EUROPEAN COMMISSION

DIRECTORATE-GENERAL FOR ENERGY AND TRANSPORT

STUDY ON THE TECHNICAL SECURITY RULES OF THE EUROPEAN ELECTRICITY NETWORK

FINAL REPORT
62236A/001 REV 2

FEBRUARY 2006

100 YEARS ®

KTH VETENSKAP OCH KONST

KTH Electrical Engineering

LIST OF REVISIONS

Current Rev.	Date	Page affected	Prepared by	Checked by (technical)	Checked by (quality assurance)	Approved by
Final Report	2/2/06	All	AO Ekwue JAK Douglas L Söder	JAK Douglas	RG Bruce	RG Bruce
			REVISION HISTORY			
Interim Report	April 2005	All	Original issue			
Draft Final Report	04/08/05	All	First issue as 62236/PBP/000001			
Draft Final Report	08/09/05	All	Issued for consultation.			
Final Report	21/11/05	All	Revised in accordance with DG-TREN's comments at meeting on 21 October 2005			
Final Report	20/1/06	All	Revised in accordance with DG-TREN's comments sent by email on 11 January 2006			

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GLOSSARY

ABBREVIATION	DESCRIPTION	COUNTRY/JURISDICTION OF ORIGIN
BETTA	British Electricity Transmission and Trading Arrangements	Great Britain
BSC	Balancing and Settlement Code	Great Britain
CEER	Council of European Energy Regulators	
CER	Commission for Energy Regulation	Ireland
CMEP	Compliance Monitoring and Enforcement Process	UCTE
CRE	Commission de régulation de l'énergie	France
CREG	Commission de Régulation de l'Electricité et du Gaz	Belgium
CURTE	French Power Transmission Systems Users Committee	France
CUSC	Connection and Use of System Code	Great Britain
DG-TREN	Directorate General for Energy and Transport	EC
DACF	Day Ahead Congestion Forecast	ETSO/UCTE
DTe	Directie Toezicht Energie	Netherlands
EC	European Commission	
EDI	Electronic Data Interchange	ETSO
EEA	European Economic Area	
EFTA	European Free Trade Association	
EMS	Energy Management System	
ERGEG	European Regulators Group for Electricity and Gas	EC
ESB	Electricity Supply Board	Ireland
ETSO	European Transmission System Operators	EC
HVDC	High Voltage Direct Current	

ABBREVIATION	DESCRIPTION	COUNTRY/JURISDICTION OF ORIGIN
GW	Gigawatts (1GW = 1000 MW)	
IEM	Internal Energy Market	EC
MLA	Multi Lateral Agreement	
N-1	Outage condition; specifies that one transmission system element is out of service	
NERC	North American Electric Reliability Council	North America
NGC	National Grid Company[1]	Great Britain
NGC	Nordic Grid Code	Nordic Countries
NIAER	Northern Ireland Authority for Energy Regulation (formerly Ofreg)	Northern Ireland
NIE	Northern Ireland Electricity	Northern Ireland
Nordel	Association of electricity co-operation in the Nordic countries	
NTC	Net Transfer Capacity	
OH	Operation Handbook	UCTE
Ofgem	The Office of Gas and Electricity Markets	Great Britain
RTE	Réseau de transport d'électricité	France
SME	Small and Medium Enterprise	
SQSS	Security and Quality of Supply Standard	
SAA	Synchronous System Associations	
SONI	System Operator Northern Ireland	Northern Ireland
STC	System Operator Transmission Owner Code	Great Britain
TRM	Transmission Reliability Margin	
TSO	Transmission System Operator	

[1] Subsequent to the initial issue of this report, NGC has changed its name to National Grid Electricity Transmission plc (NGET). For the purposes of this report, however, the name NGC has been retained.

ABBREVIATION	DESCRIPTION	COUNTRY/JURISDICTION OF ORIGIN
TSOAI	TSO Association of Ireland	EC
UCTE	Union for the Co-ordination of Transmission of Electricity	
UKTSOA	United Kingdom TSO Association	EC
VDN	Verband der Netzbetreiber	Germany

EXECUTIVE SUMMARY

This document presents the work on the Study initiated by the Directorate-General for Energy and Transport (European Commission) to assess the adequacy of the present electricity transmission security network and reliability rules; scrutinise and evaluate the rules under development and specify further needs to improve the rules.

The Terms of Reference (TOR) of this Study are as follows.

- Make an inventory and comparative analysis of the transmission network security and reliability rules in Europe.
- Analyse the current implementation of local, national and supranational grid codes.
- Scrutinise and evaluate the existing security and reliability rules (with particular emphasis on the UCTE Operation Handbook).
- Propose options for the scope of European transmission network security and reliability.
- Propose the scope and contents of the implementation framework of the defined rules and regulations in the codes.

The Study commenced on 1 January 2005 and a kick-off meeting took place on 18 January 2005 in Brussels to finalise the programme of work.

This Study is based on a review of documents in the public domain and essentially comprising those documents that are available on government ministry, regulator or transmission system operator (TSO) websites. The regulatory grid codes or equivalent documents reviewed so far are varied in scope, presentation and content, depending on their evolution in the country concerned. In some cases detailed technical requirements (e.g. generator voltage and/or frequency capability) are laid down in formal government decrees written in the form of legal documents, for example.

In **Section 1 – Introduction** – we discuss the background to the study including the requirements of Directive 2003/54/EC and EC Regulation 1228/2003. The Terms of Reference for the Study are presented in Appendix A.

Section 2 –Local National and Supranational Rules, reviews the sources of information available, principally on the websites of governments, regulators, network associations and transmission system operators (TSOs). We introduce the term “Synchronous System Associations” (SSAs) to describe supranational network associations namely UCTE, Nordel, TSOAI (Ireland) and the Baltic IPS (DC Baltija). A schedule of websites for access to grid codes and related or equivalent documents is presented in Appendix B.

This section also reviews the present status of supranational organizations and regulatory authorities. Electricity regulation is constantly changing and evolving including important developments whilst undertaking this study, notably the consultation process on congestion management, co-ordinated by ERGEG[2]. The codes of three SSAs and six TSOs are reviewed in detail. Gaps between codes and actual behaviour are identified.

The conclusions of Section 2 are:

- The report is based on documents accessed from the Internet.
- The structures and publishers of (governments, regulators, TSOs) existing transmission network security and reliability rules vary in scope, presentation and content.
- The transmission security and reliability rules may be contained in more than one document in a given jurisdiction.
- Some documents have not been revised for some time and may be outdated and cross-referencing may also vary.

Organisational issues include the following:

- SSAs being apparently answerable to their member TSOs only.
- Codes and other regulatory arrangements, including regulators themselves being at differing stages of development.
- Variability of regulatory documents, such as codes and supporting documents, in the public domain.
- Legal precedence of codes, particularly supranational codes over national codes.

Recurring themes on implementation of rules and gaps between codes and actual behaviour are:

- Lack of a common definition of the 'N-1' security criterion or equivalent, particularly on interconnections across common borders.
- Lack of effective exchange of data in real-time of the status of a neighbouring network, to the extent that it is material for the operation of a given network.
- Need for improvement in defence plans, particularly load shedding.
- Requirement to train operators under simulated conditions; certification/authorisation of operators.

Section 3 – Comparison and Evaluation of Existing Security and Reliability Rules compares existing documents in detail and in particular evalutes the UCTE Operation Handbook. A detailed comparison of documents is presented in Appendix C showing the extent to which the codes as reviewed address the detailed requirements of the codes

[2] ERGEG, the European Regulators Group for Electricity and Gas, was established by Commission Decision 2003/796/EC.

(Operating Code, Data Registration (Exchange) Code, Scheduling and Despatch/Balancing Code). Appendix D presents a detailed comparison of the provisions for generation adequacy and frequency control, including parameters. Appendix E presents a detailed comparison for network (voltage) adequacy and reactive power control.

We survey the differences in the ‘N-1’ or equivalent security criteria and discuss a proposal for the harmonization of such criteria at interconnections. We also review the scope for a trade-off between network security and capacity made available to market players.

In addition we review the section on Electric Reliability Standards in Energy Policy Act of the United States. This Act and the latest version of the North American Electric Reliability Council’s Reliability Standards are relevant to the drafting of European standards as the processes in both continents are parallel, relate to like sized transmission networks and are responding to similar circumstances (blackouts). We find the Reliability Standards to be a well structured document and a useful precedent, particularly in respect of compliance monitoring and enforcement.

From the comparative analysis of the grid codes carried out, there is a wide variety in the style and content of the codes and even in the direct purposes for which they are written. Furthermore there would appear to be a requirement for a general form of standardisation of grid codes in terms of the following.

- Legal precedence such as Electricity Law > Decree > Transmission Licence > grid code.
- Electricity Laws and Decrees should specify minimum of technical requirements being those that establish overall responsibilities as well as the quality of supply; voltage and frequency levels and tolerances, construction and safety requirements (including earthing), continuity requirements and access rules.
- Responsibility for issuing of grid code – ideally this is primarily a technical and not a legal document and so should be prepared by the TSO to the approval of the regulatory authority concerned.
- The process for the drafting and periodic review of the grid code should be clear, including the membership of the review body which should be representative of the electricity industry.
- The grid code may need to be complemented by similar documents covering connections, balancing mechanism and related market.
- Ideally a common format and terminology should be adopted; codes should not only state what should be done, but by whom and when.
- There are a number of instances of “good practice” within existing codes and related documents, which may provide useful precedents for general use.
- At the very minimum there should be common definitions of N-1 or equivalent security of supply criteria, together with common and agreed definitions, across an interconnection.

- The detail in which security of supply criteria are stated by TSOs differs – in some cases the definitions provided would appear to be inadequate.

- Across an interconnection the:

    - provision of operating data (such data including real-time data),

    - agreement of emergency operations procedures (including defence plans), and

    - agreement of a procedure of which TSO is to take charge in an emergency

  should be agreed between TSOs, registered and available for review by the SSA.

Trade-offs between network security and capacity can be made available in the form of "non-firm" operation, such as generator intertripping although there may be appreciable system design considerations; other considerations are provision for intermittent generation and the application of economic criteria such as the Australian "regulatory test".

We propose that TSOs should be required to report annually to their respective regulators on transmission system reliability performance, that these reports should be to an EC standardised format and should be published[3].

Section 4 provides an analysis of issues and identification of problems to be addressed by European Transmission Network Security Rules. The reliance of neighbouring TSOs on each other is discussed, noting that electricity markets may develop as in Nordic countries to the trading of reserves. The following items are identified for incorporation in the Rules, principally to an SSA Technical Code:

- Common definition of the N-1 security of supply standard for operational purposes, initially on a bilateral basis and then as a common definition, within an SSA.

- A data exchange code for interchange of data between neighbouring TSOs, to:

    - include real-time data at sufficiently short intervals to enable on-line security analysis to be carried out,

    - include such data and information as may materially impact neighbouring TSOs and

    - be subject to an inter-TSO agreement registered with and available for review by the SSA.

- Monitoring of security level would be met by similar requirements as the data exchange code.

[3] Unipede: Availability of Supply, Ref: 04000Ren9706, April 1997

- Restoration plans should be mandatory; inter-TSO restoration plans should be subject to formal SSA approval and subsequent review; there should be agreed levels of proficiency of dispatching operators, procedures for authorization or ongoing accreditation of operators.

- Performance reporting, to the appropriate regulatory authority, should include an annual (high-level) performance report together with reports of major incidents.

- A compliance and enforcement policy should monitor performance against stated compliance levels for each code or policy; sanctions could be either naming, reporting to a regulatory authority or financial.

- Congestion management issues should be aligned with the Congestion Mangement Guidelines issued under Regulation 1228/2003, Article 8(4).

- SSA agreements and TSO licences should include a “derogation” procedure for granting of exemptions.

- Whereas TSOs presently report separately to national regulators, there is a case for considering a process whereby an SSA reports to a committee of regulators of the countries concerned, coordinated by ERGEG.

- The codes should incorporate procedures for review and modification; a code review panel should be openly constituted, its proceedings published and its membership should reflect regulatory and TSO interests.

Section 5 proposes the Guidelines for the European Transmission Network Security Rules (the Rules) for SSAs and TSOs. We discuss legal requirements and the order of precedence for the Rules in which, for matters of common interest particularly load/frequency control, an SSA Technical Code would be referenced by a national TSO Grid Code. It is proposed that Guidelines for the Rules be issued in accordance with EC Regulation 1228/2003. The frameworks for an SSA Technical Code, the technical agreement for an (HVDC) interconnector between SSAs and a TSO (national) grid code are proposed.

We propose that:

- the European Transmission Network Security Rules (the Rules) consider the following three general categories of codes:
    - SSA Technical Codes
    - Technical agreements for interconnectors between synchronous systems and
    - TSO (national and where applicable area) grid codes, prepared by TSOs for the technical governance of their own networks.
- The Rules would be in accordance with an “umbrella regulation” by means of Guidelines under EC Regulation 1228/2003.

- The Rules would have an order of precedence and would state common requirements, notably a definition for (N-1) security of supply, harmonisation of terminology and requirements for data exchange.
- As there is an issue of regulatory control and reporting, two alternate Regulatory Structure arrangements should be considered through a consultation process.
- Proposed Guidelines for the Rules, namely:
    - SSA Technical Code
    - Technical agreement for an (HVDC) interconnector between synchronous systems and
    - TSO (National) grid code

  be adopted.
- Processes and procedures for preparing the Rules, as well as the Rules themselves shall be published.
- Reports of system performance and major events shall also be published.
- Whereas the standards against which compliance is reported should be in the Rules, the quasi-legal processes relating to monitoring and penalties would, in our view, be more appropriately stated in an inter-TSO agreement and/or transmission licence.

Section 6 proposes the scope and contents of the implementation framework. Issues to be resolved, principally legal and regulatory are identified. We propose that the action plan would broadly follow that of the Guidelines for Congestion Management, particularly the consultation process. Essential requirements of the defined framework are identified as well as areas (N-1 criterion) requiring particular attention.

In summary we identify the following actions to be taken:

- Resolution of issues (legal, regulatory, governance, reporting)
- Action plan, comprising
    - consultation on regulator structure
    - road map with proposed milestones
- "Lowest common denominator" to be implemented by TSOs, SSAs and Regulators
- Remaining part of the regulatory framework to be implemented
- Care be taken in the use of terminology of power flows in respect of the congestion market

- A caveat on the introduction of a common definition of the N-1 security of supply criterion be considered

1. INTRODUCTION

1.1 EC Directives and Regulations

In July 2005, the European Parliament endorsed (subject to certain amendments) the proposed EC Directive concerning measures to safeguard security of electricity supply and infrastructure investment[4]. Article 4, Operational Network Security, item 1, requires Member States or competent authorities to ensure that transmission system operators (TSOs) set the minimum operational rules and obligations on network security, and that TSOs shall maintain an appropriate level of network security. Reference is made in the Security of Supply Directive to rules and recommendations such as are contained in the Operation Handbook of the UCTE (Union for the Co-ordination of Transmission of Electricity), by the Nordic grid code (Nordel, association of electricity co-operation in the Nordic countries), the Baltic grid code and the grid codes of the British and Irish systems.

Directive 2003/54/EC[5], concerning common rules for the internal market in electricity, and in particular Article 5, Technical rules, requires Member States to ensure that technical safety[6] criteria are defined and that technical rules establishing the minimum technical design and operating requirement for the connection to the system of generating installations, distribution systems, directly connected consumers' equipment, interconnector circuits and direct lines are developed and made public. Article 23, Regulatory authorities, requires regulatory authorities to monitor (inter alia) the rules of the management and allocation of interconnection capacity and the publication of appropriate information by TSOs.

The requirement for provision of information on interconnection capacities is also stated in Regulation (EC) No. 1228/2003 on conditions for access to the network for cross-border exchanges in electricity, where in Article 5, item 2, the safety, operational and planning standards used by transmission system operators are to be made public.

In effect a main objective is to develop common rules on minimum security and operational standards for use and operation of the network. Some of the above requirements pre-dated the many system blackouts that occurred within two months during 2003 in Europe and US. Increased urgency has been provided by the findings of the Regulatory Forum held in Rome on 16 to September 2004 (the 11th Florence Forum) and as reported further at the 12th Florence Forum in September 2005.

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[4] Published at 12th meeting of the Florence Forum - 1 - 2 September 2005;

http://europa.eu.int/comm/energy/electricity/florence/12_en.htm

[5] Directive 2003/54/EC repealed Directive 96/92/EC with effect of 1 July 2004.

[6] Presumably safety of the system i.e. security of supply (as distinct from safety to the person).

1.2 Supranational network associations

Electricity utilities have been co-operating for many years to maximise system reliability and quality of supply while optimising their use of energy sources and capacity. As a result, four regional network associations of TSOs emerged from this co-operation, namely:

- UCTE (the "Union for the Co-ordination of Transmission of Electricity") is the association of transmission system operators in continental Europe; the UCTE system is synchronously presently connected with some of the Maghreb countries in North Africa and to the east with Western Ukraine.

- Nordel is a body for the co-operation between the TSOs in the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) – all these countries other than Iceland being interconnected.

- Baltic IPS (DC Baltija) is the Baltic Interconnection of the Power Systems of Estonia, Latvia and Lithuania, interconnected with Russia.

- TSOAI (Ireland) is the association of the TSOs of the Republic of Ireland and of Northern Ireland.

- UKTSOA, the United Kingdom TSO association[7], is for the purposes of this report considered as a national TSO, namely NGC.

ETSO, the European Transmission System Operators, is an organization comprising the members of UCTE, Nordel, DC Baltija[8], UKTSOA and TSOAI. ETSO's principal concerns are cross border trade issues including congestion management and network access. ETSO maintains a number of task forces including a task force on Security of Supply and Adequacy of Power Systems whose activities relate mainly to consideration of generation adequacy.

Within many countries of Europe (except in the Nordic countries which have had connections to UCTE and Russia for a long time), the grids were not designed to transfer power outside coordinated areas. Traditionally, interconnected systems were established for sharing reserves and providing better frequency response as well as coordinating power exchanges. By contrast networks operated by TSOs have been relatively strong. Consequently an inadequate level of coordination with neighbouring TSOs could result in a slow response to contingencies; which was evident from some of the blackouts that occurred during 2003.

[7] As a result of the introduction of BETTA (British Electricity Transmission and Trading Arrangements, which came into force on 1 April 2005, there is now one GB (Great Britain) TSO for England, Wales and Scotland, namely the National Grid Company plc (NGC). NGC, Scottish Power Transmission and Scottish Hydro-Electric Transmission are the transmission licensees owning, developing and maintaining the transmission system.

[8] Only Estonia and Lithuania are listed as having companies which are members of ETSO.

With the increasing liberalisation of electricity supply and the development of the Internal Energy Market (IEM) in Europe, significant increases in cross-border trades have been reported.

1.3 UCTE report on September 2003 in Italy

Following the blackout in Italy in 2003, UCTE has made a number of recommendations in its report "FINAL REPORT of the Investigation Committee on the 28 September 2003 Blackout in Italy"[9]. The recommendations are at both a UCTE level (resulting in the Operation Handbook) and at a national level. The recommendations are referred to later in this study.

1.4 Purpose of study

It is against this background that the Directorate-General for Energy and Transport (DG-TREN) initiated the contract PB Power/C2/31-2004-TREN/04/EC/ADM/S07.39015 requesting a Study to assess the adequacy of the present electricity transmission security network and reliability rules, to scrutinise and evaluate the rules under development and to specify further needs to improve the rules.

The main headings of the scope of work, shown in Appendix A, are as follows.

- Make an inventory and comparative analysis of the transmission network security and reliability rules in Europe.
- Analyse the current implementation of local, national and supranational grid codes.
- Scrutinise and evaluate the existing security and reliability rules (with particular emphasis on the UCTE Operation Handbook).
- Propose options for the scope of European transmission network security and reliability.
- Propose the scope and contents of the implementation framework of the defined rules and regulations in the codes.

The Study commenced on 1 January 2005. At the initial meeting on 18 January 2005, DG-TREN advised that the emphasis should be on reviewing operating as distinct from planning standards (as would be concerned with longer-term planning and development). A questionnaire for issue to TSOs had been prepared by PB Power but for practical reasons this was issued only on a selected basis. Instead TSOs were asked to identify the source (websites) of published documents (or in some cases to provide the documents) and consequently the Study has concerned itself with published documents only. This process has however limited the number of codes that could be reviewed within the study timescale.

[9] File: 20040427_UCTE_IC_Final_report.pdf

1.5 Structure of report

The report is divided into 6 Sections covering the items set out in the TOR, and is supported by 6 Appendices.

- **Section 2** makes an inventory of the local, national and supranational transmission network security and reliability rules relevant to the European transmission system security and describes the current implementation of the existing rules.

- **Section 3** provides a comparison and evaluation of the existing security and reliability rules, in particular with the UCTE Operational Handbook.

- **Section 4** analyses the issues and identifies problems to be addressed by the European Transmission Network Security Rules.

- **Section 5** discusses the scope of the European Transmission Network Security Rules.

- **Section 6** discusses scope and contents of the implementation framework.

Appendices:

- **Appendix A** shows the Terms of Reference for the Study.

- **Appendix B** shows the websites for the grid codes.

- **Appendix C** gives a detailed comparative analysis of the grid codes with the UCTE Handbook.

- **Appendix D** provides the comparison of the Codes for generation adequacy, and frequency control.

- **Appendix E** shows the comparison of the Codes for network (voltage) adequacy including reactive power control.

- **Appendix F** provides a summary of the recommendations of the Hagman Report, as published by Nordel.

2. LOCAL, NATIONAL AND SUPRANATIONAL RULES

2.1 Introduction

The objectives of this Section are to

- make an inventory of the local, national and supranational network security and reliability rules relevant to the security if the European transmission system (part of item 1 of the terms of reference) and
- is to address the second item of the Terms of Reference, namely to analyse the current implementation of the local, national and supranational grid codes and to check their consistency with existing and proposed security and reliability rules.

2.2 Reliance on published information

The websites from which we have accessed the documents include:

- European Commission (EC Directives, Regulations and publications from DG TREN);
- Governments;
- Regulators;
- Network Associations;
- Transmission System Operators;
- Electricity industry associations such as ETSO (European Transmission System Operators) and the North American Electric Reliability Council (NERC); and
- International technical organisations, notably Cigré, (Conseil International des Grands Réseaux Électriques – International Council on Large Electric Systems).

The reliance on published information has, in our view, added value to the report as the publication of regulatory documents such as grid codes is in accordance with EC policy as Directive 2003/54/EC, Article 5, and Regulation 1228/2003, Article 5.2, specifically require the safety, operational and planning standards used by TSOs to be made public. Where appropriate we have commented where we have been unable to access information that in our view should be in the public domain, thereby indicating the level of and differences between the information that is in the public domain, a key point of EC policy.

We have also taken note of the consultation presently being carried out by ERGEG, the European Regulators Group for Electricity and Gas, on the Guidelines for Congestion Management to be issued under EC Regulation 1228/2003.

2.3 Network Associations and TSOs

We have considered the security and reliability rules, namely the grid codes or equivalent documents, as produced by the following entities:

- Supranational network associations which we have referred to hereafter as "Synchronous System Associations"; SSAs - namely UCTE, Nordel, TSOAI (Ireland) and the Baltic IPS (DC Baltija).
- TSOs entering into technical agreements for interconnectors[10] between SSAs.
- TSOs, either national or area (Germany has 4 TSOs, for example).

As described later in the report we have concentrated on the technical codes of:

- three SSAs (UCTE, Nordel and DC Baltija); and
- a sample of TSOs in six countries (Belgium, France, Germany, Great Britain, Netherlands and Poland).

In some instances a number of separate but related documents were reviewed. The regulatory grid codes or equivalent documents reviewed were found to be varied in scope, presentation and content, depending on their evolution in the country concerned and the immediate purposes for which the codes are written. In some cases detailed technical requirements (e.g. generator voltage and/or frequency capability) are laid down in formal government decrees written in the form of legal documents.

For reasons amplified later in the report the UKTSOA referred to in the terms of reference is now in effect the National Grid Company (NGC) only as this TSO assumed role of the British system operator in April 2005.

2.4 Websites of the grid codes

The web links to the grid codes (or technical rules) and related or equivalent documents of the various organisations are listed in Appendix B. It is important to note that often more than one document was reviewed for the purposes of the Study and that each country/TSO appears to have arranged its codes and technical rules differently. As some of the grid codes are available only in the language of the country concerned, some translation to English language has been carried out where possible. In some cases, the documents have not been revised for some time and maybe outdated. As a consequence cross-referencing to a higher level document (e.g. that issued by an SSA) may vary.

[10] In general technical agreements for HVDC links.

2.5 Recent developments in electricity transmission regulation

Electricity regulation is constantly changing and evolving. Whilst undertaking the review:

- the consultation process on Congestion Management, co-ordinated by ERGEG, has proceeded;
- UCTE's Multilateral Agreement (MLA) came into force on 1 July 2005;
- UCTE issued the final versions of Operation Handbook Policy 4: Coordinated Operational Planning and Policy 5: Emergency Operations on 14 June 2005 and 15 September 2005 respectively;
- a number of TSOs have continued in the development of extensive requirements in their grid codes for the connection and operation of wind-powered generation;
- in France RTE has recently issued the "Référentiel Technique de RTE" (Technical Reference Guide)
- in Germany the formation of the Federal Network Agency (Die Budesnetzagentur) has been announced, with effect of July 2005
- The European Parliament voted on the proposed EC Directive on Security of Supply and Infrastructure on 5 July 2005
- (of relevance since this is a parallel process to the development of the UCTE Operations Handbook) the United States Energy Policy Act came into force in August 2005 and
- the North American Electric Reliability Council (NERC) issued its Reliability Standards for the Bulk Electric Systems of North America to take effect on 1 April 2005.

UCTE

The UCTE inter-TSO Multilateral Agreement (MLA), a legal instrument making the technical standards of the Operation Handbook binding and enforceable among TSO members, came into force on 1 July 2005[11]. UCTE states that a second step is to make these standards binding to both TSOs and users. The Inter-TSO liability cap is set to EUR5 million where damage has occurred but there are no financial sanctions where no damage has occurred.

The UCTE Operation Handbook (OH) was issued in complete form in July 2004 although the policies on Operational Planning (P4) and Emergency Operations (P5) have been updated in June and September 2005 respectively.

The OH and the MLA are reviewed in more detail later in the report, although the text of the MLA is not in the public domain. Details of the Compliance Monitoring Enforcement Process have yet to be announced.

[11] UCTE; Enforceable Reliability Standards, http://www.ucte.org/pdf/Aboutus/Mission/OH-and-MLA-2005.pdf

Nordel

The Nordic Grid Code (Nordisk regalsamling) is the subject of a protocol[12] signed by the TSOs of Denmark, Finland, Norway and Sweden. Most of Nordel's work is carried out by committees and working groups, notably Nordel's Operations Committee, Planning Committee and Market Committee.

The Nordic Grid Code is reviewed in more detail later in the report.

Great Britain – UKTSOA

In Great Britain a single wholesale market, including Scotland, was introduced on 1 April 2005 under the British Electricity Trading and Transmission Arrangements (BETTA). As a result there is now only one transmission system operator, NGC, in Great Britain with the responsibility of operating the transmission systems of three transmission owners (NGC itself, ScottishPower Transmission Limited and Scottish Hydro-Electric Transmission Limited). This change has contributed to appreciable changes in the (British) Grid Code. In the review we have treated the (British) Grid Code as a national or TSO grid code because following the introduction of BETTA the grid codes hitherto issued by the two Scottish companies have been superseded by the (British) Grid Code. Instead the relationship between NGC (as TSO) and the two Scottish companies as transmission owners is now governed by the new System Operator Transmission Owner code (STC) and this code is also reviewed.

The legal obligation on NGC, as national TSO, is through its Transmission Licence. The obligations on other users, including the obligations through the Grid Code, are discussed later in the report.

Ireland - TSOAI

The transmission systems of the Republic of Ireland (TSO – ESB (National Grid)) and Northern Ireland (TSO – SONI) are synchronously interconnected and both TSOs publish comprehensive and mature Grid Codes for the governance of their own networks. In particular the code WFPS1 "Wind Farm Power Station Grid Code Provisions" in the ESB (National Grid) code is worthy of mention. We have not reviewed these codes as they are similar in concept and structure to the British Grid Code, although much simpler and therefore (arguably) easier to follow. Both systems share generator reserves but the technical agreement between the two TSOs is not published and so we have not been unable to review what in effect would be the TSOAI Code. (The allocation and auctioning of the interconnector capacity is however in the public domain.) In the Republic of Ireland ESB (National Grid) and the transmission asset owner ESB Networks report to the Irish regulator the Commission for Energy Regulation (CER). In Northern Ireland SONI and the transmission asset owner NIE report to the Northern Ireland Authority for Energy Regulation (NIAER – hitherto known as Ofreg).

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[12] System Operation Agreement for the interconnected Nordic Power System, 1 April 2004 (replacing an earlier agreement)

Similarly the technical agreement for the Moyle HVDC interconnector between Northern Ireland and Scotland is not published either. (Although this interconnector is within the United Kingdom (of Great Britain and Northern Ireland to give it its full title), the respective electricity supply industries report to separate regulators, namely Ofgem in Great Britain and NIAER[13] in Northern Ireland.)

France

The energy regulator, CRE, is an independent administrative body governed by the laws of 10 February 2000 and 3 January 2003. CRE is responsible for opening up the electricity market to the above laws, in accordance with relevant EC Directives.

The TSO is RTE (in effect the transmission arm of Electricité de France (EDF)), was made official on 1 July 2000.

The publication of electricity laws, decrees and codes reflects the change from a highly centralized electricity supply industry to one which is market orientated, a process which is still undergoing change.

Germany

The German electricity networks have been subject to self-regulation by the Association of German network operators – Verband der Netzbetreiber – VDN.

The new German Energy Industry Act became effective on 13 July 2005 and the regulator, the Federal Network Agency (Die Bundesnetzagentur), commenced work on that date.

2.6 Codes reviewed

The codes reviewed are as in Table 2.1 and the detailed analysis is presented in Section 4 and Appendices C, D and E.

