Balance Management Harmonisation and Integration

4th Report

January 2007

Contents

1. Summary

This report represents ETSO's view on balance management harmonisation and integration.

This view recognizes and stresses that TSOs and their regional organisations are responsible for network security and therefore should determine technical feasibility and financial implications before harmonisation and/or integration decisions are made. The harmonisation and integration steps explored in this report haven't been subject to such technical and economic justifications. These should be left to regional initiatives, so all regional specifics can be taken into account.

The report starts with an introduction chapter describing the scope of the report and the scope of a regional balancing function that is outlined in chapter 3. Chapter 4 describes the harmonisation issues that are important for balance management. Finally, chapter 5 describes possible integration steps towards regional balancing markets.

For simplicity and practical reasons, congestion management issues have not been included within the scope of this report. There is an important overlap with intra-day markets and the work of the ETSO taskforce NACM[1], therefore including this subject would have required much more in depth analysis and time. Intra-day markets will be subject of a next report of this Taskforce. However, the model is high level and flexible enough to allow for the development of regional harmonisation and integration of congestion management.

For this report ERGEG's "Guidelines of Good Practice for Electricity Balancing Markets Integration" has been consulted[2]. Also Eurelectric's paper "Towards European intra-day and balancing markets" of October 2006 has been reviewed.

ETSO envisages an evolving regional harmonisation and integration process enabled by a cooperation agreement between the TSOs in the region and supported by changes in existing legal, regulatory and inter-TSO arrangements as far as necessary.

The main drivers for this regional process are competition and efficiency. Depending on the regional situation harmonisation steps could drive integration steps and vice versa, therefore no priority has been given to either process. It is important to note as a key principle that regional balancing markets can not overlap, i.e. one market area can only belong to one regional balancing market.

To achieve full benefits all issues that define the characteristics and costs of the services used by a TSO to balance the system need to be harmonised to facilitate competition between providers in the cross-border procurement and activation of these services. These issues include: reserve definitions, technical requirements and procurement principles such as whether reserves are procured on a longer term basis or not and whether they get a capacity payment or not.

To achieve full benefits all issues that define the characteristics and price of the services that the TSOs deliver to the market in balancing the system need to be harmonised in order to get comparable prices and imbalance risks and improved transparency. These

[1] Network Access and Congestion Management
[2] "Comments on ERGEG Guidelines of Good Practice for Balancing Markets Integration", ETSO, July 2006, see www.etso-net.org.

issues include: gate closure time, balance responsibility, imbalance definition, settlement period, determination of imbalances and imbalance pricing principles.

The balance management integration process involves implementation costs which can be quite substantial and may not be out-weighed by economical advantages. Also, integration may influence operational network security and long term security of supply. Before taking any integration steps, these effects should be carefully analysed by the TSOs concerned. Three possible integration steps are described within the report.

Balancing market integration will, in most cases, require changes in legal, regulatory and inter-TSO arrangements, these will take time. The TSO's within a region will need to determine the steps which they are willing and able to take and how, as part of the agreement process.

The described model does not foresee nor requires the establishment of a separate organisational entity to undertake the specific role of the regional balancing.

2. Introduction

2.1 Objective

Balance management is a keystone in the well functioning of electricity markets in Europe. Each member state has designed a different keystone in this respect.

The objective of this report of the ETSO TF BM is the design of a guideline reference model for balancing mechanisms, as an aid to harmonised and integrated regional balancing markets.

Market integration normally leads to more overall efficiency; however there are potential side-effects in welfare transfer, resulting for example from the various situations of each country regarding the management of security of supply or the arrangements (and therefore costs) for procurement of required balancing services. Where these effects originate from differences or incompatibility between balance mechanisms, harmonisation is required. It is extremely difficult if not impossible to quantify these effects ex ante or even to assign them to regulatory differences ex post. In the end it is most efficient and fair (level playing field) to use harmonised or at least compatible balancing mechanisms throughout Europe.

2.2 Scope of Report

This report will describe a model of balance management in a regional market, coupling one or more balancing areas. In the context of UCTE, the balancing areas could be conceived as the control areas. However, the borders of the balancing areas should be defined according to principles to be agreed by the TSOs who operate the networks of the regional balancing market.

The detailed responsibilities of the regional function of balance management depend on the agreements between the TSOs involved taking into account the various legal, regulatory and technical prerequisites.

Economic impact analyses on balance management harmonisation and integration as well as impact analyses on operational network security and long term security of supply are out of scope of this report.

2.3 Motivation and application

The overall economic motivation for harmonisation[3] is the greater facilitation of electricity trading in the European electricity market and for integration[4] it is to use the cheapest balancing resources within a regional context.

The overall market objective is to provide the right region-wide prices for real time imbalances (shortages and surpluses) within the region.

If the region is synchronously interconnected within a larger region, supporting frequency standards and maintaining tie-line exchanges within agreed limits is the first technical objective. If the region equals a whole synchronously interconnected area the technical objective would be to maintain frequency within standards, as is the case in Nordel. A second technical objective, whether synchronously interconnected within a larger region or not, is to respect security limits concerning tie-line flows between balancing areas.

