreover, it was easy to carry out protection systems by means of radio links and later by means of optical fibres.

In addition to grid operation, the telephone network was also used for long-distance calls between substations and even for international telephone communications to Russia.

The commissioning of Fingrid's digital telephone network (Dixi) started in 1986. The network replaced the electromechanical network DX-20 and enabled for example the automatic routing of calls in fault situations.

Even though technical support from the manufacturer of the telephone exchanges finished at the end of 1999, the system would still have been operational despite its age of 20 years. However, the exchanges of the network were located in wrong places in view of the needs. Moreover, operative telephone traffic has shifted to mobile phones, and substations now have a smaller need for separate telephone modem connections thanks to better broadband connections and developments in energy measurement technologies.

The dismantling of the old telephone network started in the summer of 2005. In the summer of 2006, a direct telephone connection was built between Fingrid and the northwestern grid control centre in Russia, the direct

telephone subscriptions of the Vyborg converter substation were turned into customer subscriptions of the north-western grid control centre, and the last exchanges in the telephone network were dismantled.

At Fingrid, the reform was reflected in the changing of some telephone numbers of substations.

Reform praised by Power System Control Centre

As part of Fingrid's telephone system reform, the operative telephones of the Power System Control Centre have been shifted under the exchange of Fingrid's Arkadiankatu office, and personnel monitoring the main grid have workstations where they can see the incoming calls and pick the telephone calls they want to answer.

The software and hardware in the office exchange systems were updated in the same conjunction. The update ensures software support for the system and gives improvements in some functions and data security. Voice instructions for the use of functions are the biggest change for the actual users.

The exchange was updated by TDC Song in co-operation with Alcatel, Instcom and Scando.

Fingrid's Project Manager **Ari Ritamäki** says that several options were experimented for call control at the Power System Control Centre. "The work was challenging. It was an interesting experience to construct a direct connection to Russia. **Yrjö Repo**, who served as an interpreter, had a major role in this project."

Fingrid employees can now place telephone calls directly to the north-western grid company in Russia. Correspondingly, there is a direct connection from this company to Fingrid.

Reijo Huhta, who heads Fingrid's Power System Control Centre, is satisfied with the revised system. "The update gave us two important features: an option to pick the telephone calls and continuous recording of telephone calls," he says and points out that privacy is secured and the listening option is strictly restricted.

One main objective of the reform was to make sure that telephone calls do not jam up. The old telephone exchange is still in reserve use for software updates, and it can be commissioned quickly.

"Our other backup systems comprise some customer subscriptions in

Lauri Puskala and Pentti Ahlqvist dismantling the old telephone network.

the general telephone network, mobile phones of two operators, and telephones in the Virve network used by authorities, so it is very unlikely that all our telephone communications would be out of order," Reijo Huhta says.

More reliability and speed through Virve

Fingrid has had some telephones in the digital Virve network used by authorities in trial use for a couple of years. Stationary Virve telephones have now been installed both at the Power System Control Centre and at the Network Control Centre. These telephones will also be installed at the main substations.

The Virve telephones will partially replace the normal telephone network, and they will replace the line telephones at new substations. Fingrid has also recommended that network operators and power plants purchase Virve telephones for their control rooms.

The benefits of the Virve network over the GSM mobile phone network include group calls and swift connection of telephone calls and text messages. Direct calls between telephones without network base stations are also possible.

Engineering concerning the Virve network has been ordered from Suomen Erillisverkot. The engineering is due to be ready in the early autumn so that the potential joint groups can also be taken into use in the partner companies.

IN BRIEF

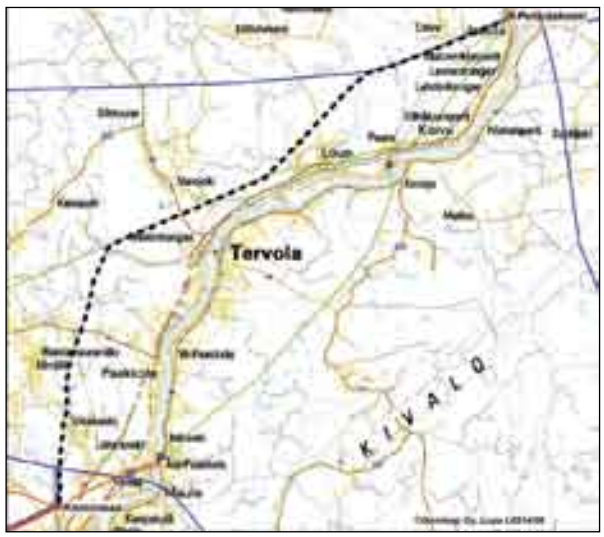
Route chosen for the Keminmaa - Petäjäskoski 400 kilovolt line

■ Fingrid has completed the environmental impact assessment (EIA) for the route of the new 400 kilovolt transmission line to be constructed between the Keminmaa substation and the substation at the Petäjäskoski hydropower station in Northern Finland. Route alternative A with a length of approx. 60 kilometres has been chosen for further engineering.

