Guidelines for the Development of the Market and System Inter-Operability Model Agreement

Energy Charter Secretariat

The Market and System Inter-Operability Agreement Guidelines (Guidelines) offer guidance on how to deal with some of the rules and issues that a Market and System Inter-Operability Agreement can contain. The Guidelines can be used on a voluntary basis and to the extent desired, by a state or investor involved in the negotiation of a cross-border electricity project. The Guidelines have been developed by the Energy Charter Secretariat with the support of the Legal Advisory Task Force (LATF), which consists of senior legal experts from leading energy companies and international law firms.

Whether or not the Guidelines will be used either in full or in part depends entirely upon the agreement of the parties. Cross-border electricity projects are subject to numerous specific legal requirements, including requirements arising from international law and relevant supra-national and national legal systems. Whilst the utmost has been done to develop guidelines which meet these multiple requirements, legislative frameworks are inevitably complex and varied and it is recommended that specialised advice be obtained in this regard in relation to any specific project and the jurisdictions to which it relates.

It is clear that all parties should fully understand the rights and obligations established in any agreements they conclude and that neither the Energy Charter Conference, nor any of its members, nor the Energy Charter Secretariat, nor any member of the LATF accepts any liability to any person for any consequence arising from any use of the Guidelines.

GUIDELINES FOR THE DEVELOPMENT OF THE MARKET AND SYSTEM INTER-OPERABILITY MODEL AGREEMENT

Acronyms

AC	Alternate Current
CBETP	Cross-Border Electricity Transmission Projects
DC	Direct Current
ECS	Energy Charter Secretariat
EMA	Model Agreements for CBETP
HGA	Host Government Model Agreement
IGA	Inter-Governmental Model Agreement
IMA	Market and System Inter-Operability Model Agreement
ITC	Inter Transmission Providers Compensations
LATF	Legal Advisory Task Force
NTPA	Negotiated TPA
PMA	Model Agreements for Cross-Border Pipeline Projects
PPA	Power Purchase Agreement
RTPA	Regulated TPA
SCADA	Supervisory Control and Data Acquisition
SO	System Operator
TO	Transmission (Asset) Owner
TPA	Third Party Access
TSO	Transmission System Operator

1 INTRODUCTION AND BACKGROUND

In 2008, the Energy Charter Secretariat (ECS), supported by Mercados - Energy Market International (Mercados EMI) and with the assistance of the Legal Advisory Task Force (LATF) developed the Inter-Governmental Model Agreement (IGA) and the Host Government Model Agreement (HGA) for Cross-Border Electricity Transmission Projects (CBETP). These Model Agreements for CBETP (EMA) were developed on the basis and according to the same structure of (the Second Edition of the) corresponding Model Agreements for Cross-Border Pipeline Projects (PMA).

In developing the EMA it was noted that the IGA and the HGA in the PMA "mainly focus on the issues relevant to the development and operation of physical infrastructure, and only contain a few provisions related to the gas or oil carried through the pipeline". Correspondingly, the EMA's IGA and HGA have a similar focus.

There is however a number of additional issues, relevant for the development of CBETP, which are not addressed in the IGA and HGA. In particular, little or no provisions are contained in the IGA and HGA about the way in which the CBETP will fit into the electricity markets and systems of the affected jurisdictions. For this reason it was suggested that an additional Model Agreement is required as part of the EMA: the Market and System Inter-Operability Model Agreement (IMA).

However, the way in which electricity markets and systems inter-operate between interconnected jurisdictions depends, at least in part, on the institutional characteristics, electricity sector structure and market organisation of the different jurisdictions involved.

In fact, some issues that are crucial for the interconnection of two or more jurisdictions in which electricity markets operate are irrelevant or not applicable in the case of electricity sectors with State-owned monopolies.

Moreover, the solutions adopted for some aspects of the IMA depend, to some extent, on the expected use of the CBETP/cross-border capacity and the related trading arrangements. It is much simpler to manage cross-border capacity used only for a long-term Power Purchase Agreement (PPA), which will produce flows in only one direction, than in the case when multiple sellers and buyers located in the different jurisdictions attempt to trade across borders and there is competition for the use of the scarce cross-border capacity.

Therefore, a legal text for the IMA, similarly to the way in which the IGA and HGA have been developed, would involve multiple alternatives on many aspects. As a consequence it is more appropriate, at this stage, to develop Guidelines for the IMA, rather than specific legal text.

Finally, the IMA should contain sufficient details for ensuring the interoperability of systems and markets in the jurisdictions involved in the CBETP, and possibly others which may be affected by it. The IMA, however, is not intended to replace the system and market rules (e.g. Grid Codes) which apply within each jurisdiction. Market and system inter-operability requires a certain degree of consistency and harmonisation of regulations and technical rules in the different involved jurisdictions, and Section 2.6 describes some possible approaches. However, technical codes – and, where markets operate, market rules – contain a wider range of provisions than those which are relevant for cross-border exchanges and with respect to which consistency should be ensured to support inter-operability. Therefore, the IMA needs to focus and provide reference for consistency and harmonisation on a subset of issues typically addressed by technical and market rules in each jurisdiction.

This document contains the Draft IMA Guidelines and provide:

- a taxonomy of the institutional characteristics, electricity sector structure and market organisation which are relevant in defining the way in which a jurisdiction inter-operates with neighbouring ones (Chapter 2);

- A list of the issues related to the inter-operability of electricity systems and markets which should be covered by the IMA (Chapter 3);

- A detailed description of how each of the issues listed in Chapter 3 should be addressed in the IMA, including the way in which the institutional characteristics, electricity sector structure and market organisation may impact on such treatment (Chapter 4).

A glossary containing the definition of some of the terms used frequently in this document is contained in Annex 1.

2 TAXONOMY OF INSTITUTIONAL CHARACTERISTICS, SECTOR STRUCTURE AND MARKET ORGANISATION

2.1 INTRODUCTION

The IMA should contain rules governing:

- the interoperability of electricity systems. These rules will be mainly of a technical nature and will depend, to some extent, on the technical characteristics of the interconnection between different control areas;

- the interoperability of the electricity markets, which will depend on institutional characteristics and organisation of the electricity sector in the different jurisdictions.

This chapter describes:

- the main alternatives for interconnecting systems from a technical standpoint;

- the main models for the organisation of electricity sectors which are relevant for the market inter-operability of interconnected systems;

- the trading arrangements which may be supported by the CBETP;

- the role of the different jurisdictions involved in the CBETP;

- the way in which the necessary degree of harmonisation of national regulation required to support trading using the CBETP capacity can be achieved.

2.2 SYSTEM OPERATION AND THE INTERCONNECTION OF CONTROL AREAS

Electricity systems require to be operated according to certain technical criteria, which mainly depend on the nature of electricity itself. In fact, electricity cannot be stored[1] and balance between injections of power into a grid and withdrawals of power from the same grid should be maintained at all times in order to keep system frequency within the limit of secure operation. Deviations of the frequency outside these limits result in the collapse of the system.

Therefore electricity systems should be operated in a coordinated manner. At one level, within a single area, coordination is centralised; this area is generally referred to as a "control area". Many times the control area corresponds to a

[1] There are however ways of indirectly storing electricity, e.g. as kinetic energy in water stored in high-elevation reservoirs.

national jurisdiction[2], but there are cases where a national jurisdiction includes more than one control area. There are also rare occasions where a control area covers more than one national jurisdiction.

In each control area the centralised coordination of the electricity system is performed by a single entity, generally referred to as the System Operator (SO). More specifically, the SO is responsible for the operation (including ancillary services), ensuring maintenance, and, if necessary, the development of the transmission system in the control area so as to guarantee the system's long term ability to meet reasonable demand for electricity transmission. The SO is also responsible for the secure operation of the electricity system as a whole, including maintaining frequency within admissible limits.

The need for electricity system coordination, however, extends beyond the individual control area. In fact, as long as the different control areas are interconnected, there is the need to ensure their "interoperability" and the different SOs involved would be also responsible for jointly operating the interconnections between control areas. This is due to the technical characteristics of (interconnected) electricity systems and depends on the way in which control areas are interconnected.

Control areas may be interconnected through:

- alternate current (AC) lines. This is the most common case and leads to the interconnected control areas operating synchronously, i.e. over a common system frequency, thus becoming a "synchronous area". This common frequency, which is affected by the balance of injections into and withdrawals from the grid across the whole synchronous area, needs to be maintained within admissible limits and any disturbance in one control area affects the other control areas as well. Therefore, strong coordination of the operation of the electricity systems in the involved control areas is required, as each SO has to contribute to maintaining the overall injection-withdrawal balance. Moreover, flows on AC networks cannot be directly controlled; therefore, it is necessary to schedule inter-control area operation based on control area net exchanges (export or imports). During real time operation each SO must keep a tight control over the power balance in its control area to ensure that cross-border flows correspond to schedules.

- direct current (DC) lines. If different control areas are interconnected only through DC lines, they do not share a common frequency. However, some degree of coordination between the involved SOs is still required, especially with respect to exchanges of power.

The coordination between control areas could be implemented through an umbrella organisation (e.g. in the past, Nordel in the Scandinavian region or UCTE in Continental Europe, now ENTSO-E across the whole European Union and other synchronously interconnected countries) which defines common rules for the

[2] A (national) jurisdiction is defined here as a territory which is subject to single sovereignty and where a single body of laws and rules applies. In particular, in the case of electricity transmission, a jurisdiction is defined with reference to the regulatory provisions which are relevant to each planning and operational activity, and to the power of the institutions with regulatory responsibilities.

interoperability of the interconnected grid. In these Guidelines we assume that coordination between control areas is governed by the IMA.