[13] Northern Ireland Authority for Energy Regulation (NIAER), http://ofreg.nics.gov.uk/

Table 2.1 – Summary of codes reviewed in detail

NETWORK ASSOCIATION	ASSOCIATION/ COUNTRY	DESCRIPTION OF CODE
Synchronous System Associations (SSAs)	UCTE (Continental Europe)	UCTE Operation Handbook
	Nordel (Denmark, Finland, Norway, Sweden)	Nordic Grid Code
	TSOAI (Republic of Ireland, Northern Ireland)	No TSOAI code as such exists, only national (TSO) Grid Codes
	UKTSOA (Great Britain i.e. England, Wales and Scotland)	See review of British codes under TSO Grid Codes.
	DC Baltija (Estonia, Latvia. Lithuania)	Baltic Grid Code
Technical agreements for (HVDC) interconnectors between SSAs	None	None are published other than the relevant clauses within the Nordic Grid Code
TSO Grid Codes, including equivalent and/or related documents	Belgium	Technical Transmission Regulations
	France	Référentiel Technique de RTE
	Germany	TransmissionCode 2003 (TC) issued by VDN
	Great Britain	Grid Code and system Operator – Transmission Owner Code (STC)
	Netherlands	NetCode, MeasuringCode, SystemCode and Co-operation Regulation
	Poland	Technical Grid Code

2.7 Regulation and compliance with codes

General

An overview of the responsibilities for security of supply (generation, transmission and distribution) is presented in the report by CEER entitled “Report on Security of Electricity Supply 2004”[14]. In particular the responsibilities of governments, regulators and TSOs (of the countries that participated in the report) are identified. The CEER report also contains a

[14] http://www.ceer-eu.org/

summary of power system security criteria (N-1 criteria). Both regulatory responsibilities and security of supply criteria are addressed further in our report.

Great Britain and Ireland

The starting point is the trend for restructuring of electricity supply industries. In England and Wales the hitherto vertically integrated industry was restructured in 1990 to allow the emergence of an electricity market and the entry of new generators and suppliers. The role of electricity regulator was established and a number of codes were introduced, in particular the Grid Code that sets out the operating procedures and principles governing NGC's (as TSO) relationship with all the users (generators, distributors) of the transmission system. The British Grid Code and related documents, as discussed in more detail later in the report are an example of a mature, yet still evolving, set of network security and reliability rules and which are subject to regulatory supervision and approval. A point to note, however, is that the British Grid Code does not necessarily govern the internal procedures within NGC as such - it governs the interface between the TSO and users - and there is a philosophical difference with other comparable codes elsewhere in Europe. There are, for example, detailed frequency criteria that are clearly stated in some European codes and which are omitted from the British Grid Code and related documents.

The Irish Grid Codes are similar in concept to, but much simpler than, the British Grid Code. The Irish codes are similarly subject to regulatory supervision and approval.

2.7.1.1 Continental Europe

The starting point was the coming into force of Directive 96/92/EC[15] concerning common rules for the internal market in electricity. Chapter IV, Articles 7, 8 and 9, made certain provisions for transmission system operation including technical rules. Implementation of the Directive has proceeded at different paces in the member countries of the EC and we find that this is reflected in the corresponding codes, as they exist at present. One factor would appear to be the operation of the regulator in each country, particularly the terms of reference (i.e. national policy), engineering capability and date of establishment. The European regulators themselves are nevertheless becoming a more cohesive force, firstly through the establishment of the Council of European Energy Regulators (CEER), the "Florence Forum" and more recently the establishment of the European Regulators Group for Electricity and Gas (ERGEG).

Of the counties whose codes we have reviewed in detail, we would note that:

- the Belgian regulator CREG appears to concentrate almost exclusively on economic, market and tariff aspects[16]

[15] (Directive 96/92/EC was repealed by Directive 2003/54/EC.)

[16] CRE (France), CREG (Belgium) and DTe (Netherlands) have recently announced a consultation on regional market integration, including improvement of security of supply. CREG has also recently called for reinforcement of Belgian transmission interconnections.

- the French regulator CRE was established under the laws of 10 February 2000 and 3 January 2003 and that most of its subsequent work has been concerned with market opening

- in Germany the codes have been agreed by industry through the competent associations and

- the regulator in the Netherlands, DTe, has been established for some years.

Another point to be borne in mind is that historically the internal transmission networks have been well developed but the interconnections with neighbouring countries have been of limited capacity. With the development of the internal electricity market these interconnections are now being required to carry higher flows.

Electricity market reform has led to decentralized decision making, particularly regarding construction and operation of generating plant. This may lead to greater volatility of power flows on transmission systems. Effective price regulation may also lead to a reduction in excess transmission capacity.

2.7.1.2 Supranational associations

The two principal supranational associations UCTE and Nordel are established through multilateral agreements between TSOs and, as associations, appear to be self-regulating.

2.7.1.3 Precedence

Later in the report we comment on legal precedence. We identify two instances where there are statements to the effect that national electricity laws take precedence over the agreements of supranational associations.

2.7.2 Gaps between codes and actual behaviour

Gaps that have been publicly identified are summarised in the table below.

Table 2.2 – Gaps between codes and actual behaviour

Serial	Gap	Reference
1	For interconnections between UCTE control blocks, confirm, set up or update where necessary the emergency procedures between the involved TSOs. The procedures should be made mandatory and integrated in the joint operator training programs. Their performance should be evaluated at regular intervals. Improve defence plans including load-frequency control in event of system split. Implement these measures in national grid codes.	UCTE Report on Blackout in Italy 28 September 2003, recommendations R1, R5, R6, R8 and R9.

Serial	Gap	Reference
2	UCTE Operation Handbook policies 3 and 5 to harmonise N-1 security of supply criterion, including interval within which system should be returned to an N-1 state.	UCTE Report on Blackout in Italy 28 September 2003, recommendation R2.
3	Improve Day-Ahead Congestion Forecast (DACF) procedures.	UCTE Report on Blackout in Italy 28 September 2003, recommendation R3.
4	Extend real-time data exchange among TSOs, improve operation of state estimators and accelerate Wide Area Measurement System (WAMS) Programme.	UCTE Report on Blackout in Italy 28 September 2003, recommendations R4 and R7.
5	Improve tree trimming practices and auditing thereof	UCTE Report on Blackout in Italy 28 September 2003, recommendation R9.
6	Blocking of on-load tap changers of transformers under severe low voltage conditions.	UCTE Report on Blackout in Italy 28 September 2003, recommendation R10.
7	Discrepancies between traded volumes and physical current flows.	Swiss Federal Office of Energy press release 2 December 2003.
8	High unscheduled power flows from the north into the grids of the Netherlands and Belgium causing infringement of N-1 criterion. These flows are attributed to high wind generation in Denmark and Germany and led to curtailment or reduction of commercial contracts.	UCTE System Adequacy Retrospect 2004, section 4, Transmission System Adequacy – also reported by TenneT; major transit flows via the TenneT grid in the winter of 2004/05.
9	Need to examine (N-1) criterion due to hidden modes of failure.	Prof Janusz W. Bialek, University of Edinburgh[17]
10	Requirement for simulation exercises to train operators to restore supplies under emergency and/or blackout conditions.	IEEE PES General Meeting, Power System Operations Committee, 13 June 2005[18]

[17] http://www.econ.cam.ac.uk/electricity/news/autumn03/bialek.pdf

[18] http://www.ieee.org

Serial	Gap	Reference
11	Operators and Control Centres (Improvements required) Information: Improved visibility of bulk system. Co-operation and communications: Demand of clear communication protocols Regulations/procedures: Adjustment/certification of procedures of entities involved. Authorities/obligations of operators: Preventive actions may affect commercial transactions. Availability and use of technical tools: Bring technical control centre equipment on up-to-date state/automatic load shedding schemes and status alarm systems. Preparedness of operators: Consequent and regular training of taking preventative actions and restoration; certification.	Cigré, WG C2.03[19], Session 2004, SC C2 Workshop on Large Disturbances, Paris, 30 August 2004
12	Key lessons from blackouts for improving system operation include: • Appropriate real-time management tools • Appropriately qualified staff to manage crisis situations • Effective management of vegetation around transmission lines	International Energy Agency[20], Workshop on Transmission Network Performance in Competitive Electricity Markets, Scoping Paper, November 2004

[19] www.cigre.org

[20] www.iea.org

Serial	Gap	Reference
13	Lessons learnt in respect of TSO/Distribution co-operation from South London Blackout 28 August 2003. • Outage planning process-ensure all parties including distribution network operators and large users (e.g. underground transport) are aware of the risks to security of supply under pre-arranged outage conditions. • Network analysis studies-impact of unusual running arrangements – need to share data and models.	Presentation by EDF Energy, UK, to Round Table 3b, CIRED, Turin, June 2005
14	Differences between Nordic operators include: • No common rules for forced load shedding • Connection requirements require harmonisation • Balance control and balance regulation procedures differ in subsystems	Hagman Energy AB: Survey of system responsibility in the Nordic countries, February 2005 (published by Nordel)
15	German grid is not always N-1 secure.	Illerhaus, Cigré-IEEE workshop, Oslo, May 2003
16	Unexpected power flows through bottlenecks in the Belgium Grid	P Bornard (RTE), IEEE PES 2003 T&D Conference, Panel Session

2.8 Conclusions

- The report is based on documents accessed from the Internet.
- The structures and publishers of (governments, regulators, TSOs) existing transmission network security and reliability rules vary in scope, presentation and content.
- The transmission security and reliability rules may be contained in more than one document in a given jurisdiction.

- Some documents have not been revised for some time and may be outdated and cross-referencing may also vary.

Organisational issues include the following:

- SSAs being apparently answerable to their member TSOs only.
- Codes and other regulatory arrangements, including regulators themselves being at differing stages of development.
- Variability of regulatory documents, such as codes and supporting documents, in the public domain.
- Legal precedence of codes, particularly supranational codes over national codes.

Recurring themes on implementation of rules and gaps between codes and actual behaviour are:

- Lack of a common definition of the ‘N-1’ security criterion or equivalent, particularly on interconnections across common borders.
- Lack of effective exchange of data in real-time of the status of a neighbouring network, to the extent that it is material for the operation of a given network.
- Need for improvement in defence plans, particularly load shedding.
- Requirement to train operators under simulated conditions; certification/authorisation of operators.

3. COMPARISON AND EVALUATION OF EXISTING SECURITY AND RELIABILITY RULES

3.1 Introduction

The objective of this section is to undertake a comparative analysis, scrutinise and evaluate the existing security and reliability rules and the rules under development by network associations and to compare the rules with other international rules. In particular comparisons are made with the UCTE Operation Handbook.

This section addresses the second part of item 1 and all of item 3 of the Terms of Reference (TOR).

3.2 Comparison

The comparison of grid codes is based on information in the public domain, either downloaded from the Internet (Appendix B) or obtained from papers and presentations published by bodies such as Cigré.

The comparison of the published documents as reviewed is provided in tables in Appendix C – Document Comparison. Tables in Appendices D and E cover generation adequacy and network adequacy respectively; these are the two main themes for the security of supply underlying the requirement in Article 5.2 of EC Regulation 1228/2003 for the safety, operational and planning standards.

The tables in Appendices C, D and E describe the current implementation of local, national and supranational grid codes; comparative analysis of the transmission network security and reliability rules as well as comparing these rules with the UCTE Operation Handbook.

The principal points arising out of the review of the codes are discussed below, in the order already presented in Table 2.1, under the following headings.

- Relevant documents
- Roles and responsibilities
- Development and updating process
- Links to supranational rules
- Compliance with the UCTE Operation Handbook

These headings were chosen to address part of the first term of reference (see Appendix A):

“A comparative analysis between these different transmission grid codes shall be done. This analysis should especially focus on technical issues and on organizational issues like roles and responsibilities of TSOs, network users, stakeholders, regulators in the codes as such and in the development process of the codes”.

We have assumed some documents to be equivalent to a grid code. Documents have been classified in order of legal precedence and who is responsible for issuing them (government, regulator, TSO), using the structure of the British Grid Code and related documents as a comparator as shown in Table3.1. (The British Grid Code has been selected for this exercise, as it is both a comprehensive and mature document, albeit under constant review).

Table 3.1 – Document Classification using Great Britain as an example

General category	Specific document	Issuing organisation
LAW (or Act)	Electricity Act 1989, Utilities Act 2000, Energy Act 2004	DTI (Government)
Decree (Statutory Instrument, Arrêté)	Electricity Safety, Quality and Continuity Regulations 2002	DTI (Government)
Licence	Transmission Licence	Ofgem (regulator)
Grid Code or Equivalent Document – Principal	The Grid Code (GC) The System Operator Transmission Owner Code	NGC (TSO) Ofgem (regulator)
Subsidiary Document or Standard	Security and Quality of Supply Standard (SQSS)	NGC (TSO)
	Balancing Principles Statement (BPS)	NGC (TSO)
	Engineering Recommendations (ER)	Energy Networks Association
	National Grid Technical Specifications (NGTS)	NGC (TSO)

Many operating systems have different objectives for setting up their standards. For example, most of the countries within the UCTE are keen "to keep the lights on" i.e. an emphasis on security whereas in Nordel, the main objective is "to make use of the advantages of interconnected operation… and maintain… a satisfactory level of security and quality".

The key aspect of load/frequency control on interconnected systems mainly addresses three time frames and these are generally considered as Primary Control (or governor response, designed to arrest frequency decay), Secondary Control (designed to reset the primary control response as well as to balance supply and demand) and Tertiary Control.

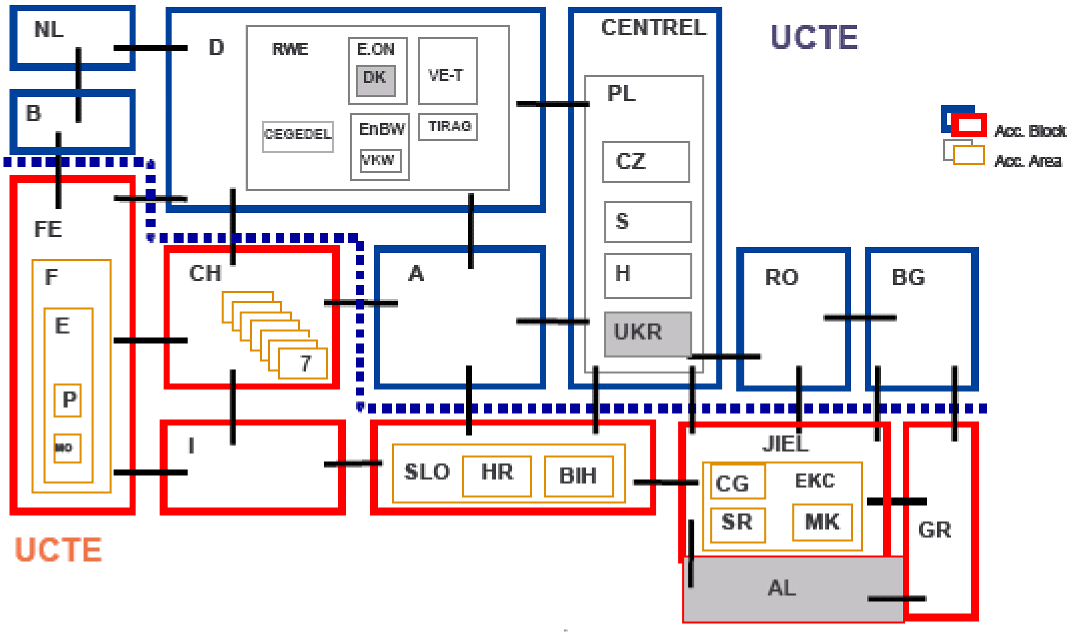
3.2.1 UCTE: Operation Handbook (OH)

Relevant documents

Philosophy. UCTE's basic philosophy is one of decentralized control without any supra-regional "UCTE control centre" governing the whole system. Instead UCTE relies on adherence to the OH. UCTE is not a system operator at all and is not responsible for dispatch.

Operationally UCTE comprises Control Areas (often national systems) and one or more Control Areas may form a Control Block for the purpose of exchange balance (load-frequency control), metering and accounting (of unintentional deviations of cross-border energy flows). UCTE has two Co-ordination Centres (North and South) for organizing the accounting process. The diagram below in the OH presents the structure and organization of the Control Blocks/Areas of the UCTE synchronous area by countries or companies (i.e. TSOs).

Fig 3.1 – Hierarchical Levels of UCTE Co-ordination



UCTE states that the main intention of the "UCTE Operation Handbook", as a comprehensive collection of all relevant technical standards and recommendations, is to provide support to the technical operation of the UCTE interconnected grid (the Synchronous Area), including operation policies for generation control, performance monitoring and reporting, reserves, security criteria and special operational measures[21]. The basic objective of the Operation Handbook is to ensure the interoperability among all TSOs connected to the Synchronous Area.

The OH excludes standards for network access of customers and commercial arrangements that are expected to be covered by national grid codes, laws and contracts (OH: Introduction – E). The OH therefore excludes planning codes and connection conditions that would form part of a TSO Grid Code.

[21] http://www.ucte.org/

Policies. The OH comprises eight Policies, each of which is structured into an introduction, criteria, requirements, standards, procedures and guidelines. In general the policies contain comprehensive statements of what is to be done, with some indication as to by whom and when. Three of the Policies are supported by Appendices. The style of the OH is less assertive than other major Codes (e.g. NERC Reliability Rules and NGC's Grid Code, both reviewed later in the report) and so the responsibilities for implementing and action are in some cases not clear. In particular the compliance monitoring procedure is not yet available although UCTE states that it is under development.

The Policies repeatedly state the requirements for inter-TSO cooperation and agreement. We recommend that such inter-TSO agreements should be registered with and be available for review by UCTE. We also comment on the relationship between the Policies of the OH and the documents of ETSO regarding power exchange and congestion management.

In the table below we present our detailed comments on the OH Policies and Appendices.

Table 3.2 – Detailed Comments on the Operation Handbook

Policy	Title	Status	Comment
P1	Load-frequency control and performance	Final version	Control Areas/Blocks to implement the Policy but no mention of any subsidiary procedures, particularly where a Control Block comprises Control Areas of more than one country.
P1A	Primary Control	Final version	P1-A (Primary Control) contribution coefficients to be published annually but there is no example of such a publication in the public area of UCTE's website. The MW amount of Primary Control is fixed and not optimized with system demand[22]. P1-A-P4.1. Control Performance Reports of Load-Frequency Control appear to be accessible to Members only.

[22] ETSO; Current State of Balance Management in Europe, section 2.3, December 2003, www.etso-net.org

Policy	**Title**	**Status**	**Comment**
P1B	Secondary Control	Final version	P1-B. Secondary Control is under automatic generator control such that a control block/area that is in imbalance following a disturbance autonomously restores the frequency to the target frequency and the power interchanges with adjacent control blocks to their pre-set levels. (This arrangement differs, for example, from Secondary Control in Nordel and Secondary Response in Great Britain which do not employ automatic generator control on blacks of generation.)
P1E	Measures for Emergency Conditions	Final version	P1-E-S2 - The statement "all TSOs have to notify the neighbouring TSOs in case of an emergency situation and ask for help" may be regarded as imprecise and weak.
P2	Scheduling and Accounting	Final version	P2 applies to unintentional deviations in power exchanges between Control Areas/Blocks only. The cross reference to the Exchange Program is unclear.
P2A	Scheduling of Power Exchange	Final version	Exchange Program (P2A) is not cross-referenced with ETSO procedures (in draft). However data protocols in P2 are to ETSO Electronic Data Exchange (EDI) standards.
P3	Operational Security	Final version	P3 does not cover long term planning requirements (i.e. system development) but does cover medium and short-term planning of outages.

Policy	Title	Status	Comment
P3A	N-1 security (operational planning and real-time security)	Final version	P3A-C1 – definitions of N-1 criteria differ between TSOs. P3A-R2.1 – N-k or N-2 to be considered where there is “sufficient probability”. P3A-R1.1 – TSOs monitor N-1 criterion for their own system through observation of interconnected system – a “wide area” view may be required but data requirements from neighbouring TSOs are not specified (nor is there a mechanism for mutual identification and agreement of data requirements). The frequency at which security computations are to be carried out is not specified (in North America the intervals are typically between 5 and 10 minutes). P3A – R2.1 – after a contingency each TSO is to return its power system to N-1 compliant condition “as soon as possible” – in Nordel this is to be done within 15 minutes. P3A – S3.1 - Data exchanges information on pattern of generation subject to national confidentiality. P3A – S3.1 – Data exchanges - and P3A - P3 – on-line calculations for network security - consider “real time” data but do not define at what intervals this data should be exchanged. P3A-P3 also applies an arbitrary limit to the extent of the network representation to be exchanged.

Policy	Title	Status	Comment
P3B	Voltage Control and Reactive Power Management	Final version	P3B – S4 – Standards states that the voltage range for boundary substations has to be agreed. This standard should also include limits on voltage step changes and on durations of high voltages following system contingencies.
P3F	Information Exchanges between TSOs for Operation	Final version	Exchanges of real-time data to neighbouring TSOs should meet the requirements of State Estimator programs.
P4	Co-ordinated Operational Planning	Final draft	This Policy is too vague. Above all the procedures for capacity assessment and congestion management need to be more explicit and the cross-referencing to ETSO documents should state which takes precedence (i.e. are the bibliography references for information only or for conformity?).
P4A	Outage scheduling	Final draft	P4A-R1 – regional groups are not defined.
P4B	Capacity assessment	Final draft	Introduction. Entity responsible for coordinating the TSOs' capacity assessment process is not stated. P4B-C2 –The entity responsible for compiling the UCTE reference base-case is not stated.

Policy	Title	Status	Comment
P4C	Day-Ahead Congestion Forecast (DACF)	Final draft	P4C-S2 – the UCTE-format for DACF load-flow data is not in the publicly accessible part of the UCTE website, for stated reasons of confidentiality (production schedules). There is a case for making the underlying principles and activities of the UCTE Steering Committee and Working Groups more transparent. P4C–S6 and P4C-G3 – The subsequent procedure for TSOs after identification of congestion is not clear.
P4D	N-1 Security Management	Final draft	P4D-P1 – The procedure in event of identification of congestion is in outline only and refers (bibliography) to ETSO papers which themselves are principally discussion documents and not necessarily agreed procedures.
P5	Emergency Operations	Final draft	This Policy is a statement of principles that should be incorporated into TSO and inter-TSO procedures.
P5A	System operation in insecure conditions	Final draft	P5A-R1.1 – Agreements and procedures between neighbouring TSOs required. P5A-R1.2 – Exchange of information. P5A-R1.3 and P5A-S2.3 – The details of bilateral/multilateral procedures (including defence plans) are left to subsidiarity – should these procedures not be approved by UCTE? P5A-R4 – There does not appear to be an agreed level of proficiency for dispatching operators, procedure for authorization or ongoing accreditation.

Policy	Title	Status	Comment
			P5A-G1 and P5A-G10 - The authority identifying which TSO should declare an alert should be stated; also, in an emergency, authority should be delegated in real time to a particular TSO in order to co-ordinate/instruct the actions of other TSOs. Another convention that could be considered is whereby, in the event of two or more TSOs being islanded and an underfrequency situation developing, the importing TSO always sheds load first. P5A-P1 and P5A-G13 – System disturbance reports to be submitted by TSOs to UCTE. No indication given of to whom UCTE would report. P5A-G14 – There should be a common standard for the performance of new generation units, to be incorporated into TSO Grid Codes as a connection condition. Existing generation units not complying such a standard could be granted derogations in accordance with an agreed procedure.
P5B	System restoration after collapse	Final draft	P5B-S4 – the procedure for assessing and declaring the load limits of tie-lines should be agreed. P5B-G3 – Each TSO should have its restoration plan available for review by UCTE.
P6	Communications Infrastructure	Final draft	Introduction. The terms pNOC and sNOC do not appear elsewhere in the OH. The responsibility for the Electronic Highway is not clear nor is its relationship to the ETSO Electronic Data Interchange (EDI).

Policy	Title	Status	Comment
P7	Data Exchanges	Final draft	Non-technical clauses covering handling of data.
P8	Operational Training	Projected	Not yet available.
Appendix			
A1	Load Frequency Control and Performance	Final Version	Detailed description.
A2	Scheduling and Accounting	Final Version	Detailed description.
A4 A4A	Co-ordinated Operational Planning Capacity Assessment	Final draft Final draft	 The relationship between A4A and the ETSO Capacity Assessment publications is not clear. The detailed security aspects to be exchanged between neighbouring TSOs are not defined.
A4B	UCTE Network Calculations	Final draft	The "UCTE format" for the data set is not defined (see previous comment). The UCTE network datasets do not appear to include for on-line contingency analysis performed close to real time (say at intervals of 5 to 10 minutes).

Points arising from review of OH Policies. In addition to the comments made against the Policies in the table above the following general points arise.

1. Whether the UCTE concept of relying on inter-TSO co-ordination and de-centralised control will be adequate for the IEM in future?

2. Should the Coordinating Centres not have a more direct and enhanced role similar to that of the Reliability Coordinators under the NERC Reliability Rules? (At present the role of a UCTE Coordinating Centre role appears to be that of accounting for unintentional power exchange deviations.)

3. The requirements for information exchanges between TSOs are stated in different ways in various parts of the OH and should be combined in a single data exchange code.

4. The information in the "Members only" area of the UCTE website should be reviewed as this may be unduly restrictive and so impede transparency. (Market-sensitive information may be regarded as confidential but data exchange templates, for example, may not be.)

5. Inter-TSO agreements and procedures should be registered with and be available for review by UCTE.

6. The role of ETSO in respect of market-related (balancing and settlement) procedures applying to TSOs should be stated briefly and clarification should be given to the status of ETSO documents referred to in the OH.

Enforceability. A Compliance Monitoring and Enforcement Process (CMEP) is proposed, but its present status is unclear[23].

ERGEG position and recommendations on OH

At the 12th meeting of the Florence Forum in September 2005, ERGEG published a paper entitled "ERGEG Position and Recommendations on the UCTE Operation Handbook" identifying the following key issues and actions in the executive summary of the paper:

1. Recommendations on General Issues
   a. Formal modification procedures need to be defined
   b. Congestion management related issues in Policy 4 must be aligned with the Congestion Management Guidelines of the Regulation (EC) 1228/2003 (CM Guidelines)
   c. In particular and related to the CM Guidelines, the definitions and assessment methodology of physical cross-border capacities must be tackled
   d. For the full applicability and liability for all the stakeholders, MLA, being a private contract only among the TSOs within UCTE, shall be complemented with a EU-wide legislation (e.g. Security and Reliability Guidelines according to the Article 8(4) of the Regulation (EC) 1228/2003)
2. Recommendations on Technical Issues

[23] G Maas, UCTE Compliance Monitoring and Enforcement Process, 11th Energy Regulatory Forum, Rome, 20 September 2004

   a. A more precise and transparent definition of (N-1) security criteria is needed
   b. Restoration plan (Policy 5) must be made mandatory requirement.
   c. Experiences and lessons learned from large disturbances in the past shall be taken into account (in particular those presented in reports on the September 28, 2003 blackout in Italy)

3. Recommendations on Validity and Applicability
   a. MLA[24] shall be discussed with ERGEG, which might in turn result in some requests for change or for additional regulatory framework, either from ERGEG or national regulators
   b. Compliance monitoring and enforcement process – the key objective is to ensure compliance with the standards defined in OH. This shall be done in a transparent manner and involving regulatory authorities where appropriate.

4. Conclusions
   a. ERGEG welcomes and recognizes the work on OH done by UCTE
   b. ERGEG stresses the need to ensure the binding character of the "new" rules, compliance monitoring and enforcement procedures as well as interactions between the OH and market aspects.
   c. ERGEG also stresses that all possible effort needs to be invested by UCTE, regulators and also stakeholders other than the TSOs' associations, to complete the recommended actions. This will contribute further to the IEM development and to the strengthening of the operational security.

PB Power comment. We agree with the findings of the ERGEG paper. In respect of congestion management there is clearly a strong connection between "physical cross-border capacities" and security of supply.

Roles and responsibilities

UCTE is the association of transmission system operators in continental Europe, providing a reliable market base by efficient and secure electric "power highways" including the control of the 50 Hz UCTE frequency related to the nominal balance between offer and demand.

The OH, which contains the UCTE technical rules and standards, is an annex to the Multi-lateral Agreement (MLA) between transmission system operators (TSOs).[25] The MLA came into force on 1 July 2005.

[24] Presently referring to the first three policies of the OH

[25] L de Francisci, UCTE Multilateral Agreement, 11th Energy Regulatory Forum, Rome, 20 September 2004

Development and updating process

The current complete version of the OH is dated 20 July 2004. although some of its policies and appendices were issued more recently. Policies 4 to 7 inclusive are at the Final Draft stage. Policy 8 – Operational Training is "projected" and no text has been issued.

The preparation of the OH has been the responsibility of UCTE's Working Group "Operations and Security", as directed by the Steering Committee which is composed of one national representative of each member country.

There is an OH Consultation Forum to which interested parties may register. Correspondence was active in 2004 and into early 2005, reflecting the drafting activity then in progress.

Links to supranational rules

In the bibliographies to the Policies there is some cross-referencing to ETSO documents, particularly in respect of power exchange and congestion management. Where such reference is made, the precedence should be stated.

3.2.2 Nordel[26]

Relevant documents

General. The Nordic Grid Code (Nordisk regelsamling) is the subject of a protocol signed by the Nordic TSOs, namely the TSOs of Eastern and Western Denmark (Elkraft and Eltra respectively), Finland (Fingrid Oyj), Norway (Statnett SF) and Sweden (Svenska kraftnät). The transmission system in Eastern Denmark is synchronously connected with that of Sweden (and therefore with those of Norway and Finland). The transmission system of Western Denmark is synchronously connected with that of Germany (E.ON Netz) and therefore with that of the UCTE.

The Nordic Grid Code covers the operation of both the synchronous interconnectors between Nordel countries and the HVDC links across the Skagerrak, Kattegat and elsewhere in the Baltic sea region. The Nordic Grid Code comprises the following.

- General provisions for collaboration
- Planning Code
- Operational Code (System Operation Agreement)
- Connection Code

[26] www.nordel.org

- Data Exchange Code (Data Exchange Agreement between the Nordic transmission system operators (TSOs)

The Operational Code and the Data Exchange Code are binding agreements signed by the Nordic TSOs. The Planning Code is a preferred requirement and has the status of a Nordel recommendation. The Connection Code can also be seen as a Nordel recommendation but many parts are binding in different countries.

The subsystems of Norway, Sweden, Finland and Eastern Denmark being synchronously connected are termed the *synchronous system* whereas that of Western Denmark is considered as a *subsystem* for the purposes of the Nordic Grid Code.