The route alternative chosen runs west of the river Kemijoki parallel with the existing transmission lines Kuikero – Varevaara and Kinnula – Petäjäskoski. Approximately half of the line route will be in a new right-of-way.

The feedback received during the EIA process was primarily in favour of the chosen route alternative A. Fingrid has also concluded that this route is technically and environmentally superior to the other alternative.

The Keminmaa - Petäjäskoski 400 kilovolt line will secure the reliability of the power system in the region and enable the forecasted increase in electricity use. The line will also add to the transmission capacity between Finland and Sweden by approx. 200 megawatts, hence improving the functioning of the electricity market by reducing transmission congestions between Finland and Sweden.



The selected line route is indicated on the map by a broken line.

Based on a survey permit granted by the State Provincial Office of Lapland, Fingrid will launch the engineering of the transmission line and related field surveying. In 2006, there will be measurements which support engineering, and the tower locations will be marked and their soil will be analysed.

Power between us

There was too much tension, too much effort. Efficiency did not yield results, only destruction. Spring can be the cruellest of the seasons of the year.

When the spring comes, everything gets powered up and ready for action. There is still time to reach the half-yearly objectives. There is still time to get into bikini shape for the summer.

There is still time to argue over the holiday. Everyone's got power.

***

The protecting gloom of the winter changes to the revealing light of the spring.

It fills some people to the brim, only to be released with a hiss. The small pineal gland works at full speed. Melatonin, adrenalin and serotonin surge in the bodies of such people.

Others, the powerless, become exhausted at the outset. To them, the activity of others is a depressing model, not an energising example.

You swallow an energy pill and get back into full speed. Maybe we should really ask: What caused the burn-out? Why are we standing again at the smoking ruins of broken promises?

You get job supervision, nice furniture and a team-building adventure trip, and you are again a member of an effective and winning team. Yess!

Maybe we should really ask: At what point did we lose all the natural relays protecting us from overheating, the people who guided and mended the welfare of the organisation naturally?

Where are those people now who had time? Who's got the time now?

***

The overwhelming growth of the natural environment is apt to make your eyes break into tears. That's the way it should be. Sensitivity is the virtue which raises us to humanity. But if any old thing makes you cry, you are dangerously close to hypertension.

It's worth your while to listen to the signals of your power net. Does it moan? Lament? Howl? Or does it hum in a reassuring and steady manner?

It is a mistake to go on holiday so that you could get back to work refreshed. You should go on holiday because of yourself, not to charge your batteries just to exhaust them at work. You should power up yourself continuously; work should be a reward to the worker while doing the work, not when leaving it behind.

If this is not so, the interruption in power supply may become too long without you even noticing it. You keep up the old pace until you burn out.

***

When you have burnt out, you are like a small child who has burnt his finger. You are afraid of the thing that hurt you, the same pattern of doing things: never again! You cannot go back to the old way for a long time, maybe you don't even want to, and the tolerance for the thing that hurt you may have decreased permanently. Even moderately tolerable things have turned quite impossible.

The group at risk comprises those conscientious men and women who are dedicated to their work, who are proud of their performance, who consent to being available, and who ultimately pay a high price for it. The spirit soars but the body can't keep up with the pace.

Sure enough, there are manuals for success. There are piles of guides into how to relieve the burden of organisational behaviour. Creativity, laziness, unconventional choices of life. Prioritisation, trekking, full-body communication.

The problem is often that the return to healthy and active life must be made in small steps. Instead, people often charge towards their inner determination in huge leaps. Small, ordinary things do not seem to make any difference. Who would settle for a light bulb when you can have a searchlight!

***

Burn-out is not just about a temporary disturbance in power supply; it means that the energy source has petered out and that there are serious failures in the distribution system.

