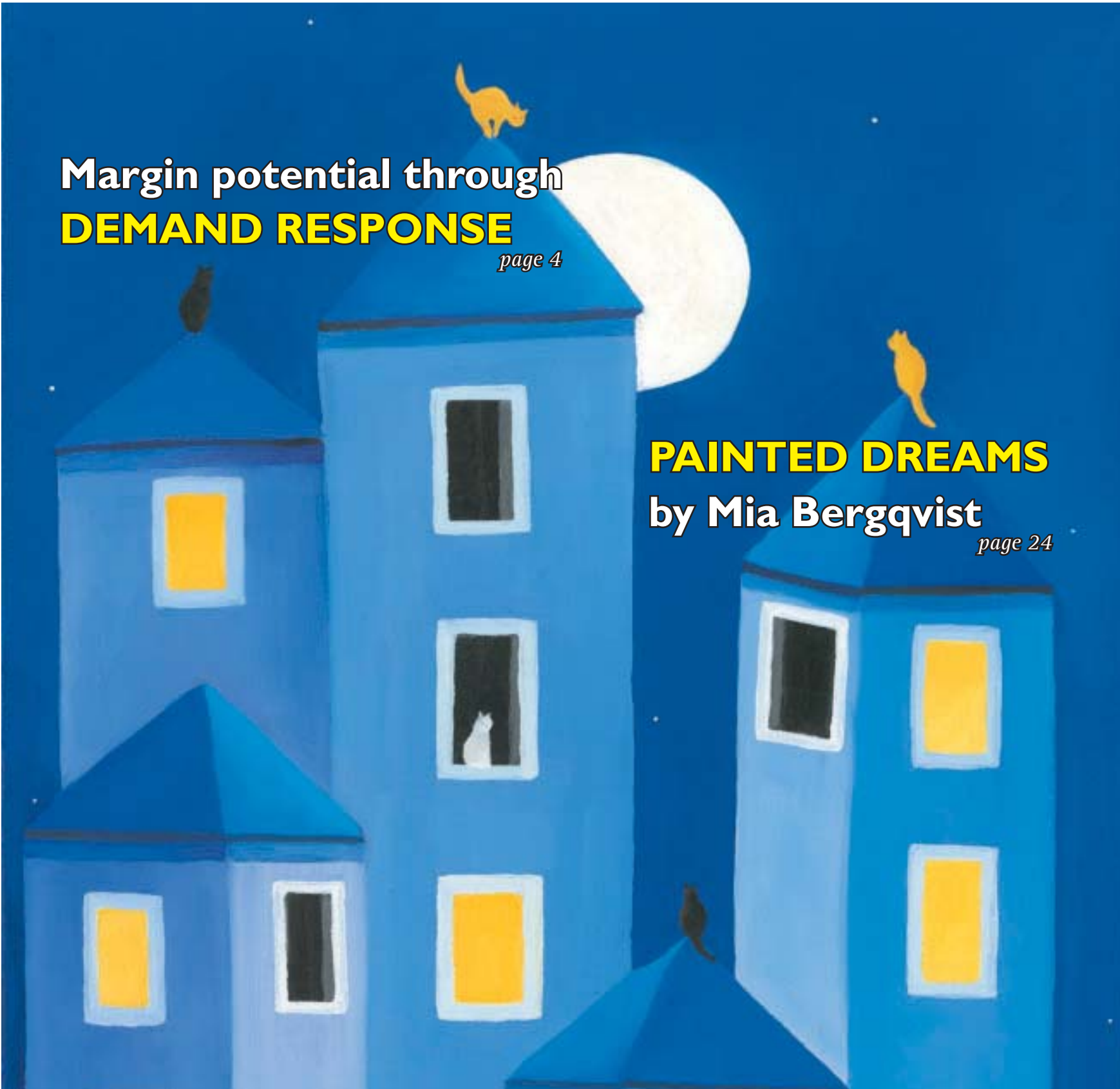
Corporate magazine
Fingrid Oyj
1/2005

FINGRID



Margin potential through DEMAND RESPONSE

page 4

PAINTED DREAMS by Mia Bergqvist

page 24

Stability through long-term contracts

It is Fingrid's duty to take care of the functioning of the power system in Finland. The long time span of the related operations is described by the fact that the grid assets worth approx. 2,500 million euros have a long technical lifetime of more than 50 years. Annual capital expenditure required by increasing electricity consumption, new power plants and ageing of the grid accounts for 2 – 3 per cent of the replacement value of the grid.

Moreover, capital expenditure by Fingrid in enhancing cross-border electricity transmission opportunities has totalled tens of millions of euros.

When Fingrid's model of operations was being discussed during the company's establishment process, it was decided to adopt a model that supports a steady price trend. An alternative to this would have been an annually changing pricing, which could have entailed significant price variations. In accordance with the principle adopted, Fingrid has carried out capital expenditure with a long perspective, stabilised the tariffs through contracts having a reasonably long validity period, and attempted to ensure a moderate cost trend.

Fingrid's revenues and also the price paid by customers continue to be stabilised by the new three-year contract period for grid service, which commenced at the beginning of 2005. The price level will remain unchanged for the sixth consecutive year.

The objective in cost control, too, is to achieve long-term efforts. One example of this are the contracts signed with seven industrial enterprises last summer, extending until 2015 and concerning the use of industrial loads of a total of more than 1,000 megawatts for the management of disturbance situations in the power system. These contracts also contribute to the integration of the fifth nuclear power unit in Finland to the power system in an advantageous manner. The contracts for technical regulation reserves required at power plants were also renewed towards the end of 2004. The contract period for these is also long.

The biggest uncertainty in Fingrid's finances is currently caused by the European tariff levied on transit transmission of electricity. Its cost impact on Fingrid will vary between 5 and 20 million euros annually, depending on the power situation prevailing in the Nordic countries. Moreover, the long-term tariff principles are still undecided.

Good results in international benchmarking studies and customer satisfaction surveys have repeatedly indicated that Fingrid's operating model is efficient and that its transmission price is inexpensive. It is to be hoped that supervision by authorities concerning the reasonableness of grid pricing and system responsibility do not bring restrictions to the way in which Fingrid aims to secure its long-term development and operational quality.

During 2004, Fingrid made long-term commitments which concern both its revenues and expenses. The predictability of Fingrid's financial trend is hence good. The contracts have been drawn up in good co-operation with our customers and partners, for which many thanks are due to them.

Timo Toivonen is Fingrid Oyj's President.

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Editorial staff
Telephone: +358 (0)30 395 5000, Fax +358 (0)30 395 5196,
Postal address: P.O.Box 530 , FIN-00101 Helsinki, Finland
Street address: Arkadiankatu 23 B, Helsinki, www.fingrid.fi
Editor-in-Chief: Leni Lustre-Pere, leni.lustre-pere@fingrid.fi
Editorial board: Nina Elomaa, Jari Helander, Aila Itäpää, Antti Linna, Erkki Stam
Design by bbo, Better Business Office Oy, Maria Hallila and Tuija Sorsa
Translation by Kielipaja Hannu Hakala

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New procedure introduced for quality assurance of grid maintenance.

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Tribute to the engineers of the main grid.

In this issue

PEAK LOAD SITUATIONS AND POWER BALANCE

on the electricity market

How can an electricity user influence power balance?

According to an estimate presented by Nordel, demand response could give the Nordic electricity market a regulation resource of up to 12,000 megawatts for the maintenance of power balance. The utilisation of this demand response requires that an electricity user decides whether he needs all electricity during peak load hours and whether he is prepared to pay an expensive market price for it.

TEXT BY: Erkki Stam PHOTOGRAPH BY: FutureImageBank

The principle in trade is that the price of a product is determined on the basis of the price at which the seller is prepared to sell the product and what price the buyer is prepared to pay for it at any given time. If the supply or stock of the product exceeds demand, there is a buyer's market and prices tend to go down. If, on the other hand, demand exceeds supply, the prices are apt to rise. Buyers optimise their purchases and stocks as determined by the market outlook and their own needs. Price controls the behaviour of buyers.