Compliance. A stated objective of the Nordic Grid Code is that it should be a starting point for the harmonisation of national rules, with minimum requirements for technical properties that influence the operation of the interconnected Nordic electric power system. The Nordic Grid Code states that it must be subordinate to the national rules in the various Nordic countries, such as the provisions of legislation, decrees and the conditions imposed by official bodies.

We would comment that the Nordic Grid Code is a high level document setting out the technical principles for the planning and operation of the Nordel system, including load/frequency control, system protection, load shedding, transmission capacity and joint operation on each ac or dc interconnector. In some instances technical information is stated in detail. The emphasis of the Nordic grid Code would appear to be on what should be done rather than by whom and when. Furthermore although different committees draft the codes there would appear to be scope for more co-ordination between the codes. For example the Data Exchange Code is mainly a high-level statement of data to be exchanged for the purposes of modeling and planning a system.

Operational Code. A separate appendix, Appendix 4, Exchanging information, to the Operational Code (System Operation Agreement) outlines the data to be exchanged for operational purposes but is not detailed. Appendices 7, Joint Operation of interconnectors (i.e. neighbouring TSOs), however nominate the operations centres responsible for monitoring and control. At the Nordel Annual Meeting 2005[27], it was announced that the Nordic Outage Planning System (NOPS) had been taken into operation during Spring 2005 and that the specification of the Nordic Operation Information System (NOIS) is ongoing. No further details of these two systems are published however. At the same meeting a statement was made that a programme for training of control center operators had started and that a Nordel Training Group had been established. System Operation Agreement, Appendices 7 (Joint operation of inteconnectors) contain outline procedures for disturbance management, an operational disturbance being defined as typically loss of circuit or generating unit.

Load-frequency control. Another particular point to observe is that the philosophy behind the operation of the load/frequency control in the *synchronous system* differs from that of UCTE. Distribution of the requirement for the frequency controlled disturbance reserve is

[27] Nordel; Annual Meeting 2005; Håkon Borgen, Highlights Operations Committee.

updated once a week, or more often if required. The requirement per TSO depends on load level and dimensioning faults. The secondary (spinning and non-spinning) reserves (fast active disturbance reserves, including demand control, to be available within 15 minutes) are partly directly controlled by the TSOs and partly traded on a common regulating market. There is no automatic generation control in the *synchronous system*.

Miscellaneous. Nordel also publishes an annual report of fault statistics (Driftstörningsstatistik) that provides a comprehensive comparison of the performance of the systems, including plant and equipment, of the member TSOs.

A critical assessment of differences between Nordic operators is presented in the report by Hagman Energy AB entitled “Survey of system responsibility in the Nordic countries”, dated February 2005 and published by Nordel. (A summary of the findings of the Hagman Report is presented in Appendix F)

Roles and responsibilities

Nordel states that it is a body for co-operation between the transmission system operators (TSOs) in the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden), whose primary objective is to create the conditions for, and to develop further, an efficient and harmonised Nordic electricity market. The organisation adopted new By-Laws at its Annual Meeting in June 2000, thereby formalising Nordel’s changed status as an organisation for the TSOs in the Nordic countries.

Development and updating process

Nordel’s highest decision-making body is the Annual Meeting, whose participants are drawn from representatives of the TSOs. Most of Nordel’s work is carried out by committees and working groups. Nordel’s Operations Committee, Planning Committee and Market Committee are made up of the leaders responsible for the corresponding sectors in the TSOs. The working groups are composed of technical specialists drawn from the various sectors involved in co-operation within Nordel.

The protocol signed by the TSOs states that the Nordic Grid Code must be updated when necessary and, in addition, it must be reviewed at least one a year. Nordel’s Planning Committee is responsible, in consultation with its Operations Committee, for the continued work on and further development of the Nordic Grid Code. The Operations Committee has particular responsibility for the Operational Code. Nordel’s legal advisor group must always be consulted before any decision is taken that involves significant changes to the Nordic Grid Code.

Compliance with the UCTE Operation Handbook

The Operational Code in the Nordic Grid Code states that Eltra manages the balance regulation of the Western Danish area, within its sphere of responsibility for the UCTE system, in accordance with an agreement with E.ON Netz. The Nordic Grid Code notes that special conditions for Eltra as a member of UCTE include N-1 security, primary and secondary control.

3.2.3 DC Baltija[28] - Baltic Interconnection of Power Systems (Baltic IPS)

Relevant documents

The Network Code of the Baltic IPS states that it provides a collection of principles and standards to reliable functioning of the transmission power networks of Estonia, Latvia and Lithuania and features a basis for coordinating parallel operation with the power systems of Russia and Belorus.

The Network Code includes sections on the following.

- Technical criteria and standards for improving reliability, including criteria for frequency control, stability, voltage control, protection and substation plant.
- Planning and dispatch, including N-1 security criterion, operational planning, power and energy balance, control of normal operations, voltage control, emergency operation, islanded operation and training of operating personnel.
- Long-term planning of transmission network development.
- System of collection, processing and transmission of information.
- Processes for further development of the Network Code.

We would consider the Network Code at present to be mainly a statement of principles for the control block operator and the respective TSOs in each of the three Baltic states. Furthermore Baltic IPS is a relatively small part of the synchronous system that also includes Russia and Belorus and therefore the lead on frequency control will come from Russia. The details for the cooperation with the other parties in the synchronous systems (e.g. users) are not treated in detail.

Role and responsibilities

The interconnection of the power systems of Estonia, Latvia and Lithuania as an organisation (Baltic IPS) was founded after the Baltic countries regained complete independence of in 1992. The Baltic IPS comprises the state owned power systems of Estonia (Eesti Energia), Latvia (Latvenergo) from Lithuania (Lietuvos Energija), all of which operate in parallel (on a synchronous AC grid) with the Unified Power System (UPS) of Russia (RAO UES) and the power system of Belarus (Belenergo). The common grid at 330kV dates from 1960.

The Baltic IPS Regional Control Centre (DC Baltija) in Riga carries out the operational-dispatch management of the Baltic IPS within the frame of its legal competence and in

[28] www.dcbaltija.lv

accordance with the multilateral agreement on parallel operation of the power systems of the Baltic countries.

Development and updating process

The Network Code is in draft only although Chapter 5 (System of collection, processing and transmission of information) is in force already.

The Network Code provides for a Network Code Commission, on which the operators of all three countries are represented, to meet at least 2 times per year to consider changes to the Code.

Compliance with the UCTE operation handbook

At present the Baltic IPS and importantly the systems of RAO UES and Belarus are not connected with the UCTE system. However in the Network Code a general statement is made that consideration may be given to the drafting or changing of the present operating principles of the Baltic IPS for parallel operation with other power systems and that the principles of organisations including UCTE and Nordel are considered. UCTE has recently announced the start of a major study of an interconnection of the transmission systems UCTE and IPS/UPS (i.e. transmission systems of the Baltic States, Russia, Belorus and others).

We are therefore uncertain that there is an immediate requirement for the Network Code to line up with the UCTE Operation Handbook. Another development is the projected HVDC link between Estonia and Finland and we would expect this development should shortly also be taken into account in the Network Code and be subject of a technical agreement between the respective TSOs.

3.2.4 Belgium

Relevant documents

The Belgian Technical Transmission Regulations are in the form of an “Arrêté” or decree published by the Federal Public Service Economy, SMEs, Self-employed and Energy of the Belgian Government, with effect from 19 December 2002[29]. The Technical Transmission Regulations were prepared after a request from the European Commission followed a ruling in 2002 by the Court of Justice of the European Community that Belgium had not taken all the measures necessary to comply with the EC Directive 96/92/CE concerning the common rules for the internal electricity market. The Technical Transmission Regulations are written in the style of a legal document and impose requirements on the System Operator although these requirements tend to be worded in a general fashion – for example statements of technical parameters, particularly operating parameters such as voltage and frequency limits, are minimal.

[29] Arrêté royal établissant un règlement technique pour la gestion du réseau de transport de l’électricité et l’accès à celui-ci, http://mineco.fgov.be/energy/markets_liberalisation/electricity/law_electricity_liberalisation_005.pdf.

Roles and responsibilities

The electricity regulator is CREG[30] and the TSO is Elia[31].

Development and updating process

There is no indication of the process for reviewing or updating Technical Transmission Regulations or even what body might undertake such a task (there are apparently no procedural or technical requirements published by the federal regulator CREG, for example).

Links to supranational rules

The only substantial supporting document published by the system operator, ELIA, and which makes reference to the Technical Transmission Regulations is the contract for access to the system, as would be entered into with system users.

Compliance with the UCTE operation handbook

Although the Technical Transmission Regulations mention interconnections to other European countries, there is no mention of UCTE as such, nor to the UCTE Operation Handbook or previous UCTE operating principles. The Technical Transmission Regulations contain comprehensive requirements for connection conditions and for the provision of planning data, but the operational data to be provided by Users is not specified in detail. Primary reserve (control) is only partially defined (Art 242) and in respect of secondary control (response) there is no mention of automatic generator control of the Belgian system as a balancing area, as is (now) required by the UCTE Operation Handbook.

3.2.5 France

Relevant documents

The governing law is law No 2000-108 of 10 February 2000 relating to the modernisation and development of the public electricity service. Decree 2003-588 of 27 June 2003, published in the Journal Officiel de la République Française, states the general technical specifications for connections to the transmission system[32] and in Article 2 specifies the requirements for four documents to be provided by the transmission system operator, namely:

- “Cahir des charges fonctionnel du système de protection” (functional schedule of responsibilities of the protection system);

[30] Commission de Régulation de l'Electricité et du Gaz, http://www.creg.be/indexie6.html

[31] www.elia.be

[32] http://www.legifrance.gouv.fr/WAspad/UnTexteDeJorf?numjo=INDI0301440D#; General connection conditions

- "Référential Technique du réseau public de transport" (technical reference code of the public transmission system);
- Convention d'exploitation (exploitation convention); and
- Convention de raccordement (connection convention).

Subsidiary decrees (arrêtés) of 4 July 2003 state the general technical specifications for connection of generators[33] and consumers[34] respectively; the decrees are written in the manner of legal documents. RTE has published an educational guide entitled "Mémento de la Sûreté du Système Électrique" but, as stated in the foreword, this document is not intended as a substitute for exploitation rules or contracts[35].

While subsidiary decree (arrêté) INDI0301719A, Technical Specifications for Generator Connections, contains some detailed requirements for generator voltage performance and reactive power capability (e.g. polygons [U, Q]; elsewhere (articles 20 and 21) reference is made to the "Référential Technique" for further details. The decree is essentially a high-level statement of principles and not of detailed requirements and furthermore appears to be concerned mainly with connection and not operating requirements.

The scope of the "procédure de traitement des demandes de raccordement aux réseaux publics de transport des installations de production" (procedure for dealing with requests for connection of generators) is limited to the connection procedure only and while specifying the planning data required for study purposes, does not cover operational requirements or procedures[36].

RTE also publishes a report entitled "French Power System Reliability Report"[37] which contains references to other RTE documents, some described as internal, notably:

- Référentiel d'Exploitation Système RTE (RTE System Operation Reference Guide); and
- le Code de Conduite des Réseaux de Transport (Transmission operating procedures).

(Section 3.5 of the RTE reliability report refers.) As we have been unable to access these documents we have not reviewed them further.

The rules for the programming, adjustment mechanism and recovery of charges for the Balancing Mechanism, published by RTE, contain technical operating procedures[38], such as

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[33] http://www.legifrance.gouv.fr/WAspad/UnTexteDeJorf?numjo=INDI0301719A; Generator connections

[34] http://www.legifrance.gouv.fr/WAspad/UnTexteDeJorf?numjo=INDI0301721A; Consumer connections

[35] http://www.rtefrance.com/htm/fr/qui/qui_reseau_memento.jsp; Mémento de la Sûreté du Système Électrique, Édition 2004

[36] http://www.rte-france.com/htm/fr/offre/offre_raccord_prod.jsp

[37] http://www.rte-france.com/htm/an/vie/vie_publi_annu_sur.htm

in Section 1, Chapter C, Programming (day ahead); however this document is mainly contractual and commercial in content.

RTE has also recently published the "Référentiel Technique de RTE"[39] (Technical Reference Guide) which largely covers planning and connection requirements for users (generators, distributors) in some detail. Importantly Article 4.1, load/frequency control, reflects the requirements of the UCTE Operation handbook.

PB Power comment. We would consider that the information on RTE's operating procedures that is publicly available to be insufficient for the purposes of this report. We consider that the operating code (or equivalent) should be in the public domain in accordance with Article 5 of Directive 2003/54/EC and Article 5.2 of Regulation 1228/2003.

We would also comment that, despite the publication of the Référentiel Technique, we find the regulatory documents covering the general subject matter of a "Grid Code" to be both diffuse and varied in content, which impedes their comprehension.

Roles and responsibilities

The regulator is the commission de régulation de l'énergie (CRE)[40] and the TSO is RTE (réseau de transport d'électricité)[41].

Development and updating process

On 16 September 2004 RTE invited the members of the CURTE (the French Power Transmission System Users Committee) to join a new sub-group to draw up the grid code (the technical reference code - Référentiel Technique pour le raccordement au réseau public de transport). As noted earlier this document was published on 28 June 2005.

Links to supranational rules/Compliance with the UCTE operation handbook

Section 3.4.1 (le réglage automatique de la fréquence) and Annexe A.1.5 (Les marges d'exploitation et le mécanisme d'ajustement) of the Mémento de la Sûreté du Système Électrique describe the RTE contribution to primary and secondary control as provided in accordance with UCTE Operation Handbook. Further cross-reference is provided in the Référentiel Technique.

In a joint report on the separation of the Italian network from the other UCTE networks on 28 September 2003, the French and Italian regulators call for a tightening of UCTE rules and procedures[42].

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[38] http://www.rte-france.com/htm/fr/vie/vie_bilan_surete.jsp; Bilan Sûreté Annuel, Bilan 2004 de la sûreté du système électrique français

[39] http://www.rte-france.com/htm/fr/offre/offre_publications_ref_technique.jsp

[40] http://www.cre.fr/

[41] http://www.rte-france.com/htm/fr/qui/qui_mission.jsp

3.2.6 Germany

Relevant documents

The TransmissionCode 2003 was issued in August 2003 by the Verband der Netzbetreiber (VDN) on behalf of the Verband der Elektrizitätswirtschaft (VDEW). (An earlier grid code had been issued in 1998 by the Deutsche Verbundgesellschaft.)

No references are made in the TransmissionCode 2003 to any grid codes or related documents issued by the four German TSOs; nevertheless the limited coverage of connection and planning aspects may indicate an implicit reliance on TSO and other subsidiary documents.

The statement on the tasks for expansion planning in section 5.1 of the TransmissionCode 2003 is only a statement of general philosophy and not a detailed procedure to be followed by TSOs and Users.

The Pre-qualification Questionnaire (Appendix D to the TransmissionCode 2003) requests data on primary control, secondary control and minute response to be provided by those parties offering these services. Those parties wishing to connect to the system are required to provide detailed data of their connection assets to the TSO concerned.

Appendix C to TransmissionCode 2003 provides a detailed definition of the N-1 criterion.

Roles and responsibilities

VDN is with the VDEW a registered association of system operators, including the ÜNB - Übertragungs-netzbetreiber – namely the four transmission system operators - (see page I-4 of UCTE OH). In the past, the different associations (VDN, grid user associations and others) have negotiated so-called "Associations Agreements" (Verbändevereinbarungen) which were supposed to serve as a basis for grid usage. This was due to the principle of negotiated network access that was in force before the new German Energy Law (Energiewirtschaftsgesetz (EnWG) came into force in July 2005. Under the new law the Federal Network Agency (Die Bundesnetzagentur[43]) assumed the responsibility for regulating Germany's electricity and gas markets. The German regulator is represented on ERGEG.

The four TSOs are E.ON, EnBW Transportnetz AG, RWE Netz AG and Vattenfall Europe Transmission GmbH, each with its own defined service area and forming a balancing zone for settlement purposes. RWE is responsible for the co-ordination of the interconnected system in Germany and, as UCTE Coordination Centre North, for the northern section of the UCTE system[44].

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[42] http://www.cre.fr/imgAdmin/1082721399747.pdf

[43] http://www.bundesnetzagentur.de

[44] www.rwe.com

Development and updating process

The VDN committee that drafted the TransmissionCode 2003 included representatives of the four transmission system operators[45] as well as representatives of generators and distribution network operators. According to VDN, its expert Task Forces are dissolved after successful completion of their respective tasks and as no Transmission Code Task Force is listed in VDN's annual "Facts and Figures" statement, the mechanism for periodic renewal of the TransmissionCode 2003 is not apparent.

Links to supranational rules

Please refer to the review of grid codes and related documents issued by TSOs that is presented below.

Compliance with the UCTE operation handbook

TransmissionCode 2003 contains a number of references to UCTE procedures. Although the references to UCTE documents in Appendix 9, Literature, of the TransmissionCode 2003 are out of date, the concepts and procedures in the TransmissionCode 2003 appear to be in harmony with those of the UCTE Operation Handbook (issued in 2004).

Grid Codes and related documents issued by TSOs

a. **E.ON** publishes its own grid code in both German and English, dated 1 August 2003. The E.ON grid code appears to be in accordance with the TransmissionCode 2003 but makes no reference to it although there are some references to UCTE (but not the Operation Handbook which was issued more recently). The E.ON grid code contains additional connection requirements, notably the fault ride through capability of generating plant (which have been adopted or considered for adoption elsewhere in other countries). The E.ON grid code makes extensive reference to the E.ON "Technisches Handbuch Netz" and other DIN and VDEW documents. The E.ON grid code also contains a detailed definition of the N-1 criterion, which is similar to that in TransmissionCode 2003.

b. **EnBW Transportnetz AG** does not appear to publish its own grid code and its website, for example, provides direct links to documents for the Pre-qualification Procedures (TransmissionCode 2003 Appendix D) for providing control energy.

c. **RWE Netz AG** does not appear to publish its own grid code as such and its website, for example, provides direct links to the VDN documents for the Pre-qualification Procedures for providing control energy. RWE Netz also publishes its connection rules and requirements for providing control energy. The glossary on the RWE Netz' website provides reference to both the

[45] RWE Net AG, E.ON Netz GmbH, EnBW Transportnetze AG, Vattenfall Europe Transmission GmbH.

TransmissionCode 2003 and to UCTE. The RWE Netz' control centre near Cologne acts as coordination centre for the German TSOs as well as for the northern section of the UCTE system.

d. **Vattenfall Europe Transmission GmbH** has published its "Netzanschluss und Netznutzungsregeln der Vattenfall Europe Transmission Gmbh", dated 1 January 2004 and based on the TransmissionCode 2003 and covering rules for connection and use of system.

3.2.7 Great Britain (GB), NGC: The Grid Code[46]

Relevant documents

The structure of the electricity transmission regulatory documents is shown in Figure 4.1. The two principal codes of interest are the System Operator Transmission Owner Code (STC) and the Grid Code.

STC[47]. The relationship between NGC and the two other British transmission owners (ScottishPower Transmission Limited and Scottish Hydro-Electric Transmission Limited) is governed by the STC. The two other transmission owners are not bound by the Grid Code as such, but through the STC are required to comply with certain provisions of the Grid Code. The STC covers the following technical aspects.

- Transmission services and operations
- Planning co-ordination
- Communications and data.

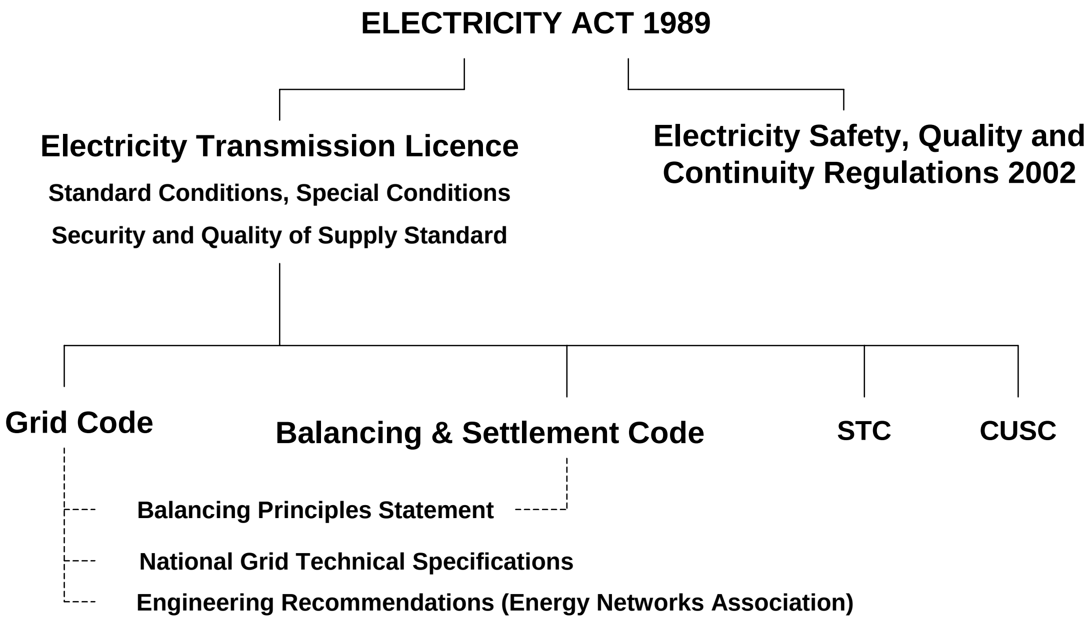
Information exchange between NGC and the two other transmission owners is of particular note and may provide a useful precedent for adoption elsewhere. Ofgem's decision in March 2005 on the matter of information exchange is published and the treatment of commercially confidential information is discussed. The information exchange in question includes real-time data in respect of substations and circuits either side of the transmission owners' boundaries and to the extent which such exchanges materially impact neighbouring transmission owners.

[46] NGC, (http://www.nationalgrid.com/uk), is the transmission system operator for England, Wales and Scotland (after implementation of BETTAin April 2005), but not Northern Ireland. The UKTSOA (a term not generally used in Great Britain) now has only one TSO, namely NGC.

[47] Ofgem, BETTA (publications), www.ofgem.gov.uk

Figure 3.2

STRUCTURE OF ELECTRICITY TRANSMISSION REGULATORY DOCUMENTS IN GREAT BRITAIN



Grid Code. The Grid Code contains the operating procedures and principles governing NGC's relationship with all Users of the GB Transmission System and is written with the assistance of an experienced legal advisor. However the Grid Code does not necessarily cover NGC's own internal procedures (e.g. calculation of the reserve required, some frequency related criteria are not published in detail) and furthermore as the philosophies of the Grid Code and the UCTE Operation Handbook differ in detail, the styles and arrangements also differ.

For the purposes of the Study, other relevant documents, which have been included in the review, are as follows.

- The Electricity Safety, Quality and Continuity Regulations 2002
- GB Security and Quality of Supply Standard (SQSS), version 1.0, September 22, 2004[48]
- NGC's Balancing Principles Statement (BPS)[49]

[48] NGC Transmission Licence, Special Condition AA2: Transmission System Security Standard and Quality of Service

[49] http://www.nationalgrid.com/uk/electricity

Other related documents such as the Connection and Use of System Code (CUSC) and the Balancing and Settlement Code (BSC), which are of a contractual or commercial nature, have been excluded from this review.

The requirements for Users to comply with the Connection Conditions and Operating Codes within the Grid Code are very precise and detailed. NGC does not use automatic generator control to control secondary response, unlike UCTE connected transmission system operators; instead NGC has a requirement for generation reserves. The Grid Code (Operating Codes 5 and 12) contains precise requirements for testing and monitoring, principally of generating plant and, for the carrying out of system tests to simulate material events. The Main Interconnected Transmission System is designed and operated to N-2 security of supply standards, as stated in the SQSS.

The SQSS is a comprehensive and detailed statement of:

- design or planning security of supply standards for generator connections, distributor connections and the main interconnected transmission system including N-2+ criteria;
- operating security of supply standards;
- voltage limits (both planned and operating); and
- guide for economic justification for investment in addition to that required to meet the planning criteria.

NGC also publishes its annual report to Ofgem on electricity transmission system performance in terms of availability, system security and quality of service.

NGC is subject to revenue penalties/incentives in respect of:

- transmission system reliability performance (energy not supplied against a set target); and
- system operator costs targeted at managing, on behalf of customers, the costs of operating the transmission system and the costs of balancing real time supply and demand for electricity, including being responsible for ensuring that the pattern of generation and demand is consistent with any transmission system related constraints.

Roles and responsibilities

The government department with responsibility for energy is the Department of Trade and Industry (DTI). The Electricity Act 1989 (as modified by the Utilities Act 2000 and the Energy Act 2004) sets out the responsibilities of the regulator, Ofgem; such responsibilities including the issue of the transmission licence. The TSO is the National Grid Company, a subsidiary of National Grid.

Development and updating process

The Grid Code, first issued in 1990, is subject to periodic revision by the Grid Code Review Panel, comprising the regulator Ofgem, NGC, Generators (including renewables) and Distribution Network Operators. The most recent edition of the Grid Code incorporates requirements for users in Scotland, power parks (wind farms – including fault ride through) and DC converters.

Links to supranational rules

Links to supranational rules are not applicable. The technical agreements covering the HVDC interconnections between England and France (Interconnection France – Angleterre (IFA)) and between Scotland and Northern Ireland (the Moyle Interconnector) are not published.

Compliance with the UCTE operation handbook

The Grid Code is not required to comply with the UCTE Operation Handbook, as the British grid is not in synchronism with the UCTE network. Nevertheless for the purposes of the study and in order to make a comparison with the load/frequency requirements (Policy 1) of the OH in particular, reference should be made to the Balancing Principles Statement and subsidiary documents as published by NGC.

3.2.8 Netherlands

Relevant documents

The electricity law is contained in the Electricity Act of 1998; section 31 of the Electricity Act specifies the requirements for the codes. The principal codes, as issued by the regulator DTe, are the following.

- NetCode (also referred to as the Grid Code)
- MeasuringCode (Metering Code)
- SystemCode
- Co-operation Regulation, the most recent versions being dated in late 2004[50].

The Netcode also covers distribution aspects and connection to distribution networks; references in NetCode 5.6.4 to German utilities directly connected to the Dutch transmission system are, however, out of date and do not reflect the recent re-grouping of German TSOs.

The SystemCode covers both system control and balancing market aspects. SystemCode 2.1 talks in terms of primary response and primary reserve without mentioning secondary

[50] The codes are subject to frequent revision and their publication in the Dutch Government Gazette is duly recorded at the start of the respective codes.

reserve. SystemCode 2.21 states that the Dutch Electricity Act has precedence over UCTE requirements.

Subsidiary documents are issued by the TSO, TenneT, notably the:

- Operations – Managing Concept, BS_NES 02-064 dated 23 May 2002;
- Implementation Regulations concerning the NetCode and SystemCode, BS-NES 004-034 dated 4 March 2004; and
- Summary of the current operating rules of the UCTE concerning primary and secondary regulation.

Both the Managing Concept and the Implementation Regulations describe regulating power, reserve power and emergency power and the mechanism of preservation of the system balance using the regulating and reserve power bids made within the power market.

Roles and responsibilities

The regulator is DTe[51] and the TSO is TenneT[52].

Development and updating process

The codes are prepared by the joint grid administrators (TSO and area (distribution) network operators and submitted to the regulator DTe for approval.

Links to supranational rules

While TenneT declares the reserve in the Netherlands to meet the UCTE primary control requirement, only a very brief description is given of the mechanism to meet the UCTE secondary control requirements and furthermore the UCTE and TenneT terminology appear to differ.

Compliance with the UCTE operation handbook

Article 14 of the Co-operation Regulation calls for consultation with and implementation of UCTE requirements.

3.2.9 Poland

Relevant documents

The Poland Technical grid code is officially in Polish language. For the present Study, a translation version of the original grid code approved by the Management Board of the

[51] http://www.dte.nl, Office for Energy Regulation.

[52] www.tennet.org.

Polish Grid Company SA (PSE SA) on July 19, 2001, which was then registered at the Notary office and introduced on August 1, 2001, was used.

The Polish grid codes are provided in four different documents.

- Instruction of Transmission system Operation and Maintenance (IRiESP) – General Part
- IRiESP – Detailed Part 1 – Rules of Balancing Market
- IRiESP – Detailed Part 2 – Rules of Ancillary Market
- IRiESP – Detailed Part 3 – Rules of Must-Run Generation

Roles and responsibilities

The system operator is the Polish Power Grid Company SA (PSE SA).

Development and updating process

Currently the existing grid code is being revised and updated

Links to supranational rules

Not applicable.

Compliance with the UCTE operation handbook

The load frequency control for the system is not specified in detail in any of the documents. Hence, it was not possible to carry out a comparative analysis with UCTE documents.

3.2.10 North America

The bulk power supply systems of the United States, Canada and part of Baja California in Mexico are interconnected. Following the major Northeast blackout on 14 August 2003, the Unites States has recently introduced important legislation to improve the reliability of its electricity transmission system.

United States - Energy Policy Act

The Electricity Modernisation Act of 2005 (also referred to as the Energy Policy Act) includes a section (1211) on Electric Reliability Standards that:

- introduces the requirement for an “Electric Reliability Organisation” (ERO), certified by the Federal Energy Regulatory Commission (FERC)[53], to establish and enforce “Reliability Standards” for the bulk-power system

[53] www.ferc.gov

- defines the term "Reliability Standard" as a requirement to provide for reliable operation of the bulk-power system, including cybersecurity protection, where
- 'reliable operation' means the operation of the bulk-power system so that instability, uncontrolled separation or cascading failures will not occur and
- excludes the authorisation of the ERO or FERC to order the construction of additional generation or transmission capacity.

The ERO is to be independent of owners, operators and users of the bulk-power system. The ERO may be authorised to delegate powers to a regional entity, on an interconnection-wide basis, for the purposes of proposing reliability standards. Regional entities may propose regional standards or variances to the ERO. It is policy that regional entities should be encouraged to (re) organise themselves on an interconnection-wide basis where an interconnection means a synchronous area within which operators are inter-dependent[54].

Co-ordination with Canada and Mexico, with which the US bulk-supply system is interconnected, is foreseen (Alaska and Hawaii are excluded from the provisions of the Act).

North American Electric Reliability Council (NERC) [55]

NERC presently performs the function of the ERO, but as a voluntary self-regulatory body (formed in 1968 and "relying on reciprocity, peer pressure and the mutual self-interest of those involved") without the compliance powers to be made available to FERC and ERO. It is generally expected that NERC will apply to become the ERO and will offer its existing Reliability Standards for formal review and approval by FERC.