Will power alone does not get you out of it; the back-up power only gets you to the start of recovery. All resources, including the subsurface reserves, are needed so that a powerless person becomes whole again. Other people are needed, including those whose efficiency cannot be measured in high values. In fact, their true significance is measured in the invisible microwatts of closeness and togetherness. All such people put together, they make up terawatts. Caring is a huge power.

A community which just seeks and favours power soon consumes its own power. A community which interprets and feeds power in a variety of ways generates new power.

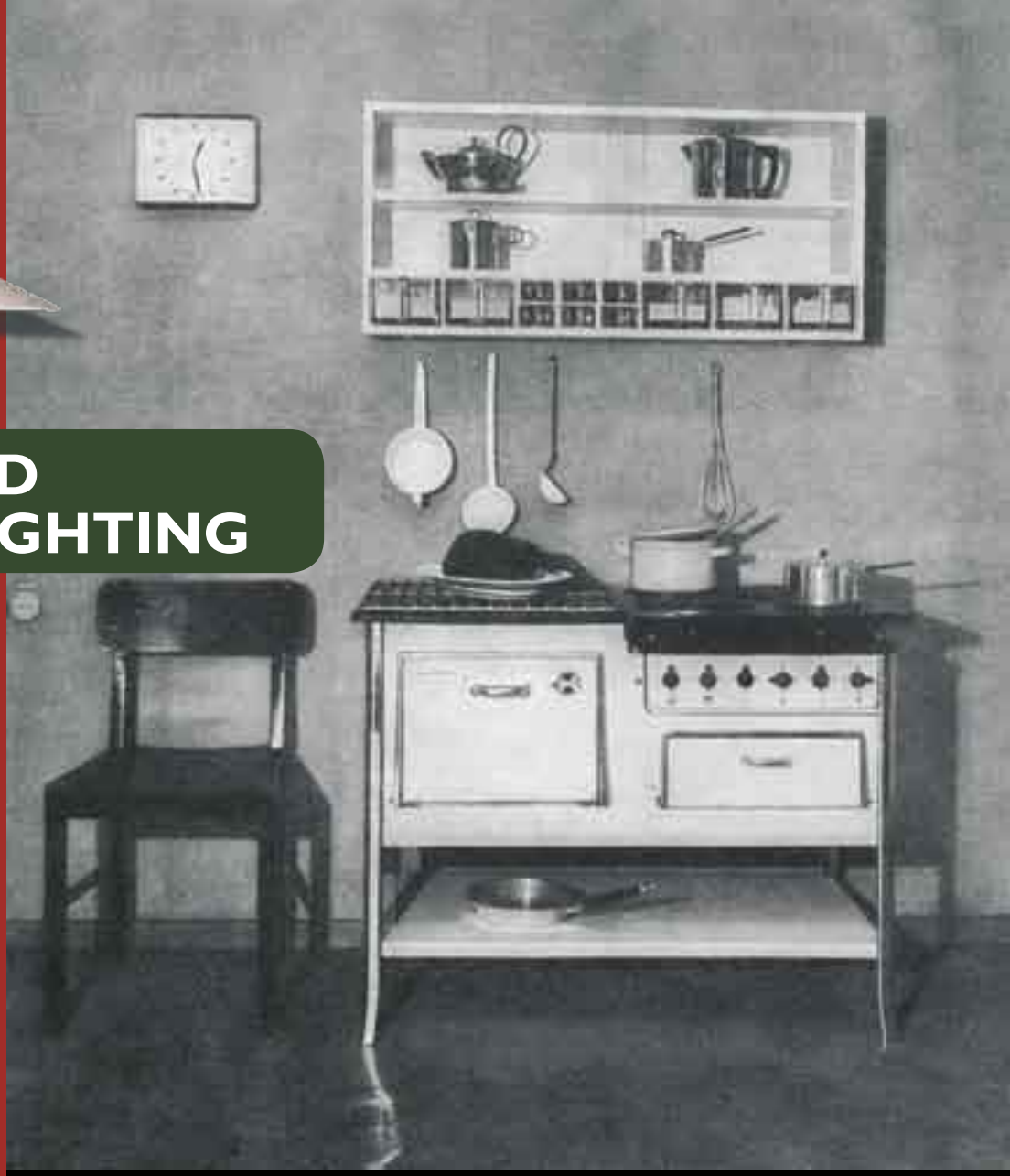
Hilkka Olkinuora

Hilkka Olkinuora is the columnist of the Fingrid magazine. She presents herself as follows: "Minister and journalist from Tampere, wrote earlier of economy, nowadays also again a student. Also works at workplaces, and discusses electric encounters in this magazine."

