NETWORK CODE FOR ELECTRICAL TRANSMISSION SYSTEM OPERATION

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Pursuant to Article 84, of the Energy Law ("Official Gazette of MK", no. 96/18 and "Official Gazette of the Republic of North Macedonia" No.96/2019), and Article 19, point 18 of the the Statute of the Company ("Official Gazette of the Republic of North Macedonia" Ho. 165/2020), the Management Board of the Electricity Transmission System Operator of the Republic of North Macedonia, Joint-Stock Company for Electricity Transmission and Management of the State-Owned Electricity System, Skopje (abbreviated title: state-owned AD MEPSO, Skopje), after prior approval by the Energy and Water Services Regulatory Commission of the Republic of North Macedonia with the Decision on the approval of the Network Codes for the electricity transmission of AD MEPSO Skopje No. 12-1237/7 of 29.12.2021 passed:

THE NETWORK CODE FOR ELECTRICITY TRANSMISSION

I.GENERAL PROVISIONS

I.1. Subject of the regulation

Article 1

(1) The Network Code for electricity transmission (hereinafter referred to as the „Network Code") regulates:

1) Technical and other requirements for safe and reliable operation of the transmission system,
2) Technical and technological conditions and methods of connection of users in accordance with transparent and non-discriminatory principles,
3) Conditions and methodology for determining fees for connection to the transmission system in accordance with transparent and non-discriminatory principles,
4) Terms and conditions for third party access to transmission system in accordance with transparent and non-discriminatory principles,
5) Objective, non-discriminatory and transparent procedures for resolving overloading in the transmission system,
6) Technical and technological requirements for production facilities in operation mode with a temporary permit,
7) Planning of the maintenance and development of the transmission system,
8) Method for coordination with transmission system users in case of planned outages,
9) Content of the transmission system development plan, as well as methods and procedures for the submission of necessary data for development plan by the transmission system users,
10) Methods and procedures for forecasting electricity consumption and the obligations of the transmission system users (suppliers, generation facilities and demand facilities directly connected to the transmission system) to transmit the data necessary for making predictions,
11) Measures necessary to maintain operational security of the transmission system,
12) Measures, activities and procedures in case of disturbances and incidents,

13) Functional requirements and accuracy class of measuring devices, and the method of measurement of electrical energy and power,

14) Criteria for the provision of ancilary services,

15) Dispatch of generation units in the electric power system of the Republic of North Macedonia,

16) Quality of the electrical energy (power quality),

17) Quality of the services that MEPSO provides to the users,

18) Mechanisms for coordination and information exchange with transmission system users and neighboring TSOs,

19) Communication protocols for system monitoring and control,

20) Operation of the controlling system,

21) Methods for publishing information which MEPSO is obliged to publish in accordance with the Energy Law, and

22) Methods and procedures for reporting to transmission system users.

I.2. Basic principles

Article 2

(1) The implementation of these Network Codes is based on the following principles:

1) Transparency, non-discriminatory and impartiality,

2) Protection of the public interest and rights of transmission system users,

3) Reliability, security, continuity and quality of delivery of EE

4) Efficiency and economy of MEPSO's operation, and

5) Minimum of prerequisites of the ENTSO-E related to the operation and exchange of EE between synchronously connected systems.

I.3. Area of Implementation

Article 3

(1) MEPSO is the owner of the transmission network and is responsible for reliability, security and quality of EE supply through the transmission network, ensuring the development and maintenance of the transmission network for safe and efficient operation.

(2) The basic principles of delimitation of ownership and responsibilities between MEPSO and the users of the transmission network is the boundary of delimitation. The boundary of delimitation is defined as follows:

1) If the user is connected to high voltage transmission network through system transformer station, connected to at least two other transformer stations with two or more lines, the

power transformer together with all high voltage equipment in the transformer bay (disconnectors, breaker, measurement transformers and surge arrestors) belongs to the user, while part of high voltage equipment for connection of transformer bay to busbars belongs to MEPSO. Place of delimitation is the terminal of the busbar coupler toward high voltage busbars, and

2) If the user is connected radially to the transmission network through high-voltage transformer station and high voltage transmission lines, the transformer station with the radial lines belongs to the user. Place of delimitation is the tension insulators on the portal system in the transformer station that belongs to MEPSO.

(3) If the delimitation limit is in accordance with paragraph (2) point 2) of this article, a new user can be connected to an existing radial connection in conditions when it is technically and economically justified, does not threaten the security of the system and when the owner of the connection has given his consent. In this case, the connection and measurement of the electricity can also be performed by a distribution system operator.

(4) The existing and the new user conclude an agreement for maintaining the voltage terminal from paragraph (3) of this article. MEPSO and ODS are not responsible for the unwanted impacts and consequences that may happen to any of the users from paragraph (3) of this article due to joint use of the connection.

(5) The existing user and the new user, MEPSO and DSO conclude an agreement for the exchange of data and information.

(6) MEPSO has obligation to apply these Network Code in the control and use of:

1) the transmission system, which includes power facilities, and other equipment for electrical energy transmission at the 400 kV and 110 kV voltage levels, which are in MEPSO's property and

2) the parts of facilities and 110 kV and higher voltage level which are either owned by transmission system users or which they are entitled to exploit.

(7) In the EPS of the Republic of North Macedonia, distinction of ownership or right to use the power facilities and other equipment for the transmission of electricity as well as parts of the facilities and network of 110 kV and higher voltage level, between MEPSO and transmission system users is determined with the is determined according to the border of demarcation from paragraph (2) and (3) of this article or in a manner determined by individual Agreements on access and usage of transmission network, concluded between MEPSO and transmission system users or according to an already established border of demarcation for an already existing connection.

(8) All electric power entities and transmission system users are obliged to apply this Network Code and to comply in a manner of utilization of the transmission system in its operations.

(9) Electric power entities and users referred to in paragraph (8) of this article are:

- Electricity generation facilities connected to the transmission system,
- Electricity distribution system operator(s),
- Electricity traders,
- Electricity suppliers and
- Users directly connected to the transmission system

I.4. Basic Requirements and Responsibilities ensuing from the Compliance with the Network Code

Compliance of existing users with the Network Codes

Article 4

(1) The existing users of the electricity transmission system are obliged to comply with the provisions of these Network Codes, first of all in relation to the general requirements for connection and the requirements from Annexes 3 and 4 of these Network Codes, for which ERC makes a decision under which conditions, manner and deadlines the compliance is carried out.

(2) Existing users within the meaning of these Network Codes are:

- users connected to the electricity transmission network on the day of entry into force of these Network Codes or
- users who have concluded binding agreements for the purchase of the main equipment within a period of 24 months from the date of entry into force of these Network Codes and have notified MEPSO about the same within 30 months from the entry into force of these Network Codes by submitting information on: subject of the agreement, date of signature and date of entry into force of the agreement and specification of the main equipment to be built, assembled or procured.

(3) MEPSO is obliged to submit a proposal to ERC for making the decision from paragraph (1) of this article within six months from the end of the public participation procedure. An integral part of the proposal is an operational procedure for notification and confirmation of compliance of existing users, the report from paragraph (8) of this article and the public participation report from paragraph (10) of this article.

(4) In order to prepare the proposal from paragraph (3) of this article, MEPSO is obliged to prepare a preliminary qualitative analysis of the costs and benefits of compliance of existing users with the provisions of these Network Codes, based on available market-oriented or network-oriented alternatives and to submit it to the ERC.

(5) If the preliminary analysis from paragraph (4) of this article shows that the expected benefits are greater than the expected costs, ERC will notify MEPSO within 30 days from the day of receiving the analysis that it is obliged to prepare a quantitative analysis of costs and benefits. If the preliminary analysis from paragraph (4) of this article shows that the costs are high or the benefits are low, MEPSO will stop the procedure and notify the ERC.

(6) The quantitative analysis of costs and benefits from paragraph (5) of this article should be prepared in accordance with the regulations adopted on the basis of the Law on Energy and should in particular contain:

1) costs for existing users to comply with the provisions of these Network Codes,
2) the socio-economic benefits resulting from compliance with the provisions of these Network Codes and
3) other alternative measures that will potentially achieve the same results.

(7) MEPSO has the right to request data and information necessary for the preparation of the analysis from paragraph (4) and from paragraph (6) of this article from the existing users, which they are obliged to submit within 30 days from the day of the request.

(8) Within three months from the completion of the quantitative analysis of costs and benefits from paragraph (6) of this article, MEPSO is obliged to prepare a report and implement a public participation procedure for it in accordance with paragraphs (9) and (10) of this article. The report must contain the following elements:

- the quantitative analysis of costs and benefits with a recommendation for future steps and
- proposed deadline for compliance of existing users with the provisions of these Network Codes, which cannot be longer than two years from the date of entry into force of the decision from paragraph (1) of this article.

