Norwegian System Operation facing a Tight Capacity Balance and Severe Supply Conditions in Dry Years

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ABSTRACT

A competitive electricity market was established in Norway in 1992. Statnett, the Norwegian Transmission System Operator (TSO), was established to own, operate and develop the main grid and facilitate a well-functioning electricity market. From 1996 onwards liberalisation followed in Sweden, Finland and Denmark. In 2001 all four countries had been integrated in a common Nordic market with no cross-border tariffs.

Norwegian generation is by 99% hydro power based. Upon liberalisation, competition and abundant generation resources resulted in lower electricity prices. Generation investments dropped to a minor level even if consumption continued to grow by 1.5-2% per year. Thus, during these 12 years the Norwegian electricity supply situation has been changed completely. Norwegian generating capacity may presently be insufficient to cover the peak load in case of an extreme winter. Regarding the energy situation, about 7 TWh of imports are required in a normal hydrological year. In a very dry year demand is expected to decrease due to high spot prices. But still the annual need of imports may become higher than the about 15 TWh that might be transported on the existing interconnections.

Statnett as System Operator is responsible for keeping the real time balance, today as well as in the future, and has to secure sufficient operating reserves for this purpose. An option market for fast operating reserves was launched in 2000 where generators as well as industrials (disconnection of loads) give bids. This market has contributed to more demand side flexibility, refurbishment of old hydro units and installation of new units.

The gravity of dry years was demonstrated by the occurrence of an extremely dry automn in 2002. During the winter 2002/03 the hydro reservoir levels became so low that the probability of rationing was significant in December and early January. Demand reductions due to high electricity prices, imports, a couple of mild and rainy weeks in January and an early spring saved the severe situation, however. The common Nordic electricity market and TSO cooperation functioned quite well. It was revealed, however, that the Nordic electricity market needs generation investments, more demand side price flexibility and more interconnections to thermal systems.

A Norwegian White Paper on Security of Supply was issued in December 2003 and discussed in the Parliament in May 2004. An important conclusion is to extend the responsibility of Statnett as the System Operator. Statnett shall currently evaluate and develop measures in order to secure the real time balance during the entire winter season. The objective is to avoid rationing in dry years as far as reasonably possible. New measures to be applied must not affect the electricity market to any extent. In particular, incentives for investments in power plants must not be weakened. Focus so far is first of all on mobile or permanent gas turbines to be applied for reserve purposes only. An arrangement where the System Operator may negotiate agreements with industrials and generating companies, for demand reduction and saving of reservoir water respectively, is also under consideration. Appropriate measures are to be approved by the Regulator before the winter 2005/2006.

1. INTRODUCTION

Norwegian generation is by 99 % hydro power. Upon electricity market liberalisation in 1992, competition and abundant generation resulted in lower electricity prices, and generation investments dropped to a minor level. As consumption continued to grow by 1.5-2 % per year, the Norwegian supply situation has gradually been worsened. A comfortable generation capacity margin has disappeared, and the energy balance in an average hydrological year has turned from surplus to deficit. The challenging supply situation to be faced by the Norwegian System Operator and potential solutions and measures are addressed in this paper.

2. THE NORWEGIAN AND NORDIC ELECTRICITY MARKET

2.1 The Liberalisation Process

Nordic market liberalisation started in Norway. Following the Energy Act of 1990 a competitive electricity market was implemented in Norway in 1992. From the very beginning there was open access to all network levels, with all customers, even the smallest, made eligible with free access on equal terms. By 1st January 1992 Statkraftverkene, the state owned generation and transmission company, was unbundled, but not privatised. The generation was taken care of by the new company Statkraft. Statnett, the Norwegian Transmission System Operator (TSO) was established to serve as the national System Operator and to own, operate and develop the main grid. All Statnett tasks are to be performed with the aim to facilitate a well-functioning electricity market. A more or less similar market liberalisation followed in Finland in 1995, Sweden in 1996 and Denmark in 1998. TSOs were also established in the other Nordic countries: Svenska Kraftnät in Sweden in 1992, Fingrid in Finland in 1997, Eltra in Western Denmark and Elkraft System in Eastern Denmark in 1998.

