




ATSOI

BALTSO

UKTSOA

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# 2006-2007

# WINTER REVIEW

**CONTENTS**

## EXECUTIVE SUMMARY

The Winter Outlook Report, published on November 10th 2006, showed that no particular risks of power shortages were expected under normal conditions but that the power systems could become stressed under severe or unfavourable conditions.

In reality, no serious threats to the power system balance were experienced. This was mainly due to the mild weather and climatic conditions experienced over the winter.

The most remarkable condition experienced across most of Europe was the wind storm 'Kyrill' on January 18th, however generally there were no major supply losses as a result.

In general there was a high level of cross-border exchanges, but these were impacted by unexpected generation outages and high wind in-feeds.

There was a very low level of precipitation, impacting on the level of water in reservoirs. This may impact on the power system balance this summer and even next winter, if reservoir levels are not returned to near normal.

Key risks for next winter are: weather conditions, levels of unexpected outages, levels of wind generation and reliance on cross-border exchanges.

Analysis by Block

UCTE

As was the case across all of Europe, the UCTE winter was characterised be a mild winter, leading to lower demand than expected.

There were high exchanges within the UCTE area – although a high wind in-feed in Germany had a negative impact on some borders as the import capacity had to be reduced in order to avoid high transits causing security margins to be exceeded. Most difficulties were caused by the unexpected availability of generation units. A lack of energy was evident due to the shutdown of the two nuclear power plants in Bulgaria. Generation adequacy was however not at risk in most UCTE countries.

Unfavourable weather conditions were experienced across Europe on January 18th, with the storm Kyrill. However this was managed so that there were minimal disruptions on the transmission network.

The most relevant unplanned event that occurred on the UCTE network happened in the evening of 4th November 2006 and was the most severe disturbance in the history of UCTE. The severe frequency drop in the Western part of the UCTE grid, which was caused by the splitting of the interconnected system, was not caused by extraordinary climatic conditions during the winter or technical failures.

Nordel

The winter started with high temperatures and mild weather but finished with more normal conditions. High prices were seen, but this did not necessarily result in higher imports from outside the Nordic countries. The high prices were a result of very low levels of water in the reservoirs. Nordel area is relying on imports from the other EU-countries and Russia especially in severe conditions. This reliance is likely to be even more pronounced in upcoming winters, if unfavourable conditions are repeatedly experienced (e.g. low water levels or cold temperatures).

BALTSO

The BALTSO area did not experience any system adequacy issues over the winter. The hydro conditions were favourable and this twinned with low demand due to the high temperatures meant that minimal imports were required and consequently the newly commissioned EstLink cable was mostly used for export.

GB/NI/ROI

The winter situation in this region was characterised by the unusually mild weather conditions. Northern Ireland and the Republic of Ireland were both heavily reliant on imports, but this was matched within the region. The risk of large exports from Scotland to England, which was realised this winter, remains a risk for next winter but will be dependant on the surrounding market conditions.

# 1. Introduction

## 1.1 Winter Outlook

The Winter Outlook Report, prepared at a European level, presented a summary of the national power balances between forecasted generation and peak load for the winter period. The report for winter 06/07 was published on November 10th 2006.[1]

This report showed that on the whole, no particular risk of power shortages was expected for the winter under normal conditions. Under severe conditions (e.g. low temperatures or unfavourable hydro conditions), it was predicted that the power systems may be stressed, especially if critical periods were experienced simultaneously by neighbouring countries. There was also, in some countries, risk related to the gas markets.

## 1.2 Objectives

The objective of this Winter Review is to present what happened during the winter just passed regarding: weather conditions and their consequences on the power system; availability of generation units; market conditions etc. What happened will be compared with what was predicted in the Winter Outlook Report.

Information that has been collated is that which is already available to TSOs – no additional studies were asked to be carried out.

## 1.3 Contributing Countries

This report has been drawn up with the contributions of the following countries.