In this context, the CBETP can perform different functions:

- it can represent a DC link between control areas which were previously not interconnected. In this case, the CBETP provides cross-border transmission capacity between the involved control areas, without however introducing synchronous operations. It creates opportunities for exchanges of power – which, given the technical characteristics of DC links, can be controlled - without imposing extensive inter-operability requirements;

- it can represent an AC link between control areas which were previously interconnected only through DC links. In this case, the CBETP introduces the synchronous operation of the involved control areas and increases the cross-border capacity between them;

- it can represent an AC link between control areas which were previously not interconnected. In this case, the CBETP introduces the synchronous operation of control areas which were not previously interconnected. In this case, both opportunities for exchanges of powers and the requirements for synchronous operation are introduced;

- it can represent an AC link between control areas which were already operating synchronously (i.e. already linked through AC lines). In this case, the capacity of the CBETP has to be managed and operated jointly with the capacity of the other (AC) lines over the same border between control areas;

- it can represent a DC link between control areas which are already operating synchronously. In this case, the CBETP does not introduce any additional requirement in terms of synchronous operation of the involved control areas, but only additional cross-border capacity, the use of which can be controlled separately from the AC links between the same control areas.

Depending on the function of the CBETP, the IMA would have a different content. In particular, the IMA associated with a specific CBETP would have to cover those additional aspects of system and market inter-operability which were not already agreed between SOs because not relevant under the previous form of interconnection.

The following table presents the additional aspects which would have to be governed by the IMA, depending on the technical characteristics of the CBETP and on the type of interconnection previously linking the involved control areas.

Aspects to be governed by the IMA

Type of interconnection(s) previously linking the involved control areas	Technical characteristics of the CBETP	
	DC link	**AC link**
No interconnection	Coordination CBETP Capacity Usage	Coordination Synchronous Operation CBETP Capacity Usage
Interconnection through DC lines only (non synchr. operation)	CBETP Capacity Usage	Synchronous Operation CBETP Capacity Usage
Interconnection through AC (and DC) lines (synch. operation)	CBETP Capacity Usage	CBETP Capacity Usage (as part of congestion management)

2.3 ELECTRICITY SECTOR STRUCTURE

Electricity sectors can be structured in different ways. Typically, the structure of the electricity sector depends on past legacy, as well as on the achieved stage of reform.

For the purpose of providing Guidelines for the development of IMA, the following reference models for the electricity sector structure may be considered:

a) a model in which a single entity operates in the electricity sector in a jurisdiction. This is the case of the vertically integrated monopolist utility which characterised many European and Latin American jurisdictions in the past (generally until the 1990s), and it is still typical in many other regions (e.g. Asia and Africa);

b) a model in which multiple agents operate in the electricity sector. In turn, two sub-models can be identified:

   b.1) one in which, despite the fact that many agents operate in the sector, only one agent is allowed to import and/or export electricity from/to other interconnected control areas. This is the Single Buyer model which may be implemented in the transition from the monopolist model to a liberalised setting;

   b.2) one in which all or several of the agents operating in one jurisdiction are allowed to import and/or export energy from/to other interconnected control areas. This is the liberalised model currently mandated in the European Union and characterising the electricity sector in many jurisdictions in the US, Canada and Latin America.

In models a) and b.1), only one entity in the jurisdiction imports or exports electricity from or to neighbouring control areas and therefore there are no competing demands on the interconnection capacity provided by the CBETP. This entity typically plans exchanges (import and export) consistently with the available interconnection capacity and therefore no congestion[3] occur.

In model b.2) the additional issue of how to allocate the available capacity on the CBETP may need to be addressed.

More generally, possible regimes for CBETP capacity usage include:

- Third Party Access (TPA), where the CBETP capacity is made available to "third parties" – electricity sector entities or to support trading on organised markets – on the basis of pre-defined, transparent and non-discriminatory conditions (including on charges):
    - defined by the Regulator (or other institution) (Regulated TPA or RTPA);
    - negotiated between the user and the operator (Negotiated TPA or NTPA);
- Capacity reservation, where the CBETP capacity is reserved for usage by identified entities (typically, the developer). The CBETP capacity can be made available to "third parties" on a voluntary basis and at freely-negotiated conditions.

The models identified above result in three possible situations with regards to exchanges between neighbouring jurisdictions:

1. Exchanges between jurisdictions each characterised by a single agent being allowed to import/export and therefore to access the cross-border capacity;
2. Exchanges between jurisdictions some of which are characterised by a single agent allowed to import/export, and therefore to access the cross-border capacity, and others with multiple agents being admitted to cross-border trading;
3. Exchanges between jurisdictions each characterised by multiple agents allowed to enter into cross-border exchanges.

These different situations are further characterised and discussed in Section 2.4.

When a single entity operates in the electricity sector within a jurisdiction, the SO is typically a division of such entity. When multiple agents operate, different organisational structures for the SO activities are possible, characterised by different levels of separation of these activities from the other ones in the

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[3] As further discussed in Section 4.3.2, congestion occurs when the demand for cross-border capacity exceeds the available level.

electricity sector, and especially from those – generation and supply - where competition can be introduced:

- the SO may be a division of one of the agents, typically the former monopolist or incumbent utility, which also operates in other segments in the electricity sector, including those in which competition can be introduced. Despite its being part of an electricity sector company, the SO may enjoy some degree of managerial independence (managerial unbundling);

- the SO may be a separate company within a conglomerate which also operates in other segments of the electricity sector, including those in which competition can be introduced (legal unbundling). Again a degree of functional and managerial independence can apply, which is generally stronger than in the case of pure managerial unbundling;

- the SO may be a separate entity, with no ownership link of a controlling nature to other agents operating in the electricity sector (ownership unbundling)[4]. This is the organisational structure for the SO activities which provides the strongest degree of independence from other entities in the sector.

The degree of separation of the SO from other agents in the market, and therefore the degree of independence that it enjoys, are crucial aspects for the development of competition in those segments in which this is possible – i.e. generation and supply. However, they may also impact on the development of the IMA, because they affect the level of details according to which the relationship between the SO and potential agents needs to be regulated.

2.4 TRADING ARRANGEMENTS

Depending on the sector structure in the jurisdictions involved, CBETP can be developed to fulfil several purposes, which in general are not mutually exclusive:

1) Short term energy trading, based on differences in marginal costs/prices in the different countries or control areas. Short-term trading may change direction from time to time depending on cost/price relativities. Depending on the organisation of the sector in each of the involved jurisdictions, short-term trading may originate from short-term bilateral agreements or from the operation of organised (day-ahead or intra-day) electricity markets;

2) Long term energy and power supply contracts (PPAs). Long-term trading on the basis of PPAs is generally unidirectional, i.e. involves the transfer of power in the same direction for the duration of the contract;

3) Reserves sharing. CBETP capacity may be used to share generation capacity reserve among interconnected control areas. Each system requires some capacity to be maintained in “stand-by”, with different activation times, to support a certain level of system security. The purpose of this reserve

[4] A SO is generally still considered to be ownership unbundled if it also operates as a Transmission Asset Owner (thus becoming a TSO) or as Distribution System Operator, as the most critical separation is between the SO activities and those activities - generation and supply - in which competition can be introduced.

capacity is to intervene in the case of unexpected events which may threaten the continuous balance between injections into and withdrawals from the grid, e.g. substitute for another generating unit which was scheduled to operate, but which has suffered an unplanned outage, or meet an unexpected sudden increase in demand. The level of reserve which needs to be maintained to guarantee a certain level of system security depends, *inter alia*, on the typical extent of unpredictable divergences of actual demand from the scheduled level, on the ability of the generating units to comply with their scheduled commitments and on the size of the largest generating unit operating in the system. As the size of the system for which reserve needs to be provided increases, the requirement, as a proportion of generating capacity, is generally reduced, as some of the drivers for the reserve requirement mentioned above are not additive. Therefore sharing reserve among different control areas may be beneficial, by reducing the costs of reserve required to support the same level of system security. Reserves sharing may be explicit, through agreements between the SOs, or implicit through option-like contracts, where a participant in one electricity market commits itself to provide energy to another participant in a different country when some conditions are fulfilled[5];

4) Support during emergencies. This includes all the actions taken from some interconnected control areas to support another in an emergency situation when the risk of demand curtailment or even of total collapse of the power system arises.

Once the systems are interconnected, it is possible that other services are interchanged, for instance primary frequency control.