Price formation on the electricity market works much in the same way. However, the electricity market differs from other markets because of the special features of electricity. Electricity cannot be stored; it needs to be produced at the same time as it is consumed. It is only possible to gather water in reservoirs, and the Nordic water reservoirs have a vital impact on the market price of electricity in the Nordic countries.

Since electricity cannot be stored, its price varies in different times. On the Elspot market in the Nordic countries, price is determined for each hour of the next day. The Nordic Elbas market complements the spot market, and trade in Elbas can take place up to one hour before the physical delivery of electricity. The regulation power market is intended for trade during the specific hour.

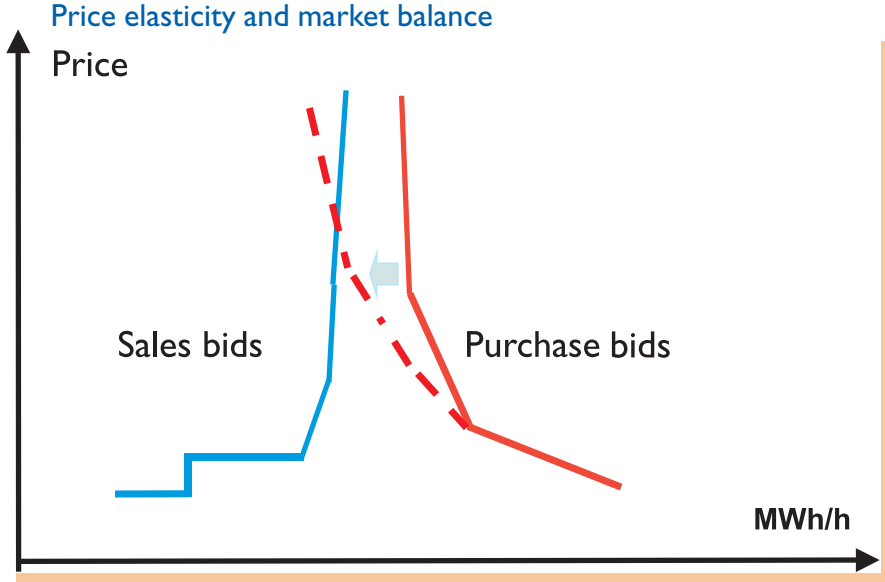
Cold weather increases demand

Demand for electricity grows significantly on cold winter days, which is reflected in the price of electricity. The momentary sufficiency of production capacity during peak load hours may become a critical factor in terms of the entire power system. Extreme measures may be called for in a power shortage situation: it may be necessary to disconnect loads in order to maintain power balance in the system so that its frequency and system security remain within the agreed limits.

The conventional approach has been that electricity is used whenever it is needed – irrespective of the price. However, in view of the functioning of the power system, electricity market and their own interest, all electricity users should ask themselves: Do I need all electricity just during the most expensive peak load hours and am I prepared to pay an expensive market price for it?

Cases where the user is prepared to voluntarily shift his electricity use to another time are referred to as demand response of electricity, which can also be called price elasticity of electricity.

Price elasticity and market balance



Why is demand response important?

By shifting electricity use from a period of high price to a period of more inexpensive price, the user can save his own procurement costs and also contribute to a reduction in the market price of electricity through a decrease in total demand.

In terms of the entire power system, demand response contributes to maintaining a balance between demand and supply during peak load situations. In this way, it is possible to prevent power shortage situations and forced load shedding during extreme situations.

Fingrid has actively contributed to Finland having a voluntary demand response forum which assembles three to four times a year. The forum consists of the representatives of a dozen or so spheres of interest, and its goals include identification of development needs pertaining to demand response, launching of necessary projects, and serving as a nation-wide background group for such projects. The forum also arranges an annual price elasticity seminar, next time in April.

Fingrid also supports research projects concerning demand response (such as the project of VTT and Turku Energia presented on pages 7 – 9) and Finland's participation in a related international study by the IEA (International Energy Agency).

Fingrid is also launching, together with other interest groups, a study concerning the demand response potential of large and medium-sized enterprises.

How can demand response be implemented in practice?

Even before the electricity market was liberalised, two-tariff pricing was used for promoting night-time use of electricity, for instance for space and service water heating. These cases can be referred to as structural demand response, which has a long-term impact on the daily demand profile.

Those who use electricity for heating were also able to obtain a price reduction if they permitted a short-term reduction in their load whenever necessary a few times a year. A short-term reduction in heating power does not have a significant impact on the indoor temperature. This case is about short-term demand response as per the momentary situation. The market prices of electricity are currently incentives for short-term demand response.

Industries have loads which can be disconnected for short periods of time without causing interruptions in the entire production process. As an example, refiner and grinder motors with high electricity consumption used in the production of mechanical wood pulp in the pulp and paper industry can be disconnected for short periods of time, during which the mills can use buffer storages of mechanical pulp that have been created earlier.

In Norway, there is a great number of electric boilers which are used for producing heat when it is more inexpensive to produce heat with such boilers than with oil-fired boilers. The chemical industry also has many electricity-consuming processes (such as electrolysis), where the price of electricity has a decisive impact on the manufacturing costs of the product.

The sales price of a product is determined on the world market, and an enterprise can determine a break-even point for the input costs, such as price of electricity. Whenever the price of electricity exceeds that point, it is not profitable for the enterprise to manufacture the product.

For an industrial user of electricity, factors which have an impact on the possibilities to implement demand response in volumes and on the critical price include economic fluctuations, state of buffer stocks, time available for making preparations, and duration and repeatability of demand response.

Short-term demand response of electricity requires that the electricity user is aware of the prevailing market price of electricity and that electricity consumption is measured on an hourly basis. Industries and other large-scale electricity users use hourly electricity measurement. It is also becoming more common among smaller-scale consumers. Vattenfall has decided to acquire hourly meters for all of its 360,000 network customers in Finland. Small and medium-sized users most often purchase their electricity at a fixed price, meaning that changes in the market price are not a direct incentive for them.

Significant demand response potential exists in the Nordic countries

In its report published in the spring of 2004, Nordel estimated that the demand response potential in the Nordic countries would total approx. 12,000 megawatts, of which Finland would account for approx. 2,500 megawatts.

Even though this potential was not available simultaneously, demand response could contribute crucially to the Nordic power balance.

Part of this potential has been reserved as disturbance reserves controlled by the Nordic transmission system operators. Fingrid has signed contracts with industries concerning consumption loads of a total of approx. 1,000 megawatts, which can be disconnected against compensation during a disturbance situation.

In the winter of 2002 – 2003, the market prices of electricity were high on account of the poor hydropower situation. Different analyses have indicated that in this situation, demand responded to the prices of electricity in all Nordic countries, most clearly in Norway.

The Nordic market model calls for active demand response

The Nordic electricity market model is based on the incentive of electricity price: price controls both capital expenditure in production capacity and the behaviour of electricity users on the basis of the price, i.e. demand response.

Demand response of electricity is a necessity for the efficient functioning of the Nordic market model. Demand response is an existing resource, and its utilisation does not necessarily require additional capital expenditure. Its utilisation requires that the users have identified the option available to them and that they use it actively.

Money is a controlling signal, but alongside it, input by all parties is needed in order to activate the users. Each Nordic transmission system operator has drawn up a plan of its own, aiming to promote demand response on the shared market.

Progressive research project

ASCERTAINING THE POSSIBILITIES AND CHALLENGES OF DEMAND RESPONSE

TEXT BY Reija Kuronen

Professor Seppo Kärkkäinen of VTT (Technical Research Centre of Finland) examines demand response from the viewpoint of an ongoing research project. The project examining electricity use management and control on the basis of market signals is a highly progressive research project concerning the demand response of electricity.