NERC covers the US, Canada and parts of Mexico. NERC's mission is to ensure that the bulk-supply system is reliable, adequate and secure. As at November 2005 NERC's members comprised 10 Regional Reliability Councils organised within the three Interconnections. The members of a Regional Reliability Council typically comprise Regional Transmission Organisations (RTOs) or Independent System Operators (ISOs) and transmission customers including public interest members such as state regulators. In certain areas there are independent system operators (ISOs), which control the operation of generators, TSOs and markets within their own areas (PJM – Pennsylvania-Jersey-Maryland is an example of an ISO – with a peak demand of some 130GW; PJM also refers itself as an RTO). There are also over 100 Control Areas in the US which are electric systems consisting of one or more TSOs capable of regulating generation to maintain a schedule of electricity flows[56].

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[54] There are three such areas, Eastern, Western and ERCOT (Texas) interconnections, connected by HVDC links, covering the 48 contiguous states of the USA, Canada and a portion of Baja California Norte in Mexico.

[55] www.nerc.com

[56] EIA: Electricity Transmission in a Restructured Industry; Data Needs for Public Policy Analysis, December 2004, DOE/EIA-0639.

NERC Reliability Standards

NERC Reliability Standards[57] define the reliability requirements for planning and operating the North American bulk electric system and may be considered to being equivalent to a high-level synchronous area code in European parlance. (The word "reliability" in the title appears to have been used in a broad sense, namely standards required to deliver reliability.) There are about 90 Reliability Standards, arranged as 14 topical areas (each headed by an acronym) as summarised in the following table. Most of the Reliability Standards are operating standards.

Table 3.3 - NERC Reliability Standards

Standard (Acronym)	Title	Quantity	Comment
BAL	Resource and Demand Balancing	6	Frequency control, Area Control Error (ACE), Contingency Reserve
CIP	Critical Infrastructure Protection	1	Sabotage protection, cyber security
COM	Communications	2	Telecommunications
EOP	Emergency Preparedness and Operations	9	Emergency operations planning, alerts. load shedding, disturbance reporting, restoration, black start
FAC	Facilities Design, Connections and Maintenance	5	Generation, transmission and end-user connection requirements, vegetation management, facility ratings for system modelling
INT	Interchange Scheduling and Coordination	4	Interchange transactions, tagging and implementation
IRO	Interconnection Reliability Operations and Coordination	6	Responsibilities and authorities, facilities, operations planning, current day operations, transmission loading relief
MOD	Modeling, Data, and	20	TTC, ATC, TRM calculation

[57] NERC: Reliability Standards for the Bulk Electric Systems of North America, published February 2005 and to take effect 1 April 2005, known as the "Version 0" Reliability Standards.

Standard (Acronym)	Title	Quantity	Comment
	Analysis		methodologies, capacity benefit margin, modelling data, data exchange, load management
ORG	Organization Certification	0	
PER	Personnel Performance, Training, and Qualifications	4	Reliability Coordination - Responsibility, authority, training, credentials, staffing
PRC	Protection and Control	17	Protection coordination, fault recording, misoperations, maintenance and testing, under-frequency/voltage load shedding, special protection systems
TOP	Transmission Operations	8	Reliability responsibilities, operations planning, outage coordination, operations, operational data exchange, system monitoring, operating limit violations,
TPL	Transmission Planning	6	System performance, normal and after loss of an element, reports, data
VAR	Voltage and Reactive	1	Voltage and reactive control

Each Reliability Standard follows the same structure, comprising introduction, requirements, measures, compliance, regional differences and version history. Entities to which the Reliability Standards are applicable comprise Regional Reliability Organisations, Reliability Coordinators (the entity that is at the highest level of authority which is responsible for the reliable operation of the Bulk Electric System), Balancing Authorities (responsible for an area within which a load-resource balance is maintained), Reserve Sharing Groups (two or more Balancing Authorities), Transmission Operators, Generator Operators, Distribution Providers.

Other relevant documents include:

- NERC Reliability Functional Model (summarises functions and entities responsible together with relationships with other entities), dated 10 February 2004 and

- NERC Operating Manual, dated 14 September 2005, an organization and procedures manual which includes many, but not all, of the Reliability Standards, as well as training documents and reference material for system operators.

Items in the following standards are of particular note:

- Standard COM-002-0, Communication and Coordination, requires users to have communications (voice and data links) available for addressing real-time emergency conditions; Balancing Authorities shall inform all other potentially affected Balancing Authorities of any condition that could affect the reliability in its area

- Transmission Loading Relief – Standard IRO-006-1, Reliability Coordination – Transmission Loading Relief (TLR) provides for a Reliability Coordinator to issue instructions to return a transmission system to within its Interconnection Reliability Operating Limits (IROL) within a maximum of 30 minutes; (the number of TLR logs is reported as steadily increasing, indicating increasing system utilisation)

- N-1 contingency is a minimum requirement for unscheduled changes in system configuration and generation dispatch (Standard TOP-002-0 – Normal Operations Planning), although the contingency requirements for regular system simulations in the planning standards (Standards TPL-001-0 to TPL-003-0) are more detailed

- Standards PER-001-0 to PER-004-0 provide detailed requirements for the training, accreditation and authorization of control centre personnel

- Standard EOP-004-0, Disturbance Reporting, includes details of the US Department of Energy Disturbance Reporting requirements and

- Standards in the MOD series provide for provision of system modeling data.

NERC Compliance Enforcement Program (CEP)

Under its Compliance Enforcement Program, NERC assesses compliance for some 96 requirements in 44 reliability standards (e.g. frequency/area power balance in Standard BAL-001-0, on-site reviews of operating personnel and document verification under Standard PER-001-0). NERC states that its compliance efforts comprise two key activities, compliance review and enforcement but that until the Energy Policy Act of 2005 is implemented, NERC would be unable to enforce compliance with its own standards, including penalties and sanctions. Until then NERC states that it would continue to rely on its existing compliance processes and simulated enforcement actions.

Regional Reliability Councils

Regional Reliability Councils establish the processes for the reliable and efficient operation of interconnected power systems within their geographic areas, including the provision of regionally specific implementation of reliability standards and supporting documents. Typical functions of a Regional Reliability Council include:

- Coordination of operation

- Co-ordination of planning
- Assessment of reliability
- Compliance
- Critical infrastructure protection
- Market reliability interface.

As an example, one Regional Reliability Council, the Northeast Power Coordinating Council (NPCC – peak demand about 112GW)[58], has established criteria, guides and procedures as well as a reliability compliance and enforcement program. NPCC has five defined Control Areas (serving as Balancing Authorities, Transmission Operators and Reliability Co-ordinators) within the north-east US and Canada. NPCC's criteria are intended to meet or exceed NERC policies and standards and cover design and operation of Interconnected Power Systems, Emergency Operation, Maintenance Criteria, Bulk Power Protection, Operating Reserve, Special Protection Systems and the Reliability Compliance and Enforcement program. Guides and procedures are more detailed documents following on from the criteria.

Although the NPCC documents are international, disputes in relation to enforcement are referred to national regulatory authorities. Non-compliance sanctions however appear to comprise letters to authorities with increasing levels of public disclosure.

ISOs

An ISO would typically perform the role of a Reliability Coordinator and Balancing Authority. Each ISO typically operates in accordance with the NERC Reliability Standards and Regional Reliability Organisation requirements. As an example ISO New England (maximum demand 26GW)[59] issues the following principal rules and procedures: Manuals, Operating Procedures, Planning Procedures and a Compliance Procedure. These documents are issued in accordance with NERC Reliability Standards and NPCC documents.

[58] www.npcc.org

[59] www.iso-ne.com

Comment on North American Rules

Positive points

1. The NERC Reliability Rules, Regional Reliability Organisation procedures and ISO Rules and Procedures, as accessed and reviewed, offer a structured and consistent set of codes.

2. Regional Reliability Organisation procedures and ISO Rules and Procedures take their precedence from the NERC Reliability Rules and are consistent with them.

3. NERC Reliability Rules provide a good example of international coordination, albeit with one dominant member country.

4. Regional variations are permitted, as required.

5. Publication of documents appears to be comprehensive and therefore transparent.

6. Procedures for drafting the Reliability Rules and in particular the compliance process are well documented.

7. Responsibilities, particularly for Regional Reliability Organisations and Reliability Coordinators (the latter are in effect ISO control centres, operating on a 24 hour x 7 day basis) are specific.

8. NERC Reporting and Disclosure Guidelines require occurrence reports to be filed quickly (preliminary reports by operators within 24 hours and by Regional Reliability Organisations on a confidential basis within 48 hours).

Negative points

1. The reliability organisation is hierarchical, as might be expected from a bulk-supply system with a demand of some 800GW supplying three countries each with a federal constitution, but invites the question at to whether it is not over-bureaucratic (large number of committees) with duplication of effort

2. There are some 10 Regional Reliability Councils and, as at least one merger is underway, the question arises as to whether there could not be further mergers (the Energy Policy Act appears to invite this process)

3. The effort required to audit the compliance process may be appreciable.

4. Reliability Standards do not cover some of the key areas within a TSO Grid Code as planning standards, connection conditions and detailed data exchange requirements (schedules) are excluded – in the US connection conditions are generally imposed by the transmission operator on the user (generator or distributor).

3.3 Differences in the definition of the 'N-1' security criterion

Section 2 identified the lack of a common definition of the 'N-1' Security Criterion particularly on interconnections across common borders.

Appendix E presents the various 'N-1' Security Criteria in the Codes as reviewed.

3.3.1 Brief survey of differences in 'N-1' or equivalent security criteria

Definitions of the 'N-1' or equivalent security criteria differ between SSA and TSOs. These differences have particular importance across common borders as a particular TSO may either be at risk through believing a system state to have higher integrity than it in fact has or alternatively the TSO may be making more provision than necessary, say in the amount of generating plant synchronised, and so incurring economic penalties.

UCTE

UCTE (OH-P3A) defines the 'N-1' security criterion as any probable single event leading to a loss of power system element and that should not endanger the security of interconnected operation (either cascade tripping or loss of load). After such a contingency each TSO is required to return its power system to an 'N-1' compliant condition "as soon as possible". An N-k or N-2 criterion may be adopted where such interruptions are credible. Busbar systems are also to be taken into account.

Nordel

Nordel (Grid Code: Appendix 2 of System Operation Agreement) defines an N-1 criterion whereby the power system is assumed to be intact apart from the loss of individual principal components (generators, circuits, busbars). The concept of a "dimensioning fault" is introduced in which such a fault must not bring about serious operational disturbances in other subsystems. Following a disturbance at the N-1 level, an interval of 15 minutes is allowed within which the system must be restored to N-1 operation.

In France **RTE** specifies system security according to the "N-k Rule' whereby the level of maximum risk tolerated is evaluated by a value of reference of

Probability of the event x depth of power cut (MW)

A diagram is provided in the Mémento de la Sûreté du Système Électrique, section A1.4. For a double circuit 400 kV line, for example, an N-D criterion would be applied.

In Germany **VDN** specifies a N-1 single outage criterion which may also apply to busbar systems if there is a potential for common mode failure. Operation at N-0 may be allowed temporarily with advance notice to users (i.e. generators).

In Great Britain the operational and planning criteria with which **NGC** is required to comply in accordance with its transmission licence are stated comprehensively and in detail in the Security and Quality of Supply Standard (SQSS). For demands over 300 MW an N-1-1 criterion is applied and for demands over 1500 MW an N-2 criterion is applied.

In the **Netherlands** the N-1 criterion is such that a fully operational grid requires secure transmission of such input and output as the connected parties require, even if one network element fails. Further requirements are specified for when equipment is out of service for maintenance (N-1-1 condition).

In the **Republic of Ireland**[60] a single N-1 contingency test is applied covering the loss of any single item of generation and transmission equipment at any time. Overlapping outages such as N-G-1 (generator and line outage) and the trip-maintenance N-1-1 (forced outage of a transmission or generating element occurs which another element is out on maintenance). The N-1-1 tests also include the overlapping forced outage of two elements at a time, where there is sufficient period between the first and second outage to allow for adjustment back to normal operation.

Differences in the details of the interpretation of the N-1 criterion are also reviewed in a report on networks in the Accession Countries[61].

Table 3.4 compares the operational security criteria of the SSAs and TSOs reviewed in this report and illustrates the various different approaches. Planning criteria may, however, differ and indeed may be more stringent.

Table 3.4 – Comparison of operational security criteria

Country/SSA/TSO	Document	Criteria	Description
UCTE	OH-P3A, Operational Security	N-1	Any probable single event leading to loss of power system element (e.g. generating set, transmission circuit). Loss of multiple elements (N-k where k > 1 or N-2) may be considered where there is sufficient probability of occurrence. After contingency each TSO is to restore to N-1 compliant operating condition as soon as possible.

[60] ESB National Grid; Transmission Planning Criteria, October 1998

[61] European Commission, Directorate-General Energy and Transport; Analysis of the network capacities and possible congestion of the electricity transmission networks within Accession Countries, June 2005.

Country/SSA/TSO	Document	Criteria	Description
Nordel	Appendix 2 of System Operation Agreement 1(7)	N-1	“Dimensioning fault”, i.e. according to impact on system, on a subsystem must not bring about serious operational disturbances on other subsystems, considered separately for frequency disturbances and network interruptions. After contingency, TSOs to restore to N-1 compliant operating condition within 15 minutes.
DC Baltija	Grid Code section 2.3 and 2.4	N-1	
NERC	Reliability Standard TOP-002-0, Normal Operations Planning	N-1	Minimum of N-1 contingency planning in accordance with regional reliability requirements.
France	Mémento de la Sûreté du Système Électrique, section A1.4.	N-k where k varies between 1 and 2	The ‘N-k’ rule defines the maximum level of risk, evaluated by reference to the ‘product of probability of an event x load interrupted (MW)’. For example the loss of a double circuit line leading to an interruption of 1500MW would not be acceptable.
Germany	TransmissionCode 2003, Appendix C	N-1	Appendix C lists the contingency conditions to be met.
Great Britain	SQSS, section 5	N-1-1 N-2	For demands over 300MW the system shall be secure for a single fault outage following a local system outage. For demands over 1500MW the system shall be secure against a double circuit overhead line outage.

Country/SSA/TSO	Document	Criteria	Description
Netherlands	NetCode, Management Conditions, 5.5.2	N-1-1	380kV and 220kV System to be N-1 secure when an element is out of service for maintenance (i.e. N-1-1) condition.[62]
Poland	IRiESP Part 3 Section 6.1.2 (6)	N-1	
Republic of Ireland	ESB NG Transmission Planning Criteria	N-1 N-G-1 N-1-1	In addition to N-1 contingency, overlapping single contingency and generator outage and overlapping trip-maintenance criteria may be considered, where these are probable. Following a single contingency, the system shall be restored to withstand a second contingency.

This brief survey shows the differences between SSAs and TSOs in the:

- Concept of security of supply criteria (N-1, N-k, N-2)
- Applicability (busbars, dimensioning faults)
- Restoration times and
- Detail in which the criteria are specified as the relevant clauses in some cases appear to be inadequate.

3.4 Trade-off between network security and capacity made available to market players

3.4.1 Generator operational intertripping

Generator operational intertripping[63], where an intertrip is a device that may be armed so that it automatically trips a circuit breaker that removes a generator from the transmission signal

[62] TenneT; 2003-09, Capacity Plan, section 6.

[63] Ofgem; Treatment of System to Generator Intertripping schemes, June 2005

when it receives a specific signal. The signal is delivered if a predetermined fault on a specific part of the transmission system occurs.

The requirement for an intertrip is usually identified at the time of a connection offer to a generator.

Operational intertripping may be consistent with security standards, depending on circumstances. Alternatively operational intertripping may be a temporary arrangement subject to a derogation granted by the regulatory authority, for example, awaiting the construction of a transmission line delayed by planning approval. An example was the operational intertripping applied to Teesside Power Station in the North East of England pending the long-delayed construction of the second Yorkshire transmission line.

3.4.2 "Non-firm" operation of intermittent or variable generation

The question is being debated as whether transmission connections of intermittent or variable generator such as wind power should be run "non-firm", a relaxation from N-1 or equivalent security criteria. Economic considerations include:

- cost of constrained-off plant (constrained energy).
- intermittent generation offers a reduced capacity contribution to the security of demand compound with conventional generator.
- The provision of secure transmission capacity to meet the requirements of intermittent generation may be a major cost.

There are, of course, appreciable system design considerations for non-firm operation, particularly in respect of system stability.

3.4.3 Economic criteria in codes

A prime example of an over-arching economic criterion comes from Australia where the National Electricity Code includes the requirement for investments on a transmission network to meet the requirements of the "regulatory test" taking all economic and technical factors into account. The regulatory test is based on a traditional cost-benefit analysis framework and, according to the Australia Competition and Consumer Commission, relies on the two key principles of economic efficiency and competitive neutrality so that only efficient investments are built. An investment would satisfy the regulatory test if it maximised the net present value of the market benefits having regard to a number of alternative projects, timings and market development scenarios.

Guidance on economic justification is also provided in Appendix E to the British Security and Quality of Supply Standard and concerns the justification of the additional costs of operating or of investments compared to those required to meet either the operational or planning criteria.

In the Nordel region there is presently discussion of a procedure for the cost-benefit analysis for evaluating transmission reinforcements to reduce cross-border transmission constraints and so reduce congestion. Such a procedure would need to be subject to regulatory approval.

3.5 Conclusions

From the comparative analysis of the grid codes carried out, there is a wide variety in the style and content of the codes and even in the direct purposes for which they are written. Furthermore there would appear to be a requirement for a general form of standardisation of grid codes in terms of the following.

- Legal precedence such as Electricity Law > Decree > Transmission Licence > grid code.
- Electricity Laws and Decrees should specify minimum of technical requirements being those that establish overall responsibilities as well as the quality of supply; voltage and frequency levels and tolerances, construction and safety requirements (including earthing), continuity requirements and access rules.
- Responsibility for issuing of grid code – ideally this is primarily a technical and not a legal document and so should be prepared by the TSO to the approval of the regulatory authority concerned.
- The process for the drafting and periodic review of the grid code should be clear, including the membership of the review body which should be representative of the electricity industry.
- The grid code may need to be complemented by similar documents covering connections, balancing mechanism and related market.
- Ideally a common format and terminology should be adopted; codes should not only state what should be done, but by whom and when.
- There are a number of instances of “good practice” within existing codes and related documents, which may provide useful precedents for general use.
- At the very minimum there should be common definitions of N-1 or equivalent security of supply criteria, together with common and agreed definitions, across an interconnection.
- The detail in which security of supply criteria are stated by TSOs differs – in some cases the definitions provided would appear to be inadequate.
- Across an interconnection the:
  - provision of operating data (such data including real-time data),
  - agreement of emergency operations procedures (including defence plans)
  - agreement of a procedure of which TSO is to take charge in an emergency

  should be agreed between TSOs, registered and available for review by the SSA.

- Trade-offs between network security and capacity can be made available in the form of "non-firm" operation, such as generator intertripping although there may be appreciable system design considerations; other considerations are provision for intermittent generation and the application of economic criteria such as the Australian "regulatory test".

Recommendation

We propose that TSOs should be required to report annually to their respective regulators on transmission system reliability performance, that these reports should be to an EC standardised format and should be published[64].

[64] Unipede: Availability of Supply, Ref: 04000Ren9706, April 1997

4. ANALYSIS OF ISSUES AND IDENTIFICATION OF PROBLEMS TO BE ADDRESSED BY EUROPEAN TRANSMISSION NETWORK SECURITY RULES

4.1 Introduction – reliance on neighbouring TSOs

4.1.1 Increased trading levels

There is a future challenge to maintain the required level of security on a bulk power system. The situation in general is expected to change because the introduction of the deregulated market is likely to lead to a more efficient use of the power system. This means that if distant production resources are cheaper than local resources the distant resources would be used. This statement is valid for both daily trading of power and energy and for the use of regulating reserves i.e. the resources that would be needed when there are outages of generators and/or transmission circuits used for importing power. Moreover with the connection of increasing amounts of wind power, with uncertain power output, it is essential to have an economic and efficient regulating market. Each TSO is responsible for balancing supplies in its own area but increasingly the trading with neighbours of resources such as reserve capacities may be used to achieve this balance.

The consequences of this trend would at least include the following:

1. there would be even higher transfer levels over the transmission system between different regions of Europe:

2. expensive local power plants providing reserves would be closed if import of reserves is cheaper: and

3. there could be a reduced level of security since there would be market pressure both to run the transmission system closer to its limits and to close under-utilised power plants in each region which in turn would rely more on interconnections with neighbouring systems.

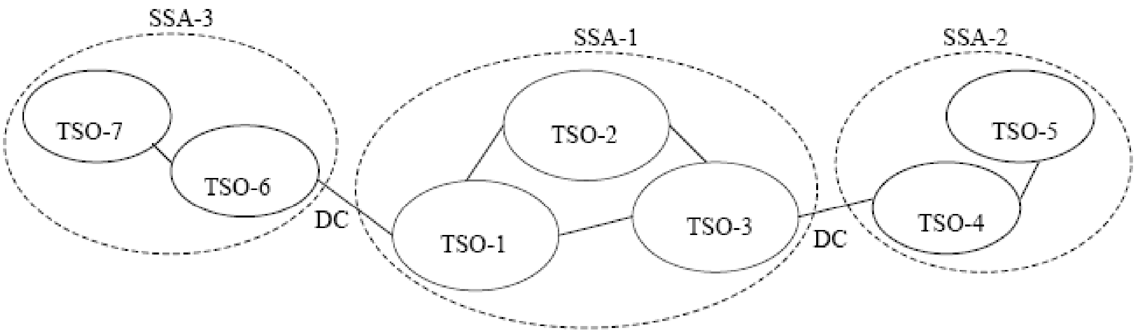
The question is whether the deregulated market currently has adequate rules in order to meet this new situation? In the Nordel system there is already a challenge in this area since both points 1 and 2 above are occurring. The Nordic question is generally on the level of system adequacy[65], but with lower margins than at present the commercial pressure to operate the system closer to its limits will increase, which might in turn jeopardize the system security. It can be expected that other synchronous systems will face the same challenge as the Nordel system when the markets open up more on those other systems.

[65] UCTE quotes the Cigré definitions of Reliability, Adequacy and Security in respect of generation adequacy assessment.
http://www.ucte.org/Statistics/Terms_Power_Balance/e_default_methodology.asp

4.1.2 Interdependence of SSAs and TSOs

The challenge can be illustrated as a generality in the example in Figure 4.1.

Fig 4.1 Trading of reserves and increasing interdependence



TSOs are responsible for system security which includes providing sufficient reserves, while allowing the possibility of load shedding in extremis, and it is a TSO's responsibility that a contingency does not lead to cascading failures.

Consider TSO-1 in synchronous system SSA-1. TSO-1 is also connected by a DC-link to TSO-6 in synchronous system SSA-3. TSO-3 in synchronous system SSA-1 is also connected with TSO-4 in system SSA-2 by a DC-link. In order to perform its duties TSO-1 has to some extent to rely on its neighbours. Furthermore there are two possible reasons why problems may occur in the TSO-1 network:

a) large failure within the TSO-1 network, e.g. an outage of a large power plant or an important part of the network or

b) large problem in a neighbouring grid which changes the power flows on the interconnectors.

For problem a) the question is how much TSO-1 can rely on import from its neighbours? Concerning TSO-2 and TSO-3 there may be SSA-1 rules concerning "dimensioning faults" (e.g. as defined in the Nordic Grid Code and taking account of criticality – likelihood of occurrence compared with consequence), but the question is also whether these rules are monitored or not?

TSO-1 has to keep sufficient margins so problem a) does not lead to cascading failures. If the system is run closer to its limits, it is important for TSO-1 that in the event of problem a) occurring the potential import thus required is reliable. If TSO-1 cannot rely on this import it has to maintain extra margins in its own system. This means that it is essential for TSO-1 to have accurate and reliable information on the reliability of extra import (and/or voltage support) in the event of problem a). In these circumstances it is also important for SSA-1 to have reliable information of the possible level of support from TSO-4 to TSO-3 as this in turn may affect the ability of TSO-2 and TSO-3 to support TSO-1. Since support for TSO-1 may also be on hand from TSO-6 over the DC-line, it is also important to have reliable information in this regard in the event of problem a) occurring. The available support from TSO-6 also depends on that available from TSO-7.

Concerning problem b) there needs to be an agreement in place between TSO-1 and its neighbours, so that a neighbour with problem b) knows how much support it can get from TSO-1. Conversely TSO-1 also needs to know how much it can rely on other neighbours in this case (i.e. mutual defence plans).

4.1.3 Provision of sufficient information

The question now s whether the existing rules require the provision of sufficient information so that TSO-1 can maintain its margins as low as possible in order to use the existing resources as efficiently as possible. Elsewhere in the report we comment the mechanisms for such provision of information. If lack of information availability requires very high margins to be kept (e.g. always be able to stand an outage of a 1000 MW failure at the same time as a failure of two interconnections to neighbouring regions), then this situation would significantly limit the possibilities of increased trading and economic operation.

There are two important issues here:

1. How is the required security level for each TSO defined? It is important here to distinguish between the

    - security, i.e. how often would disturbances occur that would lead to TSO-system-wide problems, and

    - system adequacy, i.e. how to keep enough margins so as few consumers as possible will be disconnected during any situation.

2. How is the required security level to be monitored?

Based on these issues there are some questions that are for further consideration, namely the definition of security criterion and monitoring of the level of security.

A common definition of the “security level” is that the system should stand the N-1 criterion, i.e., a failure of the most important component, without running into cascading failures. This definition may require clarification if one does not know the exact definition of what is included in “N-1”. The same consideration may apply to the “N-2” criterion. From a system security point of view it may be more objective to consider a probabilistic criterion, such as “the system should be able to stand disturbances that occur 1 time in 20 years (or more often) without cascading failures”. It is important here to note that setting of such a security level would include a trade-off between security and trading possibilities (i.e. costs and benefits). Such probabilistic criterion may however be complex to apply but nevertheless should form the basis of (arguably) more practical deterministic criteria[66].

The next step is to monitor the security level when it is defined. This includes the on-line monitoring and also the planning of how to maintain sufficient margins in the future, e.g. one-day a-head or one-year a-head. Since the security level of each TSO is dependent on the security level in neighbouring systems, they are dependent on each other.

4.2 Issues within existing SSA Technical Codes

4.2.1 N-1 Security of supply definition

At the very minimum there should be common and agreed definitions of N-1 equivalent security of supply criteria at a given interconnection. Similarly there should be harmonisation of terminology as well as agreement on the capacities of shared assets (e.g. ratings of overhead lines over a range of operating conditions and corresponding tolerances on measurements). The extent to which such criteria apply e.g. busbar systems should be explicitly clear. Without such common and agreed definitions there is a risk of misunderstandings between TSOs particularly where a TSO may wish to assess the reliability of an interconnection to a neighbouring TSO. Furthermore security of supply criteria should be published.

The detailed definition of N-1 or equivalent security of supply criteria is essential for both the security and the operation economics of the system. It is for consideration whether there should be a harmonisation of N-1 or equivalent security of supply criteria within an SSA, say, as such changes would have major implications on the investment programmes of TSOs and may even be impractical. Security criteria, largely deterministic in nature, should in any case be determined from probabilistic cost/economic benefit studies. However as interconnection transfers increase, there may be a case for reconsidering the adequacy of the single outage criterion – the OH allows for this and the British and French criteria provide suitable precedents.

4.2.2 Information exchange between TSOs

As described in section 4.1.2 it is essential to have accurate information between neighbouring TSOs concerning the reliability on interconnections so the TSOs on each side know how much they can count on the interconnection during severe contingencies. This is a live issue in a number of codes. The UCTE OH, NERC Reliability Rules and the British STC Code address the matter in different ways.

Elsewhere in the report we have considered the requirements for continuous exchange of information on the status of the transmission system either side of an interconnection, to the extent that it is material to the neighbouring TSO.

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[66] A further alternative would be for regulators to set reliability performance criteria, whilst the TSO is required to comply with deterministic planning and operating criteria for security of supply, as in Great Britain.

Inter-TSO agreements on information exchange should be registered with and be available for review by the SSA.

4.2.3 Monitoring of security level

Referring to section 4.2.2 it is essential for the TSOs to have information concerning the security level on interconnections. But in order to rely on the information from its neighbours, it is also important that this information in some way is checked, i.e., the security level must be monitored (compliance procedure).

Information datasets should be exchanged between TSOs in sufficient detail and at intervals that enable each party to perform on-line contingency analysis (say at intervals of 5 to 10 minutes).

4.2.4 Restoration plan

Even if there is a very high level of security in the system, there is always a risk of a blackout. In order to reduce the consequences of such a blackout, it is essential to have updated restoration plans. This issue is also important for neighbouring TSOs, since they should each know how fast the system could be restored.

A related issue is the requirement for an agreed level of proficiency for dispatching operators, procedures for their authorisation and ongoing accreditation.

We consider that inter-TSO restoration plans should be mandatory, subject to formal SSA approval in the first instance and at regular intervals thereafter. It is appreciated that this may involve considerable work initially, particularly for UCTE. However we believe that it is important that an (improved) procedure of this significance should be seen to be established at the outset.

4.2.5 Performance reporting

We propose that TSOs should be required to report annually to their respective regulators on transmission system reliability performance, that these reports should be to an EC standardised format and should be published[67]. These reports should include interconnector performance. SSAs in turn should produce consolidated reports.

4.2.6 Compliance monitoring and enforcement

4.2.6.1 SSA level

Such procedures for compliance monitoring and enforcement as exist at SSA level vary and in any case are not particularly specific.

We would however draw attention to the precedent set by the NERC Reliability Standards which has incorporated for each standard a statement of the:

[67] Unipede: Availability of Supply, Ref: 04000Ren9706, April 1997

- compliance monitoring process (responsibility, monitoring interval, data retention); and

- quantifiable levels of non-compliance against which sanctions could be imposed.

For some of the standards, no compliance requirement is set. For some other standards a TSO, for example, is required only to self-certify compliance. For the more important standards, there is an auditing procedure. Sanctions at present appear to be limited to varying levels of disclosure (e.g. to state regulators). However the procedure does appear to incur a level of bureaucracy in order to ensure a common level of compliance reporting.

For an SSA and in respect inter-TSO agreements we have suggested that the agreements be registered with and be available for review by the SSA. An alternative approach would be to post the joint operation agreements between neighbouring TSOs as per the Appendices 7 to the System Operating Agreement in the Nordic Grid Code. In the case of (inter-TSO) restoration plans, which we recommend to be mandatory, we propose that each plan is subject to formal SSA approval in the first instance and at regular intervals thereafter.