Energy trading can be organised in different ways, depending on the sector structure, the regulatory regime and the market design characterising the different jurisdictions. In particular:

- If the jurisdictions involved are characterised by monopolistic utilities or if only one entity in each jurisdiction is allowed to import or export electricity:
    - the interconnection capacity may be used to trade electricity between the (single) entities in the different control areas which are allowed to trade across the border. This is the simplest form of cross-border exchange and it is the one used prior to the electricity sectors in the relevant jurisdictions being liberalised. Trading between monopolistic utilities is typically effected through long-term PPAs, even though short-term (opportunistic) bilateral trading may also occur;
- if multiple agents in each jurisdiction are allowed to trade electricity across the border, the access regime for the CBETP becomes relevant. As discussed in Section 2.3, the CBETP capacity may be reserved for use by specified entities. If the TPA regime applies:
    - the cross-border capacity may be allocated to agents in the interconnected jurisdictions for executing bilateral cross-border transactions. Different time horizons for capacity allocation (from one year or longer, to one day or one hour) and different allocation

[5] In electricity markets the usual condition is that prices in the buying country are above a predefined threshold.

methods may be used (which could be market- or non-market-based). The most common market-based allocation method relies on (explicit) auctions[6];

- the cross-border capacity may be used to allow access by agents located in a jurisdiction to an organised electricity market which operates in another jurisdiction. If the CBETP capacity is allocated as part of the market clearing routine, the approached is usually referred to as "implicit auction"[7]. This model generally operates over the short term – with the same time horizon of the organised electricity market which typically runs on a day-ahead basis – and can be considered an intermediate step towards the full integration of markets in different jurisdictions[8];

- the cross-border capacity may be used to support the integration of wholesale electricity markets in the interconnected jurisdictions. As such, the allocation is performed over the same short-term horizon as the operation of these markets. Different forms of integration exist. On the one side, the integration may be supported by a single institution (typically a Power Exchange), in which case the approach to allocate the CBETP capacity is usually referred to as "market splitting"[9]. Alternatively, markets may be coupled through the cooperation of different – typically national – institutions (again generally Power Exchanges). In this case, the approach is usually referred to as "market coupling"[10].

Reserve sharing and mutual support during emergencies are utilisations of the CBETP capacity which are agreed and managed by and in the interest of SOs, which are typically responsible for ensuring that sufficient reserve is available at all time to guarantee the secure operation of the system and for managing the system in case of emergency.

Each type of arrangement requires specific agreements and protocols, which should be included or reflected in the IMA.

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[6] This is for example the model which is being considered for cross-border exchanges between the Russian Federation and other CIS countries. The allocation of cross-border capacity through explicit auctions is also the most common approach in Europe and it is the minimum requirement under EC Regulation n. 1228/2003

[7] As the CBETP capacity is allocated implicitly as part of the solution of the organised market.

[8] One example is the use of the interconnection between Germany and the Nordic system to support access to NordPool (the Nordic Power Exchange) by market players located in Germany before a greater degree of integration through market coupling was introduced in 2008.

[9] In Europe, examples of such integration include NordPool – integrating the markets in Norway, Sweden, Finland and Denmark; Mibel – between Spain and Portugal; the Single Electricity Market – between Northern Ireland and the Republic of Ireland; and in the near future, the merger of the German and French Power Exchanges – EEX and Powernext

[10] A European example of such integration is the Tri-lateral Market Coupling between France, Belgium and the Netherlands.

2.5 ROLE OF EACH JURISDICTION

In an interconnected regional power system, each jurisdiction can fulfil one or more of the following roles:

1. Participating in one or more of the trading arrangements supported by the CBETP (and other interconnectors) and described in the Section 2.4;

2. Not participating in trading supported by the CBETP, but hosting transits originated from such trading, which use the internal transmission system.

3. Not participating in trading supported by the CBETP, but hosting transits originated from such trading, which do not use the internal transmission system. In this case a specific IMA may not be required, as the CBETP does not impact on the local system and market and therefore system and market inter-operability issues do not arise. In this case, the IGA and the HGA may be sufficient to cover the relevant areas of agreement involving the host jurisdiction.

Therefore, IMA is only required in cases 1 and 2, with greater complexity for case 1.

2.6 REGULATORY HARMONISATION

International experience shows that it is not necessary to have a uniform regulatory framework for developing cross-border trading or establishing a regional market. For instance, in Central America the SIEPAC project, an electricity transmission line which will soon link six different jurisdictions, includes four jurisdictions which have reformed and deregulated their electricity sectors and two which maintain an organisation based on state-owned vertically integrated monopolistic utilities, one of them with some role for Independent Power Producers.

When the CBETP interconnects jurisdictions with different regulatory frameworks, which is often the case, possible approaches include (in order of increasing integration of the different jurisdictions):

- Establishing rules for cross-border exchanges which may be different from the rules governing the operation and trading inside the jurisdiction;

- Creating appropriate "interfaces" to convert cross-border trading rules and actions into actions in the domestic markets. Regulation in each involved jurisdiction may differ from regional trading rules so decisions at regional level need to be internalised to have an effect in the domestic market and at the same time no undesired distortions[11];

- Introducing a minimum level of harmonisation of the rules in each jurisdiction which are most relevant for cross-border exchanges.

[11] For example, if capacity payments are in force in one jurisdiction and import/export flows are mainly based on energy prices, then an adjustment is needed to avoid distortions of the national markets.

Clearly, the harmonisation requirements and the potential problems generated by non-harmonised domestic regulatory frameworks are more important in the case in which multiple agents in a jurisdiction have access to the cross-border capacity.

The level of detail of the IMA therefore depends, at least in part, on the structure of the sector in the involved jurisdictions. In any case, it should not be higher than what is strictly required to ensure market and system interoperability. Therefore, with respect to the system and market rules of the individual jurisdictions, the IMA would typically be characterised by a more general approach, in order to avoid unduly and unnecessarily interfering in the detailed operation of the individual systems and markets. It is only when strongly integrated regional markets are established, that the technical and market rules of the individual jurisdictions are replaced – at least in some areas - by regional rules (e.g. regional Grid Codes as the ones currently envisaged in the EU).

3 RELEVANT ISSUES FOR THE INTEROPERABILITY OF MARKETS AND CONTROL AREAS

The issues that should be covered in the IMA can be classified as:

- Institutional Issues;
- Operational Issues;
- Commercial Issues;
- Issues related to Support during Emergency.

These issues are outlined in this Chapter. Chapter 4 provides guidance on the way in which these issues should be addressed in the IMA.

3.1 INSTITUTIONAL ISSUES

Institutional issues to be contained in the IMA should include:

1. Identification of the SOs for the different jurisdictions and of the parties responsible for the operation of the cross-border facilities, if different;

2. Identification of other relevant stakeholders which should be parties to the IMA (e.g. Government, Regulatory Agencies).

The treatment of these issues in the IMA is clearly affected by institutional characteristics, electricity sector structure and market organisation of the different jurisdictions involved.

3.2 OPERATIONAL ISSUES

Operational issues to be contained in the IMA should include:

1. Identification of the facilities - nodes and transmission line - to be used for cross-border power exchanges as well as for controlling and monitoring the interconnection;

2. Collection of information on the operational status of facilities used for cross-border power exchanges;

3. Communication aspects: language, communication facilities, contact persons, list of the technical terms and definitions most commonly used with a precise technical description, information interchange;

4. Methodology to establish the maximum transfer capacity in each direction between neighbouring jurisdictions, or agreement on the values, for active and reactive power;

5. Methodology for scheduling cross-border flows in each hour (or other interval);

6. Events that may trigger a deviation from the scheduled power flows;

7. Methodology for cross-border flows control and tolerances;

8. Voltage control procedures;

9. Real-time system monitoring;

10. Maintenance coordination. Agreement on the extent to which maintenance may result in changes in the cross-border transfer capacity;

11. Tests involving the cross-border facilities;

12. Coordination for the re–establishment of the cross-border flows after perturbations;

13. Definition of the analysis of the operation of the interconnector during perturbations;

14. Procedures for manoeuvres the execution of which is required immediately for the sake of security of persons or integrity of equipment;

15. Metering of cross-border flows;

16. Organisation and maintenance of data-bases containing the data pertaining to the exchanges performed and all the events;

17. Information exchange for post operation analysis;

18. Joint reporting;

19. Allocation of frequency control responsibilities.

The way in which most of the above operational issues should be dealt with in the IMA do not vary much depending on the institutional characteristics, electricity sector structure and market organisation of the different jurisdictions involved.

Moreover, most of the issues would have a similar treatment, irrespective of the type of interconnection (which may or may not lead to synchronous operation between the different control areas). Exceptions are:

- Methodology for cross-border flows control and tolerances, Coordination for the re–establishment of the cross-border flows after perturbations, Definition of the analysis of the operation of the interconnector during perturbations, Procedures for manoeuvres whose execution is required immediately for the sake of security of persons or integrity of equipment, in which the content of the provisions will have to be adapted to the technical characteristics of the interconnection facilities;

- Methodology for cross-border flows control and tolerances, where the ability to control flows over a DC link would result in a much simplified set of rules;

- Allocation of frequency control responsibilities, which is not relevant in the case of non-synchronous operation.

More generally, the degree of cooperation between SOs would have to be greater in the case of synchronous operation.

3.3 COMMERCIAL ISSUES

Commercial issues to be contained in the IMA include:

1. Identification of the allowed type(s) of cross-border exchanges;
2. Possible establishment of an Inter-Transmission Provider Compensation (ITC) mechanism and definition of such mechanism;
3. Procedure for the management of congestion of the cross-border transfer capacity;
4. Definition of the methodology for settling deviation of actual cross-border flows from scheduled values;

It is clear that the treatment of most of these issues in the IMA will depend crucially on the electricity sector structure and market organisation of the different jurisdictions involved.

3.4 SUPPORT DURING EMERGENCIES

Issues related to the mutual support during emergencies include agreed rules on the set of actions that SOs will perform when a country or control area is facing:

- the risk of collapse of its electricity system;
- the inability to meet demand and therefore the need to resort to load shedding, blackouts or brownouts.

In this respect, agreement between the involved SOs and possibly other stakeholders, needs to be achieved on:

1. the definition of the different types of emergency situations in respect to which mutual support can be activated;
2. the way in which mutual support will be sought;
3. the way in which mutual support will be provided:
4. the methodology for economically compensating the country or control area which provides support.