[3] See chapter 4
[4] See chapter 5

One important requirement for regional implementation is that the region concerned must be technically well defined. This ultimately implies that one balancing area can only be part of one regional balancing market.

The application of the reference model does however not require a regional market. In case the balancing region is restricted to one balancing area, the model can still be applied, and the regional functions of the model are then carried out by the TSO concerned. In this case application of the reference model would serve the harmonisation of balancing systems across the region without the requirement for regional integration.

However, regional integration is possible to some extent without the need for complete harmonisation of the balancing systems in all balancing areas concerned, as demonstrated in the Nordic region. Consequently regional integration of balancing systems can also drive harmonisation.

3. Outline of the reference model

3.1 Scope of the reference model

In the existing European electricity markets there is a common understanding on the nature of the balancing market and mechanism and where they fit in. ERGEG demonstrates this in the "Guidelines of Good Practice for Electricity Balancing Markets Integration" as follows:

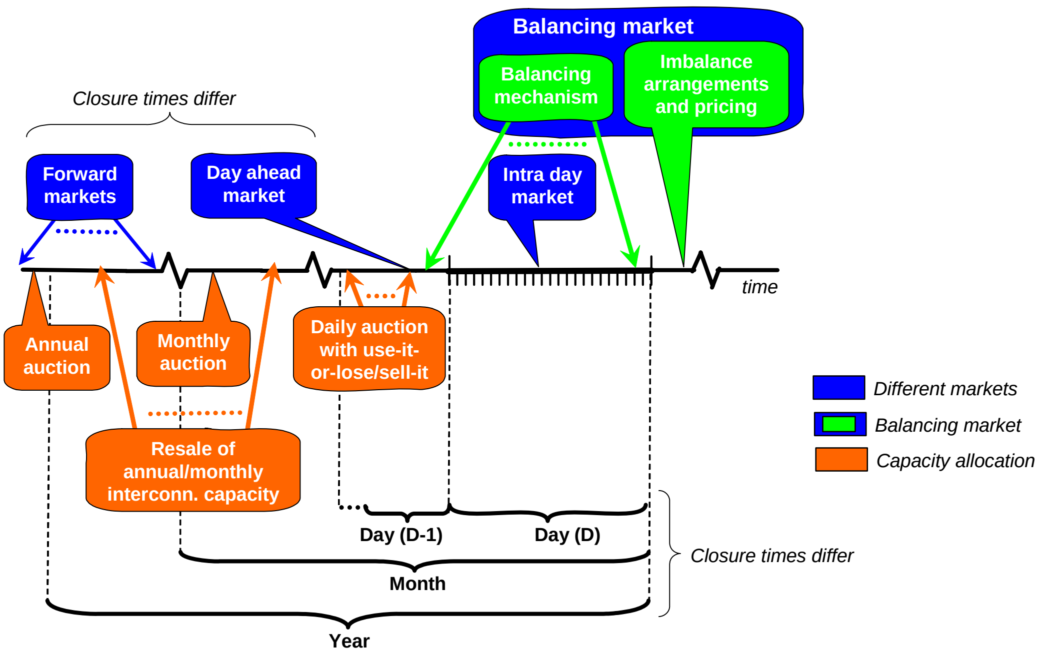

Figure 1: Electricity market timeline (source: ERGEG)

However, there is no common understanding on where balancing markets or balancing mechanisms precisely start and end, as demonstrated within figure 1. There is for example an overlap in time between intraday and balancing market definitions.

In order to avoid overlaps with other markets, the scope of the reference model will be restricted to:

- the part of the balancing process starting 15 minutes before the operational settlement period until declaration of imbalance volumes and prices
- reserves for balancing with
  - o calling time of typically 15 minutes or less
  - o activation decision no further ahead than 15 minutes (typically)

Out of scope of the reference model are:

- procurement and activation of reserves with activation decisions longer than (typically) 15 minutes, including scheduling and reconstruction of reserves
- procurement and activation decisions for congestion management (see section 4.7).

3.2 Principles

The reference model is built around the concept of a regional balancing function carrying out a number of tasks[5] which are compatible with the objectives as described in section 2.3.

In the sections hereafter the regional balancing function and the area balancing function are defined based on the following principles:

1. A balancing region consists of one or more balancing areas within a synchronously interconnected system.
2. Within a synchronously interconnected system there can be more than one balancing region.
3. Each balancing area in the region is responsible for balancing supply and demand in the area.
4. Under normal circumstances the balancing areas may hand over certain (execution) tasks to the regional balancing function for efficiency reasons.
5. What is "normal" as well as the detailed responsibilities should be defined as a regional standard within an agreement between individual TSOs in the region

3.3 Prerequisites

The implementation of harmonisation and integration will require changes in legal and regulatory arrangements as well as necessary agreements between the area balancing function operators (the TSO's). In addition it requires changes to the business processes and IT systems of TSO's and market parties. These changes are not only a prerequisite for but also inevitable with greater harmonisation and integration. Implementation of the reference model may require more or less changes in all or some of these areas, depending on the regional solution and on how far the existing situation deviates from the intended approach.