(9) The public participation procedure is carried out by MEPSO for at least 30 days and must include all stakeholders and the ERC.

(10) After the procedure for public participation, MEPSO is obliged to prepare a report from the public participation in which it will necessarily state the expectations of the existing users as stakeholders and the arguments for accepting or rejecting all the expressed views of the stakeholders, and publish it on its website before or simultaneously with submitting the proposal from paragraph (3) of this article.

(11) MEPSO may reevaluate the application of some or all of the provisions of these Network Codes by existing users and propose appropriate changes to ERC every three years in accordance with the procedure and conditions prescribed in paragraphs (3), (4), (5), (6), (7), (8), (9) and (10) of this article.

Unforeseen Events and Reporting

Article 5

(1) MEPSO is entitled to take outage measures in case of the occurrence of events that are not foreseen by the provisions of these Network Codes, or the occurrence of which was impossible to prevent, and the effect of such events may provoke the alteration of technical conditions for the exploitation of transmission system and lead to consequences for the transmission system users.

(2) Any user has the obligation to comply with the instructions received from MEPSO.

(3) MEPSO informs the Energy Regulatory Commission of any unforeseen event and of relevant decisions taken in accordance with this Code, within five (5) days of the unforeseen event.

(4) MEPSO has the obligation to prepare a report on the implementation of outage measures for unforeseen events, in the way and according to the procedure for the drafting of reports on contingencies in the transmission system operation, defined in the Article 211 of these Network Codes, which, among other, will include the event that caused the unforeseen circumstance, measures taken and effects and consequences of unforeseen event.

Information and Data Confidentiality

Article 6

(1) MEPSO is obliged to ensure and guarantee the confidentiality of the business data and information it receives from the users when performing the activity in accordance with the law.

(2) the obligation to ensure the confidentiality of the information from paragraph (1) of this article does not apply to:

1) information that is available to the public,

2) information for which there is written consent from the person to whom the information refers to the disclosure of the same and,

3) information that the license holder should provide in accordance with the obligations established in the license, a decision of a competent court or a request of a state authority.

(3) MEPSO can deliver them to other electricity entities or potential users in the case and in the manner regulated in these Network Codes.

(4) Users of the electric transmission system determine whether the data submitted to MEPSO about the technical characteristics and requirements for the use of their facilities will be marked as confidential.

(5) MEPSO publishes information and data marked as confidential by the user of the electricity transmission system only with the written approval of the user. The written approval will specify the purpose for which the data and information can be used.

(6) MEPSO is obliged to treat the data related to consumption, generation and exchange of electricity of each individual user as confidential. Summary data of this kind, at the level of the electric power system, are not deemed as confidential.

(7) MEPSO does not consider as confidential information about the operation of the electricity transmission system, including information about disturbances and other emergency situations.

(8) MEPSO is obliged to publish data on the load of the electricity transmission system in a form that does not violate the confidentiality of the information for the user of the electricity transmission system.

(9) MEPSO exchanges relevant data with transmission system operators and third parties, which may include commercially confidential and sensitive data. In order to prevent possible misuse of such data, MEPSO concludes confidentiality agreements of the available data with the transmission systems operators and with third parties, in which the data is marked as confidential.

I.5. Terms, Abbreviations and Definitions

Terms

Article 7

(1) Definitions of certain terms contained in the Energy Law, are applied in the Network Code.

Definitions

Article 8

(1) Terms used in the Network Code have the following meaning:

AFLS-Automatic frequency load shedding	Shedding of the system load, achieved by disconnection of the consumption of EE with the action of under-frequency relays
Active power	Electrical power available for conversion into other power e.g. mechanical, thermal, chemical, sound or light. It is the average product of the instantaneous values of voltage and current in a given time interval.
Database of measurement	Database that contains the verified measurement data.
Balancing Group	Balancing group consists of one or more participants from the electricity market of which one member of the balancing group takes full balance responsibility party.
Balance Responsibility	Balance responsibility is the responsibility of the participants in the electricity market in relation to the electricity generation, consumption and/or transactions, in accordance with the accepted physical schedules (nominations), and the financial responsibility towards the electricity transmission system operator for any imbalances and if it is necessary, imbalances settlement.
Balance Responsible Party (BRP)	The balance responsible party is a participant in the electricity market, or its elected representative, who assumes balance responsibility and submits physical schedules (nominations) for the balance group in accordance with their mutual contractual obligations and is responsible for imbalances towards the operator of the electricity transmission system.
Block Coordinator	MEPSO from control block, responsible for secondary regulation of the control block, for the calculations of the control area of the control block, for organization on the secondary regulation inside of the block and for coordination of the programs for exchange between control areas in the block and the programs of the exchange with neighboring control blocks
High Voltage	Rated voltage 110 kV and higher
Force majeure	- natural disasters of greater scale and intensity, such as earthquakes, floods, landslides, droughts, volcanic eruptions, hurricane winds, snow drifts, torrential and/or freezing rain, lightning strikes, fires, epidemics and similar natural events, in that the impact of natural disasters on causing the event of force majeure is evaluated in accordance with the technical specifications of the equipment, plants, devices and installations used by the operator, as well as the standards for designing and performing the operator's facilities,

	- damage, destruction, or blocking of other energy, telecommunication or traffic infrastructure that are not owned by the operator, - war or martial law, state of emergency declared in accordance with law, general military mobilization, invasion, armed conflict, blockade or serious threat of such situations, - civil war, rebellion, insurrection, revolution, military or coup d'état, acts of terrorism, sabotage, civil unrest, mass violence, - actions of state authorities taken in accordance with the law or actions taken due to extreme necessity, which are not caused by actions taken or not taken by the operator - work stoppages, strikes, boycotts or occupation of facilities by employees, and - declaration of an energy crisis in accordance with the Law on Energy.
Generator unit	Device which consists of all the equipment necessary for generation of electricity
Main equipment	main equipment - main equipment means at least one of the following equipment: motors, transformer stations, high voltage equipment at the connection point and in the user's facility, that is, on or more main parts of the equipment needed to convert the primary source of energy into electricity .
Imbalance of EPS	Deviation from the exchange program, i.e. the difference between the available energy (generation and import) and total consumption (consumption, export and system losses)
National Dispatching Center	Centre for electric power system (or control area) control
Dispatching	Control of power flows in the electric power system, including the electricity production and electricity exchange with other systems

Bilateral operating agreement	Contract between MEPSO in state ownership, Skopje and TSOs of neighboring systems on the joint parallel operation carried out through common, interconnection lines – interconnectors
Power Plant	Electric power facility that includes one or more generation units
Energy Balance	Quantity of EE which is engaged with the activation of ancilary services for alignment of the deviations between the available EE and consumption of EE in real-time.
Frequency Set-point	Frequency established by MEPSO in accordance with ENTSO-E recommendations, as the desired operational system frequency

Exemption	Approval, issued by the Energy regulatory commission or by MEPSO at the request of the transmission system user, for non-compliance with any of the provisions of the Network Code for a limited period of time, i.e. until the reasons for which the exemption has been requested cease to exist
Dispatching Instruction	Instructions issued by the EPS operational manager, related to the operation of generation units, transmission and user systems, including the use of ancillary and ancilary services
Control Block	Control block consists of one or several control areas that operate jointly in order to ensure the load-frequency control with respect to other control blocks of synchronous area.
Connectivity infrastructure	The connection infrastructure consists of the connection or upgrading or expansion of an existing connection and investments to create technical conditions in the electricity transmission system for connecting new users or increasing the capacity of existing connections.
Control Area	The smallest part of EPS that has its own control system for generation/consumption of EE and frequency, usually coincides with the territory of states and managed by the one MEPSO
Metering Point	Point of physical connection in the EE measuring system for electrical energy register and electrical parameters measurement
Metering equipment	It consists of measurement transformers, secondary measuring circuits, meter, protection, communication and supervisory equipment.
Metering Data	Data obtained from parameters of EE, contained in the electric meter registry.
Metering System	A set of metering points.
Connection Point	Point in the EPS where the generator units, customers and distribution systems are connected to the transmission network where MEPSO delivers / EE receive to / from the user of transmission system.
Power park module	Any generator unit or ensemble of units generating electricity which is not synchronously connected to the network. This includes any connection through power electronics and any ensemble of units having a single Connection Point to the network
Network parameters	Network parameters are indicators which quantify physical properties of the network elements: the line axial impedance, the line admittance, impedance between two nodes of the network, the transformation ratio (turns ratio) of the transformer, etc.
Load shedding	Reduce of EE consumption in a controlled manner with switching off the demand facilities in the event of disrupted / disturbed integrity of EPS, to bring it back in normal or transient state.