The target groups of demand response in the study are single-family houses heated with electricity and larger residential and service buildings. The study is based on Turku Energia Oy's pricing system based on the market price, and the project examines the impacts of this system on electricity users, power companies and the nation-wide power system.

Seppo Kärkkäinen says that the goal is to examine and develop solutions which can make the control opportunities of electricity use available to the electricity market.

The essential thing in the study is on one hand to study the response of electricity users to market price signals and on the other hand to study those technical solutions through which the impacts and control of price signals can be implemented automatically in the systems employed by electricity users.

At the same time, the project will develop methods based on load control, through which retailers of electricity can utilise the demand response of their customers in risk management and hedge themselves against rapid price peaks on the electricity market.

ONE OF THE MAIN PROBLEMS in promoting demand response, according to Seppo Kärkkäinen, is that it is difficult and expensive to measure the electricity consumption of small-scale consumers on an hourly basis. "This easily erodes the savings obtained by individual small-scale consumers through more inexpensive pricing."

On the other hand, the price of remote measurement of electricity will decrease as it becomes more advanced, which makes it easier to put demand response into practice.

So that demand response could be implemented automatically, consumers need to have a building or home automation system which is connected to the Internet.


Photograph by Juhani Eskelinen

At VTT, Seppo Kärkkäinen is responsible for the research project examining electricity use management and control based on market signals.

Seppo Kärkkäinen says that the project also covers buildings where electricity use during the next day (especially for space and service water heating) is optimised on the basis of the known price information which changes hour by hour.

"This will probably be the solution of the future, since we cannot expect that a consumer monitors the market prices of electricity continuously," he says.

”On the other hand, you cannot automate the use of a fireplace heated with wood, so it would be good to have an alarm system, for instance using text messages, concerning the price. In this way, you could plan the use of the fireplace determined by the price of electricity.”

THE PRICE IS COMMUNICATED to the consumer using both mobile phone and data network.

”The user can get a text message to a mobile phone when the price for the next day goes above a pre-set limit,” Seppo Kärkkäinen says.

”The project will also demonstrate a system where price information comes automatically to the consumer’s automation system through the Internet.”

INTERNATIONALLY SPEAKING, there is not another project as progressive as this, as far as Seppo Kärkkäinen can tell. He says that the electricity heating technology based on day and night time pricing in Finland has been highly advanced.

”In Norway and Denmark, there are projects which apply dynamic pricing to those who use electricity for heating, aiming to guide the heating of service water and partly the use of electric heating radiators away from the peak load hours during mornings and afternoons. In Finland, this has already been standard practice as we use night time heating of hot water tanks and electric storage heating, which is why Finland has to seek more progressive solutions in the optimisation of electricity use.”

”Trading practices and market places for controllable loads have especially been developed in the USA. We are not quite that far in this area in Finland,” Seppo Kärkkäinen adds.

THE CHALLENGES of the target groups for the near future, according to Professor Kärkkäinen, are related to the utilisation of ICT, measurement and automation technologies in the price elasticity of demand. On the other hand, it is necessary to find answers to the question of how controllable loads can be sold back to the electricity market (regulation power market, electricity exchange) at equal terms with production. This will require not only new technical solutions but also new organisational and business models. After all, a single small-scale consumer cannot enter the electricity market, but new types of players are needed for this.

”Similar solutions must also be found for large-scale consumers such as industries, where the individual controllable loads are greater. This aspect (potential, technology) requires a separate analysis,” Seppo Kärkkäinen states.

He also says that more and more common decentralised electricity production in the future will bring some new problems but also new opportunities for demand response: In addition to controllable loads, power plants and energy storages used in decentralised production are also available.

One challenge mentioned by Seppo Kärkkäinen is how the benefit derived through load control in minimising the price peaks of electricity is distributed so that control becomes sufficiently attractive from a market perspective.

NEW IDEAS FOR R&D FROM RESEARCH CO-OPERATION

TEXT BY Maria Hallila

Turku Energia is a natural partner for VTT in examining the opportunities and challenges of demand response of electricity, since Turku Energia has already innovated and commercialised products needed in research concerning electricity use and control based on market signals. According to Pekka Agge, Sales Manager of Turku Energia, the co-operation project has given the company’s products added value and provided new ideas for R&D.

Pekka Agge says that VTT and Turku Energia have conducted co-operation even earlier within various research programmes and projects.

”The research project launched at the end of 2004 has been under discussion for a couple of years, and during that time we have finalised our own product commercialisation process. We can now offer our customers the most progressive elec-

Pekka Agge believes that technological advancements will improve crucially the opportunities to utilise demand response of electricity.

tricity product on the market, based on electricity exchange pricing."

THE TARGET GROUP of the market electricity product comprises in principle all Nordic electricity users, says Pekka Agge.

"This is an open product based on the Nordic exchange price, with the price information being public and available at the 'day ahead' principle for instance on the Internet at www.nordpool.com or at the home pages of Markkinasähkö at www.markkinasahko.com," he says.

"However, sales to countries other than Finland are technically cumbersome within the limits of current regulations, so we will stick to the domestic market. Particularly suitable target groups include those who use electricity for heating, and small and medium-sized enterprises, which follow the cost factors of their energy use carefully."

The customers have been created a reporting and monitoring system which allows them to follow their costs and consumption in almost real time.

Pekka Agge says that by using Turku Energia's products, demand response can also be implemented "without the user's hand", and this particular opportunity constitutes an important part of the research programme. "We intend to ascertain the volume of potential demand response of various user groups and the cost impacts of demand response on the customer. We also have reference customers who carry out the necessary selections 'manually', and it will be interesting to see which way is better."

THE FOREMOST OBSTACLE to promoting demand response is the rigid operating environment, Pekka Agge thinks.

"Unfortunately, the currently valid recommendations and even some of the regulations applied to this business lag behind the general progress of matters," Pekka Agge says

PEKKA AGGE BELIEVES that technological advancements will bring a radical improvement to the preconditions of electricity use on the basis of demand response.

"First of all, developments in electricity metering alone, with remote reading, will give even small-scale consumers considerable benefits in line with new electricity sales products. In a more advanced scenario, various types of 'intelligent homes' will revolutionise the cost monitoring of electricity use and electricity savings in households," he says.

"Some visions suggest that various types of systems in a home can be integrated so that they can communicate with each other by means of data systems. This technology will certainly be utilised also more broadly and with different kinds of customer groups."

Pekka Agge believes that decentralised small-scale electricity production will be a future challenge to which conventional electricity sellers or distributors need to respond.

"It is also likely that we will have an opportunity to receive our customers' electricity production by means of Markkinasähkö."

New year brought NEW MAIN GRID CONTRACTS

New main grid contracts between customers connected to the Finnish main grid and Fingrid entered into force at the beginning of 2005. The 18-month development process concerning the pricing of services and contractual terms was conducted in co-operation with Fingrid's customers. The new main grid contracts for the period of 2005 – 2007 were signed towards the end of 2004.

TEXT BY Petri Parviainen
PHOTOGRAPH BY FutureImageBank and Juhani Eskelinen

Through the main grid contracts, Fingrid's customers obtain a right to transmit electricity in the Finnish main grid through their connection points. The contracts also specify the rights, responsibilities and obligations of the contractual parties pertaining to the main grid service. Moreover, there are descriptions of the tariff structure and unit prices as well as a relatively extensive description of co-operation taking place at the interface of the networks, ranging from the development of the grid to grid operation and metering.