3.3.1 Economic

Integration of balancing markets would make no sense if the costs for that integration are not out-weighed by efficiency increases. The Nordel experience has shown a considerable efficiency increase from two integration actions: 1) the sharing of balancing resources throughout the region 2) a reduction of required balancing actions by the integration of all of the balancing area control signals into one regional signal controlling the activation of all of the shared reserves. It has also shown that integration is possible without complete harmonisation: imbalance pricing and settlement and reserve procurement processes still differ among the balancing areas within Nordel. On the other hand the question remains, if the current Nordic integrated balancing process would have been possible without the existence of an integrated day-ahead market where all available transmission capacity is implicitly allocated.

The quantitative economic justification of an integrated regional balancing mechanism and market is out of scope of this report.

3.3.2 Legal and regulatory

Integration of balancing markets can to some extent be done without complete harmonisation as the Nordic Balancing Market demonstrates. Here the most important

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5 Which of these tasks are carried out and how they are carried out will be defined by the corresponding agreement between TSOs in the region. This agreement defines the extent to which the balancing markets are harmonised and integrated and may include authorization for certain actions.

benefit is the change from area control to frequency control and the sharing of resources. However, even in the Nordic example harmonisation issues prevent full benefits from the integrated market.

Full socio-economic benefit can only be reached with harmonisation on some basic aspects, like gate closure, settlement period, procurement including product definitions and, finally, imbalance pricing principles. Common gate closure, settlement period, procurement process, product definitions and imbalance pricing principles will therefore be an objective for this reference model within a balancing region.

These issues have there roots in legal and regulatory arrangements. For harmonisation to be possible necessary legal and regulatory changes are required which will need full support of all of the balancing areas' authorities.

Depending on the degree of integration the balancing area authorities have to allow the TSO's to hand over certain responsibilities to the regional balancing function as a service provider.

3.3.3 Inter-TSO arrangements

The current laws and rules (EU legislation, Regional Handbooks and Grid Codes like the UCTE operation handbook and the Nordic Grid Code) place the responsibility for operational security of supply upon the TSOs. Consequently the TSOs are responsible for balancing, congestion management, grid operation, network restoration, etc. With the reference model TSOs remain responsible and cooperate to support and enable an efficient regional balancing function. How this cooperation is undertaken will be determined by the individual TSOs within the region. The Nordic Balancing Market shows a practical example of such cooperation that fully respects responsibilities of the TSOs concerned and the necessary cooperation is laid down in the Nordic Grid Code. For other regions existing cooperation rules and agreements may not support an integrated balancing market and therefore may have to be changed.

3.3.4 Technical prerequisites

A first technical prerequisite for integration of balancing markets would be sufficient interconnection capacity. Integration makes no sense if interconnection capacity does not exist. Where it does exist it's availability for integrated balancing could be secured in the procurement process of the regional reserves, or integrated balancing can use so far unused transmission capacities, as is currently the case in Nordel.

It has to be taken into account that the Nordic solutions may not be applicable as such to other regions like UCTE due to deviating boundary conditions such as the grid structure.

In addition to the above prerequisites, changes in business processes and IT systems of TSOs, balance service providers and balance responsible parties may be necessary. However, this depends upon how far the existing situation differs from the agreed approach within a balancing region. Also a change in definitions of required reserves may require investments in for example controlling equipment of generation and cost recovery would have to be agreed.

3.4 The regional balancing process

3.4.1 General description

A general overview of the regional balancing process in the final stage is provided in this report, see Figure 2. The regional balancing function in this figure implies a number of tasks that, to the minimum, must be carried out in cooperation by the operators of the area balancing functions, the TSO's. Please note this model does not require the establishment of a separate organisational entity to undertake the role of the regional balancing. However, this is possible if the TSOs within a region agree.

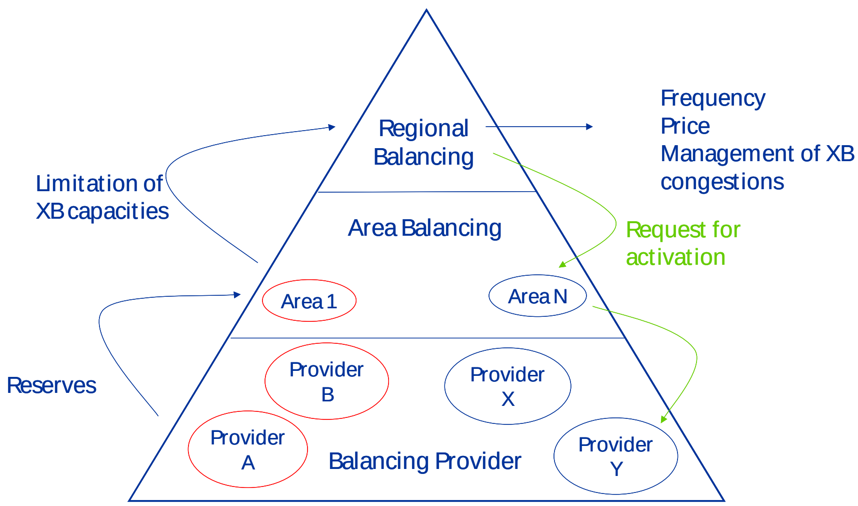

Figure 2: operation of the regional balancing process

The regional balancing function handles reserves from all the area balancing functions in the region and co-ordinates them through the area balancing function in order to support compliance with frequency and exchange deviation limits considering standards agreed by the areas concerned in the most efficient way[6]. If the region is interconnected with other regions in one synchronously interconnected network then maintaining frequency is replaced by supporting frequency and keeping tie-line exchange with the other region(s) to the programmed value according to agreed standards. Possible network congestions have to be taken into account when exchanging reserves across the borders. Standards should be agreed preferably on the synchronous area level but must be agreed to the minimum on a regional area level.