Voltage Transformer (VT)	Transformer used with metering systems and/or protection devices with function of transmitting the primary voltage variable to the secondary values as accurately as possible according to its magnitude and angle.
Voltage Flicker	a voltage waveform fluctuation, typically caused by connecting an object, that distorts the normal sinusoidal voltage waveform
Disturbed operating mode	Operating mode which deviates from normal operation.
EPS normal operation	EPS normal operation which considers operation points of system parameters with sufficient security margin.
Load	Load is a power supplied to the system or part of the system or demand facilities and is expressed in kW or kVA, or MW or MVA.
EPS operating leader	an expert authorized to lead the national EPS
Island	The part of the EPS physically separated from the main interconnection system which forms an islanded EPS. The operation of facilities in that system is called the island operation.
Capability diagram of Generator Unit	Document which determines limits of capability of operation of generation unit (in MW and MVAr) under normal operating conditions
Underfrequency Relay	Electric metering relay triggered by a system frequency drop below defined relay set-points
Auxiliary Equipment	Any part of the equipment and/or plant that is not directly the part of the EPS, but is necessary for its operation
Exchange Program	Exchange program represents the total planned exchange between control areas or between two control blocks.
Operating variables	Operating variables are quantities that characterize a certain operation of EPS
Accounting measurement	Measurement of electrical energy whose data are used for preparing MEPSO financial documents (invoices).

Frequency Containment Control Process	The automatic decentralized function of turbine controllers of generation units that supports balance between generation of generator units and demand facilities of EE in the synchronous area. Automatic function of turbine controllers enables the changes in generation of the generation unit due to frequency changes
Frequency Containment Reserve (Primary Reserve)	A positive or negative part of the total active power bandwidth for primary regulation, measured from setpoint of generator unit before disturbance occurs to the maximum power for primary control.

System Blackout	Situation in which all generation is stopped and there is no supply of electricity from other systems, which makes the whole system switched off, i.e. total blackout state in the control area.
Reactive Energy	Electric energy not consumed but existing between the system units with established electric fields and system parts with the established magnetic fields, however its flow increases current and system losses.
Reactive Power	Electric power required for establishment of electric and magnetic fields. In a chiefly electric field, reactive power is capacitive, while in chiefly magnetic field –reactive power is inductive.
Voltage and Reactive Power Control	Control of generation of reactive power in transmission system with generators, synchronous compensators, static compensation systems and reactive power flows control with changing transformation ratio by switching on/off transmission system elements
Load-frequency Control	Automatic centralized function that regulates the generation in the control area using the secondary regulation reserve, in order to: -maintain the exchange program with all other control areas at the given value, and -maintain the frequency to its default value in order to relieve the reserve used for primary control.
Automatic Frequency Restoration Reserve (Secondary Reserve)	A positive or negative part of the total active power bandwidth for secondary regulation, measured from setpoint of generator unit to the maximum/minimum power for secondary control.
Synchronous Zone	Synchronous Zone is area of interconnected control areas.
System Losses	Active energy losses in transmission system elements
System Stability	Capability of EPS to maintain the stability during normal or disturbed operational regimes as well as to achieve an acceptable new steady state after the occurrence of a disturbance.
Black Start Capability of Generators	Capability of a generating unit to start-up, without an external voltage
Current Transformer (CT)	Transformer used with metering and/or protection devices in which the current is in secondary winding, within the limits of predefined error, proportional and in phase with the current in primary winding.
Frequency Restoration Control Process	Automatically or manually change of operating points of the generation units aimed to restore the secondary reserve
Manual Frequency Restoration	Component of EPS reserves available within 15 minutes, activated with the aim to restore the secondary reserve.

Reserve (Tertiary Reserve)	
Flicker	It is occurrence of a disturbances in human sight when the illumination of a lighting fixture changes during the time (i.e. the impression of flickering light), as a result of the occurrence of voltage fluctuations caused by the plants belonging to users of the transmission or distribution system.

Abbreviations

Article 9

(1) The Abbreviations used in the Network Code shall have the following meaning:

1) AMR/MDM - System for automated collection, storage and processing of data from the EE metering equipment
2) ARS - Automatic Reclosure System
3) AAC - Already Allocated Capacity
4) ACE - Area Control Error
5) AGC - Automatic Generation Control
6) ATC - Available Transmission Capacity
7) BRP - Balance Responsible Party
8) CBA – Cost Benefit Analysis
9) CGM- Common Network Model
10) EAS – European Awareness System
11) EPS - Electric Power System
12) ERC - Energy regulatory commission of the Republic of North Macedonia
13) EE - Electrical energy
14) EC - European commission
15) EU - European union
16) ENTSO-E - European Network of Transmission System Operators for Electricity
17) ENTSO-E CE - European Network of Transmission System Operators for Electricity – Continental Europe
18) FACTS - Flexible Alternating Current Transmission System
19) FCP – Frequency containment process
20) FCR – Frequency containment reserve
21) FRP – Frequency restoration process
22) FRR – Frequency restoration reserve
23) FSM – Frequency sensitive mode

24) Y - Current year

25) GTC - Network Transfer Capacity

26) IEC - International Electrotechnical Commission

27) IGM – Individual Network Model

28) ISO - International Standards Organization

29) ITC - Inter TSO Compensation

30) CSM – control and supervision of metering

31) CCO – control command object

32) LFC – Load-frequency control

33) LFSM-O - Limited frequency sensitive mode – Over frequency

34) LFSM- U - Limited frequency sensitive mode – Under frequency

35) M - Current month

36) VT - Voltage Transformer

37) NDC – National Dispatching Center

38) NTC - Net Transfer Capacity

39) DSO - Distribution System Operator

40) ERAA – The European Resource Adequacy Assessment

41) MEPSO - AD MEPSO in state ownership, Skopje - operator of the electricity transmission system of the Republic of North Macedonia, Joint-stock company for transmission of electricity and management of the electricity system in state ownership, Skopje

42) RES - Renewable Energy Sources

43) MO - Market operator

44) RgIP - Regional Investment Plan for South East Europe

45) RR – Replacement Reserve

46) SCADA/EMS - Supervisory Control And Data Acquisition / Energy Management System

47) SAF - System Adequacy Forecast

48) SAFA – Synchronous Area Framework Agreement

49) SOAF – Scenario Outlook and Adequacy Forecast

50) STA – Short-term Adequacy

51) CT - Current transformer

52) THD - Total Harmonic Distortion

53) TTC - Total Transfer Capacity

54) TYNDP - Ten-Year Network Development Plan

55) VUF - Voltage Unbalance Factor

II. TRANSMISSION SYSTEM DEVELOPMENT PLANNING

II.1. Scope and Objectives

II.1.1 Planning-related Activities

Article 10

(1) The main objective of transmission system planning is to ensure, with respect to mid and long term horizons, the development of an adequate transmission system which:

1) Ensures safe system operation,
2) Provides a high level of security of supply,
3) Contributes to a sustainable development,
4) Access and connection to the transmission network for all market participants,
5) Development of the EE market, and
6) Efficiency.

(2) In this process have to be kept in mind, in particular:

1) National legislation and regulatory framework;
2) EU policies and targets;
3) Requirements and general regulations of the liberalized European power and electricity market set by relevant EU legislation;
4) Security of people and infrastructure;
5) Environmental policies and constraints;
6) Transparency in procedures applied;
7) Economic efficiency.

(3) Transmission system development includes:

1) Construction of new transmission system elements,
2) Reinforcement of existing transmission system elements (reconstructions and capacity upgrade),
3) Adjustment of protection systems and their modernization,
4) Reconfiguring of network topology, and
5) Permanent monitoring and implementation of new technological solutions.

(4) National development plans must be in coordination with ENTSO-E Regional Investment Plans (RgIP), the European Resource Adequacy Assessment (ERAA) and the Ten-Year Network Development Plan (TYNDP), as determined by EC Regulation 714/2009 on conditions for access to the transmission network for cross-border electricity exchange (REGULATION (EC) No. 714 /2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on conditions for access to the network for cross-border exchanges in electricity).

II.1.2 Planning-related Rights and Obligations of MEPSO

Article 11

(1) MEPSO plans the transmission network development in a way that will ensure its safe and economically justifiable operation in the interest of all users under this Network Code.

(2) In order to ensure the long-term and medium-term planning of transmission system development, MEPSO is responsible and obligated for:

1) Development of transmission development study in line with Articles 45,46 and 47,
2) Development of national transmission development plan in line with Article 48,
3) Development of Investment plan in line with requirements defined in Energy Law.

