TERM OF REFERENCE FOR REGIONAL

TRANSMISSION GRID CODE

Contents

Annex

- ✓ ***ANNEX 1- List of key documents available at the WAPP General Secretariat***
- ✓ ***ANNEX 2 - Technical Reference Documentation***
- ✓ ***ANNEX 3 – Example Regional Grid Code Contents***

ABREVIATIONS LIST

- ECOWAS Economic Community Of West African States
- ERERA ECOWAS Regional Electricity Regulatory Authority
- GC Grid Code
- ToR Term Of Reference
- VRE Variable Renewable Energy
- WAPP West African Power Pool

1. REGIONAL STRATEGIC CONTEXT

1.1. Regional Socio-economic background

ECOWAS covers a surface area of 5,105 million square kilometers and comprises 15 countries which, despite their significant diversities in terms of size, population, climate and availability of natural resources, portray very similar socio-economic realities.

The population of West Africa has experienced a rapid growth, from 70 million to over 340 million people between 1950 and 2015. At the end of 2014, this population accounted for almost 40% of sub-Saharan Africa. According to UN projections, the population of the region may, by 2050, reach 550 to 600 million people. West Africa is the youngest region in the world. Moreover, with 5% of the world population and a surface area covering 40% of sub-Saharan Africa, it is the most densely populated continent region in Africa.

The Gross national income per capita varies between US$ 430 in Niger and US$ 3,520 in Cape Verde. Despite a downward growth of 3.9% on the African continent, the West African region has despite the Ebola virus disease crisis experienced a 6% growth in 2014, with Nigeria's 6.3% growth provided mainly by the non-oil sectors. As a result of the Ebola virus disease crisis and the fall in oil prices, a marginal growth of 5% was achieved in 2015, and a rebound to the 6.1% is projected in 2016, making of West Africa the second most dynamic sub-region after East Africa.

Access to electricity is on average about 20% (40% in urban areas and 6 to 8% in rural areas). It is important to note that on average, about 60% of the population lives in rural areas. But this distribution between urban and rural areas should be quickly reversed over the forthcoming years, due to high rate of urbanization.

1.2. ERERA and WAPP regional market

The ECOWAS Regional Electricity Regulatory Authority (ERERA) is the regulator of regional cross-border trade of electricity in West Africa. The commitment of ECOWAS Member States to achieve electricity interconnections for the pooling and sharing energy resources in the region is translated into action through the adoption of a number of provisions to establish appropriate legal and institutional framework for the development of the electricity sector in West Africa. ERERA's general mission is to regulate cross-border electricity exchanges between ECOWAS Member States, while overseeing the implementation of the necessary conditions to ensure rationalization and reliability and contributing to setting up a regulatory and economic environment suitable for the development of the regional market.

The West African Power Pool (WAPP) is a specialized institution of ECOWAS. The West African Power Pool (WAPP) was created by Decision A/DEC.5/12/99 of the 22nd Summit of the Authority of ECOWAS Heads of State and Government with the aim of promoting reliable power supply in the West African sub-region.

The WAPP will contribute to integrate the operations of the national power systems into a unified regional electricity market, which will, over the medium to long term, assure the citizens of ECOWAS Member States a stable and reliable electricity supply at competitive cost. The WAPP mission is to ensure the promotion and development of power generation and transmission facilities, as well as the coordination of power trade between ECOWAS Member States.

WAPP is a public international organization operating in the general interest of the regional power systems, with a view to ensuring reliable power supply throughout the region. It covers 14 of the 15 countries of the regional economic community (Benin, Côte d'Ivoire, Burkina Faso, Ghana, Gambia, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo). The WAPP is to ensure Regional Power System integration and realization of a Regional Electricity Market. WAPP Members are made up of public and private power generation, transmission and distribution utilities involved in the operation of the West African power system. WAPP comprises 35 Member Utilities:

1. AKSA Energy Company Ghana Ltd (GHANA)
2. CENIT Energy (GHANA)
3. CENPOWER (GHANA)
4. Communauté Electrique du Bénin (CEB, TOGO – BENIN)
5. Compagnie Energie Electrique du Togo (CEET, TOGO)
6. Compagnie Ivoirienne d'Electricité (CIE, CÔTE D'IVOIRE)
7. ContourGlobal (TOGO)
8. Electric Company of Ghana (ECG, GHANA)
9. Electricité de Guinée (EDG, GUINEA)
10. Electricity Distribution and Supply Authority (EDSA – SIERRA LEONE)
11. Empressa Publica de Electricidade e Agua de Guine-Bissau (EAGB, GUINEA BISSAU)
12. Energie du Mali (EDM, MALI)
13. Ghana Grid Company Limited (GRIDCO, GHANA)
14. GTG Energy (GTG, GHANA)
15. GTS Engineering Services (GHANA)
16. Karpowership (GHANA)
17. Liberia Electricity Corporation (LEC, LIBERIA)
18. Mainstream Energy Solutions (Mainstream -NIGERIA)
19. National Water and Electricity Company Ltd (NAWEC, THE GAMBIA)
20. Northern Electricity Distribution CompanyLtd (NEDCo -GHANA)
21. NBET (NIGERIA)
22. North South Power Company Limited (NIGERIA)
23. Office National de l'Electricité (ONE, MOROCCO), Observer Member
24. Pacific Energy Company Limited (NIGERIA)
25. Paras Energy & Natural Ressources Development Limited (NIGERIA)
26. Sahara Power Group Limited (NIGERIA)
27. Société Béninoise d'Energie Electrique (SBEE, BENIN)
28. Société de Gestion du Manantali (SOGEM, MALI)
29. Société des Energies de Côte-d'Ivoire (CI-ENERGIES, CÔTE D'IVOIRE)
30. Société Nationale d'Electricité du Burkina (SONABEL, BURKINA FASO)
31. Société Nationale d'Electricité du Sénégal (SENELEC, SENEGAL)
32. Société Nigérienne d'Electricité (NIGELEC, NIGER)
33. Sunon Asogli (Power) Ltd (GHANA)
34. Transmission Company of Nigeria (TCN, NIGERIA)
35. Volta River Authority (VRA, GHANA)

1.3. Major energy resources

The major energy resources available for electricity generation in West Africa are hydropower, oil and natural gas as well as coal, uranium, solar and wind fields and fuel biomass. However, the major power generation development projects are focused on hydropower and natural gas.

Nigeria has the largest reserves in hydropower resources, and almost the entire oil and gas reserves of the sub region, exploitable in the short and medium terms.

In terms of natural gas reserves, Nigeria dominates the ECOWAS region with about 180 tcf (5.1 tcm) of proven reserves. Ghana and Côte d'Ivoire have respectively 3.2 tcf and 1.5 tcf. In recent years, important reserves of natural gas have been discovered in Senegal.

Several ECOWAS countries are endowed with oil and gas fields.

Nigeria, Côte d'Ivoire and Ghana currently exploit natural gas for electricity generation. Mauritania, a non-member State of ECOWAS but a member of the OMVS which is a member of WAPP also possesses natural gas.

The natural gas in Nigeria is largely flared. However, NLG terminals built in Nigeria and the West African Gas Pipeline (WAGP) commissioned in 2011 has enabled the use of a small portion of this gas. This 678 km long pipeline is for the transit of natural gas from Nigeria to Cotonou, Republic of Benin, and Lomé in Togo, Tema and Takoradi in Ghana mainly for power generation purposes. Its initial capacity of 170 million cubic feet per day will ultimately be brought to 470 million cubic feet per day.