4.2.6.2 National level

TSOs would in any case report violations against prescribed license conditions or performance standards to the appropriate regulatory authority as required by that authority.

4.2.7 Congestion management – calculation

We are in agreement with ERGEG's proposals, as presented at the 12th Florence Forum, that:

- congestion management related issues (for example in Policy 4 of the OH) should be aligned with the Congestion Management Guidelines of EC Regulation no. 1228/2003; and

- capacity calculations should use a multilateral and coordinated approach for the calculation of capacity of interconnections, instead of the bilateral methodologies as used at present.

4.2.8 Granting of exemptions

We consider that SSA agreements and TSO licences should allow for an exemption or "derogation" by the authority concerned. Circumstances may arise where a TSO is unable to comply with an SSA Technical Code. If there were no derogation procedure, the SSA would have little option but to find the TSO non-compliant which procedure would be inflexible. A derogation procedure would however allow temporary solutions (until a suitable reinforcement was constructed, say), subject to the security of the transmission system not being compromised.

In the case of an SSA, the authority granting a derogation would be the SSA itself but with approval of the regulators in the countries concerned. At national level the authority would be the regulatory authority and would be subject to the conditions of the transmission licence.

4.2.9 Independent assessment and regulatory oversight

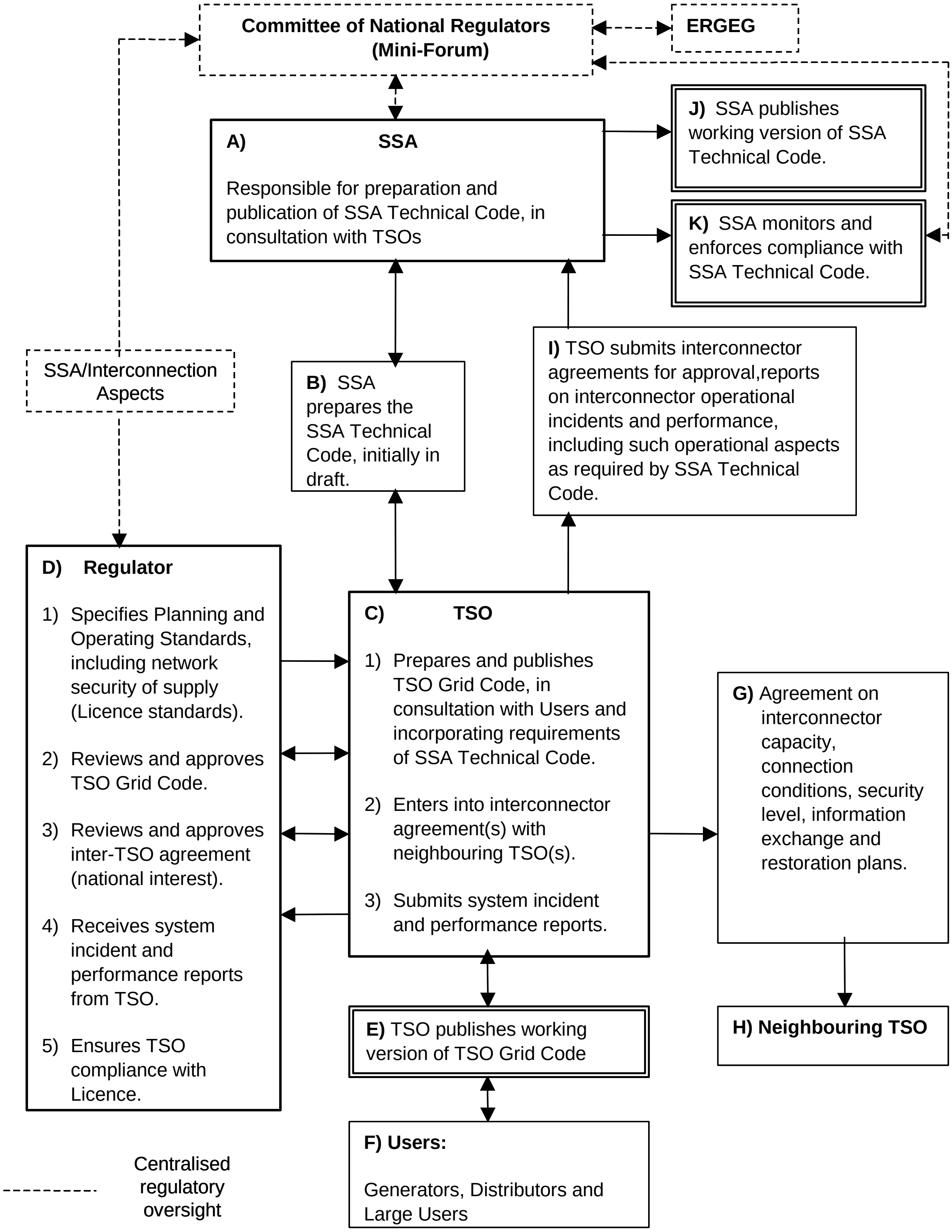
4.2.9.1 General

Two alternate arrangements for regulatory control of codes and their implementation as well as enforceability of the whole structure are considered, with a varying levels of regulatory control.

The first arrangement, a decentralised regulatory structure, would be substantially as at present with TSOs responsible to national regulators. The second arrangement proposes a centralised regulatory oversight of SSA and interconnection aspects.

The two arrangements are presented in Figure 4.2 which shows the responsibilities for the formation of codes between an SSA, TSOs and regulators. Particular emphasis is given to system security, information flow, harmonisation of definitions, compliance monitoring and enforcement,

Figure 4.2 – Regulatory structures – roles and responsibilities for codes



4.2.9.2 Decentralised regulatory structure

The basis for Figure 4.2 is as follows:

- A national **regulator** is responsible, within the framework of national law, for setting the requirements for security of supply, power quality and system performance, including reliability. In setting these standards it is the responsibility of regulators, in consultation with TSOs and other interested parties, to evaluate the overall costs and benefits of setting the standards, including very rare events. Regulators are also to be responsible for reviewing the performance of TSOs and reporting thereof. TSOs will normally have agreements with other TSOs, either as part of an SSA or bilaterally. There may be a requirement for such agreements to be subject to regulatory approval.

- A **TSO** is responsible for preparation of the detailed national rules (TSO Grid Code incorporating the requirements of the SSA Technical Code) in accordance with national regulatory requirements. A TSO may negotiate with the regulator over the practicality of meeting these requirements, for example where a TSO has no direct responsibility for generation provision (plant margin) and there may be practical difficulties in reinforcing the transmission system. The TSO Grid Code shall be approved by the regulator. A TSO shall be responsible for entering into agreements in respect of interconnections with neighbouring TSOs, in accordance with the relevant SSA Technical Code(s).

  (For avoidance of doubt, TSOs shall not be responsible for the provision of generating capacity.)[68]

- An **SSA** is responsible for the preparation of the SSA Technical Code, in consultation with TSOs. Within the bounds of commercial confidentiality, SSA Technical Code, the proceedings of its preparation and related reports shall be published. The SSA is also responsible for the reviewing, updating, monitoring of and enforcing compliance with the SSA Technical Code.

The decentralized regulatory structure is essentially the present arrangement with the relationship between TSOs and national regulators formalised. The onus of responsibility for operation of the networks and accountability lies with the TSOs.

4.2.9.3 Centralised regulatory structure

SSA Technical Codes shall be subject to the approval and monitoring by a committee of national regulators of the countries concerned, possibly on a “Mini-Forum” basis and coordinating its activity through ERGEG. Similarly the SSA shall report to the committee of national regulators on major system incidents and (annually) system performance in a prescribed format.

One issue to be resolved would be the regulators’ role in the SSA compliance process, particularly in respect of interconnector operation.

[68] Article 10 of EC Directive 2003/54/EC.

In view of the legal aspects to be considered we would propose that the regulatory structure be considered through a consultation process.

4.2.10 .Review modification procedures

We propose that SSA Technical Codes should be reviewed at regular intervals by a code review panel which would be subject to:

- an open constitution;
- publication of proceedings and revisions of codes;
- open consultation process; and
- a requirement to reflect the interests of both the regulators of the countries concerned as well as the member TSOs.

Similarly at national level a panel for reviewing a TSO Grid Code would reflect the interests of the electricity supply industry and include generators, distributors and large users. TSO Grid Codes would be subject to regulatory approval in accordance with transmission licence conditions.

4.3 Summary of analysis of issues

Table 4.1 presents a summary of the analysis of issues, options considered and proposals for incorporation in the rules as discussed in the next section of the report. The analysis is based on a comparison of the relevant policies or codes within the UCTE Operation Handbook and the Nordic Grid Code as these are the two principal SSA Codes in Europe.

Table 4.1 - Analysis of issues within existing SSA technical codes

#	DESCRIPTION	UCTE Operation Handbook (OH)	NORDIC Grid Code	ISSUES (*Problem/No problem)*	OPTIONS *(Advantage/disadvantage)*	JUSTIFICATION OR PROPOSAL FOR THE RULES
1	N-1 Security of Supply Definition (or agreed standard)	OH: P3A. Any probable single event leading to loss of power system element. After contingency, each TSO to return system to N-1 compliant condition as soon as possible.	Appendix 2 to System Operation Agreement; loss of individual principal components. “Dimensioning faults” concept, taking account of probability and severity of contingency. Restore to N-1 operation within 15 minutes.	OH-3PA definition lacks precision and transparency. Nordel definition is on a different basis to most others. Different TSO definitions exist. E.g. France has “N-k Rule”, Great Britain has SQSS (very precise and detailed) including N-2 for >1500MW and Ireland has N-1-1 and N-G-1. One common definition would mean either reduction of security from present level or conversely increased	a) Common definition within an SSA, for operational purposes. b) Bilateral definition - ensure that definitions either side of an interconnector are agreed and understood by TSOs concerned; to support standardised methodology for security assessment. c) Minimal or simplistic N-1 criterion d) Probabilistic criterion based on cost/benefit analysis.	Propose initially adopt b) to be followed after consultation by a).

#	DESCRIPTION	UCTE Operation Handbook (OH)	NORDIC Grid Code	ISSUES (*Problem/No problem)*	OPTIONS *(Advantage/disadvantage)*	JUSTIFICATION OR PROPOSAL FOR THE RULES
				investment requirement or even both.		
2	Information Exchange between TSOs to be specified	OH: Information exchange requirements stated in different ways at various parts of OH. OH: P3. Real time data exchanges. Extent and intervals not specified. OH: P3A – S3.1 information on pattern of generation subject to national confidentiality. OH: P3A-P3 also applies an arbitrary limit to the extent of the network representation to be exchanged.	Appendix 4, Exchanging information, of System Operation Agreement is not detailed. Appendices 7, Joint Operation of Interconnectors, however nominate the operations centres responsible for monitoring and control. At the Nordel Annual Meeting 2005, it was announced that the Nordic Outage Planning System (NOPS) had been taken into operation during Spring 2005 and that the specification of the	The varying statements in OH of data requirements are confusing. Data to be exchanged should be at sufficiently short intervals to enable on-line security calculations to be performed in real time (say at between 5 to 10 minute intervals). Confidentiality of generation data. If TSOs are independent of generation interests, is this an issue?	Single data exchange code e.g. NGC's Grid Code (Data Registration Code) and STC Code or NERC's TOP-005-0, Operational Reliability Information. The issue of confidentiality of generation data can be overcome if loading data is expressed in terms of • power flow by circuit • busbar loads and • indication of status of key generator circuit breakers. Self-certified inter-TSO agreement, subject to SSA review, minimises bureaucracy issue.	Requirements for data exchange should be combined as a single data exchange code. Data to be exchanged to include that which may materially impact neighbouring TSOs; to be exchanged at intervals to enable on-line security calculations . Data exchange shall (inter alia) be subject to inter-TSO agreement, to be registered with and available for review by SSA.

#	DESCRIPTION	UCTE Operation Handbook (OH)	NORDIC Grid Code	ISSUES (*Problem/No problem)*	OPTIONS *(Advantage/disadvantage)*	JUSTIFICATION OR PROPOSAL FOR THE RULES
			Nordic Operation Information System (NOIS) is ongoing. No further details are published.			
3	Monitoring of Security Level	OH: P5-A-P2.4 Emergency procedures – real time data exchanges. Extent and intervals not specified.P5B-S4 – the procedure for assessing and declaring the load limits of tie-lines should be agreed.	See above comments on Information Exchange.	See above comments on Information Exchange.	Self-certified inter-TSO agreement, subject to SSA review, minimises bureaucracy issue.	Monitoring of security level shall (inter alia) be subject to inter-TSO agreement, to be registered with and available for review by SSA.
4	Restoration Plan to be mandatory	P5A-R1.1 – Agreements and procedures between neighbouring TSOs required. P5A-R1.2 – Exchange of information.	System Operation Agreement, Appendices 7 (Joint operations of neighbouring TSOs) contain outline procedures for disturbance management.	OH P5 is in final draft status but some clauses are imprecise. Should inter-TSO agreements be subject to formal SSA approval in the first instance and at	General consensus that inter-TSO restoration plans required. Advantage of formal SSA approval is compliance with agreed standard in this vital aspect. Disadvantage is bureaucratic effort required (see Fig 3.1).	Inter-TSO Restoration Plans shall be mandatory and subject to formal SSA approval in the first instance and at regular intervals thereafter.

#	DESCRIPTION	UCTE Operation Handbook (OH)	NORDIC Grid Code	ISSUES (*Problem/No problem)*	OPTIONS *(Advantage/disadvantage)*	JUSTIFICATION OR PROPOSAL FOR THE RULES
		OH: P5A-R1.3 and P5A-S2.3- Details of bilateral/multilateral procedures left to subsidiarity. P5A-R4 – There does not appear to be an agreed level of proficiency for dispatching operators, procedure for authorization or ongoing accreditation. P5B-G3 – Each TSO should have its restoration plan available for review by UCTE.	A programme for training of control center operators has started and the Nordel Training Group had been established.	regular intervals thereafter? Self-certified inter-TSO agreement, subject to SSA review, minimises bureaucracy issue.		
5	Performance Reporting	OH: P1A-P4.1 Load/frequency control is reported, as is OH: P5A-P1 and P5A-G13 system disturbance report. However	Annual report of fault statistics (Driftstörningsstatistik) – including both system performance and plant and equipment fault	(Other examples of annual reports by TSOs include the French Power System Reliability Report by RTE and the system	a) Annual high-level performance report by SSA to regulatory authorities b) Ad-hoc reports by SSA of major incidents to regulatory authorities	a) and b) preferred. High level reports to be accessible by public.

#	DESCRIPTION	UCTE Operation Handbook (OH)	NORDIC Grid Code	ISSUES (*Problem/No problem)*	OPTIONS *(Advantage/disadvantage)*	JUSTIFICATION OR PROPOSAL FOR THE RULES
		neither is accessible by public. Security and availability also need to be reported. Reports to be accessible by public.	statistics.	performance report by NGC.) Information to be reported, when, to whom, by whom? Level of detail (annual report on availability, security and quality and/or separately by major incident). Legal liability (therefore state “what” but not “why” or “by whom”).	regulatory authorities c) Report to include plant and equipment fault statistics	
6	Compliance Monitoring and Enforcement	MLA is a private agreement between TSOs. CMEP details have yet to be announced.	The Operational Code (System Operation Agreement) and the Data Exchange Code are binding agreements with specific dispute solutions. The Planning Code and the Connection Code are rules that should	Need to establish: 1. Compliance monitoring process 2. Levels of non-compliance 3. Sanctions – what type and who to impose?	a) Respond to complaints of infringements by TSOs and build up “case law”. Without precedents this may lead to arbitrary decisions subject to legal challenge. b) Establish compliance monitoring process	b) and c) preferred.

#	DESCRIPTION	UCTE Operation Handbook (OH)	NORDIC Grid Code	ISSUES (*Problem/No problem)*	OPTIONS *(Advantage/disadvantage)*	JUSTIFICATION OR PROPOSAL FOR THE RULES
			are rules that should be observed. No procedure for monitoring non-compliance is apparent.	4. Status of an SSA-imposed compliance procedure in respect of, say, the proposed Security of Supply Directive, Article 8.	against stated levels of non-compliance against each code/policy in SSA Technical Code. Requires some bureaucratic input however. c) Sanctions could be either naming (blackboard),reporting to regulatory authority or financial.	
7	Congestion management – capacity calculation	OH: P4 Policy P4 has Final draft status but is too vague. Procedures for capacity assessment and congestion management to be more explicit. Cross referencing with ETSO documents to be improved.	The Elspot market (power exchange) takes account of “bottlenecks” in the transmission system between Elspot areas, e.g. by market splitting.	Co-ordination of operational planning with power exchange program.	For complex structural congestions between several member states, a multilateral and coordinated approach should be used for the calculation of capacity of interconnectors.	Congestion Management-related issues to be aligned with the Congestion Management Guidelines issued under Regulation 1228/2003, Article 8(4).

#	DESCRIPTION	UCTE Operation Handbook (OH)	NORDIC Grid Code	ISSUES **(*Problem/No problem)***	OPTIONS ***(Advantage/disadvantage)***	JUSTIFICATION OR PROPOSAL FOR THE RULES
8	Granting of exemptions	No procedure for exemptions is apparent.	General provisions section 3.3 provides a procedure for deviations from the Planning Code and the Connection Code. The System Operation Agreement and Data Exchange Agreement are however binding agreements with specific dispute solutions.	Circumstances may arise where TSO is unable to comply with SSA Technical Code. Precedents exist in United Kingdom and Republic of Ireland[69] where there are procedures exists for applying for derogations to the Grid Codes.	With no derogation procedure, SSA would have to find TSO non-compliant; procedure would be inflexible. Derogation procedure would allow temporary solutions, subject to system not being compromised.	SSA agreements and TSO licences to include a derogation procedure. At SSA level the authority would be the SSA but subject to approval of the regulatory authorities of the countries concerned. At national level the authority would be the regulator.
9	Independent assessment/regulatory oversight	CMEP details have yet to be announced.	No mention of reporting to NordReg, the Forum of Nordic Energy Regulators. However a TSO is required to report to its national regulator (e.g. Norway, NVE:	ERGEG: Presently no legal basis for approval of UCTE's MLA exists,	a) TSOs report separately to own national regulators, as at present. b) SSA reports on SSA and interconnection matters to ERGEG or committee of regulators	Consider options through a consultation process.

[69] Commission for Energy Regulation, Ireland, http://history.cer.ie/cer0105.pdf

#	DESCRIPTION	UCTE Operation Handbook (OH)	NORDIC Grid Code	ISSUES (*Problem/No problem)*	OPTIONS *(Advantage/disadvantage)*	JUSTIFICATION OR PROPOSAL FOR THE RULES
			Regulations relating to power system operation).		committee of regulators of countries concerned.	
10	Review and modification procedures	OH consultation forum but procedures of Working Groups not published otherwise. Procedures for review of "Final versions" of policies uncertain.	Committees and Working Groups, drawn from TSOs: • Operations • Planning • Market. General Provisions section 3.5 - The Grid Code must be reviewed at least once per year.	Panel required to review each Code and make recommendations for modifications as required. Review panel terms of reference, powers to modify and membership. Proceedings to be published	a) Internally appointed committee of experts, answerable to SSA members only. b) Openly constituted code review panel, with published proceedings, with membership reflecting regulatory and TSO interests.	b) proposed.

5. SCOPE OF EUROPEAN TRANSMISSION NETWORK SECURITY RULES

5.1 Introduction

This section describes how the introduction of guidelines for codes would address the shortcomings in existing codes.

5.1.1 Objective and aims

The objective of this section is to propose the scope of transmission network security rules for "Synchronous System Associations" (SSAs - such as TSOI, UKTSOA, UCTE, Nordel and the Baltic States (DC Baltija)) and the related TSOs. The rules would be in accordance with the proposed guidelines and would follow from EC Regulation No. 1228/2003 (Conditions for access to the network for cross-border exchanges in electricity) and EC Directive 2003/54/EC (Common rules for the internal market for electricity).

The section addresses item 4 of the terms of reference (TOR) i.e. "To propose options for the scope of European transmission network security and reliability, which could possibly be adopted as guidelines under the regulation on cross-border, trade in electricity (1228/2003)".

The aim of the proposed guidelines for the European Transmission Network Security Rules (The Rules) is to achieve the following.

a. Provide a set of standard formal requirements for the technical security rules (codes) that are subsidiary to such operating agreements that may be entered into between TSOs and that meet the requirements of the expanding electricity market.

b. Provide a set of minimum outline requirements and respective responsibilities for:

   - SSA technical codes, including bilateral agreements;
   - technical agreements for interconnectors[70] between SSAs; and
   - national (and where applicable area) grid codes, prepared by TSOs for the technical governance of their own networks.

c. Provide for the minimum requirements for operating codes to maintain the integrity of interconnected networks, particularly in respect of cross-border interconnections.

d. Prevent interruptions to supply, particularly those relating to cross-border operation, and to improve both the handling of emergencies and the restoration of supplies.

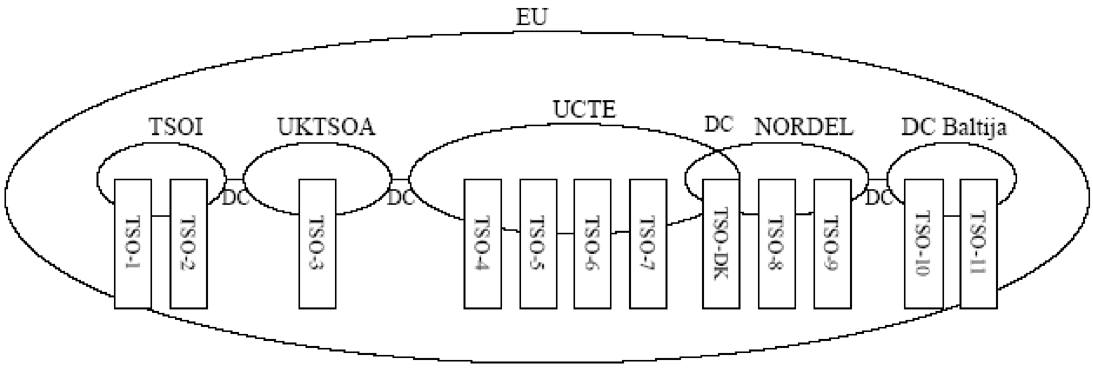
[70] In general the technical agreements for HVDC links.

e. Provide a framework for procedures for reporting on system performance and the auditing thereof.

5.1.2 Structure of the European electricity transmission system

The structure of the European electricity transmission system is shown in Figure 1. There are five different synchronous systems in Europe (Baltic States, Ireland[71], Great Britain, Continental Western/Central/Southern Europe (UCTE) and Scandinavia (Nordel)).

Figure 5.1 – Representation of European SSAs



The figure shows the five SSAs interconnected by HVDC links and that there are several TSOs within each synchronous system. For example, Western Denmark belongs both to UCTE (same frequency) and Nordel (some common rules) whereas Northern Ireland belongs to TSOI (synchronous connection between Republic of Ireland and Northern Ireland). UKTSOA (Great Britain) now has only one system operator (SO) but three transmission owners (TOs). The formal contract for the HVDC link, the Estlink, between Estonia and Finland was signed in April 2005.

Each SSA in general sets up rules for the necessary coordination between different TSOs that are interconnected in the same synchronous grid. It should be noted, however, that SSAs do not have an operational role.

The proposed rules described below apply to:

- the coordination between TSOs, i.e. on the SSA level, where SSA technical codes have to be agreed by all participating TSOs;
- interconnectors between SSAs; and

[71] Republic of Ireland and Northern Ireland

- the grid codes prepared by the TSOs themselves.

The aim is essentially to have the same structure and minimum requirements for network security rules for all SSAs and TSOs within Europe.

5.2 Principles of the Rules

5.2.1 Precedence

5.2.1.1 Legal requirements

We foresee the following precedence of legal requirements, as shown on the diagram below:

Figure 5.2 – Legal requirements

EC Regulation on cross-border trade in electricity (1228/2003)

↓

Guidelines on Technical Security Rules

↓

National Law

↓

Transmission Licence

↓

Multilateral Agreement/Bilateral Agreement

The licences and agreements would state incentive/penalty arrangements where applicable for operation outside agreed limits and rules. Procedures for enforcement (of what and how) would be included.

One difficulty at international level is to whom would an SSA report to for regulatory purposes? The Commission Decision establishing ERGEG[72] describes it as an advisory

[72] Commission Decision 2003/796/EC; European Regulators Group for Electricity and Gas (ERGEG) has been formed to facilitate consultation, coordination and cooperation between the regulatory bodies in Member States.

group although it is composed of the heads of national regulatory authorities and their representatives. At national level TSOs would report either to the appropriate government ministry or national regulator.

Another difficulty is that some jurisdictions state that national rules should predominate over an SSA Technical Code or equivalent. It is expected that the national rules would in due course be harmonized with the SSA Technical Code.

Directives only apply in those Member States to which they are directed and they usually need implementing legislation to become effective. Regulations are directly applicable and are supposed to become law uniformly and automatically in the Member States without needing further implementation. Regulations (and Guidelines issued under those Regulations) would therefore take precedence over national law. In the event of a disagreement between the two, the national law would have to be changed.

5.2.1.2 Network security rules/codes

These would be the technical rules i.e. the Rules specifying day-to-day procedures for both planning and operational purposes and cover both normal and exceptional circumstances.

We foresee the following precedence of rules/codes, as shown on the diagram below:

Figure 5.3 – Precedence of network codes

Guidelines on Technical Security Rules

↓

SSA Technical Code

↓

TSO (National) Grid Code

↓

TSO (Area) Grid Code

↓

Distribution Code

Notes:

1. Prime examples of an SSA Technical Code are the UCTE Operation Handbook, the Nordic Grid Code and the NERC Reliability Standards.

2. TSO (Area) Grid Code - Germany has 4 TSOs.

3. The Distribution Code is mentioned for completeness but does not form part of the subject matter of this report.

The proposed precedence means that, for example, a TSO Grid Code would comply with the SSA Technical Code and the TSO Grid Code would take its lead from the SSA Technical Code (for example, by reference to the appropriate clauses in the SSA Technical Code and agreement with the parameters and limits stated therein, particularly with regard to frequency control).

The Guidelines on the Technical Security Rules should not be prescriptive and should identify only the “lowest common denominator” requirements.

At present in the UCTE area the most recent edition of the UCTE Operation Handbook has been written more recently than many of the national grid codes (or equivalent documents) and the style and content of the national grid codes vary considerably. We would therefore expect that many of the national grid codes in UCTE countries, for example, would have to be rewritten in due course. Importantly the grid codes in the countries concerned should make specific reference to the appropriate policies within the UCTE Operation Handbook.

The main headings of the SSA Technical Code are discussed later in this section.

5.3 Options for provision of the technical security rules other than under EC Regulation 1228/2003

Three options for the provision of the Technical Security Rules are discussed below

1. Taking no further action and allowing existing agreements to continue.

2. Provision of an “umbrella regulation” by means of Guidelines under EC Regulation 1228/2003.

3. Provision of detailed security rules under European legislation.

5.3.1 Taking no further action and allowing existing agreements to continue

The main objections to taking no further action and so allowing existing SSA agreements between TSOs and national technical rules to continue on an independent and (for SSAs) apparently self-regulating basis are that the:

- agreements between TSOs, including subsidiary technical rules, may in the first instance be accountable to the SSA associations and TSOs alone thereby inviting the question “Quis custodet?”; and

- national technical rules are varied in content in what is increasingly becoming a supranational and therefore interdependent activity (Internal Electricity Market).

At national level TSOs are, of course, subject to national regulation. ERGEG has given advice on congestion management guidelines and in our view the establishment of guidelines on technical security rules would complement those on congestion management.

It may also be argued that for the present status quo to be maintained would be contrary to EC Directive 2003/54/EC, in particular with reference to the following Articles.

Article 5, Technical Rules

- Member States shall ensure that technical safety criteria are defined and that technical rules establishing the minimum technical design and operational requirements for the connection to the system………

Article 9, Tasks of Transmission System Operators

- (d) provision of information to the operators of neighbouring systems

Article 11, Dispatching and Balancing

- 5. TSOs to comply with minimum standards for the maintenance and development of the transmission system
- 7. Rules adopted by TSOs for balancing the electricity system shall be objective, transparent and non discriminatory

Article 23, Regulatory authorities

- (a) the rules on the management and allocation of interconnector capacity
- (d) the publication of appropriate information by transmission system operators.

Member States were required to bring EC Directive 2003/54/EC into force by 1 July 2004.

5.3.2 "Umbrella Regulation" by means of Guidelines under EC Regulation 1228/2003

EC Regulation 1228/2003 has specific requirements relating to rules that would apply to the Technical Security Rules as follows.

Preamble (7) – It is important that third countries that form part of the European electricity system comply with the rules contained within this Regulation and the guidelines adopted under this Regulation in order to increase the effective functioning of the internal market.

Preamble (15) – It is important to avoid distortion of competition resulting from different safety, operational and planning standards used by transmission system operators in Member States. Moreover, there should be transparency for market participants concerning available transfer capacities and the security, planning and operational standards that affect the available transfer capacities.

Preamble (20) – National regulatory authorities should ensure compliance with the rules contained in this Regulation and the guidelines adopted on the basis of this Regulation.

Article 5, Provision of information on interconnection capacities

- 2. The safety, operational and planning standards used by transmission system operators shall be made public. The information published shall include a general scheme for the calculation of the total transfer capacity and the transmission reliability margin based upon the electrical and physical features of the network. Such schemes shall be subject to the approval of the regulatory authorities.

- 9. Regulatory Authorities shall ensure compliance with this Regulation.

Article 8, Guidelines

- 4. (First paragraph, last sentence) Where appropriate, in the course of such amendments common rules on minimum safety and operational standards for the use and operation of the network, as referred to in Article 5(2) shall be set.

- 4. (Next sentence) When adopting or amending guidelines, the Commission shall ensure that they provide the minimum degree of harmonisation required to achieve the aims of this Regulation and do not go beyond what is necessary for that purpose.

- ANNEX, Guidelines on the management and allocation of available transfer capacity of interconnections between national systems

General

- 2. The TSOs, or, where appropriate, Member States, shall provide non-discriminatory and transparent standards, which describe which congestion management methods they will apply under which circumstances. These standards, together with the security standards, shall be described in publicly available documents.