Figure 3 shows one synchronous area with three balancing regions and six balancing areas, for the sake of simplicity this figure does not show interconnections. Each balancing region will form a regional balancing market where in case of congestion the market may be split into the relevant balancing areas[7].

[6] This leaves the level of integration from area control to regional control to the decision of the balancing areas concerned

[7] One TSO area can be split into two or more balancing areas

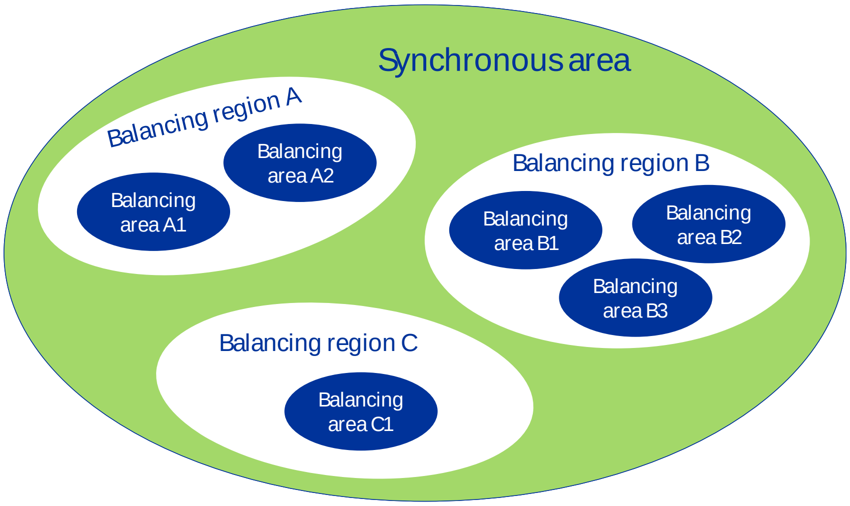

Figure 3: Synchronous area, balancing regions and balancing areas

3.4.2 Regional balancing function

The regional balancing function is able to cover one or more of the following features, as agreed or defined by the areas concerned:

a) Support compliance with frequency and exchange deviation limits considering standards agreed
b) Respects interconnection capacities between the balancing areas
c) Uses commercial and technical characteristics for all necessary balancing resources in the region
d) Decides on which resource to activate and supports activation with areas concerned of resources made available by the balancing areas in merit order while respecting interconnection capacities between the balancing areas within the rules
e) Uses common imbalance pricing principles for the whole region
f) Generates same basic imbalance prices for the whole region if there are no congestions between the balancing areas (not final imbalance prices towards market parties but same basis)
g) In case of congestion between the balancing areas splits up the region in balancing areas thus creating different imbalance prices
h) Provides the basis for settlement of imbalance power between the areas

3.4.3 Area balancing function

The area balancing function performs the following tasks corresponding to the relevant features of the regional balancing function:

a) Agrees the region and the rules for the regional balancing function together with all area balancing functions concerned
b) Defines area balancing resources requirements
c) Procures balancing resources within the area subject to common regional procurement procedures
d) Provides information to the regional balancing function to account for congestions between areas
e) Activates balancing resources in the area supported by the regional balancing function
f) Uses common principles in settlement and pricing of imbalances
g) Settles imbalances (with market parties) within the area
h) Settles imbalances with other areas
i) Settles costs of activation of balancing resources in the area

3.4.4 Comparison with UCTE control block and control area

The balancing area and balancing region concept as presented in Figure 3 and the area and regional balancing functions from the previous two sections can be compared with current UCTE concepts of control area and control block respectively. However, depending on the standards agreed as mentioned under 3.4.2a) and 3.4.3a), some reconfigurations of control areas and control blocks may be required. Such reconfigurations are not obvious. They should be compatible with the responsibilities of the TSOs concerned including their compliance with the UCTE Handbook. Among others they must be checked against technical and financial implications and operability.

4. Harmonisation issues

4.1 Introduction

From a market perspective there are two kinds of services for balancing. Services that are procured from the market and services that are delivered to the market. Regional harmonisation of services definition as well as harmonisation of pricing is fundamental to a good functioning of the regional market.

Hereafter, a number of issues are identified that define the characteristics of these services and need to be harmonised. How and what to harmonise is out of scope of this report. These issues may depend on the characteristics and the situation regarding network security in the control area, the available structure of power plants, the legal and regulatory framework etc. and have to be analysed before implementation.