II.1.3 Planning Procedure

Article 12

(1) The Planning Procedure consists of:

1) definition of input data,
2) definition of models and scenarios,
3) forecast of EE consumption and user power
4) definition of technical criteria,
5) scenario analysis,
6) preparation of proposal of solutions,
7) evaluation of solution proposals ,
8) Preparation of a study for the development of an electrical transmission network plan implementation.
9) assessment of the adequacy of the EPS
10) preparation of a plan for the development of the electricity transmission system for the transition of the next ten years

II.2. Input and Basic Data

II.2.1 General requirements

Article 13

(1) In the process of transmission system development planning, MEPSO takes in consideration the following input data and information:

1) Data trends for generation/consumption of the transmission system users,
2) Development of existing, and projects for new electricity facilities, planned by the users in Republic of North Macedonia and operators of neighboring transmission systems, as defined in their development plans,
3) Forecasts of EE balance and power,
4) Surveys for the justification of investment in transmission system planning,
5) Any possible outages conditions in the system that may occur during the operation as well as needs ensuing from such situations,
6) Issued connection approvals of new users to the transmission system, and
7) Other environmental and safety regulations.

II.2.2 EE and Power Consumption Forecast for users

Article 14

(1) Basic input data necessary for the EE and power consumption forecast are:
1) Values of EE consumption (MWh) and active power (MW) of transmission system users, with special attention paid to values in characteristic regimes of winter and summer peak and off-peak,
2) Connection requests of direct demand facilities to the transmission system,
3) Dynamics of economic development of the country (on the basis of the forecast of gross national product growth, investments, employment and consumption), and
4) Change of EE consumption in different economic sectors, in order to establish the link between the economy and the EE consumption.

(2) At request of the MEPSO, each user is obligated to submit their forecast for EE and peak power consumption for short, medium and long-term planning period.

(3) in the request from paragraph (2), MEPSO determines the deadline for submitting data, which cannot be shorter than 15 days from the day of submitting the request.

II.2.3 Data from EE generation facilities

Article 15

(1) Input data for EE generation facilities, are:

1) **Data on existing power plants**

- technical constraints in production (minimum and maximum active and reactive power) and possible changes due to planned overhaul
- upgrading/downgrading of generation capacities or decommissioning of generation units;

2) **Data on new power plants**

- If the planned year of commissioning of the plant falls on the planning period from 3-5 years and the facility is in the phase of submission of request for connection, it is necessary to submit to MEPSO detailed data according to the request for connection of user, pursuant to the Article 55 of these Network Code.
- For the planning period beyond 5 years, and if detailed data are unavailable, the following basic data are necessary:
  - Minimum and maximum of active and reactive power of the future power plant,
  - Primary energy source,
  - Power plant location, and
  - Dynamics of construction.

(2) MEPSO provides the data on energy sources from neighboring systems connected to the transmission system that are collected at the level of basic data and, depending on the influence, are taken in consideration in appropriate way in definition of basic operations scenarios of the planned operation of transmission system of Republic of North Macedonia.

II.2.4 Forecast of EE and Power Balance

Article 16

(1) Forecast of electricity and power balance for the EPS of the Republic of North Macedonia represents summary of collected forecast data from all transmission network users for mid-term and long-term period.

(2) On the basis of this data, MEPSO carries out the analysis of potential surpluses/deficiencies of EE and power in EPS of Republic of North Macedonia and evaluates total EE exchanges with neighboring systems.

(3) On the basis of such analysis and evaluation of the situation on the regional EE market, probable exchanges on interconnection lines are established.

II.2.5 Harmonization of Development Plans with Transmission System Users

Article 17

(1) Transmission system development plan is primarily based on development plans of existing and potential transmission system users and in that respect must be harmonized with their development plans.

(2) In order to ensure that development plans between MEPSO and other responsible entities are mutually harmonized on a satisfactory level, the coordination of corresponding activities related to system development is carried out already at the planning phase.

(3) MEPSO coordinates the appropriate activities related to the development already in the planning phase to ensure a satisfactory level of compliance of the bases and development plans between MEPSO and other responsible entities.

(4) For the purpose of coordination of future activities and harmonization of development plans, MEPSO regularly publishes updated available data relevant for the transmission

system development. All users, state and local self-government bodies, as well as parties interested in getting connected to the transmission system may submit to MEPSO their proposals and comments to published data, by the date indicated as the deadline for public collection of data.

(5) MEPSO informs ERC about the process of harmonizing the development bases and plans with the users of the electricity transmission system.

(6) If responsible entities from paragraph (4) fail to submit objections on, or modifications of data within 3 months from the day of the publication of data, it is considered that published/submitted data are verified.

(7) MEPSO publishes on its website the documents and plans relevant to the development of the electricity transmission system.

II.3. Models and Scenarios

Market model

Article 18

(1) MEPSO prepares a market model which contains technical, economic and financial parameters of the generation and consumption by region, covering different time horizons. The model is used for simulations of the electricity market by applying appropriate software packages.

Network model

Article 19

(1) MEPSO prepares network model that reflects the configuration of EPS i.e. gives a picture of connections and operation principles of power system elements.

(2) The network model is based on the electrical parameters of the elements of the transmission network, as well as the mode parameters of the power system, covering different time horizons. The model is used for analyzes of different operating modes of the transmission network by applying appropriate software packages.

National model

Article 20

(1) MEPSO is developing a national market model of the electricity system. Generators are modeled by technology type or in detail each production unit. The load is summed depending on the level of detail of the market model, where the loads are added to zones or to nodes.

(2) MEPSO is developing a national network model of the electric power system that contains all network elements at 110 kV and 400 kV voltage level. Generators are modeled at generator voltage level, along with block transformers. At thermoelectric power plants, the consumption for own needs is modeled separately. The load of the distribution transformer

stations is modeled at 110 kV, while for the purposes of the calculation of single-phase short circuits, the distribution 110/x/(y) kV transformers are also modeled, with recognition of the type of connection of the windings. For dynamic stability analyses, the models of the power system elements are supplemented with dynamic characteristics.

Regional model

Article 21

(1) The regional model consists from national transmission network of the south-eastern Europe countries and takes into account all regional projects (defined in regional group for system planning in ENTSO-E Continental Southeast Europe) and the equivalent of the rest of ENTSO-E interconnection. Electric power system of Republic of North Macedonia is integrated into the regional model.

Planning scenarios

Article 22

(1) MEPSO develops the planning scenarios to define different concepts of network development that are dictated by different uncertainties in the forecast, taking into account the forecast of consumption, the combination of generating units and possible exchanges with systems outside the region for which they are considered.

(2) MEPSO develops the planning scenarios based on:

1) consumption growth (uncertainty in the forecast of distribution and direct demand facilities),
2) location and installed power of the new power plants,
3) variation of hydrological conditions, which reflects the variation of power for import or export,
4) regional transit capacity in different directions, and
5) integration of renewable energy sources.

(3) MEPSO shall define transmission system planning scenarios in accordance with referent ENTSO-E methodology for Scenario building within TYNDP.

(4) MEPSO submits the scenarios from paragraph (1) to ERC and publishes them on its website.

II.4. Technical analyses and criteria for planning

II.4.1 Technical analyses

Analysis of normal operating regime

Article 23

(1) MEPSO uses the normal operating regime as the basis for transmission system technical analysis.

Outage Analyses

Article 24

(1) MEPSO makes an analysis for loss of one or several elements of the EPS, classifying contingencies in accordance with Article 130 of these Network Codes.

N-1 Security Rule

Article 25

(1) When analyzing outages from the list of outages (temporary or permanent), the N-1 safety rule is used and it is considered satisfied if the operating parameters of the electricity transmission network are within the acceptable limits specified in chapter II.4.2 of these Network Codes, for the expected state of the network defined in the planning scenarios and modes, during a temporary (or permanent) outage of one element from the list of common outages.

Market Analyses

Article 26

(1) MEPSO with market based analyses gives a detailed assessment of generation and consumption profile, using a simplified representation of the network. Market analyses performing hourly analysis throughout the year have the advantage of clearly highlighting the structural rather than incidental "bottlenecks" in the network.

Network Analyses

Article 27

(1) Network assessment is carried out by MEPSO on a sample of planning scenarios, selected on the basis of information given by the market analyses. It has a simplified representation of generation and consumption profiles, and a detailed representation of the network.

Load Flow Analyses

Article 28

(1) The calculation of power flows and voltage profiles in stationary conditions for normal operating regimes (with all network equipment available) of the transmission system determines the following:

1) loadings on lines and transformers,
2) network voltage profile,

3) production of active and reactive power of power plants, and

4) Losses of active power in the transmission system.

(2) Examination with N-1 rule is carried out by MEPSO taking into account ordinary outage of all elements in transmission system.

(3) Examination of rare contingencies only for specific cases is carried out by MEPSO (according to article 130 of these Network Codes). This kind of assessment is based on the probability of occurrence and/or based on the severity of the consequences in order to prevent interruptions in the wider area.

(4) In the process of planning MEPSO not include out-of-range outage (according to article 130 of these Network Codes). Out-of-range outage are analyzed through Defense Plans.