Since the commissioning of the WAGP in November 2011, it has been supplying gas to its founder customer apart from August 2012 major disturbance. However the contracted volumes have not been met. The maximum supply of about 50% of the contracted volumes have been met while it is expected that volumes will gradually increase until full capacity of the pipeline is attained over a period of 20 years. Since July 2012, access of third party suppliers to the WAGP is possible, but to date, no other supplier has injected gas into the WAGP. Despite this modest performance, a feasibility study for the extension of the pipeline has been initiated by ECOWAS.

Hydroelectric resources are more evenly spread than natural gas in the West Africa region which is crossed by three large rivers and their tributaries. The most important ones are:

- The Senegal River with a total surface area of nearly 436,000 square kilometers, flows through Mali, Mauritania, Senegal and Guinea ;
- The Niger River, the largest basin covering a surface area of 2,113,200 square kilometers is shared by many countries of which ECOWAS countries such as Nigeria, Mali, Niger, Guinea, Burkina Faso, Benin, Côte d'Ivoire and Sierra Leone ;
- The Gambia River with a surface area of 69,900 square kilometers, flows through Senegal, The Gambia and Guinea;
- The Volta River with a surface area of 400,000 square kilometers, the basin of which covers Benin Republic, Burkina Faso, Côte d'Ivoire, Ghana, Mali and Togo;
- Other rivers (like the Konkouré River in Guinea and others) the basins of which are located exclusively in only one country offer, due to their potentials possibilities for regional development.

Thanks to the existence of these river basins, this region happens to be endowed with significant hydroelectric potential, which are essentially located in two countries (Nigeria and Guinea), and largely under-developed to date.

The ECOWAS Revised Master Plan for the development of power generation and transmission of electrical energy was adapted in 2018. The update from 2011 was motivated by the evolution of the socio-economic context in West Africa with its impact on the demand, the delay in the preparation and the implementation of a lot of priority projects because of financing constraints and the increase penetration of the renewable energy, mainly solar, in the sub region. The main challenges identified in the sub region are: (i) an average demand growth of 5.6% which means that the demand will triple in 2033; (ii) a generation shortage; (iii) system synchronization issues; and (iv) the operationalization of the regional market and the coordination of the system operation. The outcome of the Master Plan is summarized below:

- ✓ ***Generation Projects:*** 26 Generation priority projects are identified including 23 renewable projects. The technologies are Natural Gas, Hydro, large scale Solar PV, large scale Wind, HFO, Diesel and Coal.

- New capacity/Installed capacity/ Peak load

	New Capacity (GW)	Total Installed Capacity (GW)	Peak Load (GW)	Drop in marginal cost USD/MWh
Short Term (2018 -2022)	12.6	30.6	21.3	96 to 75
Medium Term (2023 - 2029)	26.3	56.9	36.4	49
Long Term (2030 - 2033)	33.5	98	50.8	

- Percentage of installed capacity

	Natural Gas (%)	Hydro (%)	PV (%)	Wind(%)	HFO (%)	Diesel (%)	Coal (%)
Short Term (2018 -2022)	50	23	11	0	8	7	1
Medium Term (2023 - 2029)	40	19	31	2	4	3	1
Long Term (2030 - 2033)	42	13	37	2	3	2	1

To achieve the Loss of Load Expectation (LOLE) of 24 hours a year in 2033, the battery storage will have to play a major role. With the price drop expected in the coming years, battery storage could replace part of the investments in gas turbines.

In order to reach 18% of energy mix by renewable energy (excluding hydro) by 2033, the development of 36 GWp of small-scale PV and wind projects are required in addition of the priority renewable energy project identified.

- ✓ ***Transmission Projects:*** 19 priority projects have been identified to increase power exchange and system stability in WAPP.

The region has important coal reserves that are under-utilized. Nigeria is said to have more than 250 million tons of coal reserves and Niger 87.8 million tons. Some countries in the sub-region intend to make significant use of coal as a source of generation with a view to diversifying their sources of electricity generation.

Biomass is one of the main power resources of the Member States. It is mainly concentrated in the southern tropical humid part of the region, and the available quantities vary from country to country depending on the climate.

The average sunshine in West Africa represents a potential of about 5-6 kWh/m²/day, compared to only 3 kWh/m²/day in European temperate zone. The importance of sunshine and the obvious prospect of reduction in the cost of photovoltaic technology enhances the prospects of solar energy making a very significant contribution to the electricity supply and demand balance.

Wind energy, with considerable wind speeds along the coast or in desert areas, can be an attractive solution as a result of significant reduction in investment costs in recent years.

However, the deployment of regional renewable energy plants of substantial size requires an analysis of the integration of these plants into the regional power system, taking into account all other available regional generation and transmission resources to compensate for the intermittency of this form of energy.

1.4. West African Power System

The strategic objective of the WAPP is based on a dynamic vision of integrating the operation of the national power utilities into a unified regional electricity market which will, over the medium and long-term, assure a regular, reliable and affordable power supply to the ECOWAS Member States. The unified market participants would offer the benefits of equal opportunities to all, thereby facilitating the balanced development of the various sources of energy the ECOWAS Member States for the collective economic well-being, as a well as long-term cooperation in the energy sector, the free movement of energy and increased cross-border electricity trade. The basic principles of this regional cooperation are contained in the ECOWAS Energy Protocol in force within the sub-region.

To achieve this vision, WAPP is progressively implementing a regional electricity market to help ensure a more reliable and affordable power supply to its Member States. Among the various measures that have already been adopted, an Operation Manual for WAPP Interconnected Systems was developed and adopted. WAPP and the ECOWAS Regional Regulatory Authority (ERERA) have developed a Transmission Tariff Methodology for the West African Power Pool (WAPP) to be used by the System Market Operator (SMO) to develop a clear, transparent and predictable model for the calculation of transmission tariff. The WAPP Information and Coordination Centre is under construction and its commissioning in 2020 will enable the operationalization of the regional electricity market, with the interconnection of the 14 mainland countries of the ECOWAS in 2019 when key projects among others, such as the 225 kV Côte d'Ivoire - Liberia -Sierra Leone – Guinea (CLSG) interconnection, the 330 kV Ghana - Togo - Benin Southern Backbone and the 225 kV Bolgatanga (Ghana) - Ouagadougou (Burkina Faso) interconnection, will be commissioned.

At the initiative of the WAPP, ECOWAS adopted in January 2008 through a Supplementary Act A/SA.3/01/08, the strategy for the implementation of priority projects for power supply electricity under the public/private partnerships (PPP). Since then, no project has been implemented under this strategy.

The total electricity consumption of the area covered by WAPP is around 58,000 GWh of which over 83% in the three major electricity exporting countries (Nigeria, Ghana and Côte d'Ivoire) with Nigeria alone accounting for over 50% of the total.

At present, electricity demand is far from being met in almost all countries of the region, due particularly to the lack of generation and transmission facilities. The electricity tariff in the sub- region remains low and as a result the revenues of the utilities are insufficient and do not allow them to make investments and improve the quality and continuity of power supply service. Electricity consumption in West Africa is among the lowest in the world.

The imbalance between supply and demand for the interconnected WAPP system has been increasing over the years despite the various plans and strategies put in place to reduce the deficit. This situation along with a continuous increase of unmet needs is mainly due to the energy crisis in the sub-region (drought, climate change and gas deficit have led to a power generation shortfall - hydro as well as thermal-). Operational problems of national electricity sector, especially related to the inadequate tariff has contributed to the poor performance of power utilities.