4.2 Balance responsibility

Balance responsibility in Europe is the preferred way to enable the functioning of the market while keeping technical integrity of the system in a decentralized way. The most important aspect of balance responsibility is the liability for any imbalance on a set of connections in the grid. There are however throughout Europe different definitions of imbalance and the kind of connections it applies to. For the sake of an efficient European market it is important that these definitions are harmonised: only then can imbalance and the value of imbalance have a consistent meaning throughout Europe.

A balance responsible party (BRP) is responsible for keeping the net balance on all the connections within its control and faces the liability consequences if this is not achieved. The liability in case of imbalance involves the payment of an imbalance charge to the operator of the market area who is responsible for keeping the balance in the area. The imbalance charge consists of an imbalance price for every MWh of imbalance that has occurred during a predefined settlement period.

4.3 Gate closure time

'Gate closure' is the point at which generation and load parties must notify the TSO of their expected physical positions at real time. At this point in most European markets, the possibilities for bilateral trading (with counter parties other than the TSO) therefore cease. Parties may, however, submit bids and offers within the balancing mechanism as to the extent to which they would be willing to deviate from their declared positions, and by how much the TSO would need to compensate them to do so.

In some systems market parties are allowed to notify open (i.e. net non-zero) positions at gate closure and parties have the ability to self-balance post-gate closure, thereby deviating from their notified position, this is normally prohibited or is subject to an information imbalance charge. Indeed, it is important for TSOs that market parties' positions are firm, as the TSO needs to be able to assess the expected network security and system balance situation and prepare for the required actions. As for balancing this may include the calculation of bids and offers of generation and load that should be accepted in order to balance the system at least cost.

The actual time of gate closure varies across European electricity markets (examples include day-ahead and one hour before real time). However, it is clearly important that a regional market be subject to a common gate closure. This would ensure a level playing field in both bilateral trading and in the acceptance by TSOs of bids and offers across the region. Any other arrangement may lead to discrimination and could lead to different imbalance exposure between parties in areas with differing gate closure periods, and therefore fail to maximise efficiency and the resulting socio-economic benefits.

The optimum common gate closure time will vary as a consequence of other aspects of the market architecture, and it is therefore recommended that this is determined on a case by case basis per region by the TSOs and authorities involved. However in the long term there are potentially greater efficiency gains and resulting socio-economic benefits in moving towards greater harmonisation of gate closure times across all regions in Europe.

4.4 Imbalance definition

Imbalance is generally defined per balance responsible party per settlement period as the difference between net programmed values and metered values[8] of feed-ins and take-outs on the set of connections the party is responsible for corrected with net programmed trade with other program responsible parties[9]. If the set of connections is empty the imbalance is per definition equal to the net programmed trade.

Imbalances can also be defined on special subsets: feed-ins only (generation), take-outs only (demand), trade only (trade). Even within these subsets more subsets can occur like for example for wind generation. Generally however, imbalance is defined on a combination of such subsets: generation, demand and trade.

In some systems it is allowed to have an open position in the programs (net value of all programmed generation, demand and trade unequal to zero), in other systems this is illegal.

4.5 Reserves

Reserves (generation and demand side) are the resources that supply the necessary services for balancing[10]. Service or product definition, procurement principles, pricing and the recovery of acquiring costs have been identified as the most important to harmonise on a regional level.

4.5.1 Reserves definitions

In order to ensure system security, access to appropriate operating reserves must be guaranteed within the framework of the balancing process. The use of reserves for compensating short-term system imbalances has the purpose of ensuring system frequency. A major technical criterion distinguishing between different types of operating reserves is the activation time. This parameter is identified with the quality of operating reserves and usually affects the value (price) of a given type of operating reserve.

In the framework of the reference model three categories of necessary reserves have been distinguished:

1. frequency containment reserves,
2. frequency restoration reserves,
3. replacement reserves.

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[8] The handling of connections that have no metering on a settlement period basis is out of scope of this report.

[9] Network losses require special consideration but are out of scope of this report.

[10] Reserves can be used for other purposes too. If the same reserve is acquired for other purposes it is assumed that the acquiring costs for these other purposes are not part of the acquiring costs for balancing

Frequency containment reserves (**FCR**) are operating reserves necessary for constant containment of frequency deviations (fluctuations) from nominal value in order to constantly maintain the power balance in the whole synchronously interconnected system. Activation of these reserves results in a restored power balance at a frequency deviating from nominal value. This category typically includes operating reserves with the activation time up to 30 seconds[11]. Operating reserves of this category are usually activated automatically and locally.

Frequency restoration reserves (**FRR**) are operating reserves necessary to restore frequency to the nominal value after sudden system disturbance occurrence and consequently replace FCR if the frequency deviation lasts longer than 30 seconds. This category includes operating reserves with an activation time typically between 30 seconds up to 15 minutes. Operating reserves of this category are typically activated centrally and can be activated automatically or manually.

Replacement reserves (**RR**) are operating reserves necessary to restore the required level of operating reserves in the categories of frequency containment (FCR) and frequency restoration (FRR) reserves due to their earlier usage. This category includes operating reserves with activation time from several minutes up to hours.