UCTE members:

- Austria
- Belgium
- Czech Republic
- France
- Germany
- Greece
- Hungary
- Italy
- Luxembourg
- The Netherlands
- Poland
- Portugal
- Romania
- Slovak Republic
- Spain
- Switzerland

Nordel Countries:

- Denmark
- Finland
- Norway
- Sweden

[1] http://www.etso-net.org/upload/documents/WOR_2006-07_v2.pdf

BALTSO Countries:
- Estonia
- Latvia
- Lithuania

GB/NI/RoI Countries:
- Great Britain
- Northern Ireland
- Republic of Ireland

## 2. Main Results

### 2.1 Risk Factors

The main risk factors that had an impact on the power systems during winter 06/07 were:

- Mild temperatures and their effect on load
- Unplanned outages or overhauls of generation and transmission assets
- Volatile wind in-feed
- Level of inflows of hydro generation units
- Remarkable unplanned events e.g. the wind storm that affected most of Europe on January 18

Amongst the most remarkable features that had an influence on the power systems during winter 06/07, temperature and weather conditions were the most important ones, influencing the level of load and demand in comparison to the previous year in all countries. In general in most countries the average temperature during winter 06/07 was higher than normal temperature conditions due to mild climate conditions. In addition to the mild temperature, low precipitations marked this part of the year in most countries, affecting the hydro reservoirs.

There were two distinct affects on prices. In general, the south east area experienced lower prices because of the lower demand. However the Nordic area experienced higher prices due to the low reservoir levels.

### 2.2 Main Trends

There were a number of trends witnessed across Europe during the winter i.e. the increasing utilisation of interconnector capacity to stabilise the power system balance. A trend experienced in a number of countries was the volatility of wind in-feed affecting the power system balance.

On the whole TSOs did not have particular power system security problems and tight margins during the winter. The most remarkable exceptions were mainly due to exceptional weather events that occurred in some countries, such as wind storms, or due to the outages of power plants, which in some cases impacted on internal and external transmission capacity.

Some countries had identified the gas market as presenting a risk for the winter. In Great Britain the winter actually saw declining gas prices, which resulted in competition between coal and gas fired generation with neither running as baseload (over winter 05/06 coal was baseload with gas the marginal fuel).

## 3. Detailed Comments

### 3.1 Country Analysis

Austria

In Austria the winter 2006-2007, especially in the period from December to March was very warm, which resulted in a decrease of demand. The monthly demand was up to 4.3% (March) lower than last year. The peak load in winter 2006-2007 reached 9286 MW and was about 195 MW lower than in the last winter.

Despite the low demand in some periods the import was very high because of the low generation of thermal power plants.

Three phase shifting transformers (PST) were put into operation by end of November. This measure allowed for a better balanced distribution of load flows of the three existing 220 kV-lines from north to south of Austria and was very important to overcome the bottleneck on these lines. But, for a permanent improvement of these structural congestions in the future the commissioning of new 380 kV-lines (Südburgenland – Kainachtal, St. Peter – Tauern) is planned.

Belgium

ELIA forecasts revealed that the desired safety level of 1000 MW for the generation-load balance would not be reached during the peak of weeks 48, 49, 50 and 13. The system adequacy was however assumed to be respected, if available import capacity was taken into account. Therefore no outages of international 380 kV lines were planned.

In reality, the 1000 MW safety level was not reached in the peak of weeks 48, 49, 50, 51, 3, 4, and 11 due mainly to unexpected unavailability of several generators. However the system adequacy for the winter was guaranteed through:

- Maximum available import capacity being guaranteed and supplemented by an increase of NTC value from France to Belgium due to the double circuit upgrade from 150 kV to 220 kV of the line Jamiolle-Monceau with installation of a phase shifter in Monceau, and no observed outages of international 380 kV lines during the winter; and
- A low magnitude of South – North loop flows within the ELIA grid.

Demand in Belgium was lower than the forecasted demand levels, because forecasted demand took into account normal weather conditions. Temperature during the winter was 1.8° C higher than the ten year average winter temperature.

Czech Republic

System adequacy forecasts were mainly realised during the winter, with in general no significant problems experienced. The only occasion of operations being worse than expected was the loss of 2100 MW caused by the tripping of one 1000 MW nuclear power plant unit and coincidental outages of several smaller capacity units, occurring at the end of 2006. The Hurricane Kyrill, happening on January 18$^{th}$, caused much damage with loss of load on distribution networks, but transmission system operation was not affected.