Provision of information

- 1. TSOs shall implement appropriate coordination and information-exchange mechanisms to guarantee security of the network.

EC Regulation 1228/2003 is binding in its entirety and is directly applicable in all Member States, applying from 1 July 2004. The Regulation would therefore be a suitable means under which Guidelines for the Technical Security Rules could be issued.

We would draw attention to the advice provided by ERGEG for Congestion Management Guidelines in which it is stated that security and reliability rules would be proposed in separate guidelines.

We would expect that EEA and EFTA countries concerned would be covered by existing agreements with the EC. Conversely it may be necessary for countries outside the EC, EEA and EFTA, but whose electricity transmission systems are part of a European SSA, to enter into an appropriate agreement with the EC.

5.3.3 Provision of detailed security rules under European legislation

Our review of existing grid codes and equivalent documents has shown that these vary in content and in the detail contain some “legacy” requirements that differ from system to system. Furthermore the compilation of Technical Security Rules is both a highly specialised and continuously evolving task that should be undertaken by SSAs, TSOs and other large users of the electricity transmission systems but with regulatory involvement and approval. The SSAs themselves vary is size and some already have well developed rules. The centralized drafting of such rules would also require considerable effort, which if undertaken without the involvement of SSAs and TSOs, would require considerable engineering and legal resources. We would therefore advise against the specification of detailed security rules under European legislation as this would, in our view, be both prescriptive and impractical.

5.4 Common requirements

The Rules (codes) should be transparent, published and subject to periodic review. The constitution, membership and proceedings of the review body should be published.

There should be a procedure for granting of derogations [by the appropriate regulatory authority] and such derogations in force should be in the public domain.

There should be a procedure for the monitoring [by the appropriate regulatory authority] of compliance with the Rules and ensuing SSA Code/TSO Grid Codes.

5.5 Uniform definitions

There should be uniform definitions which apply to both the SSA’s rules and the grid codes. A particular example where a common definition is necessary is the “N-1” criterion where, for example, there should be more openly available information, agreed methodology and data about the calculation of the dimensioning fault. At the very minimum the N-1 criterion should have an agreed definition across a shared border.

The definitions would be contained in a glossary forming part of the Rules.

(A further commentary on the definition of the N-1 criterion is provided in Section 4.)

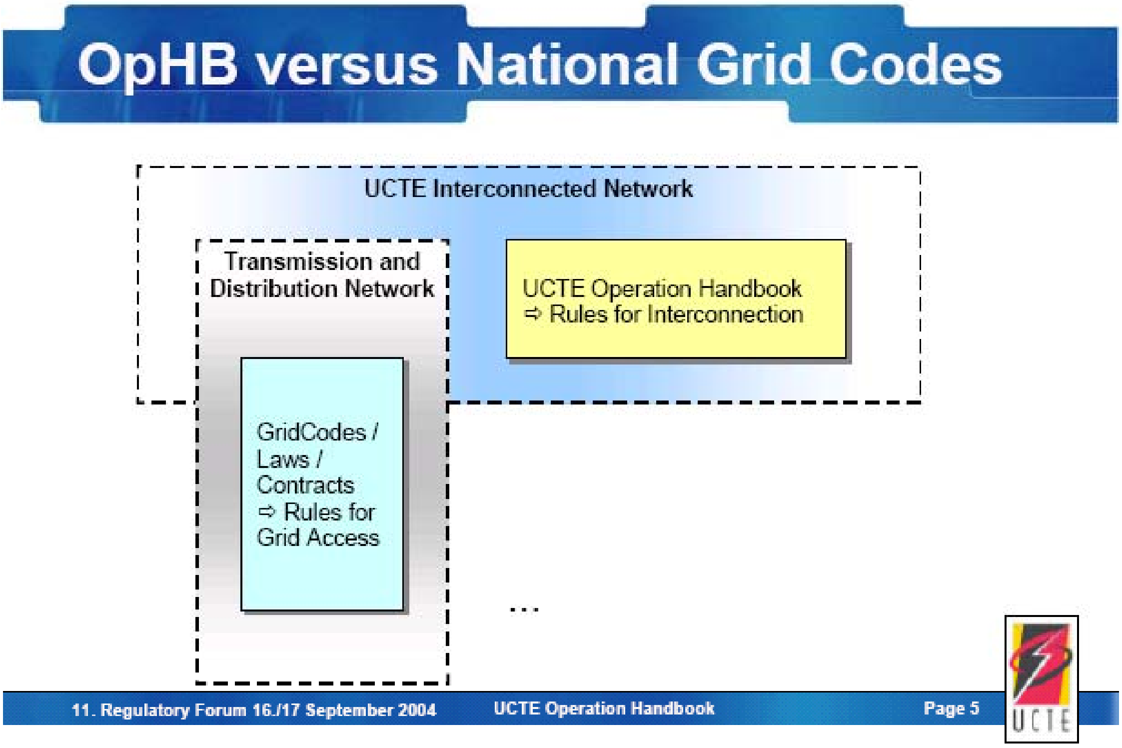
5.6 Structures of three different existing SSA codes

5.6.1 UCTE’s view

The diagram shown in Figure 5.4 was presented by UCTE at the Florence Forum in September 2004 and this structure forms the basis of our proposal for the Guidelines. The UCTE’s Multilateral Agreement (MLA) came into force on 1 July 2005. The MLA gives legal force to the UCTE Operation Handbook and sets out the rights and obligations of each TSO[73].

[73] UCTE Press Release 19 July 2005

Figure 5.4: OpHB (UCTE Operation Handbook) versus National Grid Codes



UCTE has also announced that it expects to complete the first full release of the Operation Handbook (comprising eight policies) within the next few months and that a pilot project is starting on recurrent monitoring of compliance with the standards (Compliance Monitoring and Enforcement Process).

We would also comment that the MLA is not published although the Operation Handbook is.

5.6.2 Nordel – Nordic Grid Code

The Nordic Grid Code, to which the TSOs in four countries are signatories, describes itself as a stage in the harmonisation of the rules that govern the various national grid companies and that ideally the planning, expansion and operation of all the subsystems would be governed by identical rules. The Nordic Grid Code continues that it should be starting point with minimum requirements for technical properties that influence the operation of the interconnected Nordic electric power system. The Nordic Grid Code also states that it must be subordinate to the national rules in the various Nordic countries.

5.6.3 Great Britain – The System Operator – Transmission Owner Code ("STC")

The STC is a code largely governing the procedures between NGC, as transmission system operator and the three transmission owners (NGC, SPT and SHETL). The principal headings in the STC cover transmission services and operations, planning co-ordination and communications and data (particularly provision of information between parties). The STC makes extensive cross-reference to the Grid Code, which governs the conduct of NGC and the users of the transmission system.

5.7 Proposed structure of the Guidelines for the technical security rules

5.7.1 Introduction

The Guidelines specify the arrangement, relationship between, minimum requirements and responsibilities for the technical security rules of the European Electricity Network (The Rules) comprising:

- SSA Technical Codes;
- technical requirements of inter-SSA interconnector agreements; and
- TSO Grid Codes.

The Guidelines provide a set of standard formal requirements for the Rules that are subsidiary to the operating agreements that may be entered into between TSOs and that meet the requirements of the expanding electricity market.

5.7.2 Content and level of detail of Guidelines

The Guidelines describe the general scope of the Rules and whilst comprehensive are not intended to be prescriptive. Some of the items proposed may be incorporated, for example, in inter-TSO agreements or transmission licences.

5.7.3 Hierarchy of European, SSA, National/Area codes

The Guidelines are in accordance with the requirements of EC Regulation 1228/2003, notably Articles 5.2 and 9. The following precedence of the Rules and the codes is foreseen as in Figure 5.3.

Regulatory control of the Rules, their implementation and enforceability of the whole structure

5.8 Guidelines for an SSA Technical Code

The proposed framework for an SSA Technical Code shall be as described below. An SSA Technical Code shall mainly be an operating code concerned with the interoperability of interconnected systems. It shall cover operational planning, real-time operation and system performance analysis.

5.8.1 Introduction

The introduction (or preface) shall state the following as applying to a SSA Technical Code:

- purpose;
- principles adopted in defining;
- parties to whom it is applicable; and

- responsibilities for drafting and adhering to the Code.

A description of the scope of operation of the SSA and the related electricity market, including auctioning of interconnector capacity, shall also be included but may not necessarily form part of the Code itself. The scope of operation of the SSA shall cover whether the SSA was merely a co-ordinating body or whether it had an active long-term planning function in respect of interconnectors, for example. Another important aspect shall be whether the SSA maintains its own control and monitoring centre or whether this function was delegated to nominated TSOs. A further aspect shall be responsibility for dispatch and balancing.

5.8.2 Glossary and definitions

A glossary and definitions shall be included of terms not in common usage (e.g. terms outside the IEC International Electrotechnical Vocabulary (IEV)).

5.8.3 General conditions

The General Conditions shall include the:

- procedures for review of the SSA Technical Code and resolution of disputes;
- composition of the panel undertaking the review;
- procedures for formal communications;
- publication of reports and documents; and
- “derogation” procedure for granting of exemptions.

An SSA shall be required to publish an annual statement of adequacy (concerning system security) of the transmission system in the foreseeable future.

5.8.4 Connection rules

The Connection Rules shall cover inter-TSO matters (such as connection of Users generators, distributors, and large customers) where these may be material to the SSA area and shall also be reflected in the relevant TSO Grid Codes. A particular requirement shall be common performance, testing and monitoring requirements, both of large generating plant and transmission equipment (where these may be material to the SSA area). Other particular requirements shall include harmonisation of technical standards in respect of interconnectors; such harmonisation including but not limited to protection and control. In general connection rules shall specify the usage of IEC and CENELEC standards as well as functional specifications and shall not be unduly prescriptive.

5.8.4.1 Organisational requirements

A description of the organisation and function of such operational SSA facilities as may exist shall be provided. Where any control or monitoring function is delegated to a TSO control centre, this shall be described. The responsibilities of TSOs in relation to such SSA facilities shall be specified.

Minimum control and protection requirements for cross-border/interconnectors[74] shall be stated, including but not limited to the following.

- Operational exchange of information between neighbouring TSOs.
- Operational exchange of information across interconnectors between neighbouring asynchronous systems.
- Over/under frequency and voltage protection.
- Telecommunications.

5.8.4.2 Data exchange, IT issues and back-up facilities

The requirements for the exchange of information and data between SSA and TSOs and between neighbouring TSOs shall be specified. The criteria for deciding the required information and data shall include the following.

- Requirement for operational purposes, including operational planning and safety aspects.
- Security of supply shall not be jeopardised.
- Information that may materially impact neighbouring TSOs.
- Access to confidential data, which may have commercial sensitivity, shall be restricted to those that do not have affiliation with the aforesaid commercial interests.

The roles and responsibilities of SSA and TSOs and neighbouring TSOs regarding IT and SCADA communication issues shall be stated. The obligation to provide and interchange data on status of interconnections (including Wide Area Monitoring) shall be stated.

This clause shall cover procedures and responsibilities for data exchange/format for communications/overlapping information from neighbouring systems. Requirements for reliability of communications (e.g. alternative routing, back-up power supplies) particularly under emergency conditions shall be included.

5.8.4.3 Measurements and metering

This clause shall be in the form of a “Metering Code” covering facilities to be provided between TSOs in respect of measurands and tariff metering.

[74] In effect that part of one TSO’s network which could have an influence on the operation of a neighbouring network.

5.8.4.4 Emergency situations

This clause shall cover all aspects of emergency situations in the event of system disturbances as well as roles and responsibilities under such conditions.

Restoration Plans shall be mandatory. Inter-TSO plans shall be subject to formal SSA approval in the first instance and review at regular intervals thereafter.

5.8.5 Operating rules

The main headings of the Operating Rules shall be as described below.

5.8.5.1 Demand forecast

Demand and generation forecasts shall be prepared to support operational planning including outage scheduling of interconnectors. The responsibilities for such preparation shall be stated.

5.8.5.2 Maintenance of operating reserves

This section shall cover load and frequency control including primary, secondary and tertiary control (or response) and provision of reserves and responsibilities of control areas/blocks. A statement of the following shall be provided.

- Frequency limits for normal and abnormal operation.
- Time control.
- Load shedding parameters.

5.8.5.3 Scheduling and accounting of cross-border power exchanges

There shall be a requirement to schedule in advance the power to be exchanged across borders, to monitor and account for any deviations that occur in practice. There shall be a collective definition and setting of timeframes for data transmission[75].

Congestion management issues should be aligned with the Congestion Management Guidelines issued under Regulation 1228/2003 Article 8(4).

5.8.5.4 Operational planning including N-1 operation (or equivalent security of supply criteria)

This section shall include the requirements for operational planning (contingency analysis) to take account of N-1 conditions, particularly across interconnectors.

There shall be a common definition within an SSA of the N-1 security of supply standard for operational purposes, initially on a bilateral (inter-TSO) basis and then as a common definition.

[75] In common with the requirements of the proposed Guidelines on Congestion Management.

There shall be a data exchange code for interchange of data between neighbouring TSOs, to:

- include real-time data at sufficiently short intervals to enable on-line security analysis to be carried out;
- include such data and information as may materially impact neighbouring TSOs; and
- be subject to an inter-TSO agreement registered with and available for review by the SSA.

In particular operational planning shall include assessment of net transfer capacity (NTC) of interconnectors. Other aspects include the following.

- Identification of prospective future congestion.
- Voltage control and management of reactive power.
- Short circuit levels and the fault rating of switchgear.
- Stability (transient, small signal perturbation, requirement for provision of damping/power system stabilisation).
- Outage scheduling.
- Exchanges of information material to the networks of neighbouring TSOs including, but not limited to, information on network configuration and power flows both at the operational planning stage and in real time as might affect N-1 operation.
- Standardized methodology for the calculation of capacities of interconnectors and, where appropriate, the provision of a transmission model[76] for the efficient calculation of interdependent cross-border physical power flows within operational timescales.

5.8.5.5 Coordination of maintenance scheduling

The minimum maintenance requirements of interconnectors (e.g. vegetation management, inspection and maintenance of overhead lines, routine testing of protection and control) and the verification thereof shall be stated. There shall be procedures for scheduling of maintenance as well as co-ordinating changes to such schedules.

5.8.5.6 Handling of emergency operations and system restoration

This section shall cover the preparation of procedures for emergency operations including preventative measures. For interconnections such procedures between the involved TSOs shall be mandatory and integrated in the joint operator training programmes. There shall be agreed definitions of operating states (normal/alert/emergency) as well as procedures for, but not limited to islanding, black start and restoration. The requirements for training and

[76] e.g. On-line operator load flows, possibly including short circuit level calculations if need be.

authorisation shall also be covered and shall include, but not be limited to, common training sessions covering the operation of interconnectors.

The provision of emergency procedures shall be evaluated at regular intervals and reported to the appropriate regulatory authorities.

5.8.5.7 Analysis of system performance and reporting

Each SSA and TSO shall be required to report major interruptions resulting in loss of supply as well as voltage and frequency violations to the appropriate regulatory authority. Each SSA and TSO shall be required to report annually the performance of its system to the [appropriate] regulatory authority, such report covering system availability, security (interruptions to supply) and quality of service (voltage and frequency excursions outside limits). The reports should be published.

Following a [major] event affecting the networks of two or more TSOs, there shall be a procedure for the exchange of information between the affected parties.

5.8.6 Planning rules[77]

In addition to the requirements for operational planning described earlier, there shall be requirements for the long-term planning of interconnectors, including the following:

- Security of supply (N-1 criterion or equivalent)
- Voltage criteria
- Defence plans (load tripping, islanding)
- Restoration plans

5.8.7 Compliance monitoring

This section shall state the requirements for periodic audits to ensure compliance with the SSA Technical Code. (Points to be established are the body that appoints the auditors and the terms of reference for them, particularly when monitoring international associations such as SSAs.)

The following shall be stated:

- Standards for measurements and tolerance
- Compliance reporting and monitoring process
- Enforcement process.

[77] It is assumed that the long-term planning responsibilities within networks would lie with the TSOs and would be in accordance with (national) grid codes.

As and when required the SSA shall report the following to a committee of regulators of the countries concerned:

- Compliance monitoring and enforcement
- High-level annual performance report on availability, security and quality of service and
- Major incidents.

5.8.8 Personnel

The requirements for operator training and authorisation shall be stated, including real-time simulation exercises between neighbouring TSOs. Specific reference shall be made to the following.

- Training
- Certification.

5.8.9 Liabilities

We would consider that this aspect would be more properly covered in a transmission licence and/or multi-lateral or bi-lateral agreement between TSOs, including the following.

- Incident inspection
- Penalties
- Liability towards third parties
- Dispute resolution
- Other associated legal issues

5.9 Guidelines for a Technical Agreement for an (HVDC) interconnector between synchronous systems

Note.

> The general assumption is that an interconnector between synchronous systems would comprise an HVDC link, the connection and operation of which would be subject to a bilateral Technical Agreement. However the technical requirements of an HVDC interconnector may also be subject to a related SSA Technical Code and/or a TSO Grid Code[78], depending on factors such as licence arrangements and ownership.

[78] Respective examples being the Nordic Grid Code and the British Grid Code, Issue 3, Revision 12 dated 30 September 2005.

The Guidelines here propose minimum requirements for a Technical Agreement for an (HVDC) Interconnector between synchronous systems (which requirements may alternatively be contained in either a related SSA Technical Code or TSO Grid Code). The Technical Agreement shall be made between the TSOs concerned but shall also be subject to agreement of the respective regulators and SSAs. A Technical Agreement shall principally cover connection conditions and operating procedures and shall also make appropriate reference to the related SSA Technical Code and/or TSO Grid Code. The general contents of a Technical Agreement shall be published.

5.9.1 Connection conditions

The following technical, design and operational criteria of an HVDC interconnector shall be agreed between the connected parties (TSOs and interconnector operator).

- Minimum and maximum power transfer capacity and maximum ramp rate under normal and emergency operating conditions
- Modes of operation including frequency control
- Control point, facilities/procedures for control and transfer thereof
- Control features including emergency power and provision of damping
- Operator training
- Measures for avoidance of the effects of commutation failures on adjacent HVDC links (i.e. such as might cause a sudden and material change in power transfer)
- Control of reactive power at terminals
- Limits of flicker and harmonic currents injected at terminals
- Minimum levels of short circuit capacity at terminals
- Telecommunications facilities including data transfer and protocols.

5.9.2 Operating procedures

5.9.2.1 Operational planning

A Technical Agreement shall cover the following in respect of operational planning.

- Scheduling of agreed available interconnector capacity ahead of the auction process, including residual capacity (i.e. capacity on a firm/non-firm basis).
- Scheduling of exchange volume transfer limits, being the maximum transfers as determined by the requirements of system security, including sharing of reserves.
- Outage planning.

5.9.2.2 Real-time operation

A Technical Agreement shall cover the following in respect of real-time operation.

- Gate closure procedures
- Emergency support and assistance, including the requirement where the importing party sheds load first if need be
- Management of constraints affecting the interconnector
- Transfer profiling during transitions in the import and export of power
- Energy balancing
- Fault management
- Instructed transfers.

5.10 Guidelines for TSO (National) grid code

The TSO (National) Grid Code shall set out the operating procedures and principles governing the [national] transmission system, particularly as to be observed by the users of that system (generators, distributors and large users). Where applicable the TSO Grid Code shall take precedence after the SSA Technical Code and shall invoke it as necessary. The TSO Grid Code shall contain [the headings are as in the British Grid Code] the codes and conditions as described below.

(It is for consideration the extent to which a TSO Grid Code should cover the internal governance of a TSO's System as distinct, say, from confining itself to the interaction with the users of the transmission system.)

5.10.1 Planning code

The Planning Code shall cover the long-term planning aspects, the technical and design criteria and procedures to be applied by the TSO in the planning and development of its transmission system and those to be complied with by Users (Generators, Distributors and customers directly connected to the transmission system[79]. The Planning Code shall contain procedures, planning data and planning standards (including N-1 or other security of supply criteria). In particular the Code shall specify the planning data to be provided by the Users to the TSO and vice versa.

[79] Some Grid Codes include overall economic planning criteria for system developments.

5.10.2 Connection conditions

The Connection Conditions shall specify the minimum technical, design and operational criteria to be complied with by any User or prospective User of the Transmission system. The Connection Conditions shall include:

- system performance characteristics including power quality;
- generating unit reactive power capability, frequency response profile and operating range, fault ride through capability, operation of frequency sensitive relays and related control requirements;
- generating unit house-hold operation and black start capability;
- operation of on-load tap changers of transformers under severe out-of-voltage-limit conditions;
- distributor requirements, including under-frequency load shedding;
- protection relay and telecommunication requirements; and
- maintenance standards, including testing and maintaining of plant and apparatus.

5.10.3 Operating code

The Operating Code shall comprise a number of sub-codes covering the following.

- Demand forecasts
- Operational planning and data provision
- Testing and monitoring of plant; system tests
- Demand control
- Operational liaison
- Safety co-ordination
- Contingency planning (islanding, black starts, restoration)

5.10.4 Balancing code, including statement of balancing principles

The Balancing Code shall cover the procedures for scheduling and dispatch of generating plant where power and energy are traded separately through a market. The procedures shall comprise pre- and post-gate closure and the frequency control process.

The statement of balancing principles shall include the following, or otherwise make reference to the SSA Technical Code as appropriate.

- Frequency criteria - normal and short time (abnormal) operation

- Principles relating to primary and secondary control or response as well as reserve holding
- Measures to counter sudden loss of load
- Under/over frequency relay operation
- Principles of scheduling balancing requirements
- Congestion (constraint) management
- Co-ordination with the provision of balancing services by the market

5.10.5 Data registration code (data exchange code)

The Data Registration Code shall cover data exchange requirements for planning and operational requirements, including the balancing mechanism.

5.10.6 General conditions including grid code review panel

Each TSO shall also be required to publish a statement of system adequacy/opportunity to connect to the transmission system.

5.11 Conclusions

We propose that

- the European Transmission Network Security Rules (the Rules) be consider the following three general categories of codes:-
  - SSA Technical Codes
  - Technical agreements for interconnectors between synchronous systems and
  - TSO (national and where applicable area) grid codes, prepared by TSOs for the technical governance of their own networks.
- The Rules would be in accordance with an "umbrella regulation" by means of Guidelines under EC Regulation 1228/2003.
- The Rules would have an order of precedence and would state common requirements, notably a definition for (N-1) security of supply, harmonisation of terminology and requirements for data exchange.
- As there is an issue of regulatory control and reporting two alternate Regulatory Structure arrangements should be considered through a consultation process.
- Proposed Guidelines for the Rules, namely:
  - SSA Technical Code

    - Technical agreement for an (HVDC) interconnector between synchronous systems and
    - TSO (National) grid code

be adopted.

- Processes and procedures for preparing the Rules, as well as the Rules themselves shall be published.
- Reports of system performance and major events shall also be published.
- Whereas the standards against which compliance is reported should be in the Rules, the quasi-legal processes relating to monitoring and penalties would, in our view, be more appropriately stated in an inter-TSO agreement and/or transmission licence.

6. PROPOSAL FOR SCOPE AND CONTENTS OF THE IMPLEMENTATION FRAMEWORK

6.1 Introduction

The objective of this section is to propose the scope and contents of the implementation framework of the Rules. This proposal is organised as an action plan and project specification taking into account the following.

- Roles, responsibilities and required co-operation of the regulators, TSOs and other involved stakeholders.
- Roadmap with milestones and required co-ordination.
- The “lowest common denominator” of the defined framework that is required to be implemented locally in order to provide for interoperability and market functioning as desired.
- The remaining parts of the regulatory framework that do not require harmonized implementation but that impact the market and market developments are identified and their impacts assessed in qualitative and quantitative terms.
- The impact of the operationally implemented parts of the rules and guidelines on market related concepts including congestion management, inter-TSO compensation system and balancing markets.

6.2 Issues to be resolved

From the review of differing organisations and codes that exist, the Rules should not be overtly prescriptive but should be statements of principle. The methods of their implementation may differ between SSAs and TSOs. There remain however some issues to be resolved before consultation on the Guidelines should proceed.

6.2.1 Legal

The first issue is that the proposal that the Guidelines and the Rules (The Technical Security Rules) should be issued under EC Regulation 1228/2003. The precedent is that the proposed Guidelines on Congestion Management are to be issued in accordance with this regulation. We also note that the emphasis in EC Regulation 1228/2003 is on cross-border exchanges in electricity and not the overall provision of technical security rules as such, although the Rules are mentioned as “safety, operational and planning standards”.

Another issue is the applicability of EC Regulation 1228/2003 outside of the EC, noting that the UCTE synchronous area now extends outside Europe.

We have not investigated the extent to which the principle of subsidiarity would apply in respect of the issue of the Guidelines for the Rules, if at all.

6.2.2 Regulatory

ERGEG is established as an advisory group. It is for consideration whether ERGEG should have a more specific role in respect of the regulation of the Rules and monitoring of SSAs in addition to cross-border flows, particularly as the IEM develops. To whom does a multi-national SSA report other than its own TSOs? Who should be responsible for the approval of derogations to the Rules, particularly SSA Technical Codes? There would appear to be a role for, say, committees of regulators of the countries concerned, say, with a particular SSA Technical Code. Arguably examples of suitable precedents exist include the

- public co-operation between the two Irish regulators over the conduct of the Irish North/South interconnector.
- the recently announced grouping of the regulators of Belgium, France and the Netherlands for consultation on regional market integration, including security of supply and
- the recent announcement of the Austrian and French regulators on a consultation on harmonisation of cross-border management methods for 2006.

Another precedent is the representation of regulators (as well as TSOs and other interested parties) by regional groupings at the Mini-Fora on congestion management held between December 2004 and February 2005[80].

There are nevertheless gaps at present in the regulatory framework as regulators have limited cross-border responsibility and there is therefore a case for ensuring that the regulatory framework extends across borders, particularly in respect of security of supply. We would not go as far as to suggest the establishment of a supranational regulator at this point in time. However the matter of cross-border regulation needs to be debated.

6.2.3 Governance

The regulatory monitoring of some of the existing SSA codes is unclear. There should, at each level, be regulatory monitoring of committees responsible for the preparation and revision of the Rules and the constitution, terms of reference, membership and proceedings of such committees should be published.

6.2.4 Reporting

There should be uniform reporting requirements for annual reporting on system performance and for the investigation into and reporting of major incidents.

[80] DG TREN; Florence mini-fora 17 December 2004 - 15 February 2005

6.3 Action plan

6.3.1 Roles, responsibilities and required co-operation of the regulators, TSOs and other involved stakeholders

An early consultation would be required on the proposed regulatory structure as discussed in Section 4.

6.3.2 Road map

We propose that the processes for promulgating the Guidelines for the Technical Security Rules would follow those for the Guidelines for Congestion Management[81]. We would presume that the processes would be managed by DG TREN in co-operation with ERGEG and would be in accordance with the Public Guidelines on ERGEG's Consultation Practices, dated 10 August 2004.

The proposed milestones would be as follows.

- November 2005 – DG TREN receives the final version of the report from PB Power and KTH.
- March 2006 – DG TREN publishes the report and its comments on the Proposed Guidelines for the Technical Security Rules, formally inviting views from interested parties (regulators, SSAs, TSOs and Large Users of electricity transmission networks). Importantly views should be sought on possible impediments to the Rules, identification of major deficiencies of existing codes in respect of the requirements to the Rules and the work that would be required to comply with the Rules.
- 2006 – Preparation of draft Guidelines by ERGEG
- 2006 – Public hearing and closing date for submissions.
- 2007 – Publish evaluation of submissions and forward the Guidelines to the European Commission as the formal advice on this topic.
- 2007 - Guidelines enter a formal Comitology procedure.
- 2008– Guidelines come into force.

6.3.3 "Lowest common denominator" of the defined framework to be implemented locally

Section 3 of this report provides a review and evaluation of present rules. Regarding essential requirements and, since interconnected TSOs rely on each other, the minimum level of coordination may be summarised as comprising:

[81] ERGEG Congestion Management and Tarification Guidelines, www.ergeg.org

- load and frequency control (assuming that the TSOs are synchronously connected) including sharing of reserves;

- operational procedures for defence mechanisms (under or over-frequency and/or rate-of-change of frequency load and/or generation shedding, voltage control);

- common agreement on interconnector capacity including the N-1 security of supply criterion, or equivalent;

- procedures for emergency operation to be in place and rehearsed;

- co-ordinated exchange of information between directly connected TSOs on state of their respective systems; and

- operation of co-ordinated protection and control systems.

Exchange of information regarding operation to the security of supply (N-1 criterion) is crucially important and should enable TSOs to quickly and efficiently carry out operator's load flow simulations. Further responsibilities shall be as described below.

TSOs: Each TSO shall:

- provide current information to interconnected TSOs that is material for the assessment of the reliability and security of the interconnection and its own system;

- provide its SSA with information as requested and as is reasonably required; and

- report regularly to its regulator on the implementation of the Rules and on system performance.

SSA: Each SSA shall:

- publish the processes and procedures, including details, on the maintenance of the security of supply within its area; and

- report regularly to [a committee of the regulators of the countries concerned] on the implementation of the Rules and on system performance.

Regulator: Each regulator shall:

- regularly review the level of security of supply and the system performance of the TSO(s) in its jurisdiction;

- as required, instruct its TSO(s) to review the security standards and Grid Code accordingly; and

- in the case of an SSA, jointly with other interested regulators, implement the same process with respect to the SSA.

6.3.4 Remaining parts of the regulatory framework

Section 3 and its appendices present a comparison of a number of grid codes, or equivalent, with the UCTE Operation Handbook. These codes differ not only in scope and coverage, but also in detail. The UCTE Operation Handbook contains 144 pages while the Baltic Grid Code contains only 65 pages. The latest edition of the British Grid Code contains some 444 pages and even then is only part of the relevant regulatory framework in that country. The details of the remaining parts of the regulatory framework are for consideration by industry code review panels but the remaining parts of the regulatory framework should, in our view (and this list is by no means exhaustive, address the following.

- Code review process including composition of review panel
- Testing and monitoring, including system tests
- Training and authorisation of control centre staff
- Connection conditions of users' plant and equipment, particularly generation plant (voltage capability, frequency control, protection requirements, black start capability).
- Co-ordination of protection and control
- Statement of operating parameters (e.g. normal primary and secondary frequency limits, largest system loss, frequency response characteristic, basis for primary and secondary reserves, load shedding stages, time control, voltage limits).
- Maintenance standards, including vegetation management.

6.3.5 Impact of the operationally implemented parts of the rules and guidelines on market related concepts

The following points occur.