System operation tasks as well as other TSO activities are coordinated within Nordel, the Nordic TSO organisation. An important vision for the Nordic TSOs is to act as if they were one Nordic TSO. More information on Nordic cooperation on www.nordel.org/ and in Reference [1].

An important part of the Nordic electricity market is the role of the power exchange Nord Pool. The basis of Nord Pool was laid at the end of 1992 when the Norwegian power exchange Statnett Marked was created. When Sweden opened the electricity market in 1996, Norway and Sweden jointly formed the first international electricity market with no charges on the flows across the common border. Statnett Marked was extended and renamed Nord Pool and constituted the first international power exchange in the world. Statnett shared the ownership to Nord Pool with Svenska Kraftnät, the Swedish TSO.

From 1998 also Finland joined Nord Pool and the common Nordic electricity market. Western Denmark was included in 1999 and Eastern Denmark in 2000. From 2001 there are no longer any transmission charges for cross-border trade between the Nordic countries. From 2002 the TSOs in all four countries jointly own the market place for Day-ahead Elspot trade, Nord Pool Spot.

2.2 Power System Characteristics

Installed capacity in the Nordic electricity market as of January 1st, 2004 was 91 165 MW. The all time high Nordic peak load is slightly less than 70 000 MW. In 2003 the peak load in the various countries amounted to 6 445 MW in Denmark, 14 040 MW in Finland, 19 984 MW in Norway and 26 400 MW in Sweden. Total Nordic electricity consumption in 2003 was about 380TWh.

The Nordic grid is shown in Fig. 1 and the generation mix in Table 1. As shown the generation systems are quite different in the four interconnected Nordic countries. There is a substantial share of wind power in Denmark whereas there is much less than 1 % of wind power in the three other countries so far.

Since hydro constitutes such a large part of the annual production, the flow pattern in the Nordic system will be strongly influenced by the change of inflow from year to year, most extremely within the Norwegian system and on Norway's interconnections with the other countries.

Fig. 1. The Nordic transmission grid

Electricity generation (%)	Hydro	Nuclear	Thermal	Wind
Norway	99	0	1	0
Sweden	40	50	10	0
Denmark	0	0	87	13
Finland	12	27	61	0
Nordel in total	**46**	**24**	**28**	**2**

Table 1. The mix of electricity generation in the Nordic electricity market in 2003 (%)

2.3 Market Model and Balancing Mechanism

In the Nordic electricity market about 40 % of the physical deliveries are traded at Nord Pool Spot, the remaining 60 % bilaterally. The development of Nord Pool is described in Chapter 2.1. The Nordic market area is divided in bid areas (with different prices in case of congestion). Day-ahead the hourly balance between purchase and sale is determined (Elspot). Various types of bids are welcomed, also disconnnection of demand in order to increase the demand side price flexibility.

The hourly 24 hours Elspot trade is determined just after noon the day-ahead. In the period before the operational hour meteriological and other conditions may develop differently from what was assumed when Elspot bids were prepared. The production plans and deliveries resulting from the Elspot trade, may therefore lead to real time imbalances next day. Provided System Operator acceptance production plan may be adjusted close to real time, however. In Finland, Sweden and Eastern Denmark market participants may also use a separate intra day market, Elbas, to decrease expected imbalances.

Final imbalances are taken care of by the Balance Market. This market is the tool of the Nordic System Operators to balance the system real time. It gives also the basis for settlement of the imbalances of the market participants. The various markets and their timescales are shown in Fig. 2.