Apart from the unpredicted events, the forecasted risk of low values of remaining capacity during severe weather conditions did not occur due to higher temperatures experienced during the winter. The mild weather allowed for an increase in exports.

Some unfavourable cross border conditions were caused by the extreme wind power generation in Germany. This caused capacity deviations between planned and real measured values, often higher than 1000 MW.

France

System adequacy forecasts and effective operation showed that the generation – load balance on the French system was not at risk during the winter. The real operating conditions were mostly better than expected, with the exception of the last weeks of January. Actual demand was lower than the forecasted level due to the mild temperature conditions during the winter.

Generation overhauls were realised as planned. The general level of unplanned overhauls and outages conformed to forecasted values. Hydropower generation was higher than expected due to favourable climatic conditions. Wind generation is not yet significant for the generation-load balance in France.

Two remarkable non predicted events occurred over the winter:

- The outage of the Cordemais coal power-plants caused a risk of low voltage in Brittany from December 8th to the end of January; and
- Low temperatures on January 25th caused the consumption level to nearly reach the record level.

A windstorm that affected northern France on 8th December caused the tripping of 4 extra high voltage lines.

Interconnection capacity between France and Belgium was improved during the winter due to the entry into operation of a new 225 kV Chooz - Monceau interconnection line, replacing the old Chooz - Jamiolle line, following the installation of a phase shifter transformer at the Monceau substation in Belgium.

Germany

During the winter no critical situation was observed in terms of covering the load. An extremely high average wind energy in-feed (between 1.5 times and 2.5 times as much as during the same period of the preceding year) was recorded from November 2006 to March 2007. The high wind energy in-feed increased the use of re-dispatching measures especially during periods of low demand.

No particular congestion problem occurred on the border with Poland and the Czech Republic.

The KONTEK HVDC link between Denmark and Germany was out of operation from 31st December to 12th March due to damage caused by a ship's anchor.

Network availability was temporarily interrupted by damage caused by the wind storm Kyrill.

Greece

The adequacy and security of the Greek system was not forecasted as threatened during the winter, taking into account the available import capacity on the interconnections.

A reduction of peak loads between the forecasted values and the realised ones was due to the higher temperature during the winter. As in the previous winter no particular problem with balancing demand and supply was registered and no particular demand side response was applied.

Concerning generation, most outages were as planned except for two generation units which were put out of operation due to severe disturbance. Additional wind generation capacity was installed during the winter, with a significant increase of wind production expected for the coming years. The only remarkable event was the lack of rainfall influencing hydro

production. The hydro electric power plant reservoirs are at extreme low level; the effects of this may be felt in the summer.

Furthermore, imports were reduced from the neighbouring Balkan countries (where the reduction of total production was due to the shutdown of the two nuclear power plants in Bulgaria). The lack of energy from the Balkans was reflected in very low auction capacity values at the Greek North borders for the period January – February. More energy became available towards the end of February.

Hungary

Due to the unusually mild winter, demand never exceeded a normal level. Fuel supply was not at risk. The most remarkable changes happening in the market of electrical energy in the region were due to the decrease of contracted imports to Hungary which fell from 1100 MW to under 500 MW from January. The reason was the decommissioning of nuclear units in Bulgaria and Slovakia, and resulting price changes.

As expected in March there were tight generation conditions due to the decrease of remaining capacity close to the minimum requirement due to starting the maintenance of large generating units. However, the Hungarian power system remained safe during the whole winter period.

The Hungarian power system relies on imports considerably. The peak import this winter fell from 1100 MW to 500 MW mainly due to economic reasons. Domestic generation replaced a large portion of import as the price differentials decreased.

Italy

System adequacy for the winter period 06/07 did not present any particular risk for capacity adequacy and peak load cover. Specific analysis performed to evaluate energy adequacy identified an increasing trend in gas consumption in the thermoelectric sector, which makes the support of interconnections increasingly important.

The winter period was characterised by a very mild climate and temperatures over the average, with associated decreasing of the demand in comparison to the previous year. The recorded power peak normally reached in winter was not exceeded in this period. Over this period the monthly consumption as compared to the same period in the previous year decreased.