(5) In cases of failures combined with maintenance, MEPSO analyzed non-availabilities of one element combined with a failure of another. Such investigations are done by the MEPSO based on the probability of occurrence and/or based on the severity of the consequences, and are of particular relevance for network equipment that may be unavailable for a considerable period of time due to a failure, maintenance, overhaul during major constructions.

Network Transfer Capability Analyses

Article 29

(1) MEPSO carries out the Network Transfer Capability (GTC) analyses in order to determine the ability of the network to transport EE cross-border from one area (price zone, area within a country or a MEPSO) to another. Regarding Network Transfer Capability calculation, MEPSO shall comply with valid Rules for cross-border capacity allocation, published on MEPSO's website, as well as official CBA Cost Benefit Analysis (CBA) methodology provided in *ENTSO-E Guideline for Cost Benefit Analysis of Network Development Projects*, adapted for MEPSO's needs and capabilities.

Optimal Power Flow Analyses

Article 30

(1) MEPSO performs an analysis of optimal power flows that are used to determine the optimal values of the control variables of the power system.

Short-circuit Analyses

Article 31

(1) MEPSO performs analysis for maximum and minimum symmetrical and single-phase short-circuit currents according to the MKC EN 60909 short-circuit currents in three-phase AC systems for each node of the electricity transmission network.

Voltage Stability Analyses

Article 32

(1) MEPSO performs analysis of voltage stability that refers to the ability of a power system to maintain acceptable voltages at all buses in the system under normal conditions and after a disturbance.

Dynamic Stability Analyses

Article 33

(1) MEPSO performs dynamic stability analysis taking into account rotor angle stability, i.e. ability of synchronous generators of an interconnected EPS to remain in synchronism after a disturbance. Rotor angle stability problems can be divided in two categories:

1) small-signal stability, and
2) transient stability.

(2) MEPSO performs dynamic stability analyses in all cases where problems with stability can be expected, based on MEPSO operational experience.

Reliability Analyses

Article 34

(1) MEPSO performs reliability analyses to identify network bottlenecks not only according to the N-1 rule, but ones caused by multiple outages with relatively high probability.

(2) Indicator of the reliability of a transmission network element is its availability and unavailability, respectively. Unavailability is defined as a time interval within the observed period of time (usually one year) when a network element is out of operation.

(3) The transmission system indices which are indicating the level of EE reliability supply are:

1) EE Not Supplied (EENS), and
2) Loss Of Load Probability (LOLP)
3) Loss Of load Expectation (LOLE).

(4) For the calculation of the indices from paragraph (3) probabilistic algorithms are used which use as input data statistics for the occurrence and duration of outages of elements of the electricity transmission network.

II.4.2 Technical criteria for network parameters assessment

Steady state criteria

Article 35

(1) Regarding steady state criteria, MEPSO uses specified operational security limits for active power flow control and reactive power flow control, defined in accordance with Articles 124 and 126 from these Network Codes.

Criteria for maximum consumption/generation outage

Article 36

(1) Regarding dimensioning incidents for balancing reserves, MEPSO uses specified operational security limits for dynamic stability in accordance with Article 132 from these Network Codes as well from the Balancing reserve dimensioning codes, in accordance with Articles 190 – 193 from these Network Codes.

Short circuit criteria

Article 37

(1) Regarding short circuit currents, MEPSO uses specified operational security limits for short circuit current control in accordance with Article 127 from these Network Codes.

Voltage stability criteria

Article 38

(1) Regarding voltage stability, MEPSO uses specified operational security limits for reactive power control and dynamic stability in accordance with Article 126 and Article 132 of these Network Codes.

Dynamic stability criteria

Article 39

(1) Regarding dynamic stability, MEPSO uses specified operational security limits for dynamic stability in accordance with Article 130 from these Network Codes.

II.5. Solution proposals

Identification of the problems

Article 40

(1) MEPSO is obliged to start with planning of reinforcement of the transmission system, if the assessment criteria for network parameters given in Articles 35 - 39 of this Code, are not met.

(2) If technical criteria are not satisfied when analyzing the scenarios, problems should be noticed and possible solutions should be identified by MEPSO.

Time frame for solution implementation

Article 41

(1) The time framework for implementation of the solutions from Article 4 paragraph (2) include: short-term (Y+1, Y+2 and Y+3), mid-term (Y+5) and long-term planning horizon (Y+10 and beyond).

(2) For analyzed conditions in years Y+1, Y+2 and Y+3, that belong to the short-term planning horizon, all outages in which transmission system does not meet the technical criteria from Articles 35 – 39 of these Network Codes, shall be identified as critical. MEPSO resolves the identified problems with possible corrective actions, since the implementation of solutions for upgrade and or reconfigure topology in the transmission system, takes long time (depending on the type of solution, from three to eight years).

(3) In mid-term (Y+5) and long-term (Y+10) planning horizon, for all outages in which the transmission system does not meet the technical criteria from Articles 35 – 39 of these Network Codes, and where corrective dispatching actions cannot be implemented. To solve them, it is necessary to strengthen the electricity transmission network with new elements through investments in the electricity transmission network.

Guidelines for the development of the electricity transmission network

Article 42

(1) MEPSO uses the following general guidelines for development of the electricity transmission network:

1) For supplying the areas in which 400 kV voltage level is not envisaged, 110 kV double circuit OHLs with a classic type of conductor ACSR 240/40 mm^2 or any other specific type of conductor such as high-temperature-low-sag conductor should be used,
2) For construction of new 400/110 kV transformer station, transformer with standard commercially available rating power should be used,
3) For construction of new 110 kV single circuit OHL in transmission system of Republic of North Macedonia, classic type of conductor ACSR 240/40 mm^2 or any other specific type of conductor such as high-temperature-low-sag conductor should be used,
4) For construction of new 110 kV transmission lines in Skopje region, classic type of conductor ACSR 360/60 mm^2 or any other specific type of conductor such as high-temperature-low-sag conductor should be used for overhead lines, and
5) New cables in 110 kV transmission lines should be type XLPE Al 1000 mm^2 or any other cable type with similar technical characteristics.

Possible solutions

Article 43

(1) Measures for solving the problems include, but not limited to, the following:

1) Resetting of control and protection devices of all elements in EPS,
2) Reinforcement of overhead tie-lines to increase their capacity (e.g. increased distance to ground, replacing of circuits, high-temperature-low-sag conductors),
3) Doubling of cables to increase rated power,
4) Replacing of network equipment or reinforcement of substations (e.g. based on short-circuit rating),
5) Extension of substations and construction of new ones,
6) Installation of reactive-power compensation equipment (e.g. capacitor banks),
7) Addition of network equipment to control the active power flow (e.g. phase shifter, series compensation devices),
8) Additional transformer capacities, and
9) Construction of new tie-lines (overhead and cable).

II.6. Project Assessment

Article 44

(1) MEPSO is obliged to make project assessment, for determination the impact of transmission projects, both in terms of added social welfare (increase of capacity for trading of energy and balancing services between price zones, RES integration, increased security of supply) as well as in the terms of costs. MEPSO shall perform assessment using referent CBA methodology provided in *ENTSO-E Guideline for Cost Benefit Analysis of Network Development Projects* and adapted for MEPSO's needs and capabilities.

II.7. Transmission Network Development Study

General

Article 45

(1) MEPSO is obliged to prepare transmission network development study (Study), following the release of the Strategy for development of the transmission system of Republic of North Macedonia. Study includes the activities over a long term planning period as well as basic guidelines for the development after the long term period, which gives the possibility to existing and potential users to evaluate the feasibility of connection to and exploitation of the EPS.

(2) The Study comprises necessary measures for ensuring secure and reliable supply of all demand facilities and maintaining operational characteristics of the transmission network in accordance with analysis and planning criteria from Articles 35 – 39 of these Network Codes, with the lowest transmission network development costs.

(3) MEPSO is obliged to prepare a study every 3 years and:

1) within two years after adoption of the Energy Development Strategy of the Republic of North Macedonia, or

2) after a significant change in plans for the development of the electricity transmission network, depending on the technological, economic, climatic, demographic and geopolitical trends, as well as the announcement of new users.

Methodology

Article 46

(1) The methodology for the preparation of the study consists of the following steps:

1) Collection, analysis and definition of input data,
2) Definition of scenarios,
3) Modelling of the electricity transmission network,
4) Plan for rehabilitation of existing tie-lines,
5) Analysis of the base case and N-1 security rule for the reference year for all defined scenarios (power flows and voltage profiles, and determination of optimal reactive power production, if necessary),
6) Identification of possible limitations in the electricity transmission network based on defined technical criteria for assessment of operational variables given in chapter II.4.2 *Technical criteria for assessment of operational parameters from these Network Codes*,
7) creation of a list of possible projects to strengthen the electricity transmission network
8) Project assessment for network reinforcement (according to CBA methodology),
9) Defining the final network configuration for the reference year,
10) Transmission capacities calculation,
11) Short-circuit current calculation and control/verification of technical specification of the equipment.
12) Dynamic stability calculation and determination of the measures for its preservation.