The content of the contracts is the same for all customers, and the contract can be viewed on Fingrid's Internet pages at www.fingrid.fi

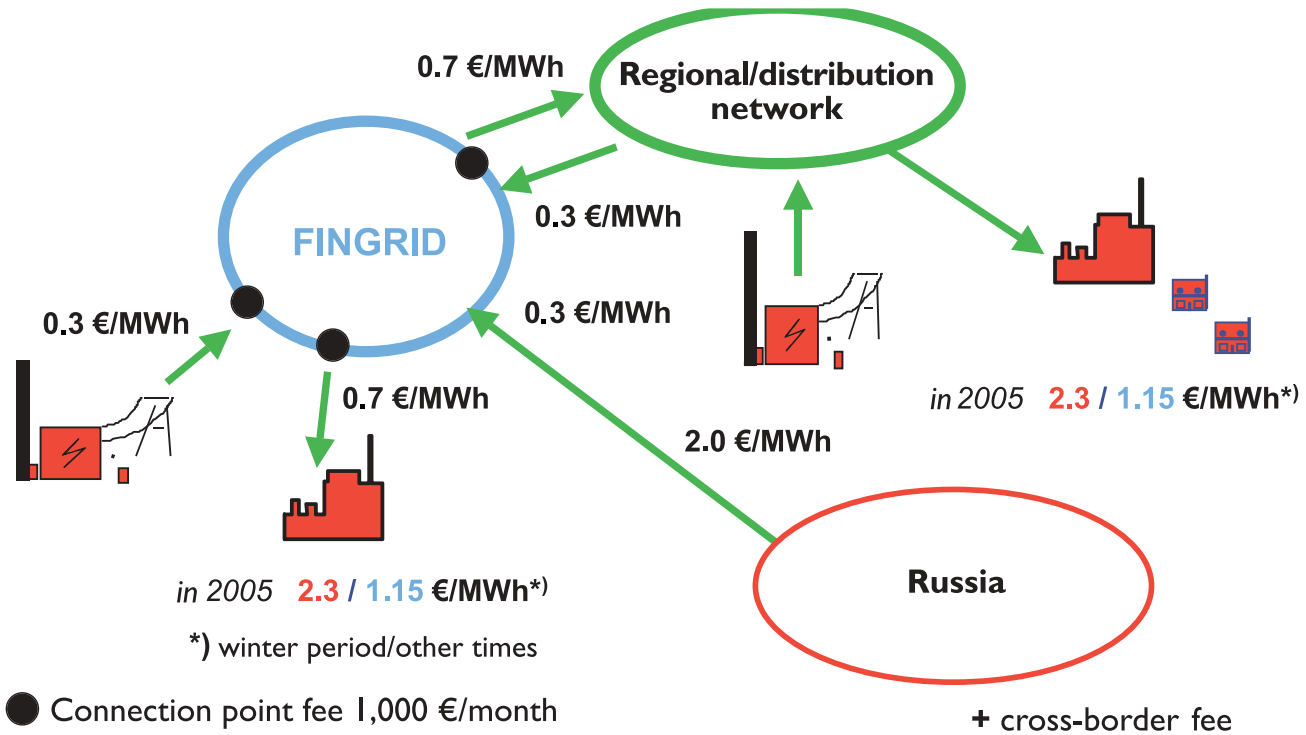
The operating environment on the electricity market keeps changing constantly. There are changes in the customers' ownership and other changes influencing their operating environment, the production structure of electricity is changing gradually, and legislation governing the electricity market evolves. It is Fingrid's duty to develop the main grid services and pricing system constantly so that they support the operations of the market players in an impartial manner and contribute to the optimum further development of the electricity market.

The negotiations on the main grid services and especially on the pricing structure for the period of 2005 to 2007 were launched in the spring of 2003. The matter was discussed on the basis of a preliminary proposal drawn up by Fingrid in customer-specific meetings and in the meetings of Fingrid's Advisory Committee.

Feedback received from customers mostly concerned the pricing structure. The foremost feedback included the following views, among other things:

- The relieving effect that decentralised local electricity production has on main grid transmissions must be taken into account in the pricing structure.
- A customer who uses electricity over a long operating time causes a smaller grid impact per energy unit than other users.
- Load situations which constitute the operating limits of the main grid occur mainly during winter, and during day or night situations depending on the grid section in question.

Pricing structure for grid service in 2005



*) winter period/other times

● Connection point fee 1,000 €/month

+ cross-border fee

- The pricing of main grid services must not have a significant impact on the electricity sales market.
- Pricing changes should be reasonable and such that they can be anticipated.

In one way or another, Fingrid's entire clientele participated in the development process for the main grid services by providing comments or presenting alternative models and specifications.

At the end of 2003, the process adopted a pricing structure which also obtained acceptance from Fingrid's Advisory Committee and clientele. The other contents of the main grid contract were in focus during the winter of 2004, and pricing details were also specified.

The entire pricing system and contract terms were presented in Fingrid's customer event in Helsinki on 10 March 2004. The subsequent bilateral negotiations with customers focused on the grounds of the changes made to the contractual terms and tariff structure as well as on related practical issues. The matter was also handled in the meetings of Fingrid's Advisory Committee in 2004, and the Committee stated that the achievements were successful.

The price components of the new main grid tariff are as follows:

Consumption fee

The fee is levied on all electricity consumption beyond the connection point. The consumption fee is specified separately for winter periods and for other times. The volume of energy forming the basis of the consumption fee is specified on the basis of the energy flowing through the connection point and production (and imports/exports) beyond the connection point. The own use of electricity production is determined on the basis of the taxation principle. Only EDIEL data exchange will be used in the exchange of production information.

Use of grid fee

• **Input**

The fee is levied on all electricity that is fed into the main grid through the connection point.

• **Output**

The fee is levied on all electricity that is taken from the main grid through the connection point.

There are no specific periods for the use of grid fee. The energies which form the basis of the use of grid fee and which are connected to the same busbar can be treated as net energies.

The use of grid fee is also levied on electricity that is fed into the main grid through cross-border connections from outside the common European electricity market area.

Connection point fee

The fee is levied on each connection conforming to the connection contract.

Market border fee

The fee is levied on all electricity that is imported into Finland from outside the common European electricity market area.

The new contract requires that the net production notices must be reported to Fingrid in hourly series using EDI messages and MSCONS message format. In many cases, the own use measurements of a production plant are not covered by remote reading, so in such cases it is expedient to deduct the manually-read own use energy evenly over the reported hours of a month. The specification of own use energy must take place in accordance with the valid decree no. 309/2003 of the Finnish Ministry of Trade and Industry.

The purpose of the fixed connection point fee included in the pricing system is to allocate the operating and energy measurement costs caused by the connections more fairly than now and to guide the connection method to the main grid to a technically and economically more advantageous direction. It should be noted that the revenues collected through the connection point fees mean a corresponding reduction in the unit prices of price components based on energy volumes.

In its meeting held in the autumn of 2004, Fingrid's Board of Directors confirmed the following unit prices for the contract period of 2005 to 2007:

	Year 2005	Year 2006	Year 2007	
Consumption fee				
- winter (1 Jan – 31 Mar & 1 Nov – 31 Dec)	2.30	2.37	2.44	€/MWh
- other times	1.15	1.18	1.22	€/MWh
Use of grid fee				
- output from grid	0.70	0.72	0.74	€/MWh
- input into grid	0.30	0.31	0.32	€/MWh
Connection point fee/connection	1,000	1,000	1,000	€/month
Market border fee *)	2.00	2.06	2.12	€/MWh

*) Also use of grid fee in a main grid connection of a cross-border line

The main grid contracts signed at the end of 2004 concern the contract period of 2005 to 2007. In accordance with Fingrid's operating model, the company intends to launch the development work for the main grid services and tariff structure for the subsequent contract period due to begin in 2008 together with the customers in good time during 2006.

A functioning main grid and related services constitute the foundation for a functioning electricity market. This is why Fingrid considers it important to continue to develop the services together with its customers – through co-operation which is at least as close as thus far – in order to ensure the achievement of shared views and purposeful services.