In the following table a cross-reference is given between these definitions and existing names of reserves.

Table 1: Reserve categories and cross-references

Category	**Function**	**Delivery Time Scale**	**Names**
Frequency containment reserves	To contain frequency deviations	15-30 s	Primary reserves
Frequency restoration reserves	To restore frequency to nominal value after a deviation	30 s – 15 m	Primary reserves, Secondary reserves; Tertiary reserves; Minute Reserves
Replacement reserves	To replace reserves used up for frequency containment and restoration	>= 15 m	Tertiary reserves, Stand-by reserves, slow reserve, standing reserve, hourly reserve

4.5.2 Reserves requirements

Besides activation time there are other technical reserve requirements that determine the costs of the reserve service that must be delivered and therefore, eventually, the price. Again, for the sake of comparability and transparency these requirements should also be regionally harmonized. Such requirements would include for example requirements for operational and settlement metering and ramping rates as well as availability requirements.

[11] Up to 2-3 minutes in Nordel

Harmonization of rules that determine the amount of reserve needed is not necessary as long as they have no impact on the playing field in the provision of reserves. Non-harmonized rules may however lead to a non-proportional share of the burden among the balancing areas to maintain quality of frequency in the whole synchronized system.

Geographical or network distribution requirements are network security requirements that typically relate to the characteristics of the networks in the balancing areas concerned. In nature they only limit competition between providers of balancing reserves because these requirements can put upper and lower limits on the volumes that must be procured in specific parts of the network. Also check Report 3 section 3.4 on procurement of cross-border transmission capacity.

4.5.3 Reserves procurement

There are several alternative methods to procure the required reserves. A description of these methods can be found in [12].

For harmonisation purposes it is preferred that for each reserve category the procurement method is regionally harmonised. However, legal and regulatory frameworks might prohibit this. For example if regulations require a TSO to secure a certain amount of reserves this could require a longer term reserve capacity contracting. Alternatively the TSO could be required to acquire the reserves on a day to day availability basis. This gives incompatible procurement methods which are impossible to harmonise by TSO agreement alone.

The way in which harmonised procurement methods should be used is out of scope of this reference report. However there is one important note to make:

If the required reserve service is of a nature which is different to the energy market product, requires extra investments and availability contracting is not allowed, it can be expected that the required reserve service will not be available in the longer term. The reserve capacity may still be available but it may no longer be capable of delivering the required reserve service. Typically frequency containment reserves and automatic frequency restoration reserves belong to these categories of reserves and would therefore require some kind of availability contracting.

4.6 Settlement

In existing European electricity markets, it is, by definition, the responsibility of balance responsible parties to maintain balanced positions. However, arrangements are required to deal with the possibility of parties being out of balance. Indeed, in practice it may be difficult for many such parties to maintain an exactly balanced position, due to a number of factors, especially the issues involved in forecasting and monitoring of the behaviour of individual consumers.

Any such imbalances need to be resolved by the relevant TSO in order to maintain frequency, and to preserve supplies to all consumers. Therefore, imbalance charges are levied on market parties that are out of balance, both to recover the costs incurred by the TSO in taking the necessary remedial actions, and to incentivise market parties to maintain balance. Settlement processes exist to determine the imbalance charges incurred by each party, and to invoice these accordingly.

[12] "Exchange of Services between Large Generating Plants and High Voltage Electric Power Systems", CIGRÉ Technical Brochure 138

In developing a reference model for balance management in a regional market, it is therefore important to consider the issues involved in the settlement of imbalance charges.

In addition it is assumed that the principle "polluter pays" will apply as far as practical and to the minimum that there will be no socialisation of energy costs.

4.6.1 Settlement period

For settlement purposes, the day is divided into a number of periods over which imbalance charges are calculated. In existing European markets these are either 15, 30 or 60 minutes. In determining the length of the period, a trade-off is made between accuracy (which is diminished over longer periods due to averaging) and the number of periods that must be processed.

However, in developing a regional market, the most important factor will be to specify a common settlement period within the region as a whole. Again, it is recommended that the exact period chosen be determined on a case by case basis per region, and this may be affected by historical factors and market architecture within the areas concerned.

4.6.2 Determination of imbalances

4.6.2.1 Market party imbalance

In most European markets, imbalances are settled on an energy account basis. In some countries each balance responsible party has a generation energy account and/or a demand energy account and/or trading accounts. In other countries there is only one combined energy account for generation, demand and trade.

In each market the imbalance volume of a market party is their "contracted" energy volume compared to their metered energy volume which can be either positive or negative. This volume is then multiplied by the relevant imbalance price.

TSOs within each region are best placed to determine the methodology for calculating imbalance volume(s). Therefore it is recommended that this is agreed multilaterally on a case by case basis per region taking into account historical and market architecture.

4.6.2.2 Network area imbalance

The reference model for regional markets presented in this paper envisages that imbalance charges continue to be levied by area TSOs. However, in the case of activation on a regional basis it may be possible to ignore imbalance between areas up to an agreed limit. In addition it will also be necessary to determine imbalances between network areas.