Integration of Study in Pan-European and Regional Plans

Article 47

(1) Models, forecasts and main conclusions of the Study, MEPSO submits to the relevant institutions in order to be integrated as part of regional investment plan of SEE (RgIP-Regional Investment plan for South East Europe), ten-year plan for development of transmission network (TYNDP - Ten Year Network Development Plan) and forecasts of the mid-term system adequacy (MAF – Mid-Term Adequacy Forecast), prepared by ENTSO-E.

II.8. Preparation of Plan

Ten Year Network Development Plan

Article 48

(1) Based on the Transmission network development study, MEPSO is obliged each year to adopt and publish on its website a national transmission development plan for a period of ten years upon prior approval by Energy regulatory commission. The plan should contain all necessary information for the expansion and upgrade of the system:

1) Measures and investments for the next ten years,
2) New connections of the transmission system users,
3) Facilities envisaged for the reconstruction and revitalization,
4) Estimating timeframe and costs to build new objects for the electricity transmission network strengthening, and
5) New interconnection lines with neighboring EPS's.

II.9. Implementation

Solutions implementation

Article 49

(1) MEPSO is obliged to implement solutions according to the timeframe provided in the electricity transmission network development plan.

(2) If defined solutions include changes in facilities, equipment and devices of users of the electricity transmission network, MEPSO reserves the right to impose such changes to the users of the transmission network.

IV.1. II.10. Evaluation of transmission network adequacy (ENTSO-E ERAA- European Resource Adequacy Assessment Metodology)

Criteria

Article 50

(1) By assessing the reliability of electricity power system, MEPSO determines whether the system can meet the needs on the electricity market and market for reserves at any time in all connection points and with acceptable standards.

(2) The evaluation of power system reliability is defined with two basic and functional criteria - adequacy and security, where:

1) The criterion of adequacy is applied to assess the ability of the EPS to supply the total EE and power needs, monitoring rated and limit values of the system variables in different regimes and taking into account planned and unexpected outages of system elements, and
2) The criterion for security is applied to assess the ability of the EPS to withstand sudden disturbances, or to withstand uncontrolled separation of the system in the case of major disturbances.

(3) Adequacy of the EPS is a measure for ability of the system to supply demand facilities with EE in normal operation regimes of the system, assuming the standard operating conditions and is analyzed over the adequacy of generation and the adequacy of the electricity transmission network:

1) Adequacy of generation is an assessment of the installed power in generation comparing to the total consumption of the EPS. Scope of the generation adequacy forecast is to identify possible problems and necessity for new generation facilities, and
2) Adequacy of the electricity transmission network is an assessment of the network capacity necessary to transmit power which is result of interaction between consumption and generation. The forecast of the adequacy of the electricity transmission network is aimed at identifying potential congestions, as well as the needs for strengthening and building new tie-lines in the electricity transmission network.

(4) MEPSO shall perform a yearly evaluation of the electricity transmission network adequacy in accordance with ENTSO-E Mid-Term Adequacy Forecast (MAF), and publishes it on its web page.

III. ELECTRICITY TRANSMISSION NETWORK CONNECTION REQUIREMENTS

III.1. General

Article 51

(1) All facilities for generation, transmission, distribution and use of electricity must be properly connected to the transmission network in order to avoid disruption of power system reliability.

(2) The requirements and obligations for connections to the transmission network given in these Network Codes are defined according to current technological achievements and recommendations of ENTSO-E.

(3) The minimum requirements specified in Articles 35-39 of these Network Codes that a demand facility has to meet in the procedure for connecting to the electricity transmission network are considered as basic requirements for connection and apply equally to all demand facilities.

III.2. Objectives

Article 52

(1) Objective of the requirements for connection to the electricity transmission network is to determine the following:

1) Minimum technical, conceptual and operational requirements that must be met by each user connected to the transmission network, or any new user requesting connection approval to the transmission network
2) Minimum technical, conceptual and operational requirements that must be met by MEPSO, related to the user's connection point.

(2) Responsible parties for implementations of rules for connection to the electricity transmission network are MEPSO and transmission network users, including the owners of interconnection lines subject to exemption from provisions for electricity transmission network access.

III.3. Connection Procedure

Procedure for connection to the electricity transmission network

Article 53

(1) The procedure for connection to the electricity transmission network consists of the following phases:

1) submitting a request for approval to connect to the transmission network,
2) definition of variant/s and preparation of electricity transmission network connection analysis,

3) preparation of a Study for connection to the electricity transmission network,
4) issuing of a consent for connection to the electricity transmission network,
5) signing an Agreement on connection to the electricity transmission network,
6) approval of the project documentation,
7) reporting for connection, compliance and testing (trial operation, testing and verification of real and simulated dynamic response of the generator, adjusting the regulator and protection, electricity quality etc.) and
8) signing an Agreement on access and usage of the electricity transmission network.

Documents for the procedure

Article 54

(1) MEPSO prepares the following documents in the process for connection:
1) request form for approval to connect to the electricity transmission network,
2) transmission network connection analyses,
3) a Study for connection to the electricity transmission network
4) consent for approval of the connection to the electricity transmission network,
5) Agreement on connection to the electricity transmission network,
6) approval of the project documentation,
7) reporting for connection, compliance and testing and
8) Agreement on access and usage of the electricity transmission network and fee for using the electricity transmission system.

Application for approval for connection to the electricity transmission network

Article 55

(1) An applicant submits to the MEPSO the request for approval for the connection to the electricity transmission network or change an existing connection in the initial phase of the planning for construction of a facility for which should be provided a new/modified connection to the electricity transmission network.
(2) in order to start a procedure for connection to the electricity transmission network, the Applicant is obliged to submit the following documentation to MEPSO:
1) request for consent for connection to the electricity transmission network, i.e. modification of an existing connection in written and electronic form;
2) a form with technical characteristics of the user's electricity facility that is connected to the electricity transmission network in written and electronic form.
(3) MEPSO is obliged to publish on its website the models of requests for connection consent and the forms with technical characteristics of the user's electricity facility.

Network Connection Analyses

Article 56

(1) The request for consent for connection to an electrical transmission network, respective modification of an existing connection contains the following data:

1) General user data
2) reason for submitting a connection request
3) location of the object being connected
4) type of connection (demand facility and/or generation facility)
5) technical data about the user's facility

(2) Forms with technical characteristics of the user's facility contain the following data:

1) Object data,
2) data on electrical equipment and devices in the building (technical characteristics, models for stationary and dynamic modes of operation and data on the impact on the quality of electricity).
3) time plan for the realization of the object.
4) data on the facility's consumption and/or generation (for short-term, medium-term, and long-term planning periods).

(3) MEPSO can request additional data from the Applicant, within a period not shorter than seven days, and the applicant is obliged to provide the requested data in a timely manner.

(4) The connection procedure begins with correctly filled connection requests and forms with technical characteristics of the user's facility;

(5) The applicant is obliged to notify MEPSO in writing if he does not have a certain type of data, and typical values will be defined in the analyses.

Analysis for connection to the electricity transmission network

Article 57

(1) After receiving the request for consent to connect to an electricity transmission network or change the existing connection, MEPSO creates an analysis for connecting to an electricity transmission network in order to assess and define the possible variants for connection, in consultation with the applicant.

(2) the analysis for connection to an electrical transmission network consists of:

1) power flow calculations;
2) assessment of the N-1 reliability criterion;
3) technical-economic analyses.

(3) MEPSO is obliged to perform these analyzes within 60 days from the payment of the fee for the Analysis for connection to the electricity transmission network by the applicant, in accordance with APPENDIX 2 - METHODOLOGY FOR CALCULATING THE CONNECTION FEE of these Network Codes.

(4) The analysis from paragraph (1) of this article is an integral part of the study for connection to an electricity transmission network.

Harmonization of the technical solution of the Study for connection to the transmission network between MEPSO and the applicant

Article 58

(1) MEPSO defines requirements for the user of the transmission network according to rules defined in this Code.

(2) MEPSO, in cooperation with the applicant, adopts the technical solutions of the Study for connection to the transmission network.

(3) The deadline for preparing the Study for connection to the electricity transmission network cannot be longer than 120 days after the submission of all the necessary data from paragraph (2) of this article. After the stipulated deadline, MEPSO and the applicant can additionally exchange technical data for the preparation of the study.

(4) The Analysis for connection to the electricity transmission network includes:

- analysis for connection to the electricity transmission network
- technical characteristics of the facility infrastructure and/or production unit,
- operational requirements and
- the cost for connection to the electricity transmission network.