Reservations for cross-border transmission capacity from Russia confirmed for 2005

A total of 900 megawatts of electricity transmission capacity on Fingrid's cross-border lines from Russia has been confirmed for four importers.

Fingrid has confirmed a transmission reservation of 200 megawatts for EGL Nordic AS, 200 megawatts for Norsk Hydro ASA, 250 megawatts for RAO Nordic Oy, and 250 megawatts for Scaent AB. The confirmations were made in accordance with an account submitted by JSC RAO UES International, which is responsible for the exports of Russian electricity, and in accordance with the reservation terms for cross-border transmission capacity. The new transmission reservations have been valid since the beginning of 2005.

The contract for the transmission of 300 megawatts with Fortum Power and Heat Oy and the contract for 100 megawatts with OstElektra GmbH continue, meaning that the entire commercial transmission capacity of 1,300 megawatts on Fingrid's cross-border interconnections from Russia has now been reserved.

Rector Matti Pursula (on the left) believes that the professorship established through Fingrid's sponsorship will expand and advance teaching and research relating to electricity transmission systems. Other persons in the photograph: Professor Pekka Wallin, Head of the Electrical and Communications Technology department, Jussi Jyrinsalo, Timo Toivonen and Kari Kuusela of Fingrid, and Professor Matti Lehtonen.

Fingrid donated professorship in electricity transmission systems

Fingrid has donated a five-year professorship in electricity transmission systems to the Helsinki University of Technology. Teaching work within the professorship will commence on 1 September 2005.

At the moment, there is not a single professor specialised in high-voltage electricity transmission systems in Finland. The new professorship donated by Fingrid will be located in the Power Systems and High Voltage Engineering unit of the Electrical and Communications Technology department of the Helsinki University of Technology. The professorship will strengthen the profile of this unit especially as an expert in system technology for electricity networks.

According to **Timo Toivonen**, President of Fingrid, the donation of the professorship aims to retain Finnish grid expertise in the top league globally.

"The high system security of the Finnish power system and the further development of the system must be safeguarded also in the future. This requires that we need to constantly find new solutions in basic infrastructure, which is characterised by technological challenges and especially by the long time span of operations," Timo Toivonen says.

Matti Pursula, Rector of the Helsinki University of Technology, says that there is due concern over the future in the entire electricity business, which is also guided by the international rules of quarterly economy.

"In line with this new professorship, research and teaching relating to electricity transmission systems will be expanded and advanced, and there will be a host of new opportunities for research co-operation with manufacturing electrical industries. I hope and believe that the challenges in this industry continue to attract the elite of the students."

FROM GOOD TO EVEN BETTER in grid maintenance management

Focusing on the work processes of service providers

Five consecutive top positions in international grid maintenance benchmarking studies have not lulled those responsible for developing Fingrid's grid maintenance management into a false sense of satisfaction. Fingrid has developed yet another procedure for improving quality: audits of the work processes of service providers.

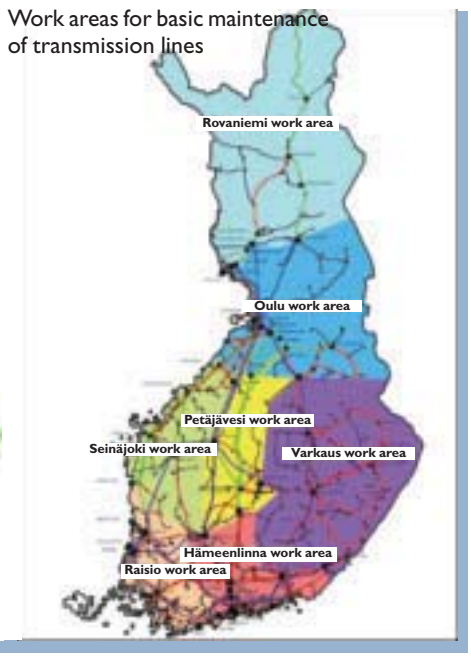
TEXT BY Timo Vienanlinna and Mika Väärämäki

Fingrid uses approx. 14 million euros annually on grid condition management purposes. Maintenance work and local operation of the grid have been entrusted to external service enterprises through fixed-term contracts. The service providers have committed themselves to providing the services in accordance with technical specifications which are defined by Fingrid's experts and appended to the contracts.

There are separate contracts for the basic maintenance of substations and transmission lines, relay testing, telecommunications maintenance and local operation services of transmission lines and substations. Fingrid has signed several contracts with different service providers throughout Finland, since the main grid has been divided into work areas which are subjected to competitive bidding as per geographical areas. These areas are indicated on the enclosed maps.

Suppliers of basic maintenance of substations 2003 – 2005

Work areas for basic maintenance of transmission lines



Reviewing the achievement of goals

In 2003, Fingrid started to review (audit) the work processes of its service providers. These audits will be an annually repeated and permanent procedure within Fingrid. The goal of the audits is to ascertain whether the goals (expertise, quality, safety etc.) specified by Fingrid on the work processes have been achieved and whether the operations call for further development. If the review is only restricted to checking the issues agreed upon in the contract, the work process reviewed does not develop. The basic duty of the review team is to find out matters such as why the goals have not been achieved at the work site and what prevents them from being achieved.

The review methods include discussions, monitoring the performance of work, and assessing the results achieved against the requirements set.

The personnel of the service provider working at the work site are activated to expressing their view about the sta-

Kemijoki Oy's team had a highly pleasant working environment at the Utsjoki substation. Photograph by Mika Väärämäki

tus of the work process. The means of activation include questions drawn up in advance, aiming to bring out ideas and suggestions from those who actually carry out the work.

Positive reporting encourages development

One of the basic goals in the reviews is to obtain an idea of the current status of the operations relative to their description (technical specification) and to come up with development suggestions to further improve the operations. A good review report is clear, well outlined, and the service provider can find in it both such issues which are in good order and ones which require improvement and which deviate from the specification.

The report has the below structure:

Strengths (verified by the auditors, matters which are in excellent order).

Development issues (matters which surfaced during the review and require improvement).

Deviations (matters which surfaced during the review and are in conflict with the documented "must" commitments).

After the review, the report together with the recorded development issues and deviations is sent for information to the contact person responsible for the execution of the work process reviewed and to the management of the work site. Corrective action is required for the deviations within an agreed schedule, and responsibilities concerning the execution of corrective action are specified.

Development issues which are not in conflict with the agreed action are handled by the management team of the work site or organisation. It launches operational development projects within the scope of available resources.

It is recommended that the personnel always give feedback to the development suggestions even though all suggestions could not be implemented in the near future.

Audit year 2004 brought up good development issues

The things audited in 2004 were power transformer measurement and related extensive switching, testing of relay protection of power transformer, grounding measurement of transmission line tower, and replacing a foundation pillar for guyed transmission line tower.

In April, Fingrid told the service suppliers that its representatives will audit these work processes at a specific work site at an agreed time. Fingrid's two experts audited the same process at the work sites of all service providers in different parts of Finland. In this way, the reviews were uniform and carried out using identical criteria.

The preliminary audit reports were sent to the service providers in November. The suppliers were requested to submit correction suggestions concerning the deviations and development suggestions concerning the observations to Fingrid by the end of December. The final report will be discussed in a quality meeting to be held with each service supplier during the early part of 2005.

The handling of deviations and observations relating to Fingrid's own operations progresses within the same schedule.

The audits carried out in 2004 provided several good development issues to improve the operations of both the service suppliers and Fingrid. The service providers' teams had a positive attitude towards the audits, and they understood their purpose. However, the teams thought that the audits brought a little additional tension as compared to the normal operations.