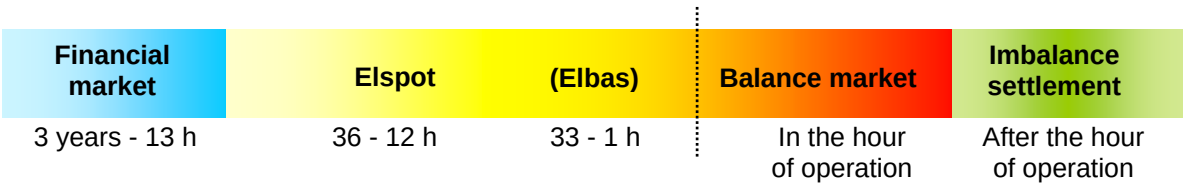

Fig. 2. The various markets and their timescales

Since September 2002 all Nordic regulating power bids to the Balance Market in the synchronous part of the area are collected in one common Nordic bidladder, Reference [2]. As far as possible the Nordel area is balanced as a whole. The cheapest available Nordic resources are applied for normal balancing as well as to restore balance after disturbances. Sometimes particular geographical needs combined with congestions may imply use of other bids than the cheapest.

In the Norwegian part of the market area deviations from day-ahead forecasts require frequent use of regulating power. About 10 % of the time there is a need of an upregulation of 500 MW or more. To be prepared to cope with forecast deviations and disturbances Statnett has defined a Norwegian need of about 2000 MW of regulating power as a minimum. Terms for the Balance Market is given in Reference [3].

3. ROLE AND RESPONSIBILITY OF THE NORWEGIAN TSO

The main role of Statnett as the Norwegian TSO is to efficiently promote and facilitate a well-functioning electricity market. There must be satisfactory access to the entire market area for all the players, sufficient transmission capacity and acceptable quality of supply. For information about the Norwegian TSO reference is made to www.statnett.no.

Regulations of quality of supply are under finalisation in Norway and expected to come into force as of January 1st 2005. The main focus is on voltage quality. There will be no specified requirements regarding number and duration of supply interruptions. Reliability of supply is the responsibility of the transmission and distribution owners, but being subject to financial regulation as described below. System security and reliability is the responsibility of Statnett, the national TSO.

Transmission and distribution charges in Norway are determined by the allowed annual income defined by the Regulator for each particular transmission and distribution owner. In 2001 the allowed income for all network owners was increased by an amount corresponding to the average social cost of historical supply interruptions. In return the network owners are to be penalized for any supply interruption caused by failures in their own network. The cost figures applied vary within the range of 1 – 13 €/kWh for energy not supplied, depending on type of consumption. The weighted average interruption cost for the total of Norwegian consumption is estimated at about 4 €/kWh interrupted.

As of 17th May 2002 the Norwegian Regulator enforced new Regulations relating to Power System Operation, www.nve.no, Reference [4]. Important elements in relation to capacity and energy issues:

- The system operator shall ensure momentary generation/demand balance with satisfactory quality of supply in the power system at all times
- The system operator shall to the greatest possible extent make use of measures which are based on market principles
- The system operator shall have adequate operational reserves at its disposal at all times
- In the event of enforced disconnection of supply, the system operator is considered the responsible concessionaire

The consequence of the last bullet point above is essential: In a situation with lack of generating capacity the System Operator may have to resort to forced demand disconnection in order to save the bulk of the system. However, he will then be subject to financial penalty according to the approach described above. The market is still supposed to provide the necessary generating capacity over time. The System Operator has been given strong incentives to encourage a sound capacity balance, however.

In supply situations with scarcity of energy Reference [4] requires the System Operator to define strained regions as separate bid areas in the Elspot market in order to signal difficult supply conditions. In Chapter 6 the need for additional and more powerful measures is addressed.

4. THE NORWEGIAN ELECTRICITY SUPPLY SITUATION

4.1 Capacity Balance

All time high peak load in Norway is 23 050 MW and occurred 5th February 2001. Installed generating capacity is about 28 000 MW. Due to hydrological conditions only about 24 000 MW, as a maximum, is available in the winter.