Photograph by FutureImageBank

ELECTRIC FOOD IN ELECTRIC LIGHTING

Enlightenment to conscientious housewives in the 1930s



COOK WITH ELECTRICITY

In 1930, the Finnish Association of Electricity Utilities launched systematic propaganda to households to raise the consumption of electricity. The campaign material especially intended for women highlighted the properties of a good mother and the virtues of family life. In her Master's thesis, Riia Kemppainen has studied the propaganda of the Finnish Association of Electricity Utilities between the World Wars. Why was electricity advertised to housewives? What types of advertisements were used for approaching homes?

TEXT BY Anne Ollikainen

The illustration of the article consists of covers of brochures published by the Finnish Association of Electricity Utilities.

The Finnish Association of Electricity Utilities rationalised the propaganda with both social and economic reasons. Electricity consumption in Finland in the 1930s was very small even though the supply of electricity had improved especially in towns.

The goal was to acquaint people with electricity and to show them that it was easy and safe to use it. Increased electricity consumption was also thought to serve the interests of the national economy.

Above all, the goal was to raise the standard of living of all people. The growth and reform requirements which were specified for the whole of Finland were also targeted at homes and at the living conditions of people. There was an ambition to modernise the realm of housewives. If electricity use was rationalised and diversified, families would have better chances of making ends meet.

Women were responsible for housekeeping, cooking, garden and handicrafts. Housewives became the natural target group for electricity propaganda.

The advertising material targeted at homes mainly consisted of flyers and small information leaflets. The values and ideals of the 1930s are reflected in the material designed by a committee consisting of men.

From Riia Kemppainen's Master's thesis: "In line with new household technology, advertisements of machines also spread into women's lives.- - - The pictures declared that the tools of a good housewife who wished to fulfil her mission in life included modern appliances."

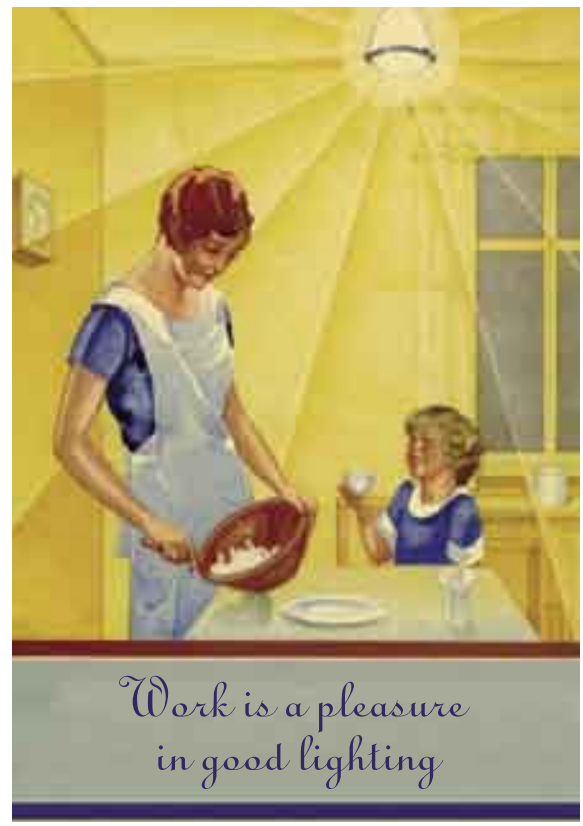
Healthy and economical - with electricity

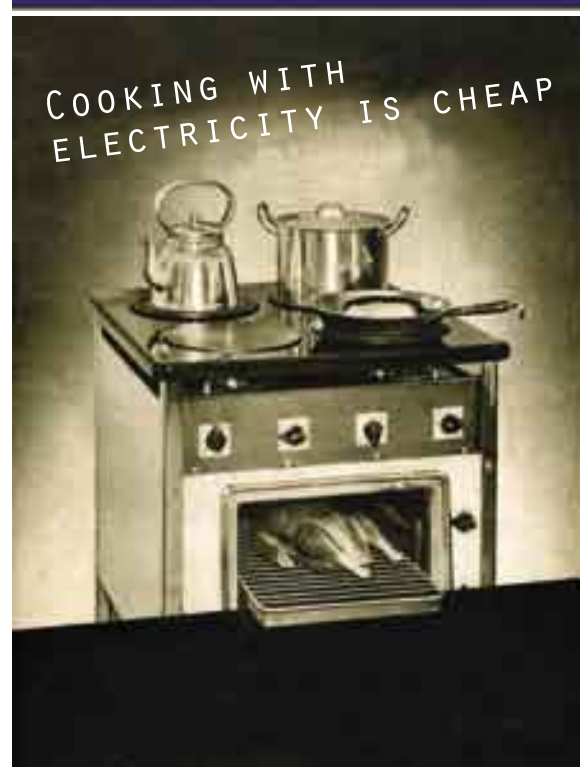
The propaganda also underlined the idea of the functioning and cleanliness of homes. Healthiness and good hygiene were paralleled with a happy home, cleaning and cooking. The kitchen received special attention in the electrification of the entire home. Additional functionality were provided by the right kind of lighting and suitable electric household appliances, especially cooker and oven.