For example, if balance responsible parties are 500MW "short" in Area 1, and it is decided that it is most economic to activate 500MW of generation in Area 2, it is the TSO in Area 2 that will pay for the resolution of the imbalance caused by parties in Area 1. Therefore, it will be necessary for the TSO in Area 1, which is levying imbalance charges on the parties that are short, to compensate the TSO in Area 2. These charges can be typically calculated on the basis of the imbalance price, common to the whole region. However the exact methodology should be determined by the TSO's within a region.

4.6.3 Imbalance pricing

4.6.3.1 Market party imbalance

Having determined imbalance volumes, it is also necessary to derive imbalance prices. Principally, there are two types of imbalance price mechanisms:

- Dual imbalance pricing, where a different price is applied to positive imbalance volumes and negative imbalance volumes (two prices system); or
- Single imbalance pricing, where a single imbalance price is used for all imbalance volumes (one price system).

Each of these mechanisms is used in a number of European markets. Of relevance to the reference model is the case of the Nordel market, where dual imbalance pricing is used in Sweden, Finland and Denmark, and single imbalance pricing in Norway. This shows that a regional market can function even if constituent areas have different imbalance pricing principles. However, it may be the case that efficiency would be enhanced by the application of a common methodology and recommended.

Where a dual imbalance pricing regime is employed, it is the “main” price that is derived from energy balancing actions. The “reverse price” can be determined by reference to a power exchange (e.g. Elspot in the Nordel market, APX in Great Britain and Powernext in France) or be based on the prices of the balancing actions in the reverse direction during the settlement period. (The main price is that applied to imbalance volumes in the same direction as the overall market, where as the reverse price is that applied to imbalance volumes opposite in direction to the overall market e.g. “short” when the market is “long”, or vice versa.) Dual imbalance can be incentive for BRP to manage their position in a more secure way for the system.

There are also two principal methods by which these imbalance prices can be determined:

- Average price of energy balancing actions; or
- Marginal price of energy balancing actions.

A third methodology – the average price of the marginal 500MWh of energy balancing actions – has been introduced in Great Britain in November 2006.

Imbalance prices calculated on a marginal basis will tend to over-recover when compared to expenditure on balancing actions, but only in a two price system and there are mitigation measures for this. In some countries, such as Sweden, this profit is retained by the TSO, where as in e.g. Denmark, the Netherlands and France the profit is socialised or redistributed to parties. Finally, in other countries, such as Great Britain, the entire imbalance charging receipts are redistributed to parties (and the costs of balancing actions are recovered through Use of System charges).

Clearly, there are a number of different imbalance pricing regimes that can be generated using the above principles. There will be advantages and disadvantages of each, and the example of Nordel has shown that it is not necessary to have a common mechanism over an integrated region. However, in developing this reference model ETSO TF BM recommends that a harmonised imbalance pricing methodology be implemented. This would provide common signals to balance and consistency in the recovery of costs, and would therefore maximise efficiency. As imbalance risks (expected imbalance price x imbalance volumes) will be accounted for by the market parties in their energy prices, harmonised imbalance definitions and pricing methodologies would also make market prices more comparable, again improving efficiency of trade across balancing regimes.

4.6.3.2 Network area imbalance

Where there is congestion between network areas, the region will need to be split into separate balancing areas, thus creating different imbalance prices in each area. This will ensure that parties responsible for imbalance in each balancing area are exposed to the costs of resolving it. The regional balancing function will identify when congestion has occurred, and will notify the appropriate area TSO of the balancing areas for which it must determine separate imbalance prices.

4.6.4 Settlement of imbalance charges

4.6.4.1 Market party imbalance

In developing this reference model, ETSO TF BM recommends that imbalance charges continue to be calculated and invoiced by area TSOs, but using common regional principles for settlement and the pricing of imbalances. Data required for TSOs to derive regional prices (or area specific prices where there is congestion) will be supplied by the regional balancing function.

The area TSO has the expertise in settlement with parties in its area, and can respect local issues, such as currency and taxation. Therefore imbalance prices may not be exactly the same across the region, but will have been generated on the same basis.

4.6.4.2 Network area imbalance

It would be possible for inter-area (and therefore inter-TSO) imbalances to be settled either bilaterally between the TSOs, or centrally by the regional balancing function. ETSO TF BM recommends that such imbalances should be calculated by the regional balancing function, but be settled bilaterally. This has the advantage that the regional balancing function will not need to be involved in any payments, but may result in fairly complex cash flows, particularly in larger regions comprised of numerous TSOs.

4.7 Congestion Management

Congestion management and balance management are highly interrelated in the time frame of 15 minutes before real time. For example, congestion management and balance management may use the same resources. From an efficiency point of view this is an important argument to integrate these processes, also on a regional level.
The integration of these processes and the harmonization of the congestion management process, except for the fact that balance management needs to respect congestion constraints, is out of scope of this report.

4.8 Transparency

The “Guidelines of Good Practice on Information Management and Transparency in Electricity Markets” published by ERGEG in August 2006 takes into account Balancing mechanisms. It provides a good picture about the data that should be published in order to enhance competition.