As shown in Fig. 3 the annual peak load is varying considerably from year to year. This is due to climatical variations and first of all temperature variations, as electricity is widely used for space heating. Despite variations, the trend has been a steady growing peak load. This is expected to continue in the years to come. Generating capacity has not increased much in later years, however. The result has been a gradually deteriorating capacity balance.

With reference to Chapter 3 it has been important for Statnett to encourage development of demand side flexibility to secure sufficient fast operating reserve and to reduce the probability of a capacity deficit to occur. This topic is addressed further in Chapter 5.

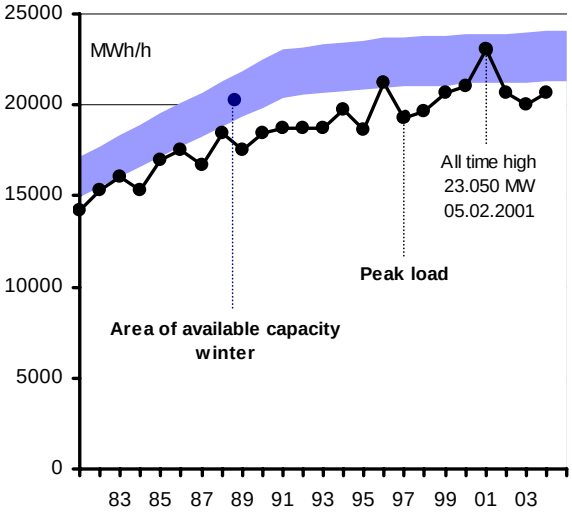

Fig. 3. Available capacity and annual peak load

4.2 Supply Situation in Dry Years

The Nordic, and in particular the Norwegian, energy situation has gradually been weakened after market liberalisation. In an average hydrological year Norwegian generation amounts to about 118 TWh. Annual Norwegian consumption is today about 125 TWh. The development is shown in Fig. 4. From a very dry to a very wet year, however, generation may vary a lot, between 90 and 150 TWh. This is illustrated in Fig. 5.

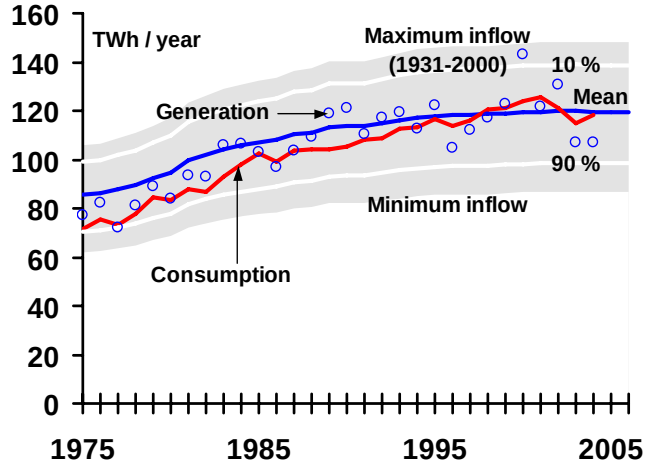

Fig. 4. Annual consumption and average generation

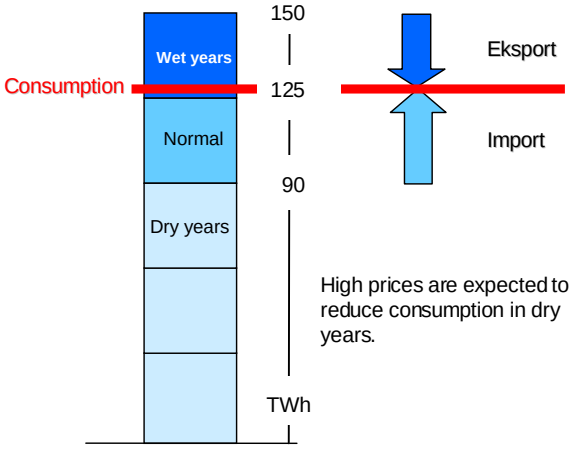

Fig. 5. Norwegian generation can vary a lot

After market liberalisation Norwegian electricity prices decreased as a result of competition, overcapacity and wet years. Exceptions from relatively low prices are the dry year 1996-97 and the very dry year 2002-03. For detailed information see Nord Pool's homepage www.nordpool.com.