In spite of their precarious financial situation almost all the electricity companies have embarked on the development of new generation plants in order to reduce the failure of the electrical system. Thus, programs and choices, particularly different from those contemplated in the ECOWAS Revised Master Plan on Power Generation and Transmission of Electrical Energy (2019-2033) are being developed in the entire ECOWAS area.

The WAPP has also established an operation manual to realize a regional market and a secure grid operation. However,

- The region is partly interconnected and the number of interconnections is very limited
- The region is not yet entirely synchronized (AC interconnections)
- Some countries are not interconnected. There are sub electrical regions where the manual could be applied inside each electrical region.
- Not all loads can be supplied at all times
- Primary reserve directives cannot be applied as they should as all production units are needed to cover the load

- The N-1 rule cannot be applied as the system is not sufficiently meshed

2. OBJECTIVES OF THE TERM OF REFERENCE

2.1. General

IDA will support the WAPP Secretariat in collaboration with ERERA to hire a consultant to define and implement a regional grid code for transmission system. The Grid code will provide rules and process that enable the power system to be operated reliably. This ensures operational stability, security of supply and contributes to well-functioning wholesale markets.

The function of grid code is to allow the network operator to provide clear rules and technical requirements for the operators of plants when connecting to the country's electricity networks. System operators make use of the services provided by power plants and other equipment to maintain system stability and safety.

Grid codes can include connection codes, operating codes, market codes, planning codes and others. Grid Codes govern the connection of power generators and ensure quality for consumers to the public electricity network. They specify the minimum technical and design requirements for generators and consumers, so that their behavior is compatible with the requirements of system stability and safety. The technical requirements in grid codes are determined by the need to maintain the reliability, security, and quality of the power supply in any power system in the WAPP:

- The electrical power needs of all consumers must be met reliably;
- Voltage and frequency must be maintained within set limits to avoid damaging equipment or power plant connected to the grid;
- The system must be able to recover quickly from system disturbances;
- At all times the system must operate without endangering the public or operating personnel.

These basic needs translate to operational requirements, which are demanded of generators, including VRE generators.

2.2. Why a regional Draft grid code for transmission network ?

The integration of regional power markets requires regulatory efforts through, for example, regional grid code. This regional grid codes do not replace national grid codes but instead provide a common framework for minimum requirements that all national grid codes should meet.

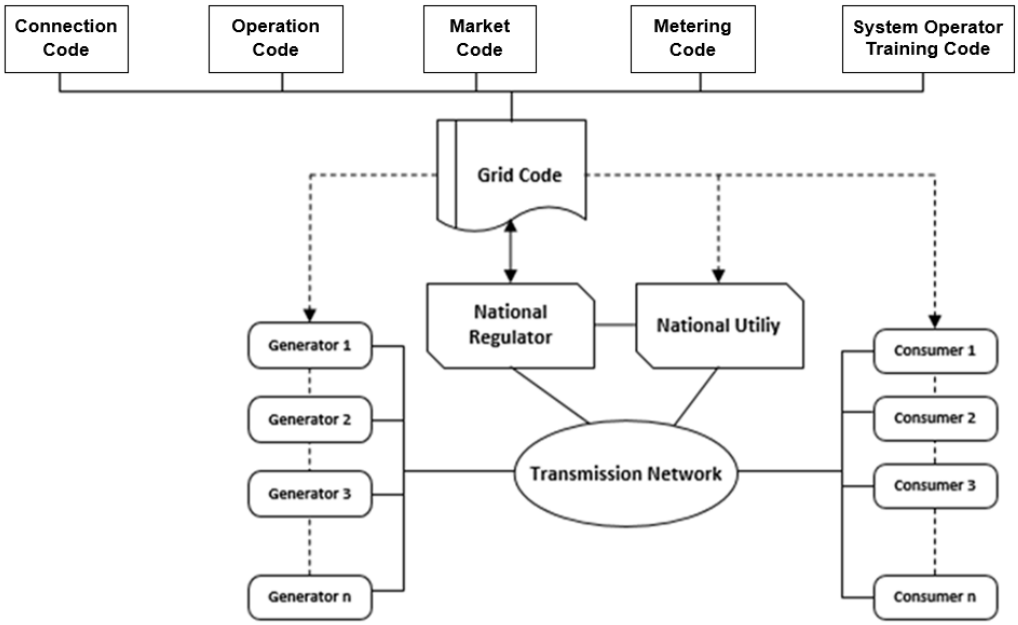
Regional Grid Code will define common processes to operate the interconnected transmission network. Furthermore, it will harmonize the work processes for a better consideration of the RE generators, in operational planning and coordination for higher security, allowing thus a higher penetration of RE sources in power systems.

Regional Grid code are the instructions, which specify technical and operational characteristic requirements of power plants and different parties involved in the production, transmission and distribution of electric power. In other words, these are the technical requirements to connect new generating plants, to the power systems.

These GC requirements shall be followed by any user for or installing new power plants or making any alteration in the existing power plants, for connection of the different components of the power system to the grid.

The regional GC is composed of several sub-codes or elementary codes covering different domains such as Requirements for Generator connection; for HVDC and DC Connected Power Park Modules (solar, wind farms) connection, for Demand connection; security operation, for operational planning and scheduling, for LFC and Reserves, for Emergency and Restoration, for Capacity Allocation, Capacity Allocation and Congestion Management, for Electricity Balancing, for Metering and for Training.

Regional grid code is intended as a tool to reach the following objectives of regional interconnected transmission network to tackle cross-border issues in a systematic manner and put forward a template to be adapted in each WAPP countries depending the energy context.



Purpose:

- ✓ Promote open, transparent and fair access to the Grid
- ✓ Harmonization of plant connection and standardization between the different WAPP Countries
- ✓ States the relationships between the Transmission Utility, Regulators, WAPP and Grid Users
- ✓ Safe, secure and stable operation of the National Power system.
- ✓ Meet the electricity system conditions and the requirements of establishment of Competitive Market in WAPP region
- ✓ Define the VRE requirements to insure stability and security of the network

Main contents

- ✓ Power System Performance Standards integrated in the Connection Code, Operation Code and sub-codes
- ✓ Connection to the Grid
  - o Procedures for connection to the Grid
  - o Defines boundary of investment, management and operation
  - o Defines technical requirements for connection for plants.
- ✓ Grid Operation
  - o Ensure secure, reliability of power system operation;
  - o Ensure transparency, fairly and equitably of Grid Operation
- ✓ Adequacy
- ✓ Capacity Allocation and Congestion Management
- ✓ Metering regulation
- ✓ Training of System Operator

2.3. Detailed Contents for Regional Transmission Grid Code

2.3.1. General

- Preamble: This document provides the context for the Regional Grid Code and its various sub-sections.
- The Governance Code - Setting out how the Regional Grid Code will be maintained. It shall describe the process that will be followed to update the Regional Grid Code to improve safety, reliability and operational standards. It shall set out how Parties can influence the amendment process and define who has the Authority to recommend and ultimately approve and enforce the changes. In addition the document shall also explain oversight and compliance requirements that need to be observed by all Parties. The Governance Code shall also set out dispute management procedures.
- Glossary of Terms - Shall contain detailed definitions and abbreviations of the terms used in the Regional Grid Code.

For Data communication requirements, the typology of data required to be exchanged with the ad hoc time schedule is integrated into each code and sub-code.

In addition to the above, complementary codes detailed below shall be developed as follows to complete the regional Transmission GC.

An example of the contents of Regional Grid Code is presented in Annex 3.

2.3.2. Connection code

This sub-code shall comprise different aspects as follows

- Requirements for Generators Connection;
- Requirements for HVDC (High Voltage Direct Current) and DC Connected Power Park Modules (solar, wind farms) Connection; and
- Requirements for Demand Connection.