In addition low hydro conditions were registered in this part of the year: values below the multi-year average capability factor were recorded, confirming a winter of scarce rainfall. Last winter was also characterised by little snow and short water reserves, causing some restrictions to the use of power plants located in the area closed to the River Po.

In terms of transmission adequacy, during the winter the new line Matera-S.Sofia 380 kV in the south of Italy has been put into operation. This very important connection addresses the previous congestions and increases the flows of energy. Other new lines and devices were put in service with reinforcement of the transmission network.

In terms of physical flows the interconnection recorded a very high increase of import/export balance of energy during the winter period. During the winter period interconnections allowed the sensible decreasing of internal production.

Luxembourg

No particular problem was encountered during the winter period. As the weather was mild compared to the previous winter period, consumption and peak loads did not reach historical values.

The most remarkable event was due to the windstorm Kyrill on January 18th.

The interconnection capacity with Germany was reduced during the winter due to the planned maintenance programme on the lines but it was coordinated with neighbouring TSOs and so no bottlenecks were caused.

The Netherlands

No special remarkable event occurred during the period. The import capacity from Germany was reduced in order to apply operational measures in case of high wind energy generation in Germany and related transits. The transits over the network of TenneT can be very high.

No significant deviations from generation and demand forecasts were observed.

Poland

The forecasts of system adequacy during winter 06/07 took into consideration the strong previous winter (05/06) and the growth of demand lasting all year, resulting in an increase in forecasted demand. It was assumed that outages of thermal power stations would increase during exceptionally cold periods.

During the winter no critical periods in the Polish power system were recorded. The most unexpected event was the Kyrill wind storm on January 18th/19th. The strong wind caused the switching off of 28 elements of the transmission system (8 x 400 kV lines, 18 x 220 kV lines, 2 x 220/110 transformers), but there was no energy not supplied at the transmission level. For the distribution network ≤110 kV load not supplied reached 2500 MW at midnight.

January was forecasted by PSE-Operator as the period with the biggest demand (for both normal as well as severe weather conditions), but the forecast was not realised due to the mild weather.

The trend of less export has been observed for some time.

Portugal

As planned, January was characterised by planned unavailability in the coal units due to the works needed to install atmospheric emissions control equipment in some thermal units in accordance with the EU directive 2001/80/EC.

On the thermal generation side, abnormal overhauls did not occur. Hydro inflows were generally above the average values with the exception of January when they were reduced.

Temperatures remained above the average for all the winter period, except at the end of January when they reached the coldest value of the year but without provoking abnormal peaks.

Transmission infrastructure reinforcements were started during this winter with entry into operation of two new substations, Portimão (150 kV) and Paraimo (400 kV) and 300 km of new lines of 400 kV, 220 kV and 150 kV.

The interconnections maintained the capacities similar to the previous winter, about 15% of the Portuguese peak, contributing to maintaining the reserve margins at comfortable levels. This winter the import balance contributed to 7% of the Portuguese consumption.

Romania

The winter 06/07 has been distinguished by an average temperature level greater than normal. Consequently the weekly peak load values recorded were lower than the forecasted ones and

led to a higher remaining capacity. As a result there was not any risk or critical periods for Romanian power system operation or interconnections.

There were more generation units in maintenance than was planned for. The approval of the additional generation overhauls was done on a monthly basis, taking into account the network topology and the updated forecasts. The additional overhauls did not influence the coverage of internal consumption, system services reserves or even the export requirements taking into account the NTC values.

During the winter several transmission lines were tripped by protection device actions but the safety system operation was not jeopardized because these outages were checked before through N-1 criterion by daily programming.

The reserves on the Balancing Market were used in January in order to remove an internal congestion caused by the bad weather conditions. In November and December the trade volumes on the Balancing Market were high, due to physical notifications in high imbalance and low hydro flows. The traded volumes in the first three months of 2007 were smaller, both for balancing and for congestion management.

Slovak Republic

Taking into account the forecasts, winter 06/07 was extremely warm with the impact being a decrease of demand and load against the forecasts of the previous year.