4 GUIDELINES ON THE TREATMENT OF PROVISIONS TO BE INCLUDED IN THE IMA

This Chapter illustrate the content of the IMA with respect to each of the aspects identified in Chapter 3. It also discusses the extent to which the electricity sector structure and market organisation of the different involved jurisdictions impact on the treatment of the different issues in the IMA.

4.1 INSTITUTIONAL ISSUES

4.1.1 Identification of the SOs and other parties responsible for the operation of the cross-border facilities

The parties involved in and responsible for the operation of cross-border facilities have to be identified.

These typically include the entities which perform the SO function in the different jurisdictions, even though other stakeholders may be involved as well. The CBETP operator may also be involved.

As indicated in Section 2.3, different sector organisations support the assignment of the SO function to different entities, ranging from a division of the vertically-integrated monopoly utility to a fully-independent SO.

The geographical area over which each SO exerts its responsibilities also needs to be clearly identified.

4.1.2 Identification of other relevant stakeholders which should be parties to the IMA

Beyond the SOs and other parties involved in the operation of the cross-border facilities, other stakeholders may be parties to the IMA.

In particular, the Regulatory Agencies in the different involved jurisdictions, or some Government departments, would have to be involved if they have responsibilities for some of the aspects to be governed by the IMA. Issues which are typically under the responsibility of the Regulatory Agency or Government department include:

- The definition of the mechanism for congestion management;
- The definition of the regime for access to specific infrastructure;
- The definition of approaches to settlement of deviations.

The stakeholders which would have to be included as parties to the IMA would therefore depend on:

- The content of the IMA, which in turn depends on the role of the CBETP, as discussed in Section 2.3;
- The sector structure in the different jurisdiction and the allocation of responsibilities among different institutions.

4.2 OPERATIONAL ISSUES

System safety is the primary goal of the operation of (interconnected) networks. In interconnected systems numerous inter-dependencies exist between the different control areas. The operation of the interconnected network is founded on the principle that each SO is responsible for its control area.

SOs should agree the methods of co-operation. More specifically, they should agree on common rules for inter-operability which create favourable conditions for cross-border exchanges, while guaranteeing security and safety of network operation. Even if each SO is only responsible for the operation of its own network it is required to inform relevant neighbours in case it assumes some risks whose consequences may be propagated abroad.

Coordination between SOs contributes to enhance the common solidarity (to cope with risks) resulting from the operation of interconnected networks, to prevent disturbances, to provide assistance in the event of failures with a view to reducing their impact and to provide resetting strategies after a collapse.

The control of performances of facilities connected to networks remains under the responsibility of SOs according to the rules applicable in each jurisdiction. Each control area - and SO - is responsible of procedures for reliable operation over a reasonable future time period in view of real-time conditions and of their preparation.

Therefore, the goal for each SO should be to avoid a cascading with impact outside its control area. But if the cascade occurs, the SOs jointly should coordinate actions to minimise the impact on the regional power systems.

Each SO has the obligation to monitor the consequences of the events defined in its contingency list and warns its neighbours when its own system is at risk at any operational planning stage and in real time.

The following aspects are aimed at pursuing the above objectives.

4.2.1 IDENTIFICATION OF THE FACILITIES TO BE USED FOR CROSS-BORDER POWER EXCHANGES

Facilities to be used for cross-border electricity exchanges includes

- lines;
- nodes;
- sub – stations.

These facilities should be clearly identified, by defining their geographic localisation and identification in transmission network diagrams.

Moreover, the technical characteristics and parameters of each of the facilities has to be clearly established. These characteristics and parameters serve as references for the operational capabilities to be assigned to each facility.

The facilities used for controlling and monitoring the interconnections must also be considered as “facilities for cross-border trading”.

These technical characteristics and diagrams are normally presented in an annex or schedule to the IMA.

The approach to the identification of the facilities to be used for cross-border power exchanges does not depend on the electricity sector structure and market organisation of the different jurisdictions involved, nor on the technical characteristics of the CBETP.

4.2.2 COLLECTION OF INFORMATION ON THE OPERATIONAL STATUS OF FACILITIES USED FOR CROSS-BORDER POWER EXCHANGES

Monitoring of the operational status of the facilities used for cross-border exchanges is essential for the secure operation of the interconnected system and for detecting possible malfunctioning as soon as possible.

Therefore SOs should agree on:

- the types of information to be captured in relation to each facility;
- the frequency with which the information is collected;
- the SO or other entity responsible for capturing the information, process it and share it with other parties (primarily, but not only, the SOs). If the SO is not also the TO of the identified facilities, the information may be captured and (at least initially) processed by the TO. There are relevant implications for the development of competitions of different models of information capturing and processing as a TO which is part of a vertically-integrated utility may take advantage, for the benefits of the commercial arm(s) of the utility, of its ability to access information on power flows over cross-border facilities. However, the same applies to non-cross-border facilities and it is unlikely that a different approach will be established for the two types of facilities;
- the way in which the information will be exchanged with other parties (including exchange mode, frequency, ...);
- the physical media used for exchanging information, which may include, partly depending on the nature of the information, emails, publishing the information on a web site and telephone;
- the identification of the entity responsible for managing the information exchange/dissemination, if different from the entity capturing the information;
- the way in which the information collected will be stored;
- the entities which have access to the information. If SOs do not directly capture the information, they should be provided access. Other entities, such as a settlement agency, may also be given access to the information, at least is some aggregate form. Information in aggregate format may also be made public, to improve transparency of the operation of the system and of cross-border facilities;
- the definition of the frequency with which the information is exchanged or made public, which may be different from the frequency with which the information is collected and processed.

The approach to the collection of information on the operational status of facilities used for cross-border power exchanges may depend on the electricity sector structure of the different jurisdictions involved, but generally not on the technical characteristics of the CBETP. In fact, as indicated above, the way in which the information will be collected and exchange may vary, depending on whether the SOs also perform the TOs role.

4.2.3 COMMUNICATION ASPECTS

Clear, precise and timely communications are vital for the safe operation of interconnections. The means of communication may vary depending on the situation: communication to support real time operation requires a different approach from communication supporting medium term planning operation or transactions settlement.

Therefore, the different types of situations should first be defined.

For each situation, means of communication should be agreed. The most commonly used communication means include:

- Land-line telephone communication;
- Mobile phone communication;
- Fax;
- Private communication network between SOs.

Other communication aspects which needs to be defined include:

- the language of communication;
- the meaning of the most common technical terms. These terms should be listed in a glossary and the definitions agreed by all involved SOs so that they can be used unambiguously during communications. The glossary must be developed and agreed before the interconnection begins operation. The glossary must be available at all times (especially during real time operation) and updated as deemed necessary. Each update should be in the form of a whole new glossary containing the modifications; in fact it is not practical to have “amendments” as separate documents;
- the way in which the person(s) responsible, in each SO, at any time of the day for the different aspects of interoperability, and his/her contact details (telephone number, mobile number, radio contact, etc.) can be notified to the other SOs;
- facilities to record voice exchanges between SOs’ technical staff;

Other means of communication for formal exchanges should also be agreed and detailed in the IMA. For example: agreement on validity of fax communication (establishing fax number, conditions for the communication to be considered, etc), agreement on validity of communication via email, etc.

The approach to communication and the aspects highlighted in this subsection do not depend on the electricity sector structure and market organisation of the different jurisdictions involved, nor on the technical characteristics of the CBETP.

4.2.4 METHODOLOGY TO ESTABLISH THE MAXIMUM TRANSFER CAPACITY IN EACH DIRECTION BETWEEN NEIGHBOURING JURISDICTIONS, OR AGREEMENT ON THE VALUES, FOR ACTIVE AND REACTIVE POWER

The level of the cross-border exchange capacity must be established for active and reactive power. This can be done either by agreeing on specific values or by establishing a method for calculating these parameters.

The cross-border capacity is defined taking into account security principles (for instance of single facility failure (N-1)) which also needs to be agreed by the involved SOs.

The cross-border capacity may be different during different periods of the year (typically summer and winter, but also during periods in which some of the facilities are out of service for maintenance). Also capacity may be different at different times during the day (i.e. peak and off-peak periods).

The agreed methodology to set the cross-border capacity should be clearly detailed in the IMA, including the algorithms, criteria to define typical load flow states and other variables needed for the calculation. The calculation procedures should be written in such a way that no ambiguity is possible.

The interchange capacity must be so that safety, security, stability, reliability and quality parameters are maintained and compatible with the systems' standards.

An harmonisation is therefore required regarding the concepts related to cross-border transmission capacity and the procedures for calculation of the cross-border capacity usually include a set of definitions. These definitions can be classified as relating to:

- the maximum transfer capacity between two adjacent control areas;
- the transfer capacity between two adjacent control areas available for commercial use.

For instance the following definitions are used in the UCTE[12] area:

- TTC = Total Transfer Capacity: maximum exchange programme between two areas compatible with operational security standards applicable in each system if future network conditions, generation and load patterns were perfectly known in advance
- TRM = Transmission Reliability Margin: security margin which copes with uncertainty on the computed TTC values arising from:
    - Unintended deviations of physical flows during operation due to the physical functioning of load-frequency regulation;
    - Emergency exchanges between SOs to cope with unexpected imbalance situations in real time;
    - Inaccuracies e.g. in data collection and measurement

[12] Soon to be replaced by ENTSO-E.

- NTC = Net Transfer Capacity = TTC – TRM_ maximum exchange programme between two areas compatible with operational security standards applicable in both areas and taking into account the technical uncertainties on future network conditions.