Photograph by Juha Rintamäki

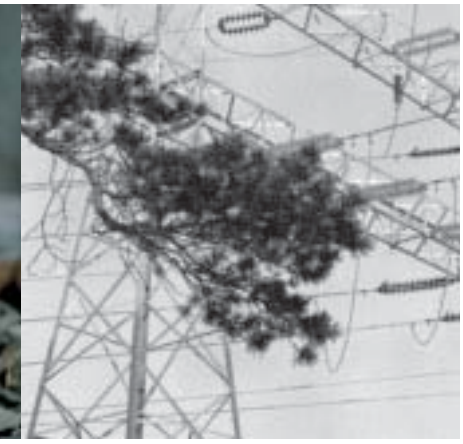
Marko Vähäpesola (on the left) and Reijo Viinamäki of Empower Oy carrying out measurements on a power transformer at Fingrid Oyj's Seinäjoki substation.

Memoir work "Yhteisillä linjoilla" is a

TRIBUTE TO THE ENGINEERS OF THE MAIN GRID

The book "Yhteisillä linjoilla" (Shared lines) published at the end of 2004 is a description of the phases of the Finnish main grid from the viewpoint of grid engineers and developers. The book published by Fingrid pays homage to the far-sighted efforts of the preceding generations.

TEXT BY Reija Kuronen
PHOTOGRAPH BY Juhani Eskelinen, Pekka Haraste and photographic collections of Electricity Museum Elektra



The book "Yhteisillä linjoilla" also contains a description of the building work of the Imatra – Turku line, which is one of the oldest sections of the main grid in Finland, and of the phases of the "Rautarouva" (Iron Lady) tower type from the 1920s to the present day.

The book describing the history of the grid and the way in which it came about contains views and experiences of those who have designed the grid with a long perspective so that it is still going strong and continues to do that well into the future.

The reliability of the Finnish electricity transmission grid has been the leading idea of its builders and engineers throughout history. This has been the basis of joint and separate visions, sometimes involving some controversy but still ending up in shared rules.

The book tells how the builders of the Finnish grid – private industries and its partners on one hand and government-owned power companies on the other hand – developed the main grid both through joint efforts and in competition with each other, and how the will and skills of the engineers and builders gave the present generations a purposeful and reliable electricity transmission system.

The grid was built with a view on the entire system

As stated above, the history of the Finnish grid is not only about decisions which would have been made in full harmony. The current Finnish high-quality grid was formed as a consequence of many hard and fast negotiations.

The electricity transmission grid in Finland originated from the needs of industries, and it was built by competing power companies. They drew their lines where they could best obtain electricity and other benefits.

When the lines were being negotiated, it was not uncommon that there were supremacy struggles or political quarrels involved. Engineering and de-

The honorary guests in the publication event of the book were grid developers interviewed for the book. Top photograph (from the left): Ilmo Nousmaa, Antero Jahkola and Lasse Nevanlinna. Centre photograph: Aimo Puromäki, Kalervo Nurmimäki, Lauri Mäkelä and Jorma Eulenberger. Bottom photograph: Aimo Puromäki and Jaakko J. Laine.

cisions were influenced not only by competition between power companies but also by official orders on a national level – and even by political intrigue, as **Jukka Kiviluoto** states in his interview.

It can be stated that one of the factors influencing the good functioning of the current grid was that there was not a monopoly of a single grid builder in Finland. The power companies constructed the grid cost-efficiently, bit by bit, line by line. Even though parallel lines were sometimes built, competition forced the builders to think about optimum technical and economic solutions. This has resulted in a flexible ring-type grid, which has been easily complemented with reinforcements, also in the future – without dismantling old or constructing completely new.

The main grid in Finland was constructed with a view on the entire system and as determined by actual needs. As an example, accomplishing the atomic ring was an indication of the far-reaching views of those planning the grid and their vital co-operation. The negotiations

were difficult, but the parties were always able to distribute the areas. This spirit is also reflected in the reminiscences and stories of the grid engineers.

Views from both sides of the negotiating table

The stories included in the book contain descriptions of the same events seen through the eyes of parties sitting on the opposite sides of the negotiating table. The phases of grid history are described from the viewpoint of both private companies and the government-owned power company.

The vivid accounts include how Finland managed the shortage of electricity after the Second World War when Finland had lost one third of its hydropower plants to the Soviet Union, and how the 1960s were a period of active grid construction. As an example, Finland had the longest 400 kilovolt line in the whole world at that time.

The 1970s introduced computers with network calculation software, and the network model acquired by Imatran Voima in 1957 – a highly modern tool for those days – was shifted to training use and ultimately put on display at Electricity Museum Elektra in Hämeenlinna in the 1990s.

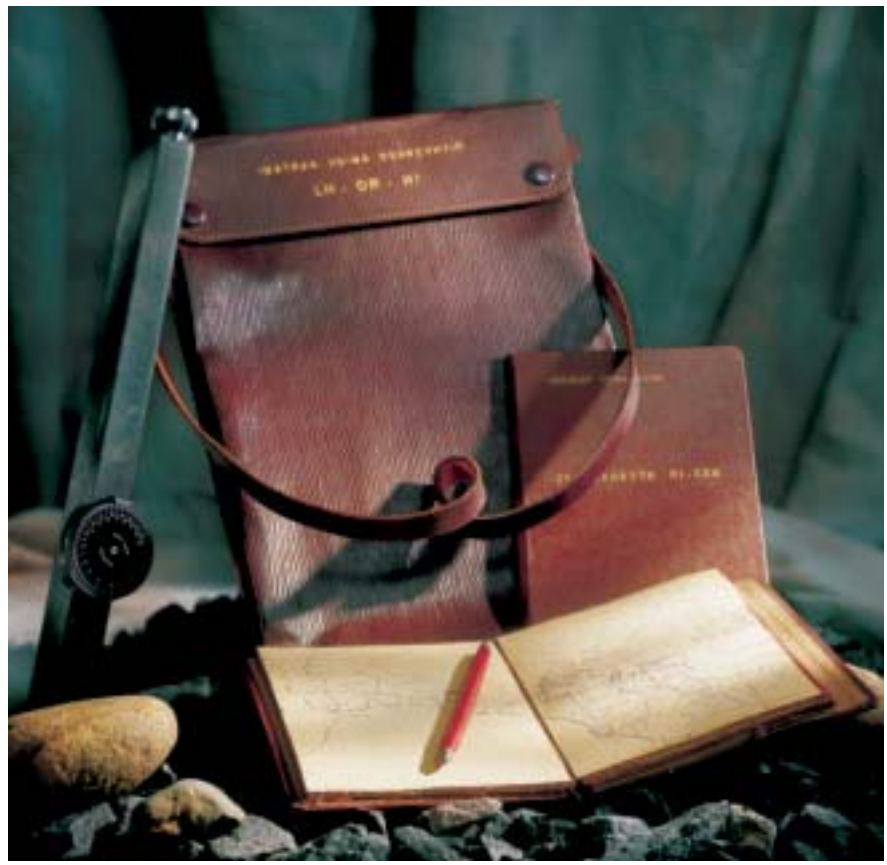
Cross-border co-operation commenced in the 1980s and 1990s, when interconnections to the neighbouring countries were opened.

Vision: uniform and jointly owned main grid

The construction of the Finnish main grid has required both visionaries and builders. The visionaries have been far-sighted engineers and seers, but practical builders were required for the actual construction work. Jaakko J. Laine describes them and their work, focusing on the phases of the "Rautarouva" (Iron Lady) tower and on the first 110 kilovolt trunk line in Finland, running from Imatra to Turku and Helsinki.

Pioneering work has also been carried out in the terrain – after all, constructing a transmission line was something new both to the engineers and workmen. A few decades passed before the idea presented by **Bernhard Wuolle**, member of the Hydropower Committee, in the 1920s concerning a uniform and jointly owned main grid finally became reality. This idea is culminated in the view expressed by **Kalervo Nurmimäki**, who had a crucial impact on the establishment of Fingrid. According to him, the current Finnish main grid is the finest joint operation system in the world. There are several generations between these two visionaries, but their idea has been the same.