Publication of relevant data will ensure the same level of information for all potential market parties and enhance competition in the balancing market. Additionally a high degree of transparency will strengthen confidence in the market and the system. Nevertheless confidentiality has to be guaranteed for sensitive data as well as published data should not enable market parties to distort the market or to arbitrage day ahead prices against predicted imbalance prices (Possibility will depend on the method for imbalance pricing).

It is recommended that publications should be in the national language of the countries of the region and in English.

4.8.1 List of data to be disclosed

To be published as soon as possible after real time:

- Bids available, bid ladder
- Energy volumes activated (separated for downward and upward regulation)
- Average and marginal prices of activated bids
- Imbalance of the regional balancing function and area balancing function
- Imbalance prices per area balancing function

To be published after final reconciliation:

- Expenses on the balancing market per area balancing function
- Payment of imbalances per area balancing function

4.8.2 Other information to be disclosed

In order to provide confidence in the balancing market the following information should be published:

- Roles and responsibilities of actors
- Description of the process
- Contractual Framework including contact persons

5. Regional integration

With regional integration of balancing markets, different integration steps can be defined. Complete integration is accomplished if all of these steps are implemented. Each of these steps involve implementation costs which can be quite substantial and may not be out-weighed by economical advantages. Also, some integration steps may influence operational network security and even long term security of supply as described in the previous report of this Taskforce. Before implementing such steps these effects should be carefully analysed by the TSOs concerned or to a minimum these integration steps must be reversible on an operational basis. Additionally, as previously stated, each step may require changes in legal, regulatory and inter-TSO arrangements including regional handbooks that will take time (UCTE Handbook Policy 1 for example requires an evenly distribution of frequency containment reserves and a strict maintaining of balance on a control area or control block level, both of which restrict integration possibilities or require changes to take an integration step. For example sharing of frequency containment reserves will at least require the relaxation of the reserve distribution requirement and going to a regional control will at least require the definition of new control blocks).

If a step should be taken, which steps to take, and how steps should be taken is again part of the agreement process of the TSOs involved, taking into account legal and regulatory requirements. Also none of the integration steps require the establishment of a separate organisational entity to undertake the specific role of the regional balancing. However, this is possible if the TSOs within a region agree.

The following integration steps are identified and described in this chapter:

1. Pooling of reserves
2. Sharing of reserves
3. From area control to regional control

The first two steps have already been explained in detail in the previous report[13].

5.1 Pooling of reserves

In summary this involves making reserves available for balancing to other TSOs. The reserve remains available for activation by the originating TSO. The reserve can only be activated by other TSOs if sufficient transmission capacity is available. Common reserves are activated in merit order on a first come first serve basis.

Pooling of reserves requires no harmonisation. Each of the providing TSOs must however be able to convert the reserves available to the characteristics of the reserve product that is pooled and the pooled product must be convertible to the required characteristics of the reserves used by the receiving TSO.

Pooling of reserves does require an agreement between the TSOs concerned on for example pricing, settlement, pooled reserves characteristics and inter-TSO imbalance settlement arrangements.

5.2 Sharing of reserves

This involves the sharing of common reserves including the determination of required volumes on a regional basis and the "supply" of an agreed individual share to the common reserves by each of the TSOs involved.

[13] "Key Issues in Facilitating Cross-Border Trading of Tertiary Reserves and Energy Balancing", ETSO Taskforce Balance Management, May 2006.

The sharing can take place on each of the categories of reserves as defined in 4.5.1. For frequency containment reserves sharing has actually and naturally taken place from the beginning of the synchronously interconnection of systems.

The sharing becomes more complex to implement with the technical complexity of the control function for the reserve category concerned. For example, it is most easy with reserves that are manually activated and it becomes quite complex with reserves that are automatically activated under central control.

The "supply" of the individual share to the common reserves can have different interpretations. It can vary from the complete procurement of that share within the own TSO area to just the payment of procurement costs of that share to a regional procurement process.

The sharing of reserves could improve efficiency in the sense that the cheapest regional resources can be procured, provided efficient transmission capacity is also available.

It is important to note that the regional volume requirements should relate to supporting frequency only. Reserves required for network security (such as for congestion management and emergency reserves) remain local TSO responsibility and can be pooled to the common regional balancing reserves on a voluntary basis but do not contribute to the regionally required volume.

5.3 From area control to regional control

So far reserve sharing and reserve pooling have been described. Reserve pooling is aimed at activating the cheapest resources available for each of the area balancing functions (in most cases within UCTE comparable to control area level). Reserve sharing aims at procuring the regionally cheapest reserves (in most cases within UCTE comparable to control block level). For a potential reduction of required reserve volumes on a regional level, the next step of integration is necessary: activate resources for the regional balance only. In this way a shortage in one area can be supplied by a surplus from another area without the need for a balancing action in any balancing area of the region and if there is a regional shortage always the cheapest regional resource can be activated in the balancing area concerned.

Frequency Containment Reserves contribute to the frequency containment of the whole synchronous area. So for Frequency Containment Reserves, regional integration does not reduce the required volumes and integration makes sense only up to the step of reserve sharing.

Only for Frequency Restoration Reserves and Replacement Reserves the step to regional control might reduce required volumes.