- Available Transfer Capacity (ATC): the part of NTC that remains available, after each phase of the allocation procedure, for further commercial allocation or usage.

All these values are to be interpreted in terms of exchange programmes between adjacent countries or control areas.

NTC and ATC are important indicators for parties involved in cross-border exchanges to anticipate and plan their cross-border transactions – when multiple agents are allowed to trade across borders - and for the SOs to manage these cross-border exchanges of electricity.

The complexity of physical calculations (and the need of transparency and to avoid manipulation of results benefiting discretionally some market participants) clearly indicates that SOs should be assigned the responsibility for carrying out this task in a fair and non-discriminatory matter. This responsibility should be agreed among all the countries.

The approach to establishing the maximum transfer capacity in each direction between neighbouring jurisdictions and the aspects highlighted in this subsection does not depend on the electricity sector structure and market organisation of the different jurisdictions involved. The technical characteristics of the CBETP may affect the calculation of some of the parameters involved in establishing the maximum transfer capacity.

4.2.5 METHODOLOGY FOR SCHEDULING CROSS-BORDER FLOWS

Performance of cross-border bilateral contracts and transaction on organised day-ahead and intra-day markets may result cross-border exchanges.

The agreed cross-border exchanges between entities allowed to trade across the border or resulting from trading on organised markets should be communicated to and processed by SOs – typically on a day-ahead basis, but also closer to real time - in order to prepare hourly exchange schedules for the next day or set of hours, which should take into consideration complex issues as transits, loop flows and congestion. The schedules would also include planned exchanges between SOs, e.g. arising from compensation of deviations (see Section 4.3.4)

Methodologies for the definition of cross-border scheduled should be agreed between SOs so that such schedules are consistently defined on the two sides of the interconnector.

In particular, the bilateral scheduled flows should include:

- transactions between two directly interconnected and adjoining countries/control areas;

- third party transmission operations or transits between non-adjoining countries;

and should be within the capacity (NTC) of the respective interconnection lines. In case the resulting flows do not fulfil this condition, the SO should ask parties involved in cross-border exchanges to reschedule transactions in order to fulfil this requirement, or congestion management procedures should apply.

SOs should also agree on what actions to take (e.g. redispatching) and how to review the scheduled flows, should transmission capacity between adjoining areas becomes insufficient, is significantly impaired or is no longer available.

A number of factors must be taken into account where electricity is to be exchanged between control areas (or even within a single control area):

- since the distribution of load flows is governed solely by the laws of physics, the distribution of power flows associated with a given transit or third party transmission operation cannot always be determined with precision, since accurate information on incoming power flows, outgoing power flows and system topology will not always be available. This will likely be the case in the early stages of the development of cross-border exchanges;

- as the number of cross-border transactions on the network increases, difficulties in the identification of the sources of load flows for the purposes of load flow management will also increase, with the possible impairment of operational security on the interconnected network;

- given the mutual influence of meshed networks, measures must be agreed to ensure that, as the number of parties involved and the number of scheduled exchanges increases, unmanageable operating conditions will not arise.

Where electricity exchanges involve transits, SOs will be required to determine the physical distribution of power flows between non-adjoining power systems. This procedure should be carried out using an appropriate computational tools. The SOs should agree on the representation (model) of their networks, which would be used for the completion of power flow analyses by each interconnected SO, in order to determine the impact of a given transit upon the various national systems.

The approach to scheduling cross-border flows partly depends on the electricity sector structure and market organisation of the different jurisdictions involved, as a larger number of agents allowed to perform cross-border exchanges will increase the complexity of the task and therefore of any coordination between SOs. The technical characteristics of the CBETP and of other interconnectors may also have an impact of the approach to scheduling cross-border flows, as it may affect the level of loop flows and parallel flows – which complicate the determination of the cross-border exchange schedules.

4.2.6 EVENTS THAT MAY TRIGGER A DEVIATION FROM THE SCHEDULED POWER FLOWS

In some circumstances scheduled flows may not be adhered with. This for example occurs in case of an unexpected outage of a major facility in one of the systems (generator, or transmission line or demand), or a situation that prevents the system from sending / receiving the scheduled flow or part of it.

A list of the situations in which flows may deviate from scheduled levels should be agreed as well as possible remedies and procedure to be follow by the SOs.

The compensation arising from the failure to meet the scheduled flows should also be agreed (see Section 4.3.4).

The approach to deviations from scheduled flows does not depend on the electricity sector structure and market organisation of the different jurisdictions involved, nor on the technical characteristics of the CBETP.

4.2.7 METHODOLOGY FOR CROSS-BORDER FLOWS CONTROL AND TOLERANCES

A method to control the cross-border flows and the tolerance to deviations in these flows must be established.

A common method for cross-border flow control is to establish that each SO must maintain the balance (i.e. total demand minus total generation must be kept in the scheduled values) in its area of responsibility. This balance is achieved through the use of the secondary control[13].

This means that the SO must maintain in his area of control the equilibrium between generation and demand plus or minus the scheduled flows in the interconnectors.

In other words, once the exchange schedule with adjacent areas are defined (see Section 4.2.5), the SO, in its programme for the day, must balance the generation with the domestic demand plus scheduled exports (considered as “demand” on the interconnector that is exporting) minus scheduled imports (considered as “generation” on the interconnector that is importing).

SOs should control their area and cross-border flows in a way to avoid that any contingency in the domestic system has a cascading impact with effect outside the border of its control area.

Tolerances for the actual flows must be established beforehand (i.e. as a percentage of the scheduled flow) and the SO must maintain the flows on the interconnectors by using the secondary control, and when necessary other slower reserves (spinning and fast start cold reserve).

The approach to cross-border flow control and tolerances does not depend on the electricity sector structure and market organisation of the different jurisdictions involved. The technical characteristics of the CBETP (e.g. in the case of DC links) may facilitate flow control.

4.2.8 VOLTAGE CONTROL PROCEDURES

Voltage is a measured physical quantity, which fluctuates as a function of the network state, i.e. grid topology, generation, load, transmission line and transformer loading. These factors may change due to SO decisions and power system contingencies.

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[13] In an isolated control area the secondary control aims at keeping system frequency in a predefined value, so the country balance is permanently corrected in order to achieve this target. In an interconnected system the secondary regulation also aims at keeping the control area balance, therefore the secondary control modifies generation based on a signal that is a linear combination of the deviations of system frequency and control area balance

The voltage levels are maintained by reactive power generation assured by different facilities. Nevertheless, for network security reasons, and in accordance with operational voltage security rules, a control of voltage is locally needed to maintain the voltage deviations within predetermined ranges.

Policies and procedures for voltage control have to be developed and implemented by each SO in its respective control area. Criteria and tolerances are normally defined in the national Grid Codes.

For security reasons and in respect of mutual commitments for operational conditions, a continuous voltage control is needed and co-ordinated between the different SOs in order to maintain voltage variations within predetermined limits in their control area.

Extensive reactive power flows beyond the own consumption of the interconnectors are the result of different voltage levels on each side of the boundary. In order to ensure a safe operation of the synchronous area, adjacent SOs shall agree on common voltage ranges on each side of the border to ensure the continuous voltage control.

Therefore coordination between adjacent SOs is needed in order to manage voltage control (primary and other means) and reactive power resources near borders preventing that individual actions have an adverse effect on the security of neighbours (including border nodes for voltage) in normal operation and in case of disturbances.

SOs should agree on the exchange of data on voltage values and reactive power data for the network security analysis and for real-time operation.

The approach to voltage control procedures does not depend on the electricity sector structure and market organisation of the different jurisdictions involved. The technical characteristics of the CBETP may however have an impact on the level and type of coordination required between SOs for voltage control.

4.2.9 REAL-TIME SYSTEM MONITORING

The task of real time system monitoring is performed during the system operation phase. In order to prevent systematic faults in the context of load – frequency control, it is essential to check the consistency of the input variables for online operation used by the parties involved.

SOs must agree to inform each other in case of detecting perturbations in the controlled networks. This control is typically performed using a Supervisory Control and Data Acquisition (SCADA) system. Through SCADA systems, SOs acquire the information on flows and voltage levels in the main transmission lines including the interconnectors and identify any anomalous situation.

The SOs should agree to share the data of total hourly scheduled exchanges and real-time active power measurements of each interconnector in their respective control areas.

The approach to real-time system monitoring does not depend on the electricity sector structure and market organisation of the different jurisdictions involved. The technical characteristics of the CBETP may however have an impact on the approach adopted by SOs on real-time system monitoring.

4.2.10 Maintenance coordination

Whenever maintenance in the transmission system of one of the control areas affects the cross-border capacity, its performance must be agreed / coordinated between the affected SOs.

Therefore, procedures for coordination of programmed maintenance should be agreed between the involved SOs. These should also involve the publication of the maintenance schedules so that the entities involved in cross-border exchanges are able to predict the impact of such maintenance on the level of cross-border transfer capacity.

An agreement between SOs should also be defined for the case of unexpected maintenance if this affects the cross-border capacity. In this case communication procedures and the time within which communication from one SO to the other involved SOs should occur must be agreed.

The approach to maintenance coordination does not depend on the electricity sector structure and market organisation of the different jurisdictions involved, nor on the technical characteristics of the CBETP.

4.2.11 Tests involving the cross-border facilities

Tests involving cross-border facilities may be needed for different reasons, including to check the state and reliability of the facilities or certain parts and to check accuracy of instruments.