This sub-code shall provide network requirements for grid connection and is broken down into sections defining the requirements in terms of:

- Frequency tolerance, active power and frequency control requirements
- Voltage tolerance, voltage control and reactive power provision
- Fault ride through capability
- Protection requirements
- System Restoration, Islanding and Black start capability
- Information requirements
- Connection and testing requirements

2.3.3. Operation Code

Several aspects shall be covered regarding the operation of the interconnected power system, such as:

- Operational Security Code - Defining the Operational Security requirements and principles for transmission systems applicable to all TSOs, DSOs and Significant Grid Users in Normal and Alert System State. Furthermore, this Network Code identifies the general provisions in relation to the Emergency State, Blackout State and Restoration.

- Operational Planning & Scheduling Code - Defining the minimum Operational Planning and Scheduling requirements for ensuring coherent and coordinated operational planning processes of the Synchronous Areas applicable to all Significant Grid Users, all TSOs and all DSOs (Distribution System Operators).
- Load Frequency Control and Reserves Code (LFCR) - Defining the minimal requirements and principles for load-frequency control and reserves applicable to all TSOs, Reserve Connecting DSOs and Reserve Providers.
- Emergency and Restoration Code - Defining the Operational Security requirements and principles applicable for Emergency State, Blackout State and Restoration to TSOs, DSOs, Significant Grid Users, Defence Service Providers, Restoration Service Providers, Market Participants and any third party that has a role pursuant to the WAPP and efficient utilisation of the power system and resources.

2.3.4. Market Code (technical aspects)

This sub code includes Capacity Allocation, Capacity Allocation and Congestion Management, and Electricity Balancing Sub-Codes as follows:

- The Capacity Allocation and Congestion Management Code - Setting out non-discriminatory rules for access conditions to the network for cross- border exchanges in electricity and, in particular, rules on capacity allocation and congestion management for interconnections and transmission systems affecting cross-border electricity flows.
- To implement bilateral trading, day ahead and intraday markets, the available cross-border capacity needs to be calculated in a coordinated manner.
- The Electricity Balancing Code shall establish a regional set of technical, operational and market rules to govern the functioning of electricity balancing arrangements. It shall set out rules for the procurement of balancing capacity, the activation of balancing energy and the financial settlement of balancing energy. The Electricity Balancing Code shall provide balancing and imbalance rules for the cases with and without a day-ahead market / intraday market and with and without a balancing market.

2.3.5. Metering code

The Metering Code - Specifying the minimum technical, design and operational criteria to be complied with for the metering of each point of interchange of energy between Control Areas, TSO's and other trading Parties. The Metering Code shall also specify the associated data collection equipment and the related metering procedures required for the operation of the Interconnected Transmission System.

2.3.6. System Operator Training code

The System Operator Training Code - Setting out the responsibilities and the minimum acceptable requirements for the development and implementation of System Operator Training and Authorization programmes. This Code shall ensure that System Operators throughout the ECOWAS region are provided with continuous and coordinated operational training in order to promote the reliability and security of the GMS Interconnected Transmission System.

3. SCOPE OF SERVICES

3.1. Approach

The general objective of this mission is to establish regional transmission network codes for the connection of different types of generators, including the integration of variable renewable energy (VRE).

The specific objectives are to provide the technical devices and requirements of the transmission network codes. In this context, the Consultant will have to take into consideration the different parameters of the current and future energy sector in WAPP Region with the Market documents from ERERA.

The development of these codes will be based on international practices and technical standards for the proper connections of generators, HVDC systems and DC-connected power park modules, and demand connection to transmission systems.

The Consultant shall consider in their methodology for regional transmission grid code elaboration the following important aspects:

- The GC should be in accordance with the existing documents (Operation Manual) from ERERA and WAPP studies on synchronization;

- The regional market players (operators, regulators) shall be tightly involved in the development of the GC all along an interactive process to be sure that all national concerns are considered. The regional GC shall result from a collective work undertaken by the national operators, and approved by the national regulators and the regional regulator. This approach shall ensure full adhesion to the delivered product and thus shall facilitate the adoption of its final version, its enforcement and the implementation of the necessary amendment and adjustment of the national grid codes for full compliance.

- The Draft final regional Grid Code will be submitted to the ERERA Council for adoption. The adoption shall be followed by its enforcement at national level in all ECOWAS member States.

- The Regional Transmission Grid Code will be the legal instrument harmonizing the standards, rules and processes to be applied mandatorily by all electricity market players for the operation of the regional transmission network. One adopted at the regional level by ERERA, the regional Grid Code is enforceable in each of the member States. The national regulatory Authorities shall take all possible measures to ensure full compliance and effectiveness of the regional GC's requirements at the national level.

- For the enforcement of the regional Transmission GC, results of gap assessment for its implementation at national level shall be considered for the national Regulatory Authorities and the regional Regulatory Authority (ERERA) to grant member States with implementation delays for compliance.

- Each national system operator will have the responsibility to check whether the codes are being obeyed at every level or not. Grid Codes are regulatory instruments. Full compliance to the national Grid Codes and regional Grid Code is mandatory. The national Grid Code shall also be fully compliant with the regional Grid Code. The adaptation of the National Grid Code will be controlled by the local regulatory authorities according the national legal and technical environment. The National Grid code may vary in term of requirements and specifications due to different system types or grid characteristics in different countries.

3.2. Phase 1 - Data Collection

As part of the data collection mission, the Consultant will:

- Consult all the documents from regional regulator ERERA and WAPP (Operation Manual) (connection requirements for variable renewable energy). Refer to Annex 1
- Existing National Grid Codes (Ghana, Nigeria, Cote d'Ivoire)

- Examine international experiences in setting up network codes for countries with a similar context as regional grid codes like the Nordic Grid Code and European Network of Transmission System Operators for Electricity (ENTSO-E) Network Codes.
- Review contract documents between producers and transmission system operators and analyze existing connection procedure requirements. In particular, the consultant will consider:
  - Network connection requirements,
  - Reliability standards;
  - Frequency control and voltage control,
  - Plant planning and operation;
  - procurement plan for ancillary services;

Based on this review, the consultant will prepare a draft data collection report, which will include the following points and in particular:

- ✓ The identification of key recommendations for the elaboration of the regional transmission grid code;
- ✓ A summary of international practices;
- ✓ A detailed work plan for this mission.

This inventory of the current situation and context in WAPP region and the existing network codes will make it possible to provide recommendations on practices and provisions to enable the establishment of the draft Transmission Grid Codes taking into account the integration of Renewable energy sources.

The data collection report will be presented, discussed and eventually amended/completed during dedicated workshop with all national and regional relevant stakeholders including WAPP and ERERA.

3.3. Phase 2 – Grid Code Development – Initial & Intermediary reports

After analyzing existing and relevant international practices, this component will examine all the necessary conditions, measures and arrangements including a full description of work processes, procedures, rules to be followed by generators, HVDC systems and DC-connected power park modules, demand facility owners and Significant grid users to be connected to the transmission grid and ensure a safe and reliable operation of the interconnected regional transmission grid. The consultant will establish all elementary grid codes as per the list presented in section 2.3 of the present ToRs.. The scope of this component will involve defining the expected results according to the scope of the network codes

The Consultant should also make recommendations for the reliable integration of VRE (international practices, technical and performance standards, connection standards, connection impact studies, operational planning and coordination modalities). These good practices will have to be analyzed in order to study their consideration in the drafting of regional network codes.