Investments in new generation in Norway have been limited because of the price situation and future uncertainties. New generation is definitely needed in Norway, and competition is foreseen to trigger the necessary investment decisions. With increasing prices lately there are indications that the situation now is about to change.

The present interconnections are insufficient to handle the huge Norwegian hydrological variations between wet and dry years. There is a strong need for new interconnections with thermal systems in addition to new domestic generation. This is why Statnett for many years has spent a lot of efforts to establish HVDC connections to other markets. The latest project is NorNed between Norway and the Netherlands.

5. STATNETT'S OPTION MARKET FOR FAST OPERATING RESERVES

5.1 Objectives

As addressed in Chapter 3 the Norwegian System Operator is required to dispose on sufficient operating reserves to be able to balance the system in real time. In case of insufficient generation to meet demand he will be penalized financially if he should have to disconnect load to save the system.

As mentioned Statnett considers that a minimum of about 2000 MW of fast operating reserve is presently needed in the Balance Market for Norwegian purposes. Due to the limited generation margin that has developed, there is a risk that all Norwegian generating capacity might be sold in the day-ahead Elspot market at winter week days; the major part to cover Norwegian demand and the rest to be transported cross-border. To be able to comply with the Regulations, Reference [4], Statnett developed an option market to secure sufficient fast operating reserves in high demand periods. This Reserves Option Market in its first version was launched in 2000, Reference [5].

From the very beginning Statnett has encouraged the demand side to participate in this market. Demand side participation would increase the competition as well as the total of potential regulating resources. It would also be essential for further development of demand side price flexibility.

Statnett also expected the market of operating reserves to give financial incentives for refurbishment of old units as well as installation of new ones; thus contributing to improving the capacity balance.

5.2 Concept and Evolution so far

The Reserves Option Market is a catalyst to secure sufficient regulating power to be available in the Balance Market. Statnett is purchasing the right (options) to dispose on regulating resources in generation as well as in demand; both kind of resources to compete on equal terms. In the early phase the contracts had a duration of 1-12 months. From the automn of 2004 the contracts have been made weekly.

Because of network constraints the Norwegian system has been divided in three areas, A, B and C as shown in Fig. 6. Fig. 7 shows the volumes traded until 5th December 2004 in total for areas A+B+C. The substantial portion of demand side contracts should be noticed.