The Finnish Association of Electricity Utilities spoke actively for so-called electric food. Together with the women's Martha Organisation, it arranged courses where women were taught to use an electric cooker. The information leaflets contained recipes and instructions in the use of a cooker as well as information on how healthy and economical electric food is. Food no longer burnt up nor were great amounts of grease needed for frying.

It was the duty of every housewife to take care of the health of her family. When cooking no longer required as much time as before, the wives could spend their time on creating a cosy atmosphere for the home.

Health aspects were also emphasised in the enlightenment propaganda. In the early stages, most of the propaganda consisted of instructions concerning the correct and sensible use of electricity as well as introduction of electrical appliances. A bad mother could ruin her children's eyes with poor lighting. Even electric lighting was not healthy if it was incorrectly arranged. The goal of enlight-





The propaganda material for the promotion of electricity in the 1930s is currently stored in the premises of Society for Electrotechnical Heritage Elektra in the archives of the Finnish Association of Electricity Utilities. The history of the use of electricity and history of power systems are displayed at Electricity Museum Elektra in Hämeenlinna. The photographs of electrical appliances are from Elektra's collections.

enment was clear:

"An electrified home is the goal towards which we travel. Use of electricity promotes cleanliness and good hygiene, saves time and work, gives better results, is highly comfortable to its user, and does not require special professional skills. Moreover, it promotes good economy." (From an information leaflet from 1938.)

"An excellent aid liked by everyone"

Electricity propaganda directed at men concerned the costs and technical features of electricity, and it also pleaded to relieving the wife's workload. However, the main target was always the family mother. Electricity facilitated life and gave more time to the family.

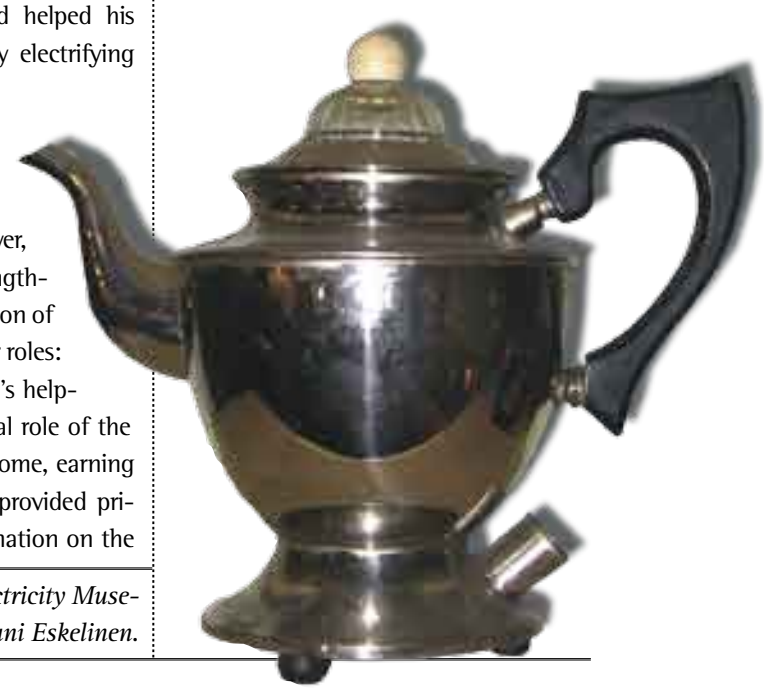
From the 1920s onwards, the home and housewife started to gain more appreciation. The mother became the source of security and happiness in the family. A sensible husband helped his wife in household work by electrifying the home.