SOs should agree on a list of tests that will be carried out with a certain frequency. For these test agreement should be reached on:

- The test's characteristics (norms to use);
- The frequency;
- The entity carrying the test out;
- The way in which the costs of the test will be allocated among the involved SOs and possibly, other entities (such as TOs);
- The dates (and times) in which the test is carried out.

If one of the parties requires a test of a facility or instrument which is not included in the agreed list or for which testing is scheduled at a different time, agreement should be reached on the procedure to follow, including: how to require the test, who will carry it out, when it will be done, who bears the costs, the right of the party to have access to the facilities.

The approach to testing of cross-border facilities does not depend on the electricity sector structure and market organisation of the different jurisdictions involved, nor on the technical characteristics of the CBETP.

4.2.12 Coordination for the re–establishment of the cross-border flows after perturbations

When perturbations that prevent meeting the scheduled flows occur, it is necessary to define the procedures that will allow the re–establishment of the flows to the scheduled levels.

Flows on the interconnectors have not only physical implications (in the equilibrium of the systems) but also commercial implications. When flows are interrupted or modified because of perturbations it is necessary to re–schedule the flows as soon as technically possible, taking into account the commercial implications.

If perturbations are minor, it may be possible to re–schedule flows in an intra-day process. If there is a major perturbation it may be necessary to modify the schedules of subsequent days.

In this respect, SOs should agree on:

a) what is considered a perturbation and types of perturbation;

b) the technical procedures to recover the interconnection to its normal state following a perturbation;

c) the procedures for re-scheduling the cross-border flows when the perturbation is cleared, or the system stabilised in a different state;

d) the commercial implications, i.e. the way in which electricity will be valued during the whole duration of the perturbation and its effects, until the interconnection is totally recovered. During this period it may simply happen that the capacity on the interconnection is reduced, or it may happen that a major incident makes a complete interruption of flows.

The approach to coordination for the re–establishment of the cross-border flows after perturbations does not depend, from a technical standpoint, on the electricity sector structure and market organisation of the different jurisdictions involved, nor on the technical characteristics of the CBETP. However, sector structure and market organisation may impact on the commercial implication of disturbances and therefore on the way in which cross-border flows are re-scheduled following disturbances.

4.2.13 Definition of the analysis of the operation of the interconnector during perturbations

SOs should agree on the analysis that will be carried out during and after perturbations. In particular, SOs should agree on the principles and models to be used for the required analysis, as well as the time frame to carry it out.

Conclusions should be obtained so as to avoid (if possible) or mitigate the recurrence of similar situations in the future. These conclusions should be presented and agreed in a report with the corresponding recommendations.

The approach to the analysis of the operation of the interconnector during perturbations does not depend on the electricity sector structure and market organisation of the different jurisdictions involved, nor on the technical characteristics of the CBETP.

4.2.14 Procedures for manoeuvres whose execution is required immediately for the sake of security of persons or integrity of equipment

Incidents in the systems may require manoeuvres in the interconnection facilities to be performed without delay. The procedure of communication between SOs must be agreed. If the situation can be foreseen in advance, SOs must establish communication immediately and agree on the actions to take.

It must also be agreed the procedure to follow when there is no time to establish communication and agree beforehand all the steps to be followed.

The approach to manoeuvres whose execution is required immediately for the sake of security of persons or integrity of equipment does not depend on the electricity sector structure and market organisation of the different jurisdictions involved, nor on the technical characteristics of the CBETP.

4.2.15 Metering of cross-border exchanges

Metering of cross-border exchanges requires both the deployment and maintenance of metering systems and the handling of metering information.

With respect to metering systems, SOs must agree on:

- The location(s) of the metering equipment;
- the technical characteristics of the equipment;
- the procedure for access to the meters;
- the entity responsible for installing and paying for the costs of the meters;
- the entity responsible for maintaining or for the cost of maintaining the meters;
- the required maintenance protocols;
- the periodic verifications protocols.

SOs should also agree on the actions and procedures to follow when one of the parties claims that the meters are not working properly or requires verification the meter (see also Section 4.2.11).

In case meters are located in a node which is not on the border, the adjustment to the measures (including the methodology) required to estimate flows at the border, should be agreed between SOs and other involved entities.

With respect to the handling of metering data, SOs must agree on:

- the unit(s) of measure used for metering cross-border exchanges;
- the frequency with which power flows are metered;
- the processing, validation, transmission and storage of metering data;
- the procedures for sharing data and for comparing metering data.

The approach to cross-border exchange metering does not depend on the electricity sector structure and market organisation of the different jurisdictions involved, nor on the technical characteristics of the CBETP.

4.2.16 Organisation and maintenance of data bases containing the data pertaining to the exchanges performed and all the events

SOs must agree in detail on:

- the type of information that will be stored;
- the formats, units of measure, frequency for each variable;
- the structure of the data base in which it will be stored;
- the validation procedure of the information acquired;
- the procedures to follow when data is observed or proved to be erroneous;
- the accessibility of this information and the procedure to exchange / share the information.

The information must be complete so as to allow settlement of transactions, follow-up of operations and operational planning.

The approach to organisation and maintenance of data bases does not depend on the electricity sector structure and market organisation of the different jurisdictions involved, nor on the technical characteristics of the CBETP.

4.2.17 Information exchange for post operation analysis

Post operation analysis of the interconnector is required regularly to record exchanges and system performance and to settle deviations. This information should be included in joint operational reports. SOs should agree on the content, format and frequency/timing of these reports.

Further to periodic information exchanges and reporting, SOs should prepare special reports in case of unusual perturbations or other types of incidents that jeopardise the system or persons security. In some cases it may be appropriate to designate a special commission to analyse serious events, which may include external experts and stakeholders representatives.

The approach to information exchange for post operation analysis does not depend on the electricity sector structure and market organisation of the different jurisdictions involved, nor on the technical characteristics of the CBETP.

4.2.18 Joint reporting

Regular joint reporting by the SOs is appropriate to inform interested stakeholders on the performance of the interconnection and the commercial transactions executed through the facility. Regular joint reporting is more crucial when at least one of the systems has a market model, as in this case transparency towards market participants is more important.

The scope of reporting has to be agreed between SOs in its format, contents, frequency and the manner to make it public (via web site, distribution by mail, publication, etc).

The approach to joint reporting typically depends on the electricity sector structure and market organisation of the different jurisdictions involved, as the importance of making information available is greater if multiple competing agents operate in the electricity sector. Instead, the approach to joint reporting is not affected by the technical characteristics of the CBETP.

4.2.19 Allocation of frequency control responsibilities

The allocation of frequency control responsibilities is a recommended practice if the control areas are interconnected synchronously. Under this scheme the SOs should agree on:

- the frequency tolerances;
- technical characteristics of the power control of the units involved in primary control; and
- a criterion to allocate primary control margins among control areas.

An agreement and coordination is also necessary on the secondary control scheme, including a common definition of the technical parameters of controllers and regulating margins.

4.3 COMMERCIAL ISSUES

The approach to the commercial issues discussed in this Section depends significantly on the structure of the sector and on the market design in the different jurisdiction. In fact, different sector structure (e.g. the number of entities operating in the sector or being allowed to trade across borders) or market design (e.g. the existence of an organised market in the different involved jurisdictions) may allow or require a completely different approaches to both the types of allowed cross-border transactions and on congestion management approaches.

4.3.1 IDENTIFICATION OF THE ALLOWED TYPE(S) OF CROSS-BORDER EXCHANGES

Different types of cross-border exchanges can take place (or can be allowed) over the CBETP, depending on the sector structure and the market model adopted by the involved jurisdictions. In turn, the way in which some of these exchanges are accommodated in the involved jurisdictions also depends on the respective sector structure and market models.

The IMA should specify the type of commercial use for the CBETP. If capacity reservation operates for the CBETP, trading is only allowed by the specified entity holding the exclusive right to the capacity, as indicated in Section 2.3.

Each type of cross-border exchanges requires some minimum regulatory conditions in the involved jurisdictions and coordination through the IMA.

In what follows, different types of cross-border exchanges are characterised by:

- The regulatory requirements in the different jurisdictions;
- The (coordination) issues which should be governed by the IMA.

In particular, we consider:

- (Long-term) Physical bilateral contracts;
- (Short-term) Opportunity trading;
- Trading through day-ahead or intra-day organised markets.

Financial trading may also occur between agents located in different jurisdictions. In this case, the parties agree on a price and volume. There is no need of effective physical delivery. Financial trading requires a spot market in each of the involved jurisdictions, which ensures the delivery and provides the price references. Given that no cross-border physical delivery is required, no coordination is necessary; financial trading should therefore not considered in the context of the IMA[14].

4.3.1.1 (LONG-TERM) PHYSICAL BILATERAL CONTRACTS

Physical Bilateral Contracts are the most flexible type of trading arrangement.

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[14] Financial contracts between agents of two systems will happen when an optimisation of the two systems is ensured. This can occur because: a) SOs of both countries take actions when short run marginal prices are different so systems are optimised or; b) the agents on the two countries take actions towards optimisation when short run marginal prices in the two systems are different. Additionally, if there is congestion in the interconnectors, some kind of transmission rights will be needed to hedge risks.

They only require the existence in each country of at least one entity allowed to import/export energy, and the agreement by the SOs to schedule the flows resulting from the contract.

Physical contracts can easily be accommodated in national regulations.