The Consultant will propose of the preliminary draft of the grid codes with the different points dealt with. Annexes 2 and 3 give an example for the connection part of the network code.

The drafts grid codes shall be presented, discussed thoroughly with all national stakeholders for good understanding and excellent appropriation of their contents including their impacts on the current electricity operational organization. WAPP and ERERA shall participate in such workshops.

3.4. Phase 3 - Final Report

Following the successive workshops of Phase 2, the Consultant will integrate all comments and amendments requested by the national stakeholders when they are relevant for the approval of the regional grid code prior its adoption by the relevant regional Authorities. The final draft of the regional grid code shall provide all the necessary conditions, measures and arrangements including a full description of work processes, procedures, rules to be followed by generators, HVDC systems and DC-connected power park modules, demand facility owners and Significant grid users to be connected to the transmission grid and ensure a safe and reliable operation of the interconnected regional

transmission grid. The consultant shall establish the final regional grid code as per the list presented in section 2.3 of the present ToRs.

The consultant will provide technical recommendations to mitigate / resolve technical problems that cannot be addressed by the network code, such as storage requirements at the distribution level, and so on.

The consultant will assess the impact of VRE systems (including solar, wind) connected to transmission networks and technical recommendations to avoid problems of reliability and quality of service. In addition, it will prepare recommendations on the requirements for connecting VRE to the grid.

The consultant will also give recommendations on the problem of the application of the network code: date of entry into force, derogations, management on existing sites, retroactivity, etc.

The consultant will prepare a draft final report to be discussed at a workshop presenting the conclusions and recommendations of the report on the establishment of the provisions of the network code.

The Consultant should seek input and feedback from the workshop stakeholders prior to issuing the final report.

4. REPORTS AND WORKSHOPS

4.1. DELIVERABLES/Reports

The Consultant will carry out the various reports for each stage of the services. These reports will be presented to the Network Codes Committee at Workshops. The Consultant will review the reports to include the comments received during the Workshops and its proceedings. These reports will be subject to validation by the client.

The Consultant shall be based on the scope of works elaborated above submit to the WAPP the following:

i) **Inception Report:** The Consultant shall submit the inception report (electronic form, pdf) within 3 weeks of signature of contract and following a kick-off meeting. The inception report shall set out the Consultant's understanding and approach to the Terms of Reference (TOR). The overall requirements, strategy, planned activities and blueprint of how the Consultant intends to carry out the assignment shall be elaborated in the inception report. The Consultant shall in the inception report provide a detailed work plan indicating milestones and timelines in submitting deliverables as required. The inception report shall be submitted in English and French.

ii) **Data Collection Report**: The Consultant shall submit to the WAPP Data Collection Report (electronic form, pdf) within 1 month after receipt of the inception report. The Data Collection Report shall contain requirements of Component 1 which include among others the analysis of existing Grid Codes, summary of international best practices, identification of key recommendations for the elaboration of a template regional transmission network code. The report shall be submitted in English and French.

iii) **Initial Report:** The Consultant shall submit to the WAPP an Initial report (electronic form, pdf) within 3.5 months after receipt and validation of the Data Collection Report. The Initial report shall contain all requirements under Component 2, Component 3, and Component 4 of the scope of works. The report shall be submitted in English and French.

iv) **Intermediary Reports**: The Consultant shall submit to the WAPP a Draft Intermediary Report (electronic form) following the review of elementary regional grid codes by the national stakeholders and their validation. The Intermediary reports shall cover all aspects as elaborated in Component 1, 2 and 3 of the Scope of Works. The reports shall be submitted in English and French.

v) **Draft Final Report:** The Consultant shall submit to the WAPP a Draft Final Report within 1 month after receipt and validation of all Intermediary Reports presenting the elementary regional grid codes. The report shall be submitted in English and French. The Final Draft report shall be submitted in electronic form (pdf) and xx hard copies in both English and French.

vi) **Final Report**: The Consultant shall submit to the WAPP a Final Report within 1 month after receipt and validation of the Draft Final Report. The report shall be submitted in English and French. The Final report shall be submitted in electronic form (pdf) and xx hard copies in both English and French.

4.2. Workshops

The consultant will travel to Cotonou, Benin or any venue within West Africa selected by the WAPP Secretariat to present the various reports and to facilitate the discussions with the committee in charge of network codes during five (5) Workshops (4 days per workshop) to be organized within the framework of the assignment. The first workshop shall be organized to validate the data collection report. The second, third and fourth workshops shall be organized to validate various sections of the initial report. Following feedback from members of the technical committee or taskforce, the Consultant shall deliver a final report and a fifth workshop shall be organized to validate the final report. This exchange will provide additional information and assess the progress of the project.

An account of the discussions between the Consultant and the Committee will be established following these workshops. It will be distributed to the committee and the World Bank for review. Based on these comments, the Consultant will finalize these reports.

5. SCHEDULE

The expected duration of this mission is 12 months. The estimated task is 22 man/month.

		T0	T1		T2		T3		T4		T5		T6		T7		T8		T9		T10		T11		T12	
	Man.Months																									
COMPONENT 1 - DATA COLLECTION	4																									
Draft Report																										
Workshop																										
Technical committee comments																										
Final Report																										
COMPONENT 2 - INITIAL REPORT	11																									
Draft Report																										
Workshop																										
Technical committee comments																										
Final Report																										
COMPONENT 3 - FINAL REPORT	7																									
Draft Report																										
Workshop																										
Technical committee comments																										
Final Report																										
Total	22																									

6. COUNTERPART AND COORDINATION

The WAPP will be responsible for the supervision, monitoring and coordination of the services mentioned in these ToRs. The project will be managed by a Project Implementation Unit (PIU) to be set up in the WAPP General Secretariat to ensure that the services provided by the Consultant comply with the initial objectives of the service.

A technical committee in charge of the application of the network codes will be established to ensure adequate coordination, and exchanges with the consultant. The committee's mandate is to review the reports and propose amendments. The PIU will be accountable to the committee for the validation of the deliverables.

The committee, which includes representatives of relevant stakeholders in the electricity sector, will be composed of:

- ✓ WAPP-PIU
- ✓ ERERA
- ✓ National Utilities

- ✓ National Regulators
- ✓ Sub-regional energy organizations (OMVS, OMVG, CLSG, CEB)

In addition to comments from the Network Code Committee, the Consultant will receive comments from the World Bank team. All exchanges between the Consultant and the committee responsible for network codes will be copied to the World Bank team.

7. LIST OF THE PROFILES OF KEY EXPERTS OF THE CONSULTANT

The scope of the work requires a consultant team to direct and carry out the scope of work with the following qualifications:

- ✓ Good understanding of operation and experience in the development or revision of the electrical system network codes (Transmission and Distribution);
- ✓ Experience in drafting network code provisions;
- ✓ Expertise in operation of synchronously interconnected power systems, modeling of power systems and operational security analysis, connection studies, protection system, integration of renewable energy, energy and power metering;
- ✓ Knowledge and experience on international practices in procedures, performance standards and technical requirements for the connection and connection of variable renewable energy;
- ✓ Relevant experience on the context of the energy sector in West Africa or in Africa would be an advantage;
- ✓ Jurist and Legal expertise
- ✓ Good writing in French/English and communication skills

The required staff should at least include the following 3 key profiles:

- ✓ **Project Manager and Operation Expert:** expert in grid compliance studies and operating of HV network with different generation types (hydro, gas turbine, solar, wind, thermal).
- ✓ **Generation Expert:** expert in operating power plants and in connecting power plants to HV Grid of more than 30 MW minimum with different generation types (hydro, gas turbine, solar, wind, thermal).
- ✓ **Client Distribution Expert**: expert in operating distribution system facilities and in requirements for connecting distribution facilities composed of MV and LV networks with decentralized generation facilities such as VRE (variable renewable energy) generators, to national/regional transmission networks.