Terminology of power flows – congestion management

The first point is that there are two dimensions, or views, of cross-border flows namely:

- a physical dimension, as seen by the operator, being the actual flow determined by the laws of physics and as might be determined from a load flow study; and
- a commercial dimension, as seen by the trader and as used for capacity allocation and auctioning or trading purposes.

The matter is discussed further in an ETSO paper[82] which advises that the use of commercial terminology (such as NTC, TRM etc.) may be different from that required in an

[82] ETSO; Cross-border electricity exchanges on meshed AC power systems, 29 April 2004,

www.etso-net.org

operational context since the physical flows may be different to the corresponding commercial flows. Furthermore assessments of capacities of interconnectors for trading purposes may be made only at infrequent intervals.

Care may therefore need to be taken in the terminology used.

N-1 Security of supply criterion

The report stresses the requirement for a common definition of the N-1 security of supply criterion, at least across common borders and for operational purposes. Caution should be exercised however in adopting a common definition throughout as circumstances and practices between countries vary and standardisation could have cost and/or reliability performance implications. In general any changes to security of supply criteria (and network reinforcement/changes to operating practices) should only follow favourable cost/benefit studies, notwithstanding that there may be a practical need to harmonise cross-border arrangements.

Inter-TSO compensation

We would regard the matter of inter-TSO compensation or penalties that might be imposed by a regulator as a commercial or licence issue.

6.4 Conclusions

We propose an action plan and project specification to implement the framework of the Rules. We identify the following actions to be taken:

- Resolution of issues (legal, regulatory, governance, reporting)
- Action plan, comprising
    - consultation on regulator structure
    - road map with proposed milestones
- “Lowest common denominator” to be implemented by TSOs, SSAs and Regulators
- Remaining part of the regulatory framework to be implemented
- Care be taken in the use of terminology of power flows in respect of the congestion market
- A caveat on the introduction of a common definition of the N-1 security of supply criterion be considered

APPENDIX A

TERMS OF REFERENCE

APPENDIX A - TERMS OF REFERENCE

Study on the technical security rules of the European electricity network

Introduction

Various electricity supply interruptions that occurred during 2003 in Europe and in the US have intensified the discussion on improving the security and reliability rules of the electricity networks. Clearly, even if large blackouts have also happened in the past, the level of incidents in 2003 was unacceptable.

The introduction of competition, particularly across national borders, brings new demands on the transmission network. The increase in the quantity of cross border transactions and the less predictable flows that tend to result mean that it is crucial that not only the infrastructure itself, but also the rules and mechanisms for controlling such flows, are adequate.

In the Internal Electricity Market there is a new allocation of responsibilities, with the independent Transmission system operators having a key role in network security. Co-ordination between transmission system operators of different Member States and neighbouring countries must be enhanced. A lack of co-ordination was a key factor in both the black out in Italy in September 2003 and the incident in the north Eastern USA.

To this end, the Union of Co-ordination of Transmission of Electricity (UCTE) at the request of the “Florence” Electricity Regulation Forum has initiated the work on Operational Handbook, which aims at binding security and reliability rules in the UCTE network. This work serves mainly to consolidate existing agreements between system operators, which have been in place for a number of years. This strengthens the case for binding security standards where the principles of reciprocity are respected and enforced. The Commission, European regulators, the TSOs outside the UCTE area, and other stakeholders have also participated in this work.

The Regulation on cross-border trade of electricity provides for the possibility to include, in the guidelines on congestion management, common rules on minimum safety and operational standards for the use and operation of the network. It is the intention of the Commission that the future guidelines will include basic rules of this type in support of the development of the Handbook. In addition, however, it is essential that Member States ensure that the TSOs comply with the detailed guidelines.

The European Commission proposed 10 December 2003 a Directive on Electricity security of supply[83] which called for strengthening of the security and reliability rules of electricity networks.

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[83] Proposal for a Directive of the European Parliament and of the Council concerning measures to safeguard security of electricity supply and infrastructure investment (COM/2003/0740)

Purpose and scope of this study contract

The purpose of this Study contract is to assess the adequacy of the present electricity transmission network security and reliability rules, scrutinise the rules under preparation and to specify further needs to improve the rules. Finally, a proposal shall be prepared in the Study for the implementation framework of the defined rules and regulations in the local, national and supranational codes and market rules. The work will be focused on the European Union countries. The countries connected to EU transmission systems will be taken into account to the extent where the rules of these countries are relevant to the security and reliability of power supply in the EU.

The scope of the work covers the following items for each Member State:

1) To make an inventory and comparative analysis of the local, national and supranational transmission network security and reliability rules relevant to the European transmission system security

   - Each TSO has its own grid code containing rules, which are relevant to the overall system security. As to supranational rules, a large majority of the European TSOs are in the UCTE. Other associations are Nordel (Nordic countries), UKTSOA (UK) and TSOAI (Ireland) and DC Baltija (Baltic states).

   - A comparative analysis between these different transmission grid codes shall be done. This analysis should especially focus on technical issues and on organizational issues like roles and responsibilities of TSOs, network users, stakeholders, regulators in the codes as such and in the development process of the codes.

2) To analyse the current implementation of local, national and supranational grid codes and to check their consistency with the existing and proposed security and reliability rules.

   - Some grid codes make explicit reference to supranational rules, some others don’t. The consultant shall identify the key links, or the areas where the link is missing, analyse how these links work in practice and suggest possible improvements.

   - An analyses of the current technical and organizational implementation by the TSOs and market participants shall show the level of compliance to that codes and point out existing gaps between codes and actual behaviour.

3) Scrutinise and evaluate the existing security and reliability rules and the rules under development by network associations and to compare the rules to other international rules.

   - UCTE is revising the recommendations in form of Operational handbook. A revision of Nordel rules is also ongoing. A major part of the work should be devoted to the UCTE work but involve views of other associations as well.

- Special consideration should be given to the following topics:
    - Primary/secondary/tertiary control and balancing markets
    - Scheduling and accounting
    - Emergency control including roles & responsibilities in emergency situations
    - IT and information exchange
    - Obligation to provide information
    - Market issues and interfaces
    - Cross border security control including a “cross-border (n-1) view and definition”
    - Legal issues and liabilities
    - Commercial issues and penalties
- An important aspect that needs to be taken into account is the trade-off between network security and the capacity made available to market players. Also the effectiveness and economic efficiency of the conditions imposed to network users or services bought from them have to be analysed.

4) Propose options for the scope of European transmission network security and reliability, which could possibly be adopted as guidelines under the regulation on cross-border, trade in electricity (1228/2003). Draft main elements of possible European transmission network security and reliability guidelines, with respect to the topics listed under point 3.

- The work on the revision of the UCTE handbook has been started with two options in mind regarding the enforcement of these rules: 1) Multilateral agreement between TSOs, 2) An umbrella of European rules under the regulation 1228/2003. A combination of these two options is also possible. The consultant shall work with a view to preparing for the second option.

5) Propose the scope and contents of the implementation framework of the defined rules and regulations in the codes, market rules and arrangements. This proposal shall be organised as the action plan and project specification taking into account:

- Roles, responsibilities and required co-operation of the regulators, TSOs and other involved stakeholders.
- Roadmap with milestones and required co-ordination

- The “lowest common denominator” of the defined framework that must be implemented locally in order to provide for interoperability and market functioning as desired.

- The remaining parts of the regulatory framework that do not require harmonized implementation but that impact the market and market developments should be identified and their impacts assessed in qualitative and quantitative terms.

- The impact of the operationally implemented parts of the rules and guidelines on market related concepts including congestion management, inter-TSO compensation system and balancing markets.

The offer has to precise for each of these points approach chosen. The consultant shall especially point out in the tender his view of the elements in the security rules which are most relevant for the European wide approach and which are the most important issues regarding the efficient use of European infrastructure.

Reports and documents to be submitted

Each of the reports should be submitted in Word for Windows electronic copy (in Excel and Powerpoint where applicable) and in 10 hard copies for the final report and 5 hard copies for interim report.

If the report is prepared in any other EU official language than English or French, the cost of translation into English or French must be given as a separate item in the financial offer.

Timetable

The timetable has to be strictly followed.

The contract shall take effect on the day of the most recent signature by the two parties.

Shortly after the signature of the contract a kick-off meeting will be held in Brussels in order to settle all the details of the Study to be undertaken.

Not later than 4 months after the signature of the contract an interim report of the Study is to be submitted to the Commission. A second meeting will be held in Brussels in order to enable the contracting parties to discuss the work accomplished. The contractor will have to take fully into consideration any suggestion made by the Commission.

Not later than 8 months after the signature of the contract the draft final report is to be submitted to the Commission.

Within one month after the submission of this draft final report the Commission will provide the contractor with its comments on the draft final report and the date of a third meeting in Brussels will be agreed upon in order to discuss the Commission’s comments.

Unless otherwise agreed, the final version of the Study, which shall fully reflect the Commission’s comments, is to be submitted one month after the communication of Commission’s comments.

APPENDIX B

WEBSITE OF GRID CODES

APPENDIX B – WEBSITE OF GRID CODES

WEBSITES FOR ACCESS TO GRID CODES AND RELATED OR EQUIVALENT DOCUMENTS

Country	Website	Comments
Cigré	http://www.cigre.org/	Reference information
EC: DG TREN	http://europa.eu.int/comm/energy/index_en.html	Reference information
ERGEG	http://www.ergeg.org	Reference information
ETSO	http://www.etso-net.org/	Reference information

Country	Website	Comments
UCTE	http://www.ucte.org	Reviewed
Nordel	http://www.nordel.org/Content/Default.asp?PageID=156	Reviewed
DC Baltija	http://www.dcbaltija.lv/english/Address.php	Reviewed
Belgium - CREG	http://www.creg.be/indexie6.html	Reviewed
Belgium - Elia	http://www.elia.be/2index.asp?l=EN	Reviewed
Belgium - Mineco	http://mineco.fgov.be	Reviewed
France - CRE	http://www.cre.fr/	Reviewed
France - Legifrance - cons	http://www.legifrance.gouv.fr/WAspad/UnTexteDeJorf?numjo=INDI0301721A	Reviewed
France - Legifrance - gen	http://www.legifrance.gouv.fr/WAspad/UnTexteDeJorf?numjo=INDI0301440D	Reviewed
France - Legifrance - prod	http://www.legifrance.gouv.fr/WAspad/UnTexteDeJorf?numjo=INDI0301719A	Reviewed
France - RTE Ref. Tech.	http://www.rte-france.com/htm/fr/offre/offre_publications_ref_technique.jsp	Reviewed
France - RTE Security report	http://www.rte-france.com/htm/fr/vie/vie_bilan_surete.jsp	Reviewed
France RTE Memento	http://www.rte-france.com/htm/fr/vie/vie_publi_annu_memento.jsp	Reviewed
France RTE Raccordement	http://www.rte-france.com/htm/fr/offre/offre_raccord_prod.jsp	Reviewed
Germany E.ON	http://www.eon-netz.com/frameset_english/net_eng/net_connection_rules_eng/net_connection_rules_eng.jsp	Reviewed
Germany EnBW	http://www.enbw.com/content/de/index.jsp;jsessionid=FD0FC2B846B15A83BA850C7117AC0008.nbw45	Reviewed
Germany RWE	http://www.rwe.com/generator.aspx/netznutzung/netzanschlussregeln/language=de/id=226320/netzanschlussregeln.html	Reviewed
Germany Vattenfall	http://transmission.vattenfall.de/files/Netznutzung/Netzanschluss/Netzanschluss_und_Netznutzungsregeln_VET.pdf	Reviewed
Germany VDN	http://www.vdn-berlin.de/networkcodes.asp	Reviewed
Great Britain (HMSO)	http://www.hmso.gov.uk/si/si2002/20022665.htm	Reviewed
Great Britain (NGC)	http://www.nationalgrid.com/uk/indinfo/grid_code/mn_current.html	Reviewed
Great Britain (Ofgem)	http://www.ofgem.gov.uk/ofgem/index.jsp	Reviewed
Netherlands - Dte	http://www.dte.nl/	Reviewed
Netherlands - TenneT	http://www.tennet.nl/english/procedures/legislation/	Reviewed
Poland	http://www.pse.pl/search/index.php	Reviewed

Country	Website	Comments
Austria E-Control	http://www.e-control.at/	Not reviewed
Austria Tirag	http://www.tirag.at/	Not reviewed
Austria Verbund APG	http://www.verbund.at/at/	Not reviewed
Austria VKW Übertragungsnetz	http://www.vkw-grid.at/Scripts/WebObjects.dll/grid?mandant=grid01	Not reviewed
Belarus	http://www.belenergo.by/	Not reviewed
Bosnia	http://www.ephzhb.ba/	Not reviewed
Bulgaria	http://www.dker.bg/papers_en.htm	Not reviewed
Croatia	http://www.hep.hr/	Not reviewed
Cyprus	http://www.eac.com.cy/EAC_Homepage.nsf/EnglishMainFrameset?OpenFrameSet	Not reviewed
Czech	http://www.ceps.cz/detail_eng.asp?cepsmenu=15&IDP=224&PDM2=0&PDM3=0&PDM4=0	Not reviewed
Denmark East, Elkraftsystem	http://www.elkraft-system.dk/C1256ABD004F7528/Drift/0EA2CDBF495A9D22C1256CD4004D1973?OpenDocument	Not reviewed
Denmark West, ELTRA	http://www.eltra.dk/composite-15638.htm	Not reviewed
Estonia	http://www.eti.gov.ee/en/oigusaktid/electricity_act	Not reviewed
Finland Fingrid (1)	http://www.fingrid.fi/portal/in_english/services/grid_service/connection_terms/	Not reviewed
Finland Fingrid (2)	http://www.fingrid.fi/portal/in_english/services/system_services/	Not reviewed
Greece	http://www.desmie.gr/content/index.asp?parent_id=322&lang=2	Not reviewed
Hungary	http://www.mavir.hu/	Not reviewed
Ireland - CER	http://www.cer.ie/	Not reviewed
Ireland - Eirgrid	http://www.eirgrid.com/eirgridportal/DesktopDefault.aspx?tabid=System%20Operations	Not reviewed
Ireland - ESB	http://www.esb.ie/esbnetworks/standards_codes/esb_networks_codes.jsp	Not reviewed
Italy	http://www.grtn.it/ita/sistemaelettrico/gridcode.asp	Not reviewed
Latvia	http://www.gridcode.lv/en/02_tikla_kodekss.html	Not reviewed
Lithuania	http://www3.lrs.lt/cgi-bin/preps2?Condition1=246666&Condition2=	Not reviewed

Country	Website	Comments
Luxembourg	http://www.cegedel.lu/cegedel-net/	Not reviewed
Macedonia	http://www.erc.org.mk/	Not reviewed
Malta	http://www.enemalta.com.mt/page.asp?p=938&l=1	Not reviewed
Moldova	http://www.bisnis.doc.gov/bisnis/bisdoc/000119elect.htm	Not reviewed
Northern Ireland - NIAER	http://ofreg.nics.gov.uk/	Not reviewed
Northern Ireland - NIE	http://www.nie.co.uk/home.htm	Not reviewed
Northern Ireland - SONI	http://www.soni.ltd.uk/gridcode.asp	Not reviewed
Norway NVE (1)	http://www.nve.no/FileArchive/85/Regulation_of_system_operation.doc	Not reviewed
Norway NVE (2)	http://www.nve.no/modules/module_109/publisher_view_product.asp>Market+regulation>Regulations&lang=e	Not reviewed
Portugal	http://www.erse.pt/erse_english/index.html	Not reviewed
Romania	http://www.anre.ro/engleza/default_e.htm	Not reviewed
Serbia	http://www.eps.co.yu/releases/recomendations.php	Not reviewed
Slovakia	http://www.sepsas.sk/seps/en_Kodex.asp?kod=129	Not reviewed
Slovenia	http://www.upo.eles.si/modload.php?&c_mod=upofiles&c_menu=6&op=readfile&id=57&tokens=Grid	Not reviewed
Spain REE (1)	http://www.ree.es/ingles/i-index_trans.html	Not reviewed
Spain REE (2)	http://www.ree.es/apps/i-index_dinamico.asp?menu=/ingles/i-cap03/i-menu_ope.htm&principal=/ingles/i-cap03/i-o03.htm	Not reviewed
Sweden - SVK	http://www.svk.se/web/Page.aspx?id=5327	Not reviewed
Switzerland Etrans	http://www.etrans.ch/services/online/gridcode/	Not reviewed
Switzerland SFOE de	http://www.energie-schweiz.ch/internet/00048/index.html?lang=de	Not reviewed
Switzerland SFOE fr	http://www.energie-schweiz.ch/internet/00048/index.html?lang=fr	Not reviewed
Turkey	http://www.epdk.org.tr/english/regulations/electricity.htm	Not reviewed
Ukraine	http://www.erranet.org/Library/Codes	Not reviewed

APPENDIX C

DETAILED COMPARATIVE ANALYSIS

APPENDIX C – DETAILED COMPARATIVE ANALYSIS

Document Comparison

CODES	SUB-CODE	Detail	SUPRANATIONAL ASSOCIATIONS			NATIONAL					
			UCTE	NORDEL	DC Baltija	Belgium	France	Germany	Great Britain	Netherlands	Poland
						ELIA	RTE	VDN	National Grid Company plc (NGC)	TenneT	Polish Power Grid Company SA (PSE SA)
ELECTRICITY LAW							LOI no 2000-108 du 10 février 2000 relative à la modernisation et au développement du service public de l'électricité (1) NOR: ECOX9800166L		Electricity Act 1989, Utilities Act 2000 and Electricity Safety, Quality and Continuity Regulations 2002	Electricity Act, July 1998, (Act 27250)	
GRID CODE OR EQUIVALENT DOCUMENT - PRINCIPAL			Operation Handbook (OH)	Nordic Grid Code (NGC)	Grid Code(GC)	Arrêté royal établissant un règlement technique pour la gestion du réseau de transport de l'électricité et l'accès à celui-ci	INDI0301440D: Decree 2003-588, 27 June 2003, General Techinical Specifications for Connections. RTE - Référential Technique	TransmissionCode 2003 (TC), including Appendices A to D and Pre-Qualification Questionnaire (Primary/ Secondary Control & Minute Reserve)	The Grid Code (GC) and the System Operator - Transmission Owner Code (STC)	Dte: Net Code (local system operators and consumers), Measuring Code and System Code	Instruction of transmission system operation and maintenance general part-2001(IRiESP)
- SUBSIDIARY						RGIE - Règlement Général sur les Installations Electriques	INDI0301719A: Technical Specifications for Generator Connections	DVG/VDN Recommend-ations/ Documents	Security and Quality of Supply Standard (SQSS)	Dte: Co-operation Regulation	IRiESP detailed Part1 : Rules of electricity balancing market in Poland
							INDI0301721A: Technical Specification for Customer Connections	VDEW Documents	Balancing Principles Statement (BPS)	Tennet: Imple-mentation Regulations concerning the Dutch Grid (Net)- and Systemcode.	IRiESP detailed Part2 : Rules of ancilliary services
							Mémento de la Sûreté du Système Électrique,	Standards and Guidelines	Engineering Recommend-ations (ER)	Tennet: Summary of the current operating rules of the UCTE concerning primary and secondary regulation.	IRiESP detailed Part3: Rules of must run generation
							RTE: Procédure de traitement des demandes de raccordement aux RPT des installations de production, Règles d'accès import export et Règles relatives à la Programmation, au Mécanisme d'Ajustement et au dispositif de Responsable d'Equilibre		National Grid Technical Specifications (NGTS)	Tennet: Operations - Managing Concept	

CODES	SUB-CODE	Detail	SUPRANATIONAL ASSOCIATIONS			NATIONAL					
			UCTE	NORDEL	DC Baltija	Belgium	France	Germany	Great Britain	Netherlands	Poland
IMPLEMENTATION			Policies P1 to P3, P6 and P7 - Final version, others Consolation draft	Published according to an agreement between the TSOs in Scandinavia and Finland	Based on the multilateral Agreement on parallel operation and the Grid Codes of Lithuania, Latvia, Estonia		On 16 September 2004 RTE invited CURTE (the Power Transmission System Users Committee) to join a new sub-group to draw up the Grid Code (Référentiel Technique), published on 28 June 2005	VDN, registered association with the VDEW, including the ÜNB - Übertragungs-netzbetreiber - comprising 4 Transmission System Operators - (see page I-4 of UCTE OH).	Grid Code Issue 3 Rev. 11, 15 July 2005		IRiESP 2001
REVIEW PROCESS			OH: Introduction - H - Procedure for handbook development	NGC Preface: NGC reviewed at leas once a year.	Network Code Commission, discusses sugested changes at least 2 times a year			TC was updated by VDN in 2003 by a panel of authors representing the four Transmission System Operators, generators and distributors.	Grid Code Review Panel		Updating IRiESP 2001
PLANNING CODE	Specifies technical and design criteria		OH Policy 3: Operational Security does not cover long term planning requirements	NGC (Planning Code) Deterministic criteria concerning operating conditions before the fault and consequences that are acceptable	Section 3. Planning of operating conditions, energy balance, system emergency analysis etc. Section 4 Long-term planning of transmission development			TC 5 Network expansion	GC - Planning Code. STC - Section D - Planning Co-ordination.		IRiESP General -Section VI.2 - VI.4
	Planning procedures	System adequacy statement	UCTE: System Adequacy Forecast	NGC (Planning code) Method to analyze necessary grid strengthening includes clarification of preconditions, system analysis and technical/economical comparison	Sections 3 and 4 clarify the tasks of each planning (see above) as well as conditions for which the plans should be tested and criteria that should be checked	Titre III Chapter II and III Art79 to 93, Request for a connection study, Chapter IV Art 94 to 112, Connection request	RTE: Connection: Capacities available at transformer substations and Generation Adequacy Report. Référentiel Technique: Chapitre 2.		PC.4 - Seven Year Statement	Tennet: System Capacity Plan	
	Planning Data	User's System Data, Generating Unit Data, Demand Data, Network Data	OH: P4-D-R2, detailed network model	Full model of the Nordic grid	- User's System Data, Generating Unit Data, Demand Data, Network Data	Titre II Chapter 1 Art 27 to 40, Network Planning Data	INDI0301719A: Chapter III, Art 23, power system studies and RTE: "Procedures de raccordement". Référentiel Technique: Chapitre 1.2.		PC.5 - Planning Data, including Appendices A to C	NetCode 4 - Planning Conditions	IRiESP General Section VI.2.8 to VI.2.11
	Planning standards					Titre III Connection to the network, Chapter 1, Art 41 to 60	Référentiel Technique: Chapitre 3.		PC.6 - Licence Standards i.e. SQSS		

CODES	SUB-CODE	Detail	SUPRANATIONAL ASSOCIATIONS			NATIONAL					
			UCTE	NORDEL	DC Baltija	Belgium	France	Germany	Great Britain	Netherlands	Poland
CONNECTION CONDITIONS	Specifies minimum technical, design and operational criteria to be complied with by Users.			NGC(Connection code) Specify requirements for minimum technical requirements to ensure security of operation in the Nordic power system.	Requirements to equipment of all (not only newly built) substations and power plants (Section 2.6)	Titre IV Chapter 1 Art 142 to 155, Access to the Network	INDI0301719A: Chapter II, Art 4 to 7 and INDI0301721A: Art 4 to 8 Référentiel Technique: Chapitre 4.	TC, Section 2, Connection Conditions			IRiESP General Section IV.1.1 ,Section IV.2 - Identification of the interconnection conditions
	Procedure			Applies to newly-built installations.	Applies to all installations	Titre II Chapter 1 Art 27 to 40 Network Planning Data	INDI0301721A: Art 5 Demand data Référentiel Technique: Chapitre 1.1.	TC, Section 2.2, mains connection and Appendix D - Prequalification	CC.4 - Procedure		IRiESP General Section IV.1.4
	Agreements				Operational information, models of the equipment	Titre III Chapter V Art 113 to 123, Implementation and Compliance of the Connection		TC: Appendix D - Prequalification	CC.5 - (Mainly operational) information submission prior to connection		IRiESP General Section IV.3
	Technical, Design & Operational Criteria	Including voltage & frequency variations, power quality, compliance with technical specifications, plant performance requirements; electronic data communication facilities	OH: Policy 6: Communication Infrastructure	NGC(Connection code) Voltage variation, harmonics, reactive power limits, frequency variation, voltage regulators, active power control, data exchange code	voltage, reactive power range, active power control, data exchange, relay protection responce times for different conditions	Titre III Connection to the network, Chapter 1, Art 61 to 78 , Annex 1, Technical characteristics of an installation, and Annex 2, maximum time for the elimination of a fault by protection	INDI0301719A: Chapter III, Art 8 to 22 including voltage and frequency response capability, Art 25 voltage quality, Annex Informative voltage and frequency variations, voltage dips and INDI0301721A: Art 9 to 10. Référentiel Technique: Chapitre 3.	TC, Section 2.2, mains connection, Section 2.3 connection of generating units and Appendix D - Prequalification. Section 2.5 Network Protection.	CC.6 - generating plant performance includes specification of minimum frequency response requirements; CC.6.5.8 specifies Electronic Data Communication Facilities		IRiESP General Section IV.6.1 to Section IV.6.8
	Site related conditions	responsibilities, diagrams, drawings				Titre VII Chapter III Art 402 to 403 Principles for compiling electrical schematic diagrams		TC: Appendix A	CC.7 - site related conditions		IRiESP General Section V.2.5
	Ancillary Services	Reactive power, frequency control, Black Start		Different national rules concerning requirements, and payment	Section 2.1 Frequency control, Section 2.4 voltage reactive power control, (Section 3.5, 3.7, 3.8 Planning of power and energy balance, reserves, voltage, reactive power)Section 3.1.3 system restoration after black out	Titre IV Chapter XIII, Art 231 to 265, Ancillary Services comprising primary control, secondary control, tertiary reserve, voltage and reactive power control, congestion management and black-start.	Référentiel Technique: Chapitre 4.	TC 2.3, Appendix D and Prequalification Process. Each TSO responsible for provision of primary and secondary control through auctions, minute reserve by daily tender.	CC.8 - Ancillary Services		IRiESP - Part 2 Section 2.5 Reactive power flow and voltage control services at generation nodes

CODES	SUB-CODE	Detail	SUPRANATIONAL ASSOCIATIONS			NATIONAL					
			UCTE	NORDEL	DC Baltija	Belgium	France	Germany	Great Britain	Netherlands	Poland
OPERATING CODES	Demand Forecasts					Titre VII, Data registration, and Annex 3, Data Tables			OC.1 Demand Forecasts	NetCode 5, Management Conditions, 5.1 General Conditions	
	Operational Planning & Data Provision	Co-ordination of outages of generating & transmission plant	OH: P3-E and P4-A, Outage Scheduling, P4-B, Capacity Assessment and P4-C, Capacity Scheduling	NGC, System Operation Agreement, Appendix 4	Section 3. Operational Planning & Data Provision	Titre III Chapter XI, Art 210 to 226 Daily Acces Programme and Chapter XII, Art 227 to 230, Daily Coordination Programme		TC 6.2 Operational Planning	GC OC.2 Operational Planning & Data Provision. STC Section C: Transmission Services and Operations	NetCode 5, Management Conditions, 5.1 General Conditions	IRiESP General Section V : Rules of grid maintenance
	Testing and Monitoring	Tests, particularly of generating plant to ensure compliance with Connection Conditions and Balancing Code		NGC (Connection code), Section 3.2.6.	Section 3.4, 3.5 and Section 5: Testing and Monitoring	Titre III Chapter VI Art 124 to 144, Tests undertaken by a User	Référentiel Technique: Chapitre 5.	TC: Appendix D 3.2.3.5	GC OC.5 Testing and Monitoring. STC Section C: Transmission Services and Operations	SystemCode 2.1.3, 2.1.21 and Appendix 4	IRiESP General - Section IV.1.4(e) and IV.1.4(f)
	Demand Control	Reduction of load	OH: P5-A-S5	NGC-System Operation Agreement, App 5.	Section 2.5.10.5 Automatic Load shedding	Titre III Chapter XV Art 298 to 311, Conduct of the network	INDI0301721A: Art 11 to 12, load shedding	TC 6.3.3 Operation under disturbed and endangered circumstances	OC.6 Demand Control		
	Operational Liaison	Information Exchange, including event reporting	OH: P3-F, Information Exchange between TSOs for Operation	NGC (Data Exchange Code)	Section Section 5. System of collection, processing and transmission of information		INDI0301721A: Art 15	TC 4.2.6 Technical Information Requirements	OC.7 Operational Liaison		IRiESP General Section IV.7: Scope of the information delivery concerning technical - operating cooperation of the transmission system operation with the entities connected to the grid.
	Safety Co-ordination	Site responsibility			Section 2.2 Requirements to measures for providing stability, Section 2.5. requirements to relay protection and automation				GC OC.8 Safety Co-ordination. STC Section F: Communications and Data.		IRiESP General Section V.7 : Conditions of a safer performance of work
	Contingency Planning	Black start, re-synchronisation of islands	OH: Policy 5: Emergency Operations	NGC(System Operation Agreement) App 6 section 1.2.4	Section 3.9.-3.13 Control of emergency conditions, system emergency analysis, defining of fault locations, isolation of power system and their parts, restotation after black out	Titre III Chapter XVI Art 312 to 315, Codes for safeguarding and re-establishing the network.	INDI0301719A: Chapter III, Art 19 black start and Art 20 islanding	TC 2.3.12 and TC 4.2.4 islanding	OC.9 Contingency Planning	SystemCode 2.3	
	Event Information Supply	Significant Events	OH: P5-A-P1	NGC, System Operation Agreement, Appendix 4	Section 3.9 contol of emergency Conditions.				GC OC.10 Event Information Supply. STC Section C: Transmission Services and Operations		
	Numbering & Nomenclature	Plant and apparatus							OC.11 - Numbering & Nomenclature		IReESP General Section V.11.2 Scope and procedure of the maintenance information exchange.
	System Tests	Simulation of material events		NGC (Planning Code) section 5.5	Section 3.4 System testing	Titre III Chapter XVI Art 316, periodical simulation and tests	Référentiel Technique: Chapitre 5.		OC.12 System Tests	SystemCode 2.1.3, 2.1.21 and Appendix 4	