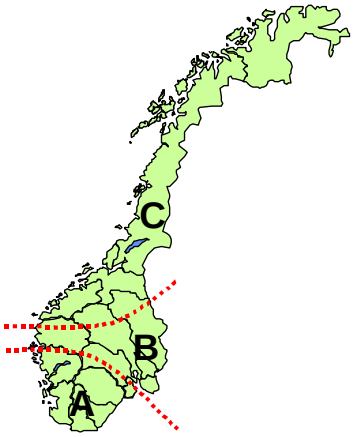

Fig. 6. Bid areas for the Reserves Option Market

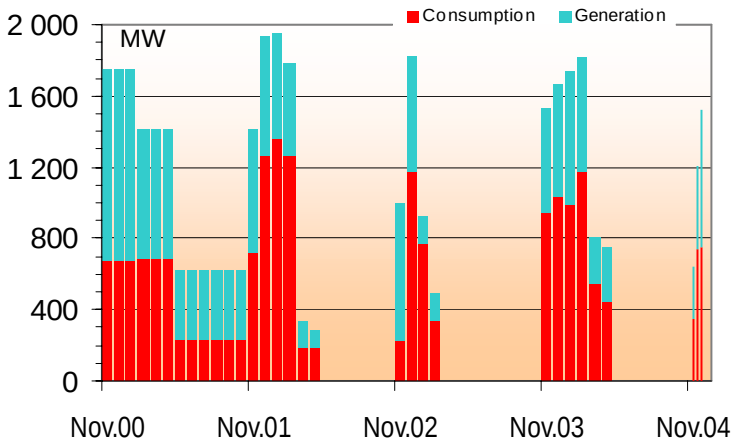

Fig. 7. Volumes of reserves purchased in the Reserves Option Market

Offers are area based and include size (a minimum of 25 MW) and option price. Potential restrictions regarding duration of continuous activation and duration between two activations are to be included. Such restrictions cause a certain price reduction based on agreed terms. Bids may be presented for 8 weeks at a time if desirable. For the trade for the next week bids may be adjusted until the weekly gate closure on Thursday at noon.

Thursday between noon and 14:00 Statnett is systematizing the offers and analysing the amount to be purchased in each area. The cheapest offers are chosen up to the desired volume. Some offers may be excluded, for instance due to network conditions. As generation and demand may have different regulating qualities, the composition of the two kinds of reserve is also considered. Marginal pricing is applied for the purchase which means that the most expensive offer accepted in an area defines the price of all contracts in that area. Option prices turn normally out differently in the three areas.

It may happen that the System Operator for special operating reasons needs to contract reserve at one particular location. Such a purchase is called a "special option" and is paid as bid without affecting the pricing of the other purchased reserves.

Thursday at 14:00 information about the concluded purchase for the next week is informed via internet to all bidders. The total areawise purchase of reserves in generation and in demand and the price are published at *www.statnett.no*.

Reserves contracted on Thursday have to be offered to the Balance Market on all week days between 06:00 and 22:00 the next week; hourly activation price to be determined by the owner. Required response time upon activation order is 15 minutes. Unavailability of contracted resources shall be reported immediately to the System Operator. The option price will then be reduced according to agreed terms.

The main reason for the change from a monthly to a weekly market is to reduce uncertainties regarding meteorological forecasts and export/import expectations. The participants are confronted with less uncertainty when deciding about volumes and prices to be offered. Statnett may better tailor the purchase to the needs. More information about the Reserves Option Market is available at Reference [6].

The purchase of reserves is financed through the grid tariff. Statnett has been allowed an increase of income to recover the expected costs. The allowed income will be adjusted every 5 years. So far the historical cost has been 6 – 12 M€/year.

5.2 Experiences and Future Development

The Reserves Option Market has been welcomed by generators as well as consumers. A market based purchase is in compliance with the Regulations, Chapter 3 and Reference [4].

The Reserves Option Market has resulted in a substantial volume of demand to compete with generation. A number of consumers have found it financially interesting to be prepared for demand disconnection on short notice. So far mainly big industrials have participated, and there is a potential for further demand to participate. Statnett is initiating pilot projets in order to arrange packages of smaller consumers. Statnett is also encouraging more consumers to bid demand disconnection in the day-ahead Elspot Market, first of all in periods with high spot prices.

In addition to the weekly contracts in the Reserves Option Market Statnett have entered into a few bilateral agreements of 5-10 years' duration with generators. The agreements have contributed to rehabilitation of old units and increased size of units to be installed. At the same time Statnett has secured some of the operating reserves at an interesting cost. Additional agreements will be considered. More information available at www.statnett.no.

Operating reserves are secured differently in the various Nordic countries. The automn of 2003 Eltra, the TSO of Western Denmark, started to purchase reserves outside its own area. For January-March 2004 Eltra made an agreement with Statnett on 150 MW of reserves to be delivered by the Statnett Reserves Option Market. The precondition was that these reserves would be available to Eltra in case of free capacity at the Skagerrak HVDC-link only. As part of this cooperation market participants in Western Denmark were welcomed to give bids to the Statnett market. A similar agreement is expected for the winter 2004/05.