The staff must be fluent in English and in French. The minimum required experience of key personnel is as follows:

Project Manager and Operating Expert	
Year of Professional Experience	20
Specific Experience	Good understanding of operation and experience in the development or revision of the electrical system network codes (Transmission and Distribution); At least an Engineering Degree or Master Level (MSc.) in electricity; At least 20 years of professional experience in power system operation (generation, transmission & distribution networks) and or energy dispatching International experience in drafting at least one grid code; Knowledge and experience on international practices in work processes, rules and procedures for operating regional power systems, covering the following fields: performance standards, technical requirements for the connection of generators including VER (variable renewable energy) generators; HVDC connections; demand connections (distribution system operators, significant transmission grid users); operational security requirements, principles and analysis; methodologies and principles to carry out coordinated operational security analysis and adequacy analysis; operational planning and scheduling; load-frequency-control and reserves requirements and principles; coordination of the system operation in emergency, blackout and restoration states. Relevant experience on the context of the energy sector in West Africa or in Africa would be an advantage; Good writing in French/English and communication skills
Generation Expert	
Year of Professional Experience	15

Specific Experience	Electrical engineer, with an experience in generation and/or power system operation (dispatch centres) electricity in an energy pool of more than 150 MW connected to the HV Transmission Network (60kV up to and above 330 kV). Knowledge of connection conditions to HV transmission networks for power-generation facilities, participation to elaboration of at least one HV grid code. An experience in regional electrical interconnection and energy exchange is appreciated. Knowledge and experience on international practices in work processes, rules and procedures, performance standards and technical requirements for the connection of generators including VRE (variable renewable energy) generators, management and response to power system operators for operational security is required. Involved in integration study of at least three (3) power generation projects of more than 30 MW minimum, including feasibility studies and one should ideally be located in Africa or in similar conditions.
Client-Distribution Expert	
Year of Professional Experience	15
Specific Experience	Electrical engineer, with an experience in planning, design and management of distribution (MV & LV) facilities with possible decentralized VRE generators, connected to transmission networks. Knowledge of connection conditions of distribution facilities to HV transmission networks, participation to elaboration of at least one HV grid code. An experience in regional electrical interconnection and energy exchange is appreciated. Knowledge and experience on international practices in work processes, rules and procedures, performance standards and technical requirements for the connection of distribution facilities including VRE (variable renewable energy) generators, management of distribution facilities and coordination with Transmission System Operators is required. Involved in distribution system study of at least three (3) projects, including planning, design and management/operation studies and one should ideally be located in Africa or in similar conditions.

9. SPECIFIC TERMS & CONDITIONS

9.1. Proposal

The Consultant will perform all tasks provided within the scope of work with high professional skills based on its experience. The Consultant will perform the work in an efficient manner and will avoid unnecessary expenses by assigning appropriate personnel, utilizing appropriate means of communication and through other appropriate means without compromising the thoroughness or quality of the work.

The Consultants should present the names of the proposed Project Team and respective CVs and clear indication of their relationship with the firm.

The Consultant should submit information regarding its suitability for the proposed assignment including:

- Experience of the Consultant and Consultant's team members specifically related to the assignment, with emphasis on experience
- Recent experience with assignments of this type
- Qualifications and competence of the key staff related to the assignment
- Comprehensive methodology and the proposed work plan in responding to the Terms of Reference.

9.2. Contract value

The consultant should bid fixed amounts to carry out the activities and deliverables required by TOR. In addition, the consultants should provide time allocation of team members and hourly / daily rates for all proposed key team members. No additional work will be carried out outside of lump sum amount - all costs shall be incorporated in the bid fixed amount.

The cost of financial Consultant offer will cover all the expenses for the missions in WAPP countries.

9.3. Selection Criteria

The selection criteria will be based (i) on the demonstration of references of similar projects undertaken in the past by the Consultant (ii) on the evaluation of the proposed methodology to undertake the assignment and (iii) on the CVs of the 3 key experts,

Criteria, sub-criteria, and point system for the evaluation of the Full Technical Proposals for the evaluation are detailed below:

- ✓ **Criteria I (20 points):** Specific experience of the Consultant (as a firm) relevant to the Assignment (elaboration of grid code, connection and operating procedures, etc. in similar WAPP context)

- ✓ **Criteria II (20 points)**: Adequacy and quality of the proposed methodology, and work plan in responding to the Terms of Reference (TORs)

- ✓ **Criteria III (60 points)**: Key Experts' qualifications and competence for the Assignment:
  - o Project Manager and Operation expert 30 points
  - o Generation expert 15 points
  - o Client-Distribution expert 15 points

  Total points for criterion (III): 60 points

The number of points to be assigned to each of the above positions shall be determined considering the following three sub-criteria and relevant percentage weights:

- General qualifications (general education, training, and experience): 20 %
- Adequacy for the Assignment (relevant education, training, experience in the sector/similar assignments): 60%
- Relevant experience in the region and fluent in French/English: 20 %

The minimum technical score (St) required to pass is 75 points.

The lowest evaluated Financial Proposal (Fm) is given the maximum financial score (Sf) of 100.

The formula for determining the financial scores (Sf) of all other Proposals is calculated as following:

- ✓ Sf = 100 x Fm/ F, in which “Sf” is the financial score, “Fm” is the lowest price, and “F” the price of the proposal under consideration.
- ✓ The weights given to the Technical (T) and Financial (P) Proposals are: T = 75 and P = 25

Proposals are ranked according to their combined technical (St) and financial (Sf) scores using the weights (T = the weight given to the Technical Proposal; P = the weight given to the Financial Proposal; T + P = 1) as following: S = St x T% + Sf x P%.

9.4. Obligations of the Consultant

The Consultant is entirely responsible for the implementation of the project. He shall take all necessary measures to ensure the timely and effective implementation of the tasks assigned to him. He is entirely responsible for project implementation including any part of study that may be eventually subcontracted.

The consultant will be required to undertake missions to WAPP Countries to collect, verify and/or validate data according to the study needs.

The Consultant shall undertake to:

- Assume entire responsibility for research study and data collection;
- Undertake the study in accordance with internationally accepted norms and standards with the support of qualified and experienced staff according to the purposes of the study;
- Check the consistency of data and information collected during the execution of his assignment;
- Conduct the study diligently and in conformity with proposed and agreed implementation schedule. He shall submit reports in timely manner and in accordance with the required format;
- Support document acquisition costs including maps, software, data and their processing;
- Maintain the confidentiality of information and results obtained in the course of the study and upon completion of study return documents placed at his disposal;

ANNEX 1- List of key documents available at the WAPP General Secretariat

A. Available at the time of sending of the tender documents:

1. ECOWAS Energy Protocol A/P4/1/03.
2. Supplementary Act A/SA.4/01/08 adopting the Emergency Power Supply Security Plan (EPSSP). January 18, 2006.
3. Supplementary Act A/SA.3/01/08 adopting the West African Power Pool (WAPP) transmission line Implementation Strategy. January 18, 2006.
4. Supplementary Act A/SA.2/01/08 establishing the ECOWAS Regional Electricity Regulatory Authority. January 18, 2006.
5. ECOWAS Revised Master Plan for Power Generation and Transmission Electrical Energy 2012-2025 (Tomes 1 to 4)