CODES	SUB-CODE	Detail	SUPRANATIONAL ASSOCIATIONS			NATIONAL					
			UCTE	NORDEL	DC Baltija	Belgium	France	Germany	Great Britain	Netherlands	Poland
SCHEDULING & DESPATCH CODE/ BALANCING CODE			UCTE is not responsible for despatch.	NORDEL is not responsible for dispatch.	Section 3. Planning and dispatch control	Balancing Group, 15 minute measuring periods		Balancing Groups, 15 minute measuring periods	Balancing Mechanism, 0.5h settlement periods		
	Pre Gate Closure Process	Balancing mechanism bids & offers, generation physical notifications, balancing mechanism data requirements	OH: Policy 2: Scheduling & Accounting,P4-D: Day Ahead Congestion Forecast, P4-E: Congestion Management	NGC, System Operation Agreement, Appendix 4	No details available	Titre III Chapter XIV Art 267 to 297, Co-ordination of the scheduling of generating units		TC 3.2 , Appendix B, TC 3.3 bottlenecks, TC 4.2.2 frequency control	BC1 - Pre Gate Closure Process - Gate Closure is 1 h before real time	Dte: NetCode 5, Management Conditions, 5.1 General Conditions and Tennet: Operations Managing Concept	
	Post Gate Closure Process	Acceptance of balancing mechanism bids & offers, calling off of ancillary services		NGC, System Operation Agreement, Appendix 5	No details available			TC 3.4 Imbalance between procurement and delivery, TC 4.2.3 voltage control	BC2 - Post Gate Closure Process		
	Frequency Control Process	Instructions to regulate frequency	OH: Policy 1: Load-Frequency Control & Performance	NGC, System Operation Agreement, Appendix 5-6	Section 2.1 Requirements to fequency control	Titre III Chapter XV Art 308 to 311, Reserve		TC 4.2.2 frequency control	BC3 - Frequency Control Process		
DATA REGISTRATION CODE	Listing of data interchange between operator and users	Obligation to provide information		NGC (Data Exchange Code) which is a binding agreement between the Nordic TSOs	Grid code chapter 5	Titre II Chapter 1 Art 27 to 40 Network Planning Data	INDI0301719A: Chapter III, Art 26, data required by system operator, and INDI0301721A: Art 13 Référentiel Technique: Chapitre 4.7.		STC - Section F - Communications and data	SystemCode 2.4 and 2.5	IRiESP General Section IV.7 Scope of the information delivery concerning techinical operating cooperation of the transmission system operator with the entties connected to the grid.
	Data categories and registration stages	Planning & operational data	OH: P3-F, Information Exchange between TSOs for Operation	Planning and operational data	Section 3.6 for normal operation, Section 2.9 for emergency operation, Section 3.14 general	Titre VII, Chapters 1 -3 , Articles 389 to 403 and Annex 3 Table of Data		TC Section 2.6, Appendix A and Appendix D 3.2.3	DRC.4 - Data categories and registration stages	NetCode 4, Planning Conditions, 4.1 Long-term planning data and 4.2 medium term planning data	IRiESP General Section VI.10: List of data subject to measurement and registration by the transmission system operator in its operation of PPS
	Procedures & responsibilities			Details in Appendix 4 of Data Exchange Code	Section 5 System of collection processing and transmission of information	Titre II Chapter 1 Art 27 to 40 Network Planning Data			DRC.5 - Procedures & responsibilities	NetCode 5, Management Conditions, 5.5.5 Data Exchange and 5.7.4 Data published for cross-border exchange	IRiESP General Section IV.8 Scope of data delivered by relevant entities to the transmission system operator for use in ends of te long term investment planning
	Data to be registered	Detailed schedules		Grid data must be available in the PSS/E version 28 format. For market simulation the Multia Area Power Market Simulator from SINTEF-Norway is used	No details provided	Titre VII, Chapters 1 -3 , Articles 389 to 403 and Annex 3 Table of Data	RTE: Procédure de raccordement: Les fiches détaillées à fournir pour obtenir une proposition de raccordement. Référentiel Technique: Chapitre 1.2.	TC Appendix D and prequalification questionnaire for bidders for different types of control energy	DRC.6 - Data to be registered	NetCode 5, Management Conditions, 5.5.5 Data Exchange and 5.7.4 Data published fro cross-border exchange	IRiESP General Section VI.10

CODES	SUB-CODE	Detail	SUPRANATIONAL ASSOCIATIONS			NATIONAL					
			UCTE	NORDEL	DC Baltija	Belgium	France	Germany	Great Britain	Netherlands	Poland
GENERAL CONDITIONS	General application provisions										
	Review panel			Nordel's Planning Committee is responsible, in consultation with its Operations Committee, for the continued work on and further development of the Nordic Grid	Section 6 Changes of Requirements and recomendations accepted in the Code. Code Commission consisting of equal number of representatives from each country is responsible for furthere development of GC		RTE 16/09/04: CURTE - Comité des Utilisateurs du Réseau de Transport d'Électricité		GC.4 The Grid Code Review Panel		Management board of PSE SA
	Communication between TSO & Users	IT and Information Exchange/Obligation to provide information			Section 5. System of collection processing and transmission of information	Titre VII, Chapters 1 -3 , Articles 389 to 403 and Annex 3 Table of Data	INDI0301719A: Chapter III, Art 26 and 27 Référentiel Technique: Chapitre 4.7.	TC Appendix D 3.2.4	GC.5 Communication between NGC and Users and Annex to GC	Co-Operation Regulation Article 9 and System Code 4	IRiESP General Section VII
	Format for communications	IT and Information Exchange/Obligation to provide information			Section 5. System of collection processing and transmission of information	ELIA: Direct protocol based connection between market participants and Elia's scheduling servers	RTE: Regles d'acces au systeme d'information et d'utilisation des applications de RTE Référentiel Technique: Chapitre 4.7.		GC.6 Data and notices	EDINE staat voor: Electronic Data Interchange in de Nederlandse Energiesector	IRiESP General Section VII.2.1 : Electronic documents and Extensible markup language(XML)
	Electrical Standards	(detailed plant & equipment specifications)							GC.11 Governance of Electrical Standards and Annex to GC		

APPENDIX D

COMPARISON OF THE CODES FOR GENERATION ADEQUACY AND FREQUENCY CONTROL

APPENDIX D – COMPARISON OF THE CODES FOR GENERATION ADEQUACY AND FREQUENCY CONTROL

Generation Adequacy

OVERALL	DETAIL	UNIT	SUPRANATIONAL ASSOCIATIONS			NATIONAL					
			UCTE	NORDEL	DC Baltija	Belgium	France	Germany	Great Britain	Netherlands	Poland
						ELIA	RTE	VDN	National Grid Company plc (NGC)	TenneT	Polish Power Grid Company SA
ELECTRICITY LAW							LOI no 2000-108 du 10 février 2000 relative à la modernisation et au développement du service public de l'électricité (1) NOR: ECOX9800166L		Electricity Act 1989, Utilities Act 2000 and Electricity Safety, Quality and Continuity Regulations 2002	Electricity Act, July 1998, (Act 27250)	
GRID CODE OR EQUIVALENT DOCUMENT - PRINCIPAL			Operation Handbook (OH)	Nordic Grid Code (NGC)	The Grid Code (GC)	Arrêté royal établissant un règlement technique pour la gestion du réseau de transport de l'électricité et l'accès à celui-ci	INDI0301440D: Decree 2003-588, 27 June 2003, General Techinical Specifications for Connections. RTE - Référential Technique	TransmissionCode 2003 (TC), including Appendices A to D and Pre-Qualification Questionnaire (Primary/ Secondary Control & Minute Reserve)	The Grid Code (GC) and the System Operator - Transmission Owner Code (STC)	Dte: Net Code (local system operators and consumers), Measuring Code and System Code	Instruction of transmission system poeration and maintenance general-2001(IRiESP)
- SUBSIDIARY						RGIE - Règlement Général sur les Installations Electriques	INDI0301719A: Technical Specifications for Generator Connections	DVG/VDN Recommend-ations/ Documents	Security and Quality of Supply Standard (SQSS)	Dte: Co-operation Regulation	IRiESP detailed Part1 : Rules of electricity balancing market in Poland
							INDI0301721A: Technical Specification for Customer Connections	VDEW Documents	Balancing Principles Statement (BPS)	Tennet: Imple-mentation Regulations concerning the Dutch Grid (Net)- and Systemcode.	IRiESP detailed Part2 : Rules of ancilliary services
							Mémento de la Sûreté du Système Électrique,	Standards and Guidelines	Engineering Recommend-ations (ER)	Tennet: Summary of the current operating rules of the UCTE concerning primary and secondary regulation.	IRiESP detailed Part3: Rules of must run generation
							RTE: Procédure de traitement des demandes de raccordement aux RPT des installations de production, Règles d'accès import export et Règles relatives à la Programmation, au Mécanisme d'Ajustement et au dispositif de Responsable d'Equilibre		National Grid Technical Specifications (NGTS)	Tennet: Operations - Managing Concept	

OVERALL	DETAIL	UNIT	SUPRANATIONAL ASSOCIATIONS			NATIONAL					
			UCTE	NORDEL	DC Baltija	Belgium	France	Germany	Great Britain	Netherlands	Poland
LOAD-FREQUENCY AND RESERVES CONTROL	**Primary (Spinning)**		**Primary Control**			**Primary Control**	**Primary Control**	**Primary Control**	**Contingency & Operating Reserves, Primary Response**	**Primary Reserve**	
	Reference		OH: Policy 1 & Appendix 1: Load-Frequency Control and Performance, A. Primary Control	NGC-Appendix 2 of System Operation Agreement	GC, Sec. 2.1.2	Titre IV Chapter XIII, Art 236 to 242	INDI0301719A: Chapter III, Art 11,Primary reserve must be >/= 2.5% of capacity for generating plant > 40MW. Référentiel Technique: Chapitre 4.1.	TC Section 2.3.6, section 2.3.7 and Appendix D 3.1.	Grid Code: CC.A.3.2, BC 1.5.4 and BPS	NetCode 5.1.1.1.a.1 and System Code 2	
	Definition		Stabilises frequency, although the level may differ from the set point and border power exchanges may be altered.	Stabilises frequency, although the level may differ from the set point and border power exchanges may be altered.	The definition of primary control reserves on page 12 is "- a second reserve of active power used for frequency control."		INDI0301719A: Chapter III, Art 11,Primary reserve response such that for frequency drop of >/= 200mHz, restoration of primary reserve in < 30s and half this in < 15s.	Generating units > 100MW must be capable of delivery of primary response as per TC Figs 2.1 & 2.2	Operating Reserve comprises Reserve for Response and Short-Term Reserve	System Code 2.1.13 and Appendix 3 presents the voltage/ frequency U/f charts, power output levels and durations	
	Governor Mode		Governor control of all generators subject to primary control	Governor control of all generators subject to primary control. Load shedding allowed for f=49.5-49.9 Hz	Governor control of all generators subject to primary control	Art 236 requires automatic control of primary reserve		Governor control of all generators subject to primary control, =/- 2% of rated output	Some generation in Frequency Sensitive Mode, other in Limited Frequency Sensitive Mode	SystemCode 2.2.20 and Imple-mentation Regulations 1.3.4	
	Speed of response		Primary Control Power to increase linearly up to 3000MW over 30s	Primary Control Power to increase linearly up to 3000MW over 30s	Ramp rate no less than 2.5% of the rated power in 5 sec. and 5% in 30 sec.; hydrogenerators and turbogenerators must be able to maintain the varied power at frequency deviation for at least 15 min.; primary control power must be available repeatedly after 10 min. of the previous attempt;	Art 242 requires 50% of primary reserve to be provided within 15s of the start of the frequency deviation with the remainder following between 15s and 30s of the start.		TC 2.3.7.1, up to 30s	Primary Response ramps from 0 to 10s, effective for another 20s	System Code 2.1.6 and Appendix 2 , up to 30s @ 7% per minute	
	Maximum load loss		Up to 3000MW load loss without load shedding; maximum permissible dynamic frequency deviation 800mHz	Up to 600 MW load loss without load shedding; maximum permissible dynamic frequency deviation 100mHz	Loss of generator transformer block up to 750 MW, bus as well as busbar of total generating power under 600 MW; loss of loas up to 250 MW; frequency should not deviate by more than 0.5 Hz				For 300 to 1000MW power loss, frequency should not deviate by > 0.5Hz	Tennet: Imple-mentation Regulation 1.3 describes regulating, reserve and emergency power categories.	
	Self regulation		Self regulation of load (MW/Hz) taken into account	Self regulation of load (MW/Hz) taken into account. Load decrease of 200 MW at 49.5 Hz assumed	Not considered in grid code. It can here be noted that DC Baltija is strongly and synchronously connected to Russia and Belorus, so all items concerning frequency control is not a responsibility of DC Baltija				Response requirement (MW) calculated by NGC every half-hour and determined according to load conditions	Self regulation of load (MW/Hz) taken into account	
	Contribution		Primary control shared between Control Areas according to contribution coefficients	Primary control shared between four countries according to yearly consumption and dimensioning faults	Primary control shared between Control Areas and is set up to 5% depending on max load of the Control Area in the previous period				Reserve standard is LOLE of 1 event per annum, a 1 in 365 expectation.	Tennet: Estimated primary reserve contribution for 2005 is 109MW i.e. 3.6% of UCTE total.	

OVERALL	DETAIL	UNIT	SUPRANATIONAL ASSOCIATIONS			NATIONAL					
			UCTE	NORDEL	DC Baltija	Belgium	France	Germany	Great Britain	Netherlands	Poland
	Secondary (spinning and non-spinning)		**Secondary Control**		Secondary control	**Secondary Control**	**Secondary Control**	**Secondary Control**	**Contingency & Operating Reserves, Secondary Response**	**Secondary Regulation**	
	Reference		OH: Policy 1 & Appendix 1: Load-Frequency Control and Performance, B. Secondary Control	NGC-Appendix 2 of System Operation Agreement	Section 2.1.3	Titre IV Chapter XIII, Art 243 to 247	INDI0301719A: Chapter III, Art 12 Référentiel Technique: Chapitre 4.1.	TC Section 2.3.7 and Appendix D 3.2	GC: CC.A.3, BC 1.5.4 and BPS	Tennet: Summary of current operating principles of UCTE, sections 3 & 5.	
	Control mechanism		Automatic Generator Control, to restore power exchanges to set point value	No Automatic Generator Controll Bids from regulating market called when needed	Automatic Generator Control, to restore power exchanges to the preset value	Art 246 The system operator determines the amount of secondary reserve that each generator is to put at the disposal of the system operator.	INDI0301719A: Chapter III, Art 12, any generating group > 120MW must have a half-band of secondary reserve > 4.5% of rating.	TC Appendix D 3.2.1 and 3.2.2.6 - automatic control by Regulating Zone using central secondary automatic controller	Short Term Reserve comprises Standing Reserve and Regulating Reserve (latter includes Fast Reserve)		
			Controls Area Control Error (ACE) to zero	Cheapest bids in the whole area accepted as long as transmission limits are not violated	Area Control Error not considered in Grid Code	Art 248 The system operator is to determine the unbalance with the foreign regulating zones		Load frequency controller for German control unit is located in Brauweiler near Cologne and is operated by RWE	Operations under instruction		
	Response		30s to 15 mins	Available in 10 mins. Disturbance reserves available within 15 minutes	30s to 15 mins			TC Appendix D 3.2.1 - entire contracted secondary response to be available in 5 minutes	30s to 30 minutes		
			Amount of reserve quantified by formula according to demand, by Control Area	No formal requirements of total reserves, but the TSO:s have extra reserves for disturbance situations	Requirements for secondary reserves for Control Areas (each country = 1 TSO = one CA) and the control Block are set according to methodology approved by the Operators and control block operator.				Response requirement (MW) calculated by NGC every half-hour and determined according to load conditions		
	Capacity		Each Control Area to have sufficient control of generation or load control to control ACE to zero.	Cheapest bids in the whole area accepted as long as transmission limits are not violated	No requirements of specific amount of control in each area. At least not in the grid code.			TC Appendix D 3.2.2.- each generating unit providing secondary response must be able to provide +/- 30 MW.			
	Tertiary		**Tertiary Control**		**Tertiary control**	**Tertiary Reserve**	**Tertiary Control**	**Minute Reserve**		**Emergency Power**	
	Reference		OH: Policy 1 & Appendix 1: Load-Frequency Control and Performance, C. Tertiary Control	NGC-Appendix 2 of System Operation Agreement	Section 2.1.4	Titre IV Chapter XIII, Art 249 to 256		TC Appendix D 3.3		Dte: SystemCode 2.2.5b and Tennet: Operations - Managing Concept 5.8	
	Control mechanism		Activated manually by TSOs	Included in secondary control	Few details concerning treatment of tertiary control	Procured through competitive bidding		Contract with ÜNB			
	Purpose		Frees up Secondary Reserves		Frees up Secondary Reserves			Frees up Secondary Reserves			
	Response		15 minute reserve		Is carried out in every control area			15 minute reserve		To be available in 30 mins	

OVERALL	DETAIL	UNIT	SUPRANATIONAL ASSOCIATIONS			NATIONAL					
			UCTE	NORDEL	DC Baltija	Belgium	France	Germany	Great Britain	Netherlands	Poland
	Time Control										
	Reference		OH: Policy 1 & Appendix 1: Load-Frequency Control and Performance, D. Time Control	NGC-Appendix 3 of System Operation Agreement	There is no information about time control in the grid code. This may depend on that DC Baltija is only a small part of the large synchronous system.				GC: BC3.4.3: Electric time		
	Discrepancy		Discrepancy between UCT & synchronous time 30s	Discrepancy between UCT & synchronous time 30s					+/- 10s		
	Frequency offset		Frequency offset 10mHz	100 mHz during normal operation							
	Measures for Emergency Conditions										
	Reference		OH: Policy 1 & Appendix 1: Load-Frequency Control and Performance, E. Emergencies	NGC-"Appendix 5 of System Operation Agreement" and "Connection Code"	Sections 2.5.8 - 2.5.10	Titre IV Chapter XV, Art 300 to 302	Référentiel Technique: Chapitre 4.4 à 4.6.	TC 6	GC: OC6, BC3.6 and BC3.7	SystemCode 2.2, energy assessment	IRiESP General Section VI.9 Continuity of the energy supply
	Load reduction/shedding		Load shedding @ < 49Hz, 48.7Hz and 48.4Hz	Load shedding in different 0.1 Hz steps when the frequency is in the region 49.4-47.0 Hz	Devices for automatic preventing stability disturbances, in dependence of concrete conditions, must actuate on / off switching of generators, a rapid decrease and increase of turbine load, a partial outage of consumers and dividing of power systems. No details provided		Load shedding @ < 49Hz, 48.5Hz, 48Hz and 47.5Hz	TC 6.3.4 - Limiting of large disturbances with 5-step plan for load decreases, with progressive load shedding at 49.0Hz, 48.7Hz and 48.4Hz.	OC6: Demand control, voltage reduction, automatic low frequency disconnection (48.8Hz), and emergency manual disconnection	SystemCode 2.2.25, progressive load shedding at 49.0Hz (15%), 48.7Hz (15%) and 48.4Hz (20%).	IRiESP General -Section VI.8.22. The load shedding protection setting <49Hz, >47.5Hz. The total power disconnected by load protection systems is not allowed <50% of the demand for peak power in the PPS.
	Generation disconnection		Power station disconnection @ 47.5Hz	Power station disconnection below 47.5Hz. Frequency controlled HVDC-links	At a frequency decrease to 49Hz the rated power of the generator must be retaired, but at a frequency decrease to 47.5Hz, it should be 0.85 from the rated value (section 2.6.2 q)			TC 2.3.9, generator disconnection at f < 47.5 Hz or U < 85%	BC3.6: response to low frequency BC3.7: response to high frequency		IRiESP General Section VI.9.4 generator disconnection at f<47.5Hz or U<80%
OPERATING STANDARDS											
	Frequency										
	Set Point	Hz	50	50	50		50	50	50	50	50
	Normal - Secondary Limits (+ / -)	mHz	20	100	500			10	200	10	
	Contingency - Primary - Limits (+ / -)	mHz	180	500	no data provided		500	200	500		
	Load Shedding Limit	mHz	-800	-600	no data provided		-1000		-1200		
	Largest Loss	MW	3,000	1,200	no data provided			1500	1,320		
	Frequency Response Characteristic	MW/Hz	18,000	6,000	no data provided					736	
	Time error limit	s	20	30	no data provided				10		
	Exceptional variation	Hz		49.5 to 50	operation under 45 Hz completely excluded, under 47 Hz for less than 20 sec, 48.5 Hz for less than 60 sec	48 to 52.5	47 to 55		47 to 52		

APPENDIX E

COMPARISON OF THE CODES FOR NETWORK (VOLTAGE) ADEQUACY INCLUDING REACTIVE POWER CONTROL

APPENDIX E – COMPARISON OF THE CODES FOR NETWORK (VOLTAGE) ADEQUACY INCLUDING REACTIVE POWER CONTROL

Network Adequacy

OVERALL	DETAIL	UNIT	SUPRANATIONAL ASSOCIATIONS					NATIONAL			
			UCTE	NORDEL	DC Baltija	Belgium	France	Germany	Great Britain	Netherlands	Poland
						ELIA	RTE	VDN	National Grid Company plc (NGC)	TenneT	Polish Power Grid Company SA
ELECTRICITY LAW		-					LOI no 2000-108 du 10 février 2000 relative à la modernisation et au développement du service public de l'électricité (1) NOR: ECOX9800166L		Electricity Act 1989, Utilities Act 2000 and Electricity Safety, Quality and Continuity Regulations 2002	Electricity Act, July 1998, (Act 27250)	
GRID CODE OR EQUIVALENT DOCUMENT - PRINCIPAL			Operation Handbook (OH)	Nodic Grid Code (GC)	The Grid Code (GC)	Arrêté royal établissant un règlement technique pour la gestion du réseau de transport de l'électricité et l'accès à celui-ci	INDI0301440D: Decree 2003-588, 27 June 2003, General Techinical Specifications for Connections. RTE - Référential Technique	TransmissionCode 2003 (TC), including Appendices A to D and Pre-Qualification Questionnaire (Primary/ Secondary Control & Minute Reserve)	The Grid Code (GC) and the System Operator - Transmission Owner Code (STC)	Dte: Net Code (local system operators and consumers), Measuring Code and System Code	Instruction of transmission system poeration and maintenance general-2001(IRiESP)
- SUBSIDIARY						RGIE - Règlement Général sur les Installations Electriques	INDI0301719A: Technical Specifications for Generator Connections	DVG/VDN Recommend-actions/ Documents	Security and Quality of Supply Standard (SQSS)	Dte: Co-operation Regulation	IRiESP detailed Part1 : Rules of electricity balancing market in Poland
							INDI0301721A: Technical Specification for Customer Connections	VDEW Documents	Balancing Principles Statement (BPS)	Tennet: Imple-mentation Regulations concerning the Dutch Grid (Net)- and Systemcode.	IRiESP detailed Part2 : Rules of ancilliary services
							Mémento de la Sûreté du Système Électrique,	Standards and Guidelines	Engineering Recommendations (ER)	Tennet: Summary of the current operating rules of the UCTE concerning primary and secondary regulation.	IRiESP detailed Part3: Rules of must run generation
							RTE: Procédure de traitement des demandes de raccordement aux RPT des installations de production, Règles d'accès import export et Règles relatives à la Programmation, au Mécanisme d'Ajustement et au dispositif de Responsable d'Equilibre		National Grid Technical Specifications (NGTS)	Tennet: Operations - Managing Concept	
SECURITY OF SUPPLY	Security of supply criterion		N-1	N-1	N-1		N-k	N-1	N-2	N-1	N-1
	Reference		OH: P3-A-C1	GC: Appendix 2 of System Operation Agreement 1(7)	GC Section 2.3		Mémento de la Sûreté du Système Électrique, A1.4,	TC 5.2, TC 6.2.2 and Appendix C.	SQSS Section 5		IRiESP Part 3 Section 6.1.2(6)
STABILITY	Reference				GC Section 2.3		INDI0301440D, Article 12. Référentiel Technique: Chapitre 4.3	TC 2.3.10, transient and static stability criteria, TC5 Network expansion	SQSS Section 5		

OVERALL	DETAIL	UNIT	SUPRANATIONAL ASSOCIATIONS			NATIONAL					
			UCTE	NORDEL	DC Baltija	Belgium	France	Germany	Great Britain	Netherlands	Poland
VOLTAGE	Grid voltage variation (steady state)					Titre IV Chapter XIII, Art 257 to 260	INDI0301719A: Annexe Informative and INDI0301721A: Annexe Informative. Référentiel Technique: Chapitre 3.1			Tennet: Operations - Managing Concept 4.	IRiESP General Section II.3.11, II.3.12, II.3.17
	380 to 400kV	%	OH: P3-B-G1: Voltage ranges at about 10% of nominal values	+ 5 to -10	+9.7 to -9.1		+/- 5	-8 to +15	+ 5 to -10	-10 to +10	-10 to +5
	220 to 275kV	%	OH: P3-B-G1: Voltage ranges at about 10% of nominal values	+ 5 to -10	These voltage levels are not considered in code.		+/- 9	-12 to +15	+/- 10		+/- 10
	110 to 150kV	%	OH: P3-B-G1: Voltage ranges at about 10% of nominal values	+ 5 to -10			+/- 10	-13 to +15	+/- 10	-10 to +10	+/- 10
	Step change (following secured event)	%	OH: P3-A-C1.1.2 Loss of elements must not lead to voltage instability.	≤180 in healthy phases, during phase-to ground fault	Automation for limiting voltage decrease to exclude load instability and collapse of voltage in postemergency states ; At voltage above 120% automation must be applied to decrease voltage; p.34				6	10	
	Step change (following operational switching)	%	OH: P3-A-C1.1.2 Loss of elements must not lead to voltage instability.	≤180 after shunt capacitor switching, ≤300 after automatic reconnection of the line	Same as above		3		3		
	Fault ride through			Detailed fault ride through rules are available in the Connection Code Section 3.2.4	All generators operating through block transformers in an electrical network of 330-750kV must maintain a stable operation at all types of short-circuits on the high voltage terminals of the block transformer with duration up to 0.25 seconds (for old equipment it is up to 0.35 seconds); (p 38 - r)	Titre III Chapter 1 Art 64	INDI0301719A: Annexe Informative and INDI0301721A: Annexe Informative. Référentiel Technique: Chapitre 4.3		GC: CC.A.4, Fault ride through requirement for generating units, power park modules and DC converters	SystemCode 2.1.16	
REACTIVE POWER	Provision of reactive power resources		OH: P3-B-R1: Each TSO to be self sufficient and reactive power flows on tie-lines to be at minimal level	From the Connection Code Section 3.2.5, each generator shall be capable of operating on the rated active power continuously at power factor down to at least 0.95 under-excited. And 0.9 overexcited.	each generator should provide a rated power at cosφ=0.95 lead (underexcited) and at cosφ=0.9 lag (overexcited); (p. 37 - c)	Titre III Chapter 1 Art 66 to Art 74, Reactive power capability to vary from -0.1 P_{nom} to 0.45 P_{nom}	INDI0301719A: Chapter III, Art 8 Generator reactive power capability as per polygon [U, Q], Art 9 and 10 voltage control and Art 16 polygon [U, Q] operation outside normal voltage limits. Référentiel Technique: Chapitre 4.2	TC: 2.3.8, Figs 2.3a and 2.3b. Either with Cos ø from 0.9 lag (overexcited) to 0.975 lead (underexcited) or from 0.925 lag (overexcited) to 0.95 lead (underexcited), from 49.5Hz to 50.5Hz over the above ranges of transmission voltage, as delivered to the network.	GC: CC.6.3.2, Generating Units at rated MW with Cos ø from 0.85 lag (overexcited) to 0.95 lead (underexcited), SCR not < 0.5, transmission voltages +/- 5%	Net Code: 2.5.4, for generators connected at 50kV + , Cos ø from 0.8 lag (overexcited) to unity.	IRiESP General Section VI.7.32 to VI.7.38

APPENDIX F

NORDEL: RECOMMENDATIONS OF THE HAGMAN REPORT

(Survey of system responsibility in the Nordic Countries, by Hagman Energy AB, dated February 2005 and published by Nordel)

APPENDIX F – NORDEL: RECOMMENDATIONS OF THE HAGMAN REPORT

Recommendations were given for the further harmonisation of system responsibility in each of sections 4.1 - 4.11. The main criteria for the recommendations were their significance for the development of the market.

These eleven recommendations are:

- Prepare a Nordic formulation of a common general definition of system responsibility. Besides the momentary balance between the supply and the consumption of electricity and the operational reliability of the national power system, it is recommended that the general definition also includes that the system operator shall perform its tasks in such a way that promotes competition in the electricity market.

- Clarify the role of the system operators regarding market behaviour and market power.

- Define the role concerning long-term security of supply in such a way that the focus is given on further development of an improved demand side flexibility and removal of barriers for demand response to high prices.

- Study the issue of more harmonised connection requirements.

- Launch a process aiming at common definitions of how the responsibility shall be distributed between the system operator and the market players during the different phases before the operational hour.

- Decide measures in order to limit reductions in trading capacities between the countries in order to handle internal limitations within one country. Common principles are essential regarding definition of what situations that can justify reduced trading capacities.

- Start a process in order to implement new types of arrangements for contractual load disconnection. It is essential that the process includes development of agreements and necessary changes in legislation and guidelines.

- Analyse the different system services in order to determine the system services that are most suitable for trading in a market and how these system services can be best standardized in order to facilitate a common market. It is essential that the study includes possible redefinitions of the reserves in order to facilitate the development of a common market.

- Give priority to harmonisation of the national rules and frameworks for balance settlement. The harmonisation shall be pursued in a way that reduces barriers of entry for new players in the national retail markets.

- Include not duties that are not directly connected with the system responsibility in the definition of system responsibility. If other energy policy tasks are imposed on a system operator, they shall not be defined as parts of system responsibility. There is also a need for special funding and separate and transparent accounts.

- Agree harmonised principles for the distribution of costs for system responsibility between costs paid by the network users and costs paid by parties in competition.

Some of these eleven recommendations are related. Recommendations 4.1, 4.2 and 4.9 refer to that the definition of system responsibility shall be such that the system operator shall perform its tasks in such a way that promotes competition in the electricity market. Recommendations 4.3 and 4.7 refer to the necessity of improved demand side flexibility and demand response to high prices in order to manage long-term security of supply and shortage situations in such a way that have no distorting impact on the functioning of the electricity market.

The three most important among the eleven recommendations are nr 4.3 (regarding long-term security of supply), nr 4.6 (regarding congestion management) and nr 4.9 (regarding balance settlement).