The book "Yhteisillä linjoilla" is about an ambition and true desire to build results of high quality that would be prevail generation after generation. The veterans presented in the book have contributed to the Finnish main grid.



The illustrations used in the book are based on the articles contained in the collections of Electricity Museum Elektra and on old photographs.

COMPOSITE INSULATOR
– new transmission line technology

Composite insulators have many benefits over insulators manufactured from conventional materials. They are lighter and endure for instance moisture, dirt and vandalism better than conventional insulators. Last year, Fingrid installed composite insulators on more than 100 transmission line towers of 110 kilovolt lines. The functioning of the new insulators will be tested and monitored carefully during the coming years.

TEXT BY Keijo Välimaa
PHOTOGRAPHS BY Jorma Hentilä

The conventional insulator type used on transmission lines in Finland has been the cap and pin insulator where the insulator section has been made of either porcelain or glass. Glass insulators have mainly been used in past decades. From the 1960s onwards, various manufacturers have also made so-called composite insulators whose use expanded clearly in different parts of the world in the 1990s.

In line with expanded use, the price level of composite insulators has come down so that they are competitive with conventional cap and pin insulators, and certain teething problems of composite insulators have been eliminated. At the same time, the standardisation of composite insulators – in terms of testing as well as mechanical and electric design and classification – has progressed to complete IEC standards, even though manufacturer-specific and project-specific products and product designations are still common.

In the composite insulators used by Fingrid, the main materials are fibreglass rods, silicone rubber insulator sheds and sheath, and steel end fittings. The end fittings have the same dimensions as those used in glass insulators, which allows the mutual change-

ability of the insulators without a need to replace any accessories.

The end fittings have been pressed on the fibreglass rod. The precision and quality of this joint is described by the fact that in a pulling test, the insulator often breaks at the pin of the steel part, not at the joint of the fibreglass rod and end fitting.

In comparison with conventional glass and porcelain insulators, composite insulators have a clearly smaller weight/strength ratio. In other words, composite insulators are lighter to transport and install. Composite insulators also endure vandalism (such as being shot at) better than conventional insulators.

Composite insulators repel water and dirt better than conventional insulators, which is why their good insulating properties are highlighted in areas affected by air pollution and sea salt. With composite insulators, it is also possible to implement higher creepage distance requirements in a compact and flexible manner, which is important in order to achieve a sufficient electric strength.

The composite insulator is still a young product and all of its ageing mechanisms are not yet known, which is why insulator manufacturers do not guarantee it the same service life as for glass insulators. In practice, a sufficient service life is ensured through careful dimensioning of the insulator itself and its protective accessories and through proper quality monitoring during manufacture.

Fingrid's grid has been provided with composite insulators in individual special locations and needs since the 1990s. Due to their light weight, they have been used in intermediate insulator sets or as interphase spacers to prevent different phases from hitting each other during exceptional oscillation of conductors.

In 2004, composite insulators were installed more extensively at two sites on the following 110 kilovolt lines:

- On all towers of the new 110 kV Huutokoski – Varkaus line (17 km, approx. 70 towers).
- Composite insulators with a longer than normal creepage distance were changed at Rautaruukki in Raahe on the Pyhäkoski – Rautaruukki 110 kV line on approx. 40 towers. This line has earlier had glass insulators, and it has been necessary to replace some of these every few years because of very rapid contamination.

These projects have provided information on the suitability of composite insulators for Finnish transmission lines in terms of engineering, dimensioning, ease of installation, and costs. The installed composite insulators will be monitored in the future years through separate inspections and tests.

IN BRIEF

Photograph by Johani Eskelinen

The partnership agreement for Finlandia Marathon was signed in Helsinki on 23 December 2004 by Jorma Väkiparta (on the left), who represented the organising committee of Finlandia Marathon, and Timo Toivonen, President of Fingrid.

Fingrid as the main partner of Finlandia Marathon

■ Fingrid signed an agreement making it the main partner of Finlandia Marathon in 2006.

Finlandia Marathon is an international running event to be arranged in Jyväskylä in the summer of 2006. The objective of the event is to make as many enterprises with their running teams as possible participate in the event. However, the Marathon is not just about running, but it intends to be a weekend event for the entire family.

The race between enterprises concerns participation activity: Each person who runs the entire marathon obtains 4 points, those going it halfway through get 2 points, and a quarter marathon gives 1 point. The total points are then divided by the number of personnel of each enterprise and multiplied by 100, which gives the reference number that decides the placing of the enterprise.

Running through a marathon (or just half or quarter) requires long-term and planned training. The training of Fingrid's own running team has already commenced.

Operation control system

The purpose of the operation control system is to send information on the power system to the control room personnel and to dispatch remote control carried out by the control room personnel to the power system. The operation control system also features several applications which support the efficient and cost-effective operation of the power system.

TEXT BY Jari Martikainen PHOTOGRAPHS BY Juhani Eskelinen

The main grid in Finland is monitored and controlled from Fingrid's control rooms. Operators responsible for the trouble-free operation of the power system monitor and control the power system through an operation control system which sends measurement, state and event information on the power system to the control rooms.

Measurement information includes powers transmitted on the transmission lines, voltages at substations, and production powers of power plant generators. State information includes the state of switching devices, for instance whether a circuit breaker is open or closed. Event information refers to information concerning events taking place in the grid, conveyed to the control rooms. Such events include controls of circuit breakers, and operation of voltage control equipment and protection equipment. The events have been categorised on the basis of their seriousness, and the control room personnel are also alarmed of events which require immediate action.

The main components of the operation control system are: remote terminal units, data acquisition and control servers (DAC) and application servers, and database and user interface with various applications.

The system is run in several computers, which are backed up so that a fault in a single computer cannot affect the operation of the entire system.

Remote terminal units gather measurement and state information from measurement instruments in the grid and convert the measurement information to a format compatible with the operation control system. The remote terminal unit is a computer which is usually located at a substation.

The data acquisition and control servers gather information from the remote terminal units and send it to the application servers. The application servers store the information in the database, where it is available to the various applications.

The data acquisition and control servers and remote terminal units also convey the control signals given by the operators to the various actuators in the grid, for instance to open or close circuit breakers.

The main components of the operation control system are interconnected by means of secured telecommunications links.

In addition to the basic functions, Fingrid's operation control system has applications for different other purposes. These applications are intended to aid grid operation, and they contribute to maintaining good system security.

The foremost applications in Fingrid's operation control system are various programs for processing historical information on the grid, power network application, and power system simulator used for the training of personnel participating in grid operation.

Measured information and events in the grid are stored for later analyses. Historical information is used when planning grid operation and development projects and while clearing disturbance situations.

The power network application is used to assist the planning of grid operation and for instance in the optimisation of voltage level to minimise transmission losses. The power network application can be used for purposes such as calculating what impacts on the grid there are if a part of the grid is separated from the grid because of maintenance work.

The power system simulator is used for exercising normal grid operation and disturbance situations in the grid. Almost the entire power system in Finland has been modelled in the simulator. The user interface of the simulator is similar to the one in the operation control system used at the control rooms, so the exercises provide a true-like response to situations which can be encountered in real life.

The operation control system is an integral part of a modern power system. It enables reliable and cost-effective grid operation and disturbance-free electricity transmission.

Mia Bergqvist's images encourage

THE JOY OF SEARCHING

The illustrations for Fingrid's calendar for 2005 have been made by Mia Bergqvist, a young naivist living in Espoo, Finland. The colour world of her works is pure, bright and clear. The pictures are dreams illustrated into reality, depicting a hint of the languorous mysticism of the East clad in warmth.

TEXT BY Leni Lustre-Pere
PHOTOGRAPHS BY Juhani Eskelinen

The artist, who describes herself as an adventurous dreamer, says that she has been interested in creative doing since childhood. She became enthusiastic in painting in the mid-1990s when she participated in an art project arranged by the City of Espoo. ”That is where I learned about different techniques, and painting obtained a whole new meaning.”