This was made easier by the fact that the costs of electrification were not too high in the 1930s. However, electrification also strengthened the conventional division of work in families and gender roles: a husband became his wife's helper in the kitchen. The actual role of the husband was outside the home, earning money. In a leaflet which provided private consumers with information on the use of electricity in 1931, husbands were addressed as follows:

"Dear Sirs, have you ever contemplated that a home is also a workplace, where many types of duties are performed in the kitchen, living room and elsewhere?- - - Does your wife have a lamp which provides her with sufficient visibility for doing handicrafts- - -"

Enlightenment directed at women also pleaded to reason. Alongside advertisements, cookery books made household technology part of good housekeeping. However, the arguments for the introduction of electrotechnology were different from those used in advertising: a systematic approach and better facilities for housekeeping.

In the advertisements, sensible use of electricity was linked to creating a cosy atmosphere. The true warmth of a home came from well-designed electric lighting.



Electric kettle. Collections of Electricity Museum Elektra. Photograph by Juhani Eskelinen.

Jari Perämäki (on the right) from the Paimio Adult Education Centre gave Fingrid employees SÄTKY training last April.

Joint principles for safe working

SÄTKY training gives uniform procedures for those working on high-voltage equipment

The nation-wide SÄTKY electrical safety training provides those working on high-voltage equipment in Finland with targeted training in accordance with standard SFS 6002. The goal is to create shared principles for all those doing high-voltage work and to improve occupational safety.

TEXT BY Reija Kuronen PHOTOGRAPHS BY Eija Eskelinen

Different procedures and a lack of shared terminology can present clear safety threats when the operating environment changes. Different work cultures adopt different types of procedures, even terminology, which complicates working in an unfamiliar environment and can cause electrical safety risks.

Nation-wide SÄTKY training gives the professionals in the field uniform procedures and hence adds to safety. It also eliminates redundant and overlapping training.

SÄTKY training is intended for those carrying out high-voltage work, including supervisory, network operation and expert duties. The training clarifies the rights, obligations and responsibilities of the various parties towards those who construct, maintain and own electrical installations.

The contents of training take into account the duties in which the participants work in each individual case. Those working on high-voltage equipment receive targeted training and uniform instructions with procedures.

The idea of the training came from Fingrid's Network Operation Committee, which established a task force to investigate new type of targeted training for high-voltage work. A manual was drawn up for this, and the instructors were selected and trained.

Nation-wide centralised safety training in electrical matters started at the beginning of 2006. It corresponds to the compulsory general electrical safety training in accordance with standard SFS 6002 and also contains the general practical principles for network operation on equipment of over 1 kilovolt. So far, more than 1,800 persons have been trained.

Jukka Muttilainen of the Association of Finnish Energy Industries is responsible for electrical training and co-ordinates the safety training.

"We have received excellent feedback concerning the contents and implementation of the training from those who have taken it. The practical aspect and relation to everyday work have been commended especially," he says.

Jukka Muttilainen says that the training will continue to be practical. The topics range from general electrical safety to switching and from the safety of the work location to concrete risks. The training presents actual situations, for example what could happen and what has happened.

SÄTKY training is monitored and developed continuously. "The contents will also pay attention to accidents and near miss situations. The goal is to enhance electrical safety through increasingly rewarding SÄTKY training," Jukka Muttilainen says.

The targeted SÄTKY training lasts for one day and contains a written examination in accordance with the standard. The participants are given a manual on the electrical work safety of high-voltage equipment drawn up by the SÄTKY team and published by the Association of Finnish Energy Industries.

Those who pass the examination obtain a safety card for electrical work in accordance with targeted training for high-voltage work. The card is valid for 5 years.

More information on SÄTKY training at www.energia.fi

Grid ABC

This article series deals with the main operating principles, equipment units and components in the main grid. The earlier articles have dealt with substation equipment, power and instrument transformers, switching devices, and operation control system.

Three generations of relays: electromechanical, static and digital relay.

RELAY PROTECTION

TEXT BY Ville Tiesmäki PHOTOGRAPHS FROM the archives of Fingrid Oyj

The electricity transmitted in the main grid has a significant role in the everyday life of people. This is why the grid must work reliably. One of the basic conditions of reliability is sufficient protection against faults.

A faulty part of the grid should be separated from the rest of the grid **quickly, reliably and selectively**.

■ **Quick** activation of protection minimises the inconveniences caused by the fault, such as heat caused by the fault current, hazard caused by the current travelling in the ground to living organisms, and deteriorated quality of electricity. Moreover, quick activation of protection is vital in the 400 kilovolt network in order to retain stability.