Two cases can be distinguished:

i. Only one entity in each of the involved jurisdictions is allowed to import or export electricity. This is the simplest case as trading parties agree on the transaction based on the available capacity of the interconnector. The SOs in the involved control areas need to be informed of the transaction with the required detail so as to schedule it on the internal market and over the interconnector.

   Contracts can easily be settled bilaterally and the contracts themselves should contain the provisions to settle deviations.

ii. Multiple agents are allowed to import or export electricity in at least one of the involved jurisdictions. In this case there must be an internal coordination in the area(s) with multiple agents allowed to trade across the border. If cross-border capacity is insufficient to accommodate the competing demand of agents who are able to trade across the border, congestion management procedures should be implemented (see Section 4.3.2).

   These procedures allocate the interconnector’s capacity and contracts should be approved if they obtain the required capacity allocation.

   Afterwards, when the contract(s) have been approved / accepted the process is similar as the previous case.

Apart for the provisions for congestion management, the IMA should contain rules regarding:

- The declaration (nomination) of cross-border contracts execution by the contract parties to the SOs involved, including:
    - Frequency of nomination;
    - Timing of nomination;
    - Formats of nomination;
- The scheduling of the resulting flows over the different interconnectors (see Section 4.2.5);
- The settlement of any deviation of actual flows from scheduled levels (see Section 4.3.4).

4.3.1.2 (Short-term) Opportunistic Trading

Short term transactions of an opportunistic nature can be scheduled when prices, or marginal generation costs, in two interconnected jurisdictions diverge. These transactions can be agreed on a day-ahead basis, on an intra-day basis, or on a real-time basis, depending on the time definition of prices and costs.

Similarly, short term exchanges may occur when the system in one jurisdiction is in emergency (mutual support).

This type of cross-border trading was common between integrated utilities, or in single buyer's schemes.

Price-driven short-term opportunistic transactions can be effected:

- by entities which have the (exclusive residual) right to access the interconnection capacity, or

- by the SOs themselves[15], even though SOs are often not allowed to trade electricity[16].

Opportunistic trading is typically used as a way of taking advantage of price differential by using any cross-border capacity which remains available after the performance of allocation procedures.

Two alternative situations may occur:

- Opportunistic trading occurs between one entity in each involved jurisdiction which has an exclusive (residual) right to use the capacity in the interconnector;

- Opportunistic trading occurs between one entity in one involved jurisdiction which has an exclusive (residual) right to use the capacity in the interconnector and one or more entities in another jurisdictions which have no specific rights to the interconnection capacity.

In order to support cross-border (short-term) opportunistic trading, SOs – and possibly other involved entities - should agree on:

- When this transactions can be scheduled. A reasonable principle can be to schedule transactions when there is spare capacity in the interconnector and there is a difference in the marginal prices in the jurisdictions involved.

- The way in which the transaction will be priced: since there is a difference in system's marginal costs/prices, this means that there is a "rent" which has to be split. An alternative is splitting the rent equally between the two systems.

- How the transaction will be settled. When opportunistic trading occurs between entity with an exclusive right on the interconnector capacity there is no major problem with settlement; however, when an entity with exclusive right trades opportunistically with one or more entity without specific rights, provisions on the selection of the trading counterparties and on settlement should be developed.

If opportunistic trading is performed by SOs, the above aspects should be defined in the IMA.

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[15] Which are probably best suited to identify opportunities for trading which are consistent with the available cross-border capacity.

[16] Often, SOs are allowed to trade (buy and sell) electricity only when required for performing their functions (e.g. buying electricity to cover network losses or buying/selling electricity for balancing purposes).

Beyond the above aspects, the same coordination requirement apply as in the case of physical bilateral trading, except that in this case the trading period will be much shorter (from one hour to one or few days).

4.3.1.3 TRADING THROUGH DAY-AHEAD / INTRA-DAY ORGANISED MARKETS

Cross-border trading involving organised markets is typically effected over the same time horizon on which these markets operate: day-ahead or intra-day.

Three different situations can be identified:

a. markets operate in both (all) involved jurisdictions. In this case a complete set of market rules for trading on the interconnector is needed. These rules may envisage a “market splitting/market coupling” approach to congestion management or the coexistence of markets splitting and explicit auctions.;

b. markets operate in only one (a few) involved jurisdiction(s), while in the other there are multiple entities allowed to trade across borders. Even in this case, a set of market rules for trading on the interconnector is needed. These rules may envisage an “implicit auction” approach to congestion management or the coexistence of implicit auctions and explicit auctions;

c. markets operate in only one (a few) involved jurisdiction(s), while in the other there is only one entity allowed to trade across borders. No congestion problems arise in this situation because the only entity allowed to trade across the border will optimise exchanges according to the available interconnector capacity. In fact this entity will be able to autonomously decide the flows in the interconnector, by buying or selling on the market.

Aspects related to congestion management to be dealt with in the IMA, and the alternative approaches, are discussed in 4.3.2. Once congestion has been addressed, the market outcome will define the cross-border exchanges between the involved control areas. These exchanges then need to be nominated with the respective SOs, typically by the market operators, in much similar ways as in the case of trading on the basis of bilateral contracts (see Section 4.3.1.1).

4.3.1.4 BALANCING MARKET TRADING

Balancing market trading is agreed on a real time basis. These markets require a high level of coordination, so presently cross-border balancing is limited to a few experiences.

A complete set of market rules are necessary.

4.3.1.5 ANCILLARY SERVICES TRADING

As is the case of balancing market trading, ancillary services (e.g. reserve) trading require a high level of coordination. However there are some experiences of bilateral ancillary services arrangements.

More specifically, in the case of jurisdictions with monopolistic utilities, the coordination of ancillary services trading would be simpler, as decisions on the use of the interconnection capacity will not have to be subject to rigid rules to protect multiple traders.

Therefore arrangements for bilateral cross-border trading of ancillary services could eventually be considered in the case of countries with monopolistic utilities.

A complete set of market rules are necessary, as well as a coordinated definition of each ancillary service, triggering criteria, monitoring and settlement.

4.3.2 CONGESTION MANAGEMENT

Congestion occurs when the cross-border capacity is insufficient to accommodate the flows originating from the cross-border exchanges entered into by entities in the involved jurisdictions.

A “congestion management” approach is therefore needed when there are multiple agents allowed to perform cross-border exchanges or to trade on markets in interconnected jurisdictions and the cross-border flows resulting from the transactions they enter into exceed the available capacity on the interconnectors.

In this context, “congestion management” includes two closely related concepts:

- Congestion relief, where transmission overloads can be eliminated through generation re-dispatching, which results in an effective and economically efficient flow reduction.

- Congestion management, i.e. the allocation of the available transmission capacity to market participants or transactions. The allocation mechanisms should be agreed by the involved jurisdictions, and may be classified depending on whether they are:

  - market based;

  - non-market based;

Market-based mechanisms include:

- explicit auctions – where the cross-border capacity is auctioned off as a separate “product” from electricity, which may then be traded using this capacity. The cross-border capacity can be allocated on the control area borders (flowgates in the UCTE), or between a node in one control area and another node in a different control area (point to point transmission rights in the Central America electricity market).

- implicit auctions – where the available capacity is used to support electricity trading on organised markets, and therefore is only allocated “implicitly” as part of the market-clearing process. These solutions are aimed at ensuring that the scarce available capacity is allocated to its most valuable use. Presently implicit auctions are used in NordPool (named market splitting), Belgium-Netherlands-France, Spain-Portugal and Ireland. Implicit auctions require the existence of markets in at least some of the involved jurisdictions.

Non-market based solutions are based on allocation criteria – such as chronological order of the requests or pro-rata allocation – which do not attempt to maximise efficiency in the use of the capacity.

The IMA would have to define the congestion management approach to be used between the involved jurisdictions:

  - in the case of explicit auctions, the IMA would have to define the procedure for the auctions, their periodicity and the term for which the capacity is awarded.

- In the case of implicit auctions, the IMA would have to define or recognise the market rules on trading between jurisdictions which will define the market clearing process that allows allocating (implicitly) the interconnectors capacity.

4.3.3 INTER-TRANSMISSION PROVIDER COMPENSATION (ITC) MECHANISM

The development of cross-border transmission facilities require dedicated lines and larger equipment. Thus, cross-border exchanges imply both capital and operational costs. These costs can be paid by the utilities operating the facilities, or charged, at least in part, to the network users in the control areas or to the market participants that benefits from the available transmission capacity. Different regional systems have adopted different arrangements to charge for this costs (the cross-border trading "fee" or Inter Transmission Providers Compensations - ITC) to market participants. The ITC compensates for the incremental cost of the transmission system that is required to support cross-border exchanges.

Therefore, three different approaches are possible for covering the costs of cross-border facilities, depending on the level of integration of the different jurisdictions:

1. each jurisdiction maintains its national transmission tariffs (NTT), and a mechanism is established to recover the costs of the cross-border facilities. In this case transits pay the internal NTTs. This practice may appear simple – in reality is may be difficult to determine which control areas are affected by a long-range cross-border exchange -, but usually inefficient, as it is likely to result in pancaking[17] if NTTs are not coordinated;

2. a ITC mechanism is put in place which allows each jurisdiction to recover the costs created by transits and the specific costs of the cross-border facilities. There are good examples how this methodology, if properly designed, avoids pancaking, e.g. in the EU.

3. a common regional transmission tariff is established. This approach is in theory the most efficient, as it introduces a common economical signal for cross-border trading.