Even if the use of a common Nordic bidladder is functioning quite well, there is a potential for further Nordic coordination. The next step may be a closer cooperation in the way the necessary fast operating reserves is secured and exchanged. More harmonization may also lead to a reduction of the total purchase of Nordic operating reserves.

6. THE GRAVITY OF DRY YEARS

6.1 Dry Year Experiences

The winter 1996/97 low precipitation during the automn lead to increased electricity prices. The weakened Norwegian energy balance was demonstrated for the first time after market deregulation. During spring 2001 supply conditions were strained in north-west Norway because of a dry period combined with limited transmission capacity to supply the region.

The automn 2002 was extremely dry, and also cold. Very limited inflow to the reservoirs during the automn created a worrying supply situation. In December it was considered a danger that Norwegian hydro reservoirs would be insufficient to cover the demand until snow melt in the spring, even combined with heavy imports.

Imports to the Nordic area and Norway were high. Elspot prices became higher than ever in the Nordic market, in January up to 114 €/MWh as daily average. The high electricity prices were focused a lot by media. The authorities went through with a campaign in order to reduce consumption. Some industrials decided to reduce their manufacturing and instead sell contracted electricity in the market. What first of all improved the situation, however, was a mild and rainy January with low consumption. When snow melt in Southern Norway also started very early, critical measures were avoided. The conclusion in brief was that the market had succeeded in handling a difficult supply situation satisfactorily.

The vulnerablility of Norwegian electricity supply had been clearly revealed, however. Even if a well-functioning market and some positive incidents had saved a difficult situation, there had, nevertheless, been a real risk that rationing of consumption could have been required. On this background the focus on the supply situation was intensified in the electricity supply industry as well as on political level. In December 2003 a White Paper on Security of Supply was submitted by the Ministry of Petroleum and Energy, Reference [7]. The White Paper gives a thorough description and analysis of the severe electricity supply situation 2002/2003 and is focusing on the roles and responsibilities of the System Operator and of the Regulator as the Rationing Authority.

6.2 Extension of Norwegian System Operator Responsibility

In the White Paper of Security of Supply the responsibility of the System Operator to ensure momentary balance at all times is interpreted as the responsibility to ensure balance also in the future, i.e. also through periods with a very difficult supply situation due to low hydro power reservoirs. In this context the System Operator must also be responsible for a continuous evaluation of the need for new measures in order to secure the balance during the winter better than today. The objective is to reduce the probability of rationing in a severe situation to a reasonable level. New measures shall be designed in close contact with the energy authorities and have to be approved by the Regulator.

It is also emphasized in the White Paper that the System Operator shall contribute actively to a further development of demand side price flexibility as such a development may reduce the need of other measures.

The White Paper was discussed in the Parliament this spring. All major proposals were supported. Reference [4], addressed in Chapter 3, is foreseen to be amended accordingly.

6.3 Requirements to Measures to avoid Rationing

When the need for measures and solutions are considered, there are important questions to be focused on, like:

- What are the consequences and social costs of electricity rationing?
- What is the extent of demand side price flexibility in scarcity situations?

A number of measures have been proposed by market participants (generators as well as industrial consumers). Conditions and qualities to be considered when potential measures are evaluated:

- Probability of rationing to be decreased
- Measures to be considered in a socio-economic context
- Market based principles to be applied as far as possible
- Generation investment incentives not to be weakened to any extent
- Neutrality and independence of the System Operator to be maintained
- Measures to comply with present legislation

6.4 Probable Future Solutions

Potential new measures to reduce the probability of rationing in years with very difficult supply conditions will have to be evaluated in view of the criteria described in the previous section. Relevance in comparison with existing measures as regulated in Reference [4] is also essential.

When measures to relieve a critical supply situation shall be executed, the probability of ending in rationing will have to be a major decision criterion. The Statnett model for that kind of calculations is very complex. Precipitation, consumption, transmission capacities and generation scheduling in the market context are crucial elements. The entire Nordic market area as well as connections to other markets have to be represented properly. The model is under continuous evolution and improvement.