■ **Reliability** means that the protection works as planned. The protection should only work in those fault cases where it is designed to work.

■ **Selectivity** means that in the event of a fault, an as small part of the grid as possible is separated and that all parts of the grid are protected adequately. Moreover, it is important for practical reasons that the protection is sufficiently simple and can be tested.

The protection of the main grid has been carried out by means of secondary relays. This means that the primary values of the grid, i.e. current and voltage, are transformed into secondary values (typically 1 or 5 A and 100 or 200 V) by means of instrument transformers, and the protective relays measure these secondary values. The protective relays are primarily of a triggering type. When a protective relay detects a fault in the grid, it sends a triggering signal to one or more circuit breakers, which separate the faulty part of the grid from the rest of the grid and hence enable the continued normal operation of the remaining parts of the grid.

The primary components in the main grid requiring relay protection are outgoing bays, transformers, compensating devices, and busbars. The most important components, such as transformers and 400 kilovolt outgoing bays, are always protected by means of doubled main protection. A securing back-up protection is mostly also constructed for lower voltage level components that are protected.

A **distance relay** is used as the main protection of outgoing bays in the main grid. The distance relay is an under-impedance relay, i.e. it measures continuously the voltage and current of the line protected. The quotient of these variables is impedance, which is moni-

tored by the relay.

In the event of a short circuit or low-resistance earth fault, the voltage of the line decreases and the current increases to the extent that the impedance detected by the distance relay decreases. In this way, the relay can conclude that there is a fault. The measuring accuracy of the distance relay is not very sensitive to fluctuations in the load currents, which is why it is well suited for the looped main grid.

Another type of main protection relay is the differential relay, which is primarily used for the protection of transformers, busbars and short lines. The differential relay is a proportional relay; it measures the current travelling through the component protected and concludes on this basis whether there is a fault in the component protected.

Quick activation of busbar and circuit-breaker failure relays in the 400 kilovolt grid is of utmost importance in view of stability. The differential relay requires a continuous communications connection between the various ends of the component protected, which restricts its use.

In the main grid, overcurrent relays and zero current relays are primarily used as backup protection for outgoing bays and transformers and as the main protection of compensating devices. A zero current relay is used in line protection also as a main protection against such earth faults which have a high fault resistance. An overcurrent relay measures phase currents and the zero current relay measures the sum current of phase currents, i.e. the asymmetry of current. Such relays are typically quite simple and give a triggering signal after a set time delay when the current has exceeded the set limit value.

Other relay types used include voltage relays, frequency relays, power relays and asymmetry relays. Of relays based on non-electric variables, the Buchholz gas relay primarily used for protecting transformers is worth mentioning.

Protective relays can be categorised in three different generations: electromechanical, static and digital relays.

■ The older protective relays are electromechanical. They are called this because they also contain moving parts. They work at the same principle as indicating gauges, i.e. they measure the effective value or average value of an electric variable.

The drawback of electromechanical relays is that their mechanical parts become rigid over time, which is why they often need to be "sensitised" in conjunction with maintenance. They are also somewhat inaccurate, large and have a high power need. On the other hand, electromechanical relays have simple and illustrative operation. Electromechanical relays are not really manufactured any more, but they are durable and there are hence still quite a few electromechanical relays in operation.

■ Static or electronic protective relays were launched in the early 1960s. These relays use a configuration based on individual semiconductor components and microchips. Static relays enable more demanding protection functions than electromechanical relays. Static relays are also more precise and quicker, because mechanical parts have been replaced with electronic parts.