Typically an ITC mechanism should be agreed by all the interconnected jurisdictions, and requires defining:

1. the costs which are included in and are compensated through the ITC mechanism. Cost produced by losses and those linked to sunk (investments) or unavoidable costs (operation and maintenance – O&M) should be treated separately. More specifically, the costs to be compensated can be classified as:

    a. Fixed costs, for which two possible alternative approaches may be implemented:

        i. Only fixed costs of facilities specifically built for cross-border exchanges are included:

        ii. Fixed costs of all the facilities that hosts transits or cross-border exchanges are included;

[17] This is the accumulation of national transmission tariffs for commercial transactions that cross several borders.

b. Variable costs, which may include:

    i. Incremental/decremental losses produced by transits;

    ii. Incremental/decremental congestion (re-dispatch) variable costs.

A recommended practice is to compensate variable costs based on their actual values, and fixed costs of facilities specifically built to host transits;

2. The parties which are liable to fund the ITC mechanism. This issue is related to the identification of the agents who should pay for the use of national and cross-border transmission facilities for cross-border trading. Several alternative criteria are possible, depending on the organisation of the electricity sector in each jurisdiction:

    a. Where markets operate:

        i. one criterion is to allocate charges to the market participants who schedule cross-border transactions ("transaction based approach");

        ii. the other criterion is to distribute costs onto all (or some category of) market participants that are connected to the national transmission system, and therefore can schedule this type of transaction ("non transaction based approach").

    b. in jurisdictions in which markets have not been established, costs can be included in electricity tariffs and paid by end consumers;

    c. in the case of lines developed to support some specific PPA, through capacity reservation, the costs are paid by the PPA parties.

The allocation of variable costs to entity scheduling cross-border exchanges is possible only in markets with a methodology to allocate transmission variable costs to internal transactions. More specifically variable costs can be identified through nodal energy prices (also named "locational marginal prices" – LMP)[18]

LMP is the most efficient method to price variable costs, and simultaneously provides exact signals for transmission expansion.

i. In some cases the congestion rents in the cross-border flowgates[19] are collected by the SOs. This is common in regional markets with implicit auctions. Each (implicit) exporter is paid at the market price of the area in which it is located, and the importers pay the market price prevailing in its area. There is an agreement between the involved jurisdictions and SOs on how to share the congestion rent, and internal regulation defines how to allocate these rents. However this practice only collects

[18] Presently LMPs are used in USA pools, the Russian Federation, the Central America electricity market and several Latin America countries.

[19] I.e. the difference of market prices in the extremes of the flowgate times the corresponding flow.

congestion costs in the cross-border flowgates, but neither internal costs nor losses in the interconnection are covered.

ii. In the case of explicit auctions, it can be assumed that the awarded market participants are paying in advance for congestion rents.

The allocation of fixed costs is a more complex aspect. In fact, economic theory demonstrates than prices based on marginal costs maximises social welfare. However, while in transmission networks marginal costs can be computed for variable costs (losses and congestion) – which represent a small part of the total costs – the same is not the case for sunk and non avoidable costs.

When marginal cost pricing collects less than the total cost of production, as it does in transmission networks, an additional charge is needed. In fact, this changes the marginal cost-based prices and causes inefficiency. The goal of designing a charge, or tax, is to minimise this inefficiency.

i. The theoretical solution to minimising inefficiency is known as "Ramsey" pricing, in which costs are allocated in inverse proportion to price elasticity of demand;

ii. An alternative (with higher social cost) is the "equi-proportional" method, wherein the allowed revenue requirement is allocated to the various rate classes in proportion to the revenue derived based on prices equal to marginal unit cost.

Some methods without a theoretical support and lack of tests to verify their impact on social welfare have been proposed in academic papers or even implemented in some countries. These methods include: marginal participation (with several variants), average participation, with and without, MW mile, Auman-Shapley, etc.

However, some simple analysis demonstrates not only that these methods are less efficient than the Ramsey approach, but that in some cases produce incorrect signals for the generation expansion, with a high social cost.

Therefore, although with some well known drawbacks, some sort of postage stamp seems to be the less distorting method to allocate fixed costs to market participants.

3. If costs are included in tariffs, the criteria according to which the tariff will be computed need to be defined:

a. Cost allocation can be based on energy injected/consumed, peak injection/consumption, a linear combination of both.

b. In most cases fixed transmission costs are only allocated to demand, based on its (expected) lower elasticity to prices than generation, i.e. based in the direct application of the Ramsey theory.

Best practices suggest to:

1. Avoid allocating fixed costs of existing assets to cross-border transactions, unless a common regional tariff is established;

2. Avoid defining transactional tariffs[20];

3. Set tariffs based on access charges applied to all the entities than can (implicitly or explicitly) participate in cross-border transactions. This is not transactional and avoids pancaking.

The IMA would have to define whether an ITC mechanism operate between the involved jurisdictions and the features of the mechanism.

4.3.4 SETTLEMENT OF DEVIATIONS

Deviations in cross-border electricity exchanges between neighbouring systems occur every time the physical flows between these systems do not coincide with the corresponding schedules. These schedules are typically compiled on the basis of the transactions nominated by entities engaged in cross-border exchanges, as well as of any exchange planned by the involved SOs (see Section 4.2.5).

It is expected that deviations will be smaller and less frequent:

- the closer to real time the deadline (gate closure) is set for cross-border traders to agree/nominate their cross-border bilateral contracts of for trading on organised exchanges;

- the greater the incentives (provided by the tariff system) for cross-border traders not to deviate with their actual injections and withdrawals from their scheduled positions.

However, some deviations between actual injections and withdrawals and the corresponding schedules are inevitable within each control system. And while some of these deviations will compensate each other and the SOs would take actions to balance the system within the control area, the cross-border flows might also be affected.

There are essentially two different ways to compensate for deviations:

- financial compensation.

- compensation in kind.

Financial compensation can be considered as the preferred option, but it has proved difficult to implement. Compensation in kind requires an agreement on a categorisation of the hours so deviation in an hour can be compensated in the future in hours belonging to the same category[21].

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[20] I.e. to a charge tariffs to energy transactions

[21] For example, a deviation during peak hours of a working day will have to be compensated in the future during peak hours of a working day.

The IMA should define the most appropriate methodology for settlement of deviations. If compensation in kind is used, the settlement period and the future period in which compensation of deviations will be made should also be defined.

In case of long term contracts and capacity reservation there is typically no need of this type of compensation, as the treatment of deviations will be part of the contract settlement process.

4.4 SUPPORT DURING EMERGENCIES

Support during emergencies includes the set of activities that SOs should perform when a country or control area is in risk of collapse, impossibility to meet the demand or blackout.

To provide support from one system to the other it is necessary first of all to establish which are the situations considered as “emergencies”. SOs must agree on and the IMA should include a list of situations which will be considered as “emergency situation”.

These situations can be differentiated between:

- those that can be foreseen, for example an extremely dry season when a hydro-based system is running out of water. In these cases, it is possible to plan and agree the support that one system will provide the other.

  For these situations the SOs can agree beforehand on the type of support or a general framework and principles for the support, but normally there is enough time to negotiate the scope, type and price of this support;

- those that cannot be foreseen (for example the sudden outage of a generation unit) and must be solved in real time. These are the cases which need more care and are the ones which are referred to here.

  Since these situations may happen suddenly, it cannot be foreseen when they may happen and because they may have an impact in both systems, SOs must agree in advance on, and the IMA should define, type and scope of the support that is provided in each situation.

  As a specific and important point, it must be clearly established those cases in which it is necessary to disconnect the systems to avoid a cascading effect that may impact the whole interconnected region.

Moreover the procedure to re-establish the interconnection (when it has been cut) which are basically the technical requirements to connect synchronously the two systems, must also be agreed.

Finally, the economic compensation of the jurisdiction providing support in each of the different situations should be agreed.

All these aspects would have to be defined in the IMA.

ANNEX 1 - GLOSSARY

This annex includes some definitions of terms used frequently in these Guidelines. In some cases the definitions have been adapted to reflect the use of the terms in the context of the IMA; therefore they may be different from those used in other markets.

Control area: an electric power system or combination of electric power systems in which a common automatic control scheme is applied to: (1) meet, at all times, the load in the electric power system(s) by dispatching generators within the electric power system(s) and capacity and energy purchased from entities outside the electric power system(s); (2) maintain scheduled interchanges with other control areas within the limits set in the respective Grid Code; (3) maintain the frequency of the electric power system(s) within reasonable limits in accordance with the Grid Code; and (4) provide sufficient generating capacity to maintain operating reserves in accordance with the Grid Code. In regional markets typically control areas coincide with the national markets, even though example exists of multiple control areas within a national jurisdiction and, more rarely, control areas covering more than one national jurisdiction.

Cross-border exchange: a power flow between two neighbouring Control Areas.

Cross-border trader: is an entity, either a market participant, a monopolistic utility or any other organisation authorised to agree a cross-border power transaction with a cross-border trader of another country.

Flowgate: is the set of transmission lines that links two neighbouring countries. Each flowgate has a commercially usable transfer capacity given by the Net Transfer Capacity, as defined in Section 4.3.2.

Gate closure: the moment in time when trading for physical delivery between market participants ceases. Gate closure should be agreed by national SOs.

Grid Code: is a document mandatory for the SO of each jurisdiction which specifically regulate technical and other criteria for safe and secure operation of networks, for access to the network.

TSO: an entity that owns the transmission assets in a jurisdiction, and simultaneously fulfil the role of System Operator.

Transit: is the increase in flows in a control area or country originated in transactions with injection and withdrawn nodes that are outside the control area.