The most remarkable events on the generation side, occurred on the 31st December 2006 when one nuclear unit (400 MW) was decommissioned and at the beginning of 2007 when two more conventional power plants (220 MW total) were shutdown. This affected both the power balance of Slovakia and the cross border exchanges. The Slovak Republic was permanently a net exporter from 2000, but in January imports were recorded from the Czech Republic and Poland on one side and export to Hungary and Ukraine on the other side. Exchanges with the neighbouring countries were measured. Hydro production increased in order to ensure the power balance.

Spain

From the point of view of system adequacy, the load – generation balance was not at risk during last Winter 2006/2007 in the Spanish System.

Real demand values were lower than expected (System Adequacy Forecast) because the average temperature in the studied period was lower than average. In fact weather conditions were pretty mild except at the end of January. The winter peak load was lower than two years ago (maximum historical value).

From the point of view of generation, hydro conditions were almost average. Because of that, hydro generation contributed to available capacity more than expected in Winter Forecast (Winter Outlook Report). Regarding thermal plants behaviour, available thermal capacity was similar to forecasted values in terms of overhauls and outages. Wind generation variation was extremely high during the winter: the minimum recorded value was 25 MW on February 4th and maximum recorded value was 8,375 MW (new maximum historical value) on March 19th. Installed capacity is about 11,500 MW.

In terms of physical flows, the Spanish System had an export balance during the last Winter 2006/2007.

Switzerland

The most critical periods in the winter were:

- During the nights, when the production of inland hydro power plants was low and the transits through the Swiss transmission network were high; and
- On working days between 7 a.m. and 8 p.m., when the production of inland hydro power plants was high.

However, this is a usual power flow pattern of the Swiss transmission network and it was not forecasted as critical in the Winter Outlook Report, because it can be successfully managed by NTC and other operational procedures.

There are unintentional (unexpected) transits through the Swiss transmission network that result in overload within the scope of (n-1) security analysis. This occurs despite the reductions undertaken within the scope of NTC procedures.

According to first impressions, load was not extraordinarily high.

Denmark

The winter started with relatively high temperatures, mild weather, much wind and high market prices causing high productions on the power stations (thermal) and wind mills. The high market prices were caused by low levels of water in the reservoirs in Norway and Sweden. The winter ended with more normal conditions.

On the generation side, on 1st January 2007 surplus production occurred in Western Denmark making the disconnection of power plants and wind necessary. The interconnections towards Norway and Sweden were fully used. It was not possible to export more to Germany because of the same conditions there.

Severe weather conditions during February caused the galloping of a number of lines in the transmission grid, without interrupting the supply to the lower levels of the grid.

The KONTEK HVDC cable was out of operation between 31st December and 12th March, blocking trading between Germany and Zealand.

Finland

The winter period started with relatively high temperatures and low hydro reservoir levels in the Nordic market and ended with more normal conditions, although the winter was exceptionally short. Due to the temperature conditions, consumption during the first three months of 2007 was 1.9% lower than during the corresponding period in 2006. No significant problems were encountered on the production side. An all time record of peak demand was reached in Finland in February during a period of cold weather.

During the winter period the system adequacy was not at risk. Fingrid used for the first time the production capacity based on the Power Reserve Act to secure the power balance.

The only significant unplanned failure on the transmission network occurred on the Fenno-Skan 550 MW cable damaged at the beginning of December 2006 (returning to operation in February), restricting the transmission capacity between Finland and Sweden.

The most relevant event was the entry into commercial operation of the Estlink 350 MW connection between Finland and Estonia, working in importation mode to Finland.

Norway

The winter period started with extraordinary low reservoir levels due to less snow than normal in the mountains during the previous winter 05/06 followed by a very dry summer. With production 100% based on hydro power, the water shortfall conditions made Norway strongly dependant on imports from Sweden and Denmark. The most remarkable unplanned event

occurring during the winter was the reduction of imports from Sweden due to the fact that a number of nuclear power plants were out of operation.

From November there was a radical change with inflows to the reservoirs, which continued both in December and January when the situation became normal, although Statnett was still concerned about the middle of Norway and defined a new bidding area to handle expected import congestions.