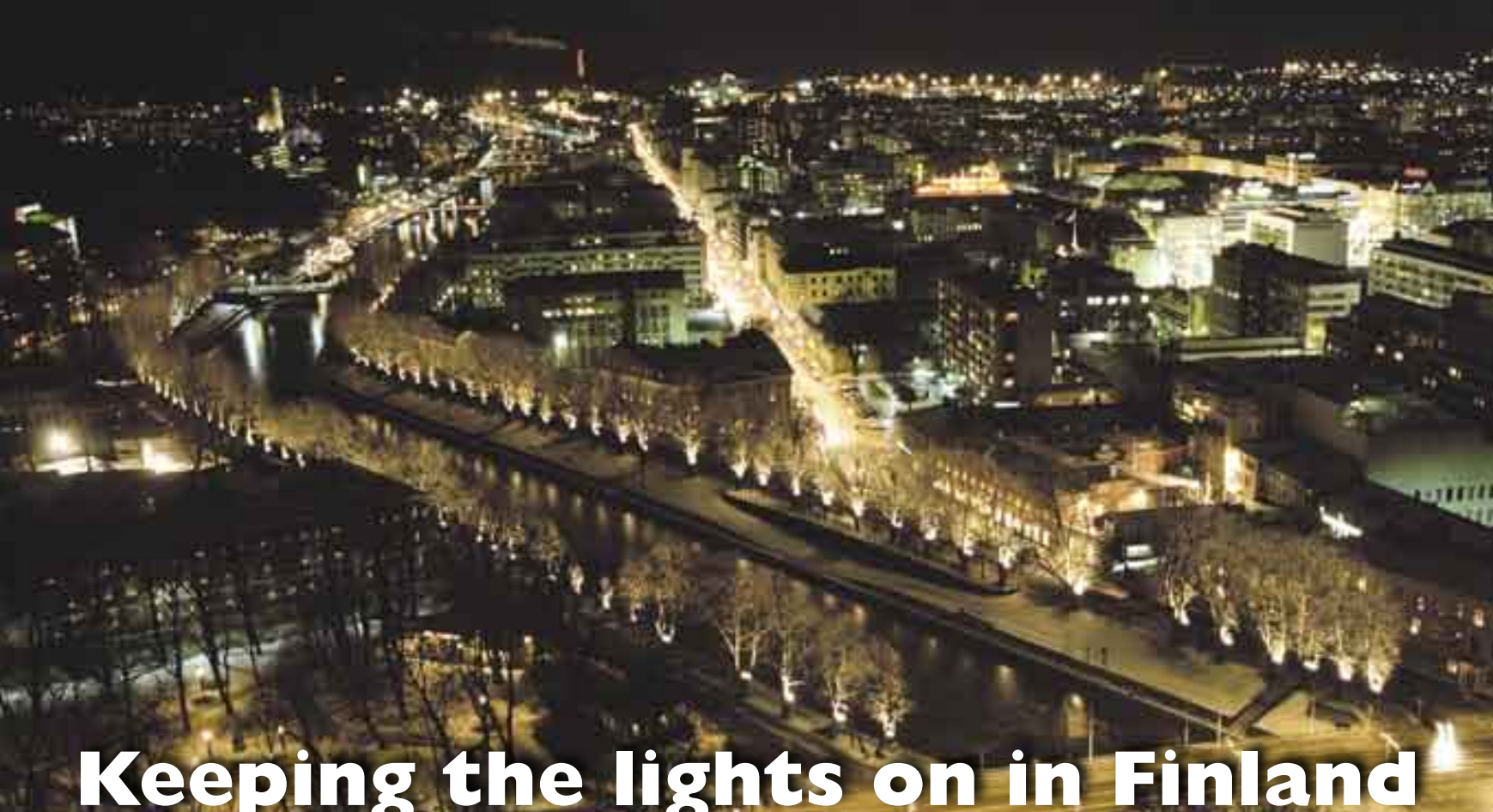
The drawbacks of static relays include their sensitivity to overvoltage and electromagnetic interference, need for continuous auxiliary power, and non-illustrative operation. Ageing of electronic components has increased the failure frequency of static relays.

■ In line with the spreading and development of microprocessor technology, digital signal processing has also been applied to the manufacture of protective relays. The first digital relays appeared on the market at the end of the 1980s. In addition to actual protection functions, digital relays enable various measurement and control functions.

A serial data bus enables for example the transfer of signals measured by the relay and the transfer of operating values set in the relay directly from the relay to a higher-level automation system or directly to the relay expert's computer via the service bus. The data transmitted in the other direction can include changes to the set values of the relay and closing and opening commands for circuit breakers.

Microprocessor technology enables multi-purpose protection where several protection and control functions can be integrated in a single relay. Modern relays are consequently referred to as IEDs, Intelligent Electronic Devices.

As a result of new functions and options, modern relays are very complex devices, which imposes special requirements on their use and maintenance.



Keeping the lights on in Finland

Fingrid Oyj is responsible for the main electricity transmission grid in Finland. We make sure that Finland obtains electricity without disturbance. Reliability, efficiency, consideration of environmental issues and good co-operation with our customers, landowners and authorities are our key objectives when we take care of our demanding duties.

FINGRID

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