(5) MEPSO conducts all necessary analysis (power flow analysis, security analysis, reactive power control, short circuit analysis, analysis of dynamic stability, power quality analysis, etc.) to verify the operating parameters of the transmission system in terms of the previously defined limits for providing connection and operation of the facility without negative effects on the transmission system and disrupting the normal operation of the facility.

(6) MEPSO prepares the Study for connection to the transmission network, taking into account the requirements for harmonization of the proposed options for connection with the approved plan for development of the transmission system.

(7) In the Study for connection to the electricity transmission network, at a level of concept design, MEPSO specifies basic technical characteristics of the infrastructure equipment for connection to the electricity transmission network.

(8) MEPSO is obliged to give a specification of the necessary equipment and works for connection to the electricity transmission network with an estimated value of costs, based on the methodology for the calculation of the connection fee (APPENDIX 2 – METHODOLOGY FOR ASSESSMENT OF CONNECTION FEE).

(9) According to Article 66 and APPENDIX 2 - METHODOLOGY FOR ASSESSMENT OF CONNECTION FEE of these Network Rules, the applicant is obliged to pay the costs of preparing the Study for connection to the electricity transmission network.

Harmonizing the technical solution from the Study for connection to the electricity transmission network between MEPSO and the applicant

Article 59

(1) MEPSO defines the requirements for connecting the user to the electricity transmission network according to these Network Codes.

(2) MEPSO, in cooperation with the applicant, adopts the technical solution for connection to the electricity transmission network from the Study for connection to the electricity transmission network.

Consent for approval for connection to the electricity transmission network

Article 60

(1) As a part of the Study for connection to the electricity transmission network, MEPSO issues Consent for approval for connection to the electricity transmission network.

(2) Consent for approval for connection to the electricity transmission network is issued within 15 days from the day of payment by the user of the fee for the preparation of the Study for connection to the electricity transmission system, according to XII. APPENDIX 2 – METHODOLOGY FOR ASSESSMENT OF CONNECTION

(3) Consent for approval of the connection to the electricity transmission network determines:

1) approved rated power at point of connection to the electricity transmission network,
2) results of the Study for connection to the electricity transmission network and selected technical solution,
3) specifications with technical requirements for connection which will be the basis for preparation of the construction of the connection infrastructure and equipment procurement,
4) terms for electricity transmission network use and
5) estimated value of the connection costs in accordance with the XII. APPENDIX 2 – METHODOLOGY FOR ASSESSMENT OF CONNECTION

(4) If MEPSO does not issue a Consent for approval of the connection, or the issued Consent is not in accordance with these Network Codes, the applicant may appeal to the ERC.

(5) The Consent for approval of the connection to the electricity transmission network ceases to apply if the permit for building the connection is not issued within five years from the issuing of the Consent for approval of the connection.

(6) The Consent for approval for connection to the electricity transmission network ceases to apply if the construction of the connection to the electricity transmission network is not commenced within the period specified in the permit for construction of the connection.

Agreement for connection to the electricity transmission network

Article 61

(1) The Agreement on connection to the electricity transmission network signed between MEPSO and the user of the electricity transmission network regulates the technical, legal and economic requirements for connection to the electricity transmission system.

(2) The Agreement on connection to the electricity transmission network covers the whole process of building connection infrastructure according to the Law on Urban Planning and Construction Law:

1) preparation of whole technical documentation,
2) providing proof of right to build,
3) obtaining a building permit,
4) construction of connection infrastructure,
5) approval for the use of the connection infrastructure, and
6) procedure for energizing and operation of the connection infrastructure.

(3) The Agreement on connection to the electricity transmission network determines the following, in accordance with the Energy Law:

1) infrastructure of the user for connection to the electricity transmission network in accordance with the provisions of the connection Study and the Agreement for connection to the electricity transmission network,
2) boundary of separation of property between MEPSO and the user, according to Article 3 of this Code,
3) commitments of the user and the MEPSO regarding the construction of the infrastructure to the electricity transmission network,
4) approval of project documentation,
5) definition of the conditions and obligations regarding the payment of compensation to build the connection or expand an existing connection and share of costs for creating technical conditions in the electricity transmission network for connection of new customers to the electricity transmission network or increase the capacity of existing connections,
6) definition of the conditions and obligations regarding to the transfer of ownership of the connection according to the border demarcation from Article 3 of these Network Codes.

(4) The obligations of the parties for the construction of infrastructure, or parts of the infrastructure, for connection to the electricity transmission network, as well as obligations related to cost compensation for this infrastructure are defined in the Agreement on connection to the electricity transmission network.

(5) The Consent for approval for connection to an electricity transmission network should be signed within 30 days from the date of entry into force of the Approval for the construction of the connection, that is, within 30 days from the issuance of the Decision on Consent for Connection if no approval for the construction of the connection is required.

Approval of project documentation

Article 62

(1) The applicant is obliged to submit to MEPSO the basic approval project before obtaining a building permit.

(2) MEPSO approves the basic design which is needed for the applicant in order to issue a building permit within 30 days from the date of the submission of the major project.

Operational Notification Procedure

Article 63

(1) The applicant is obliged to submit a report for the process of connection of the infrastructure of a user of the electricity transmission network to MEPSO where it should explain how the technical requirements and operational criteria specified in the chapter *III.4 General requirements for connection to the electricity transmission network* and in the chapter *III.5 Requirements for connection of production units and demand facilities to the electricity transmission network* from these Network Codes are met, as well as additional requirements prescribed by law, the approval for connection to the electricity transmission network or another bilateral agreement, or as prescribed by MEPSO.

(2) The procedure for compliance and testing of a new electricity transmission network infrastructure is defined in Article 81 of these Network Codes.

(3) The procedure for reporting for the process of connection of the infrastructure of a user to electricity transmission network, which is defined in *APPENDIX 1 –OPERATIONAL NOTIFICATION PROCEDURE FOR CONNECTION OF USER'S INFRASTRUCTURE TO AN ELECTRICITY TRANSMISSION NETWORK,* consists of the following stages:

1) energization operational notification (EON),
2) interim operational notification (ION) and
3) final operational notification (FON).
4) MEPSO will work out a detailed instruction on how to implement the procedure for operational notification for connection to the electricity transmission network and will publish it on its website.

Agreement on access and usage of the electricity transmission network

Article 64

(1) In the Agreement on access and usage of the electricity transmission network, MEPSO specifies basic operating rules and technical requirements for use of the connection equipment and facility of the applicant in accordance with these Network Codes and recommendations of ENTSO-E:

1) procedure for connection/disconnection of high voltage equipment at the connection,
2) conditions for synchronization with the electricity transmission network,
3) power quality of delivered electricity from/to the electricity transmission network (voltage and frequency variations, minimum power factor (cos φ), harmonics and flicker),

4) requirements for voltage and reactive power regulation,
5) archiving and data exchange in real time,
6) planning of generation/consumption in terms of energy and power,
7) operation in conditions with disturbances and emergency conditions,
8) operation in case of planned outages in the electricity transmission network,
9) elimination and investigation of disturbances,
10) deviation from the N-1 criterion (for specific variants of the connection),
11) coordination of maintenance and testing of high voltage equipment of the connection, protection devices, measuring devices and communications equipment,
12) compliance with security measures and working procedures for secure and safe operation of the electricity equipment, devices and installation at the connection according to the MEPSO occupational health and safety manual.
13) communication procedures for normal and emergency operating conditions, and
14) obligation for submission of additional data for planning that could be required by MEPSO.

(2) The Agreement on access and usage of the electricity transmission network must be agreed before the final energization of the facility.

Connection costs

Article 65

(1) The connection costs to the electricity transmission system for new users or changes in the technical parameters of the connection for existing users consist of the following:

1) construction costs of connection or extension of existing connection and
2) participation costs for creating technical conditions in the electricity transmission system for connection of new users or increasing the capacity of existing users.

(2) The connection costs to the electricity transmission system for new users or upgrade of the technical parameters for existing users are set out in the Methodology for calculating the connection fee, contained in *APPENDIX 2 –METHODOLOGY FOR ASSESSMENT OF CONNECTION FEE* which is an integral part of these Network Codes.

Construction costs for the connection or upgrade (expansion) of an existing connection

Article 66

(1) The applicant is required to reimburse the construction costs for the connection or upgrade or expansion of existing connection related to change of the technical parameters.

(2) The costs of paragraph (1) of this Article consist of fixed and variable part.

(3) The fixed part of the construction costs for new connection or upgrade/expansion of existing connection covers costs created by the applicant, related to the activities of MEPSO during the analysis and implementation of the connection:

1) costs for preparation of the Study for connection to the electricity transmission network,
2) costs for preparation of a study for connection to an electricity transmission network
3) costs for approval of technical documentation
4) infrastructure construction supervision costs, and
5) costs for compliance testing of technical characteristics of the facility and the specific operational requirements

(4) The variable part of the construction cost of the connection or upgrade/expansion of existing connection include the costs for providing the technical conditions for the implementation of a direct connection or upgrade/expansion of an existing connection.