The winter benefited from temperatures 2-4 degrees warmer than normal, substantially reducing consumption.

Sweden

The winter started with relatively high temperatures, mild weather and low hydro reservoir levels and ended with more normal conditions.

On the generation side a number of large nuclear power plants, a total of 2500 - 2800 MW, were out of operation for long periods between December and February. This caused a negative impact on the reactive power support and resulted in reduced transmission capacity from north to south, reduced exports, activation of oil-fired plants and maximum imports.

An unfavourable unplanned event was the heavy storm in the south of Sweden on 14th January which caused major problems in the electricity supply at distribution level but only a few minor outages on the national grid.

Estonia

The winter was generally mild except in the most critical period in weeks 6 to 9, which was the coldest winter period. However demand was according to expectation and no particular risks or critical cases were observed. No unplanned overhaul or maintenance work occurred on the generation side. Windmills production was on the average of 40% of the maximum available capacity during this period.

On the demand side, peak loads remained under the expected values, except in February. However the values for severe weather conditions were not reached.

Among the main events occurring on the transmission network, the most remarkable one was the entry into operation of the new interconnection Estlink.

Interconnectors were mostly used for exports.

Latvia

The winter was much milder than expected. On the generation side no outages or overhauls were registered. Hydro power plants had significantly increased output due to warmer and wet weather conditions with subsequently higher water levels in Daugava River.

Demand was close to the forecasted values. There were no major transmission outages or reinforcement because winter is a low season for maintenance. Imports were on average lower than expected during the first part of the winter and in March reversed to export as a consequence of the high water situation for hydro power plants.

Lithuania

Due to the unusual mild weather conditions with the average temperature higher than the normal winter one, demand was in range with the expected level and the generation availability was in line with the forecast.

The most remarkable event on the generation side was one 750 MW unit of the Ignalina nuclear power plant coming into operation only on the 7th January after an unexpected outage in September 2006, however due to excess of generation capacities there was no significant difficulties with power supply but there were difficulties with power imports from other power systems during generator maintenance time.

Great Britain

The winter was the second warmest on record. The expected risk of large exports from Scotland was realised. The main unexpected risks came from nuclear power stations not being in operation for a significant part of the winter and the shutdown of a key power station in Scotland. This had an impact on the National Grid outages.

The winter was generally mild in Great Britain, with a remarkable exception being the strong storm experienced on January 18th, which caused widespread damage all over the country and 22 faults on the transmission circuits – however no losses of supply arose from these faults.

On the generation side, whilst in the previous winter gas was the marginal fuel and coal was baseload, during winter 06/07 there was more competition between gas and coal fired generation, driven by declining gas prices, which made gas more attractive than coal. The decrease in nuclear generation was compensated for by lower electricity demand due to the mild weather.

Northern Ireland

The winter was forecasted as having very tight margins, which were even smaller once firm import/export contracts were taken into account. In reality the margins were not as tight as expected – the winter experienced was the 2nd warmest on record for the UK.

Republic of Ireland

Capacity during the winter was considered adequate to meet demand only with a dependence on imports and only if forced outages were within forecasted values. During the winter 06/07 the system was operated at all times within acceptable international standards for safety, security and reliability of customer supplies.

## 4. Lessons Learned for Winter 2007/8

The most important lessons learned for the upcoming winter 2007/2008 can be summarised as follows:

1) The key aspect of the forthcoming ETSO Winter Outlook Report will be the past and expected weather conditions, and after the summer season, the levels of hydro storage lakes and reservoirs;

2) The most important variations between the forecasted remaining capacity and the recorded ones are due to unexpected unavailability of generators and to changes in the maintenance programs;

3) Higher wind energy generation in Northern Europe will reduce import and export capacity and create transits on cross border networks;

4) Handling of high productions from wind power plants requires good flexibility in regulating reserve and strong connections with bordering countries;

5) Cooperation between TSOs' control centres and operations people to manage power shortage situations is very crucial and they should be regularly trained;

6) National balance cannot be approached in an isolated manner, but must be considered together with the situation in the other networks; and

7) Evaluation of effective summer conditions will assist in the assessment of risks for the following winter outlook forecasts for 2007/2008.