Mia Bergqvist says that nowadays she paints whenever she finds time for it. She also has a daytime job, so painting is luxury within limited time, ”opening your mind to new and different things.”

A naivist work is a question

Naivism, as innocently mellow as it pretends to be, is always also about narrative concentration on topics that confuse and even hurt. A good naivist work does not point a finger at anything, it does not accuse or teach. It asks and accepts every answer equally true.

”The venturers in the dream world of my pictures beckon the viewer to create their own meanings for things. Hopefully, the mysteriousness of the pictures gives room for everyone’s own creativity. I do not convey a specific message, but I may encourage to find inspiration within the viewer herself,” Mia Bergqvist says.

Life experience speaks through images

An invitation to the exhibition ”Naivistit littalassa” (Naivists in littala) next summer is a distinct recognition for the young artist. Her works are compelling – so much so that the “Unihiekkaa” (Sandman) exhibition at Galleria Maria in Helsinki last autumn made critics refer to the great naivist **Henri Rousseau.**

This is all the more noteworthy when you know that esteemed naivist artists are mostly quite advanced in years. The handling of topics larger than life usually requires that you have quite a lot of life experience so that the images on the canvas gain sufficient depth and tune the viewer to seek answers to questions which have never been presented.

Illustration by Tuija Sorsa

Let's talk to each other

Finland is a good country, inhabited by fine people. The least corrupted body of civil servants, best learning results in schools, technologically advanced infrastructure, high-quality electricity transmission networks, a respected country in European contexts. We have managed our harsh climate, geographical location, deprivation, hostile attacks, and ugly urban centres.

What will the Finnish nation and people need in the future to be able to cope just as well as thus far and even better? Another "nokia", maybe in biotechnology? More foreign tourists? A government in our Eastern neighbour that would please us? Good entertainment on the television? Revival of competitive cross-country skiing by Finnish men? Correct

strategic approaches to meet the challenges of globalisation and outsourcing to other countries? More colourful members of Parliament?

Maybe all that, who knows? But I am sure that two things are necessary: civilisation, and an ability to conduct intelligent dialogue and interaction, equally much in politics, organisations, workplaces and families.

This nation does not derive its power from great masses of people and consequently from inexpensive labour and mass production or vast natural resources, but from the fact that the amount of education, civilisation and understanding grows constantly. Population with language proficiency, wide-range all-round education, special expertise in selected areas, and social competence is the continuous asset of Finland. This is why we must support our school system, vocational and higher education, research and development, student exchange, voluntary popular education, high-quality broadcasting, high-standard newspapers and magazines, publishing of books, libraries, cinema, art institutions, and versatile theatre.

I am not against the reconditioning of roads and railways, new solutions for electricity production and transmission, improving business conditions or decentralisation of government functions, but I expect, require and demand simultaneous input in those activities and efforts which enable elevated individual and collective level of culture and education, starting from everyday manners and ranging all the way to creative social, philosophic and psychological insight. I believe that all people are more talented, creative and artistic than what they have ever dared to believe of themselves.

I think that dialogue is one sign of this elevated level of culture and education. Finns have been a fighting, jealous, moping and cursing nation. Let it be that way! But now we could gradually evolve into discussing and debating people who listen to each other and challenge each other intellectually. There is nothing more enjoyable than a debate between people who may disagree with each other but who can also both defend and examine their own viewpoint critically. It is fascinating to listen to a good, passionate debate or to be involved in search for truth which becomes deeper by each sentence spoken.

So: let this new year be a period when we contribute more wisely both to workplace meetings and to a dialogue with our spouse, friends and other generations!

Lari Junkkari

Lari Junkkari is a theologian, writer, business coach, supervisor and trainer living in Tampere, Finland. He has a long career among Finnish migrants living in Canada and Sweden, working for the church in Finland, and in recent years as a value trainer of various organisations and as a management coach. His best known books have dealt with manhood ('Mieheksi joka olet', written together with Kaija Maria Junkkari) and on business values and ethics ('Yrityksen arvot ja etiikka', written together with Tapio Aaltonen). His most recent book 'Nykyajan paimentolaiset – työ ja koti maailmalla', written together with Kaija Maria Junkkari, discusses expatriates. His other professional interests include marital and family issues and human life cycle. His hobbies include nature activities and photography.

PHOTOGRAPHS BY **FutureImageBank and Reijo Koirikivi**

All in a day's WORK

In this column, Fingrid's employees write about their one day at work.
This time, the article has been written by **AULI KARVONEN-KÖYKKÄ,**
who works as Supervisor in Northern Finland.

HELLO MY FRIEND!

Oulunsalo on a November Thursday in 2004

Many thanks for your letter. My autumn has been a busy one, which is why my reply reaches you this late. The weather has been warm with little snowfall. On the other hand, it has been rainy and dark. I am looking forward to a proper winter with a lot of snow.

Yesterday, I had to travel to Koillismaa on duty very early in the morning. That was my first trip this autumn during the dark hours, and I was a little frightened. Traffic experts say that elks are most mobile near roads one hour before sunrise and a little after that, which made me even more anxious. So, I bade myself a safe drive.

After an hour's drive, I stopped for morning coffee. While sipping my coffee, I browsed through the morning paper. It seemed to have been quiet out in the world, apart from a couple of wars and a few domestic bashings – dire news tend to carry news value. Of course, there are good news, but only royal weddings seem to make it to the headlines.

As I continued my drive, I went through the events of the previous day in my head. The day had been busy right from the outset. After reading through my e-mail, I reviewed future work that would require outage in the grid. During the day, I had countless telephone conversations with customers and suppliers to ensure that the arrangements work. I sent e-mail, replied to messages, and sent a request to the supplier concerning local guidance of the work team.

And of course you have problems with information technology. Yesterday was no exception. The communications were slow, and my e-mail programme told me that folder expansion cannot be performed. A telephone call to our competent IT support cleared the problem: it was all due to telecommunications glitches.

We've come far from the days when my eldest daughter, at the age of three, went to a bank with her father, and after looking around, exclaimed: "Daddy, there's a computer." When she got no reply, she repeated her observation at an ever louder voice, until ultimately the entire room sounded from wall to wall: "DADDY, THERE'S A COMPUTER!"

My day went on, and I prepared myself for a meeting to be held with a service provider later that day. I made sure that I had sufficient material with me and went through the main topics on the agenda. At the end of the day, I packed my papers and computer in a briefcase. I also had to pick up a printer from the store room and other necessary items to be taken to a substation.

My thoughts were interrupted suddenly – there were many reindeer on the road. Luckily, I did not see any elks that day.

The meeting with the supplier went smoothly. In the afternoon, I dropped in at the adjacent substation to take the printer with accessories, and I also had an overview of the substation. I headed back home just before 4 o'clock.

My son Hannu will have a floorball tournament during the weekend, so I will spend Saturday following his matches. Children with their bustle provide a suitable counterbalance to the hectic life at work. When I come home, I hear "Mummyyy" almost instantaneously from three different directions.

A couple of weeks ago, our eldest daughter and I went to a course instructing how to make Italian pasta – that was an interesting experience. What's best, I know now that pasta is not just about flour and water but eggs, too.

Wishing you and your family a pleasant winter!

Auli

PS. I will keep up Italian cuisine by participating in a pizza course in the spring.

Keeping the Lights on in Finland

FINGRID OYJ

Arkadiankatu 23 B, P.O.Box 530, FI-00101 Helsinki • Tel +358 30 395 5000 • Fax +358 30 395 5196 • www.fingrid.fi

Helsinki
P.O.Box 530
FI-00101 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

Rovaniemi
Veitikantie 4,P.O.Box 8013
FI-96101 Rovaniemi
Finland
Tel. +358 16 337 71
Fax +358 16 337 801

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