B. Available at commencement of work:

1. White Paper for a regional policy on access to energy services for population in urban and peri-urban areas for poverty reduction in line with achieving the MDGs for the Development. ECOWAS. January 2006.
2. ECOWAS Policy on Renewable Energy. 2013
3. ECOWAS Policy on Efficient Energy. 2013
4. Operation Manual for WAPP interconnected Power Systems. July 2007.
5. Transmission Tariff Methodology -August 2015_V4
6. West African Power Pool Transmission Service Access and Use Procedures
7. West African Power Pool Market Rules

ANNEX 2 - Technical Reference Documentation

- Area of application of network codes
- State of regulation
- Instruction of connection requests
    - Connection process
    - Data
    - Procedure for connection to the Transmission Network of new interconnections
- Connections
    - Studies for the connection
    - Method for identifying the limits Generation/Transmission/Distribution
    - Installation at the interface
- Performance of the public transmission network
    - Normal and exceptional voltage and frequency ranges
    - Continuity and quality of the voltage wave
    - Accommodation capacity
    - Safety of the Electrical System - Incident Control - Backup and Defense Plans
- Contribution of users to the performance of the Transmission Network
    - Frequency / Power Adjustment
    - Voltage adjustment and constructive capacities in reactive power of installations of production
    - Reactive to the interface of the managers of public transmission networks
    - Stability
    - Separate network
    - Reconstruction of the network / Voltage transfer
    - Protection system against insulation defects
    - Information exchange and telecontrol system
    - Metering
- Initial Compliance Verification of Facilities
- Catalog of equipment
- Management and operation of the network
    - System security - associated rules
    - Works on the network
    - Balance Responsible Mechanism
    - Adjustment mechanism
    - Access to International Interconnections
- Typical frame of contract documents

ANNEX 3 –Example Regional Grid Code

STRUCTURE OF THE GREATER MEKONG SUB-REGION GRID CODE

1. Preamble
2. Governance Code
3. Connection Codes
    - 3.1 Requirements for Generators Code
    - 3.2 High Voltage Direct Current Connections (HVDC) Code
    - 3.3 Demand Connection Code
4. Operation Codes
    - 4.1 Operational Security Code
    - 4.2 Operational Planning and Scheduling Code
    - 4.3 Load Frequency Control and Reserves Code
    - 4.4 Emergency and Restoration Code
5. Market Codes (Technical Aspects)
    - 5.1 Capacity Allocation, Forward Capacity Allocation and Congestion Management Code
    - 5.2 Electricity Balancing Code
6. Metering Code
7. Operational Training Code

1. PREAMBLE:

INTRODUCTION

1. REGIONAL POWER TRADE

1.1 REGIONAL POLICY OBJECTIVES

1.2 OBJECTIVES FOR REGIONAL POWER TRADE

1.3 REGIONAL AND NATIONAL GRID CODE RELATIONSHIP

1.4 SEPARATE SYNCHRONOUS AREAS

2. LEGAL AUTHORITY

2.1 LEGISLATION

2.2 APPLICABILITY

3. REGIONAL GRID CODE

3.1 DEFINITION

3.2 NEED FOR A GRID CODE

3.3 OBJECTIVES

3.4 GRID CODE OVERVIEW

4. NOTICES AND DOMICILE

2. GOVERNANCE CODE

3. CONNECTION CODE

1. INTRODUCTION

2. REQUIREMENTS FOR GENERATORS (RFG)

2.1 SIZE OF GENERATOR FACILITY

2.2 FREQUENCY TOLERANCE, ACTIVE POWER AND FREQUENCY CONTROL REQUIREMENTS

2.3 VOLTAGE TOLERANCE, VOLTAGE CONTROL AND REACTIVE POWER PROVISION

2.4 FAULT RIDE THROUGH CAPABILITY

2.5 PROTECTION REQUIREMENTS

2.6 SYSTEM RESTORATION, ISLANDING AND BLACK START CAPABILITY

2.7 INFORMATION REQUIREMENTS

2.8 CONNECTION, COMPLIANCE AND TESTING REQUIREMENTS

3. HIGH VOLTAGE DIRECT CURRENT CONNECTIONS (HVDC)

3.1 SIZE OF HVDC SYSTEM AND DC-CONNECTED POWER PARK MODULES

3.2 FREQUENCY TOLERANCE, ACTIVE POWER AND FREQUENCY CONTROL REQUIREMENTS

3.3 SYNTHETIC INERTIA

3.4 VOLTAGE TOLERANCE, VOLTAGE CONTROL AND REACTIVE POWER PROVISION

3.5 FAULT RIDE THROUGH CAPABILITY

3.6 POWER OSCILLATION DAMPING REQUIREMENTS

3.7 SUBSYNCHRONOUS TORSIONAL INTERACTION (SSTI) DAMPING REQUIREMENTS

3.8 SHORT CIRCUIT CONTRIBUTION DURING FAULTS

3.9 POWER QUALITY

3.10 PROTECTION REQUIREMENTS

3.11 SYSTEM RESTORATION, ISLANDING AND BLACK START CAPABILITY

3.12 INFORMATION REQUIREMENTS

3.13 CONNECTION, COMPLIANCE AND TESTING REQUIREMENTS

4. DEMAND CONNECTION

4.1 FREQUENCY TOLERANCE, ACTIVE POWER AND FREQUENCY CONTROL REQUIREMENTS

4.2 VOLTAGE TOLERANCE, VOLTAGE CONTROL AND REACTIVE POWER PROVISION

4.3 SHORT CIRCUIT REQUIREMENTS

4.1 OPERATIONAL SECURITY CODE

1. GENERAL PROVISION

1.1 SUBJECT MATTER AND SCOPE

1.2 DEFINITIONS

1.3 REGULATORY ASPECTS

1.4 REGULATORY APPROVALS

1.5 RECOVERY OF COSTS

1.6 CONFIDENTIALITY OBLIGATIONS

1.7 AGREEMENT WITH TSOS NOT BOUND BY THIS NETWORK CODE

2. OPERATIONAL SECURITY REQUIREMENTS

2.1 SYSTEM STATES

2.2 FREQUENCY CONTROL MANAGEMENT

2.3 VOLTAGE CONTROL AND REACTIVE POWER MANAGEMENT

2.4 SHORT-CIRCUIT CURRENT MANAGEMENT

2.5 POWER FLOW MANAGEMENT

2.6 CONTINGENCY ANALYSIS AND HANDLING

2.7 PROTECTION

2.8 DYNAMIC STABILITY MANAGEMENT

3. DATA EXCHANGE

3.1 GENERAL REQUIREMENTS

3.2 STRUCTURAL AND FORECAST DATA EXCHANGE BETWEEN TSOS

3.3 REAL-TIME DATA EXCHANGE BETWEEN TSOS

3.4 STRUCTURAL DATA EXCHANGE BETWEEN TSOS AND DSOS WITHIN THE TSO' S RESPONSIBILITY AREA

3.5 REAL-TIME DATA EXCHANGE BETWEEN TSOS AND DSOS WITHIN THE TSO' S RESPONSIBILITY AREA

3.6 STRUCTURAL DATA EXCHANGE BETWEEN TSOS, OWNERS OF INTERCONNECTORS OR OTHER LINES AND POWER GENERATING MODULES DIRECTLY CONNECTED TO THE TRANSMISSION SYSTEM

3.7 SCHEDULED DATA EXCHANGE BETWEEN TSOS, OWNERS OF INTERCONNECTOR OR OTHER LINES AND POWER GENERATING MODULES DIRECTLY CONNECTED TO THE TRANSMISSION SYSTEM