Related to the winters of 2002/03 and 2003/04 two concrete measures were prepared by Statnett. As the difficult situation was relieved both winters, none of those measurers were attempted in practice. Both measures, described below, are now elaborated further and compared with other measures.

Reserve Power
Stanett has established infrastructure for installation of gas turbines in Middle Norway at short notice. A location in Western Norway is also under preparation. Installation per site is prepared for a number of small units, limited to a total of 150 MW to keep the licensing process fast and simple. The limited size per site implies use for regional purposes only and in areas with a week supply system. The gas turbines are to be rented in the world market if a critical supply situation should develop. Such reserve plants will probably have to be operated by Statnett presently, on longer term contracts with market participants may be possible. The role of Statnett in general, should such a measure be approved, will have to be defined clearly.

Energy Options
There is a lot of heavy electricity consuming industries in Norway. They have been very active in the Reserves Option Market described in Chapter 5. During the winter 2002/03 high spot prices gave some of them the incentive to close parts of their manufacturing and resell their energy in the market.

In addition Statnett elaborated in a hurry a first version of an approach for what has been called "energy options". The idea was to enter into agreements with industrials on demand reduction for a number a weeks in case of a critical energy supply situation. In such agreements Statnett would be in the position to decide if and when demand reduction should be activated. Statnett would have to pay for this right. In addition Statnett would have to guarantee against financial loss in case the right to order the contracted demand reduction should be executed. Other variants of energy options may be possible and also to combine demand reduction with storage in hydro power reservoirs.

Reserve power and energy options shall be elaborated further and compared with other measures in a prosess to last until the automn 2005. A considerable number of other measures have been mentioned. Some of them:

- Agreements to secure increased dry year capability of existing hydro power plants
- More price dependant demand side bids in the Elspot market
- More use of contracts to incentivise small consumers to save energy when Elspot prices are high
- Utilisation of emergency supply units and other small mobile generator sets

It has to be mentioned in this context that Statnett recently has reduced the transmission charges for new generation to be decided in 2005, provided this generation will be located in predefined areas with a weak supply and will relieve the need for grid reinforcements.

7. CONCLUSIONS

In a situation with gradually deteriorating Norwegian capacity balance Statnett as the Norwegian System Operator has feared a situation with insufficient fast operating reserves. The Reserves Option Market was therefore developed in cooperation with the customers and implemented in 2000. Generators as well as industry being willing to be disconnected on 15 minutes' notice compete in this market. The market has been under continuous development as described. Supplementary to this market Statnett has entered into a few bilateral contracts of 5-10 years' duration with generating companies. Demand side flexibility has increased, old hydro units have been refurbished and new ones installed. Statnett can secure sufficient operating reserves, and the probability of forced demand disconnection in a cold winter has been decreased.

The production capability of the Norwegian hydro power system in an average hydrological year is now about 7 TWh less than the annual electricity consumption of 125 TWh. Variation in precipitation to hydro power reservoirs between a wet and a dry year may be very large, roughly 90 - 150 TWh. Unless the demand decreases significantly due to high electricity prices, the supply situation may become critical in a very dry year.

Difficult supply conditions have been experienced in later years, first of all regionally. The worst situation so far occurred during the winter 2002/2003 even if rationing did not become necessary. On this background the responsibility of the System Operator has recently been extended to comprise the generation/demand balance during the entire winter season. The System Operator is urged to develop appropriate new measures in order to avoid rationing as far as reasonably possible in very difficult supply situations. Such measures must not affect the electricity market to any extent, however. Appropriate new measures are to be approved by the Regulator before the winter 2005/2006.

In addition to short term measures in the hands of the System Operator the experience of later years have illustrated strongly the need of new generation in Norway as well as more interconnections to thermal systems.

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