4.2 OPERATIONAL PLANNING AND SCHEDULING CODE

1. GENERAL PROVISION

1.1 Subject Matter and Scope
1.2 Definitions
1.3 Regulatory Aspects
1.4 Regulatory Approvals
1.5 Recovery of costs
1.6 Confidentiality obligations
1.7 Agreement with TSOs not bound by this Network Code
1.8 Roles in operational planning and scheduling, and delegation

2. DATA FOR OPERATIONAL SECURITY ANALYSIS IN OPERATIONAL PLANNING

2.1 Individual and Common Grid Model General Provisions
2.2 Year-ahead scenarios
2.3 Year-ahead Individual Grid Models
2.4 Year-ahead Common Grid Models
2.5 Updates of Year-ahead Common Grid Models
2.6 Month-Ahead Individual and Common Grid Models
2.7 Week-Ahead Individual and Common Grid Models
2.8 D-1 and Intraday Grid Models

3. OPERATIONAL SECURITY ANALYSIS IN OPERATIONAL PLANNING

3.1 Operational Security Analysis in operational planning
3.2 Year-Ahead up to and including Month-Ahead and Week-Ahead Operational Security Analysis
3.3 D-1, Intraday and Close to Real-Time Operational Security Analysis
3.4 Methodologies for Coordinating Operational Security Analysis
3.5 Agreements for Coordinating Operational Security

4. OUTAGE COORDINATION

4.1 Definition of Outage Coordination Regions

4.3 LOAD FREQUENCY CONTROL AND RESERVES CODE

1. GENERAL PROVISION

1.1 Subject Matter and Scope
1.2 Definitions
1.3 Regulatory Aspects
1.4 Regulatory Approvals
1.5 Regulatory Notification
1.6 Recovery of costs
1.7 Confidentiality obligations
1.8 Agreement with TSOs not bound by this Network Code
1.9 TSO Cooperation

2. OPERATIONAL AGREEMENTS

2.1 Synchronous Area Operational Agreement
2.2 LFC Block Operational Agreement
2.3 LFC Area Operational Agreement
2.4 Monitoring Area Operational Agreement
2.5 Imbalance Netting Agreement
2.6 Cross-Border FRR Activation Agreement
2.7 Cross-Border RR Activation Agreement
2.8 Sharing Agreement
2.9 Exchange Agreement

3. FREQUENCY QUALITY

3.1 Frequency Quality Target Parameters
3.2 FRCE Target Parameters
3.3 Criteria Application Process and Frequency Quality Evaluation Criteria
3.4 Data Collection and Delivery Process
3.5 Synchronous Area Monitor
3.6 LFC Block Monitor
3.7 Information on Load and Generation Behaviour

4.4 EMERGENCY AND RESTORATION CODE

1. GENERAL PROVISION

1.1 SUBJECT MATTER AND SCOPE
1.2 DEFINITIONS
1.3 REGULATORY ASPECTS
1.4 REGULATORY APPROVALS
1.5 RECOVERY OF COSTS
1.6 CONSULTATION AND COORDINATION
1.7 CONFIDENTIALITY OBLIGATIONS
1.8 AGREEMENT WITH TSOS NOT BOUND BY THIS NETWORK CODE

2. SYSTEM DEFENCE PLAN

2.1 GENERAL PRINCIPLES
2.2 MEASURES OF THE SYSTEM DEFENCE PLAN

3. RESTORATION PLAN

3.1 GENERAL PRINCIPLES
3.2 RE-ENERGIZATION
3.3 FREQUENCY MANAGEMENT
3.4 RESYNCHRONISATION

4. MARKET INTERACTIONS

4.1 PROCEDURE FOR SUSPENSION OF MARKET ACTIVITIES
4.2 RULES AND CONDITIONS FOR SUSPENSION AND RESTORATION OF MARKET ACTIVITIES
4.3 PROCEDURE FOR RESTORATION OF MARKET ACTIVITIES
4.4 COMMUNICATION PROCEDURE
4.5 SETTLEMENT PRINCIPLES

5. INFORMATION EXCHANGE AND COMMUNICATION, TOOLS AND FACILITIES

5.1 INFORMATION EXCHANGE
5.2 COMMUNICATION SYSTEMS
5.3 TOOLS AND FACILITIES

5. MARKET CODES (Technical Aspects)

1. INTRODUCTION

2. CAPACITY ALLOCATION, FORWARD CAPACITY ALLOCATION AND CONGESTION MANAGEMENT CODE

2.1 PHYSICAL TRANSMISSION RIGHTS (PTR)

2.2 FINANCIAL TRANSMISSION RIGHTS (FTR)

2.3 CAPACITY CALCULATION TIME-FRAMES

2.4 GENERATION AND LOAD DATA PROVISION METHODOLOGY

2.5 TRANSMISSION CAPACITY CALCULATION METHODOLOGY

2.6 LONG-TERM CAPACITY CALCULATION

2.7 AVAILABLE TRANSMISSION CAPACITY PUBLISHING

2.8 DISPUTE OF TRANSMISSION CAPACITY

3. ELECTRICITY BALANCING CODE

3.1 OBJECTIVE OF BALANCING CODE

3.2 ROLE OF TSOS

3.3 ROLE OF BALANCING SERVICE PROVIDERS

3.4 ROLE OF RPCC FOR BALANCING ENERGY

3.5 BALANCING MARKET RULES

3.6 ROLE OF RPCC FOR IMBALANCE ENERGY CALCULATION IN THE ABSENCE OF A BALANCING MARKET

3.7 IMBALANCE SETTLEMENTS

3.8 IMBALANCE ENERGY SETTLEMENT RULES IN THE ABSENCE OF A BALANCING MARKET

3.9 DETERMINATION OF CAUSE OF IMBALANCE ENERGY IN THE ABSENCE OF A BALANCING MARKET

3.10 "BALANCING MARKET" IMBALANCE ENERGY SETTLEMENT

3.11 REPORTING

6. METERING CODE

1. GENERAL PROVISION

1.1 SUBJECT MATTER AND SCOPE

1.2 DEFINITIONS

1.3 REGULATORY ASPECTS

1.4 REGULATORY APPROVALS

1.5 RECOVERY OF COSTS

1.6 CONFIDENTIALITY OBLIGATIONS

1.7 AGREEMENT WITH TSOS NOT BOUND BY THIS NETWORK CODE

2. METERING REQUIREMENTS

2.1 TECHNICAL AND DESIGN CRITERIA

2.2 OPERATIONAL CRITERIA

2.3 METER INFORMATION REGISTER

2.4 MAIN AND CHECK METERING

2.5 MEASUREMENT PARAMETERS

2.6 METERING EQUIPMENT STANDARDS

2.7 EQUIPMENT ACCURACY AND ERROR LIMITS

2.8 INSPECTION, CALIBRATION AND TESTING

2.9 DATA COLLECTION

3. OTHER MISCELLANEOUS REQUIREMENTS AND CONDITIONS

3.1 SECURITY

3.2 DISPUTES

3.3 METER DATA CONFIDENTIALITY

3.4 OPERATIONAL METERING

7. OPERATIONAL TRAINING CODE

1. INTRODUCTION

2. TRAINING PROGRAMS

2.1 INITIAL TRAINING PROGRAM

2.2 CONTINUOUS TRAINING PROGRAM

3. INTER-*TSO* TRAINING

4. TRAINING ORGANIZATION AND *DISPATCHERS* ACCREDITATION

5. BASIC REQUIREMENTS FOR DISPATCHER TRAINING SIMULATOR