Participation in creation of technical conditions in the electricity transmission system for connection of new customers or increasing the capacity of existing connections

Article 67

(1) Participation in the costs for creation of technical conditions in the electricity transmission system for connection of new users or increasing the capacity of existing connections are paid by applicants as additional investments to strengthen the electricity transmission system resulting from the connection of the applicant, which are not part of direct connection of any strategic plan of the electricity transmission system of MEPSO.

Change in technical parameters of an existing connection

Article 68

(1) MEPSO and the user agree on all planned modifications to components in the facility affecting the operation of the electricity transmission system. The complete technical documentation for the corresponding change is defined by alteration and/or amendment of an existing solution for connection to the electricity transmission network.

III.4. General requirements for connection to the electricity transmission network

Operational security limits

Article 69

(1) Each point of connection to the electricity transmission network must be sized and constructed to allow MEPSO management of the electricity transmission system in accordance with operational security limits defined in Article 124 of these Network Codes.

Control of part of a power plant owned by the user

Article 70

(1) The user of the electricity transmission network must install its own supervisory-control system for the part of the power plant owned by the user.

(2) The user's control center is subordinate to the National Dispatching Center of MEPSO regarding the performance of control functions, which can affect the performance of the electricity transmission system.

(3) The user's control center must be constantly in operation.

(4) The authorized personnel employed within the user's control center qualified to work with high voltage switchgear must be available to the National Dispatching Center of MEPSO at any time.

Operation in case of faults

Article 71

(1) The user facility and the electricity transmission system must be designed in such a way that all fault are automatically and immediately isolated from the network thus preventing the spread of the fault.

EE quality

Article 72

(1) The electricity system of the user of the electricity transmission network shall not have negative impact on the EE quality of third parties during operation and shall not interfere with exchange of information and transmission of signals.

(2) The user of the electricity transmission network, at the connection point, must meet the requirements for EE quality defined in Article 133 from these Network Codes.

Conditions for short circuits currents and treatment of neutral point

Article 73

(1) MEPSO sets relevant technical specifications for grounding the neutral points of the transmission system, as well as the neutral points that belong to the user's network transmission system, in accordance to Article 128.

(2) The concept of grounding of the neutral point in the transmission system is based on criteria for allowed short circuits listed in Article 127 of this Code and insulation coordination in 400 kV and 110 kV networks.

Maintenance

Article 74

(1) The MEPSO and the user of the electricity transmission network are individually responsible for the maintenance of their equipment and components in the facility, according to the ownership.

(2) The components relevant for the safety of the plant, such as switches, batteries and protective devices must be regularly tested according to the test plan, prepared by the user of the electricity transmission network and approved by MEPSO.

Protection of the transmission system

Article 75

(1) MEPSO is responsible for the concepts and setup of protection in the coupling between MEPSO on the one hand and the user on other and the protection must be configured in such a way that it cannot be affected from the risks of neighboring systems or facilities.

(2) MEPSO defines the concept of protection in accordance with the specifics of the electricity transmission system of the Republic of North Macedonia and the recommendations and requirements in terms of relay protection of ENTSO-E.

(3) At each point of connection there must be set of appropriate protection and switches.

(4) A detailed description of the system of relay protection which must be implemented by the user is defined in the Study for connection to the electricity transmission network.

(5) The user is responsible for installing and maintaining adequate protection in its facilities.

(6) The protection system of MEPSO should be examined in accordance with maintenance plan of MEPSO taking into account recommendations of protection systems manufacturer.

(7) MEPSO may install a protective device which switches off the generation capacity of the electricity transmission network in case of disturbance.

(8) The user is obliged to set appropriate protective devices in its capacities so that switching operations, voltage fluctuations, automatic reactivation or other operations in the electricity transmission network of MEPSO will not cause damage to its facility.

(9) Protection system implemented by the user of the electricity transmission network in the connection point must follow the concepts defined by MEPSO. The user is obliged to take into consideration the following aspects:

1) MEPSO specifies the time allowed for automatic re-closure of protection in the connection point of the electricity transmission network,
2) at a request of MEPSO the user is obliged to install frequency relays at the point of connection to the network, and the setting is defined by MEPSO and
3) time to clear faults larger than 150 ms can only occur in case of malfunction of the protection device or the circuit breaker.

Real time communication and exchange of data

Article 76

(1) MEPSO is required to plan and develop SCADA/EMS system and organize its maintenance.

(2) MEPSO is obliged to plan, develop and maintain telecommunications infrastructure that is in his possession.

(3) MEPSO prepares lists of information that should be recorded for all power facilities and lists of management orders to the user facilities.

Article 77

(1) The Study for connection to the electricity transmission network by MEPSO defines all technical requirements for communication and exchange of information with existing SCADA/EMS of MEPSO that the user must fulfil.

(2) The Study for the connection to the electricity transmission network and the Agreement on access and usage of the electricity transmission network in detail regulate the procedure for the data exchange in real-time communication between MEPSO and the user of the electricity transmission network that includes the following elements:

1) communication media (own and/or leased lines, fiber optic cable, radio, GSM, etc.)
2) communication devices for remote data transmission,
3) communication devices for reading and parameterization of protective devices,
4) functional requirements for the devices (systems) for monitoring and control,
5) technical solution for the implementation of the system of supervision and control,
6) technical specification of the equipment for monitoring and control,
7) way of acquisition of data, protocols and interfaces with the user,
8) obligations of the user concerning the installation and maintenance of devices for monitoring and control as well as communication devices,
9) ancilary services (training, documentation, etc.)
10) the way and conditions for joint implementation of the tests by MEPSO and the user (factory acceptance test at installation and site acceptance test) of the system/devices for supervision and control and
11) method of coordination and procedures to maintain the common elements of the Supervisory and Control Systems by MEPSO

(3) MEPSO is obliged to provide the generation facility of EE information for:

1) activation/deactivation of the frequency restoration process,
2) set point value for the frequency restoration process.

(4) The user of the electricity transmission network must install technical equipment to transfer data to MEPSO, required for real time management in accordance with chapter V.3. Data Exchange from these Network Codes.

(5) The scope of the data exchanged in real-time, requirements for protocols, confidentiality and availability of data are defined by the Study for connection to the electricity transmission network and the Agreement on access and usage of the electricity transmission network.

(6) Communication protocol for data exchange between SCADA/EMS system of MEPSO and the system/device in the facility of the user must be according to remote communication protocols IEC 60870-5-101 or IEC 60870-5-104 or ICCP (TASE.2) and it must meet definitions given in interoperable list of SCADA/EMS system of MEPSO.

(7) The communication protocol implemented at the level of the user's facility should be IEC 61850.

(8) The user is obliged to provide telecommunication infrastructure to the point of connection, i.e. telecommunication infrastructure that is owned by MEPSO.

(9) The user is obliged to plan, develop and maintain telecommunications infrastructure which is in his possession.

(10) The user is obliged to hand over to MEPSO equipment and devices for monitoring and control of 400 kV and 110 kV connection of the transmission system.

(11) If the user is an electricity generation facility, it is obliged to provide MEPSO with the information for the generation units, specified in V.3. Data Exchange of these Network Codes:

1) measurements of active and reactive power at generating unit level,
2) measurements of frequency and voltage,
3) status of primary equipment,
4) other necessary data.

(12) If the user is an electricity generation facility, it is obliged to provide MEPSO the information for generation units participating in frequency restoration process as specified in V.3. Data Exchange of these Network Codes:

1) power (Rated power (Pn), minimum power (Pmin), maximum power (Pmax)),
2) status of the frequency restoration reserve units (locally, remotely, type of regulation)
3) scope of regulation,
4) rate of change of power,
5) alarms and status for frequency restoration process and
6) other parameters required to execute the frequency restoration process.

(13) All functional requirements and technical specifications of the equipment / devices for remote monitoring and control are defined in the Study for connection to the electricity transmission network.

Measurement equipment

Article 78

(1) MEPSO specifies technical standards required for required measurement equipment. Measurement systems in points of connection (hereinafter measuring points) must be made to operate in accordance with chapter III.5 Requirements for connecting generation units and demand facilities to the power transmission network of these Codes.

(2) MEPSO defines the location for installation of the measurement equipment. As a rule, the most appropriate location that is chosen for this purpose is close to the border demarcation between MEPSO and the user (connection point).

Procedures for operational control

Article 79

(1) The procedures and principles of operational control in normal operation and with disturbances are defined in the Agreement on access and usage of the electricity transmission network. The following measures in relation to the operational control must comply with the Agreement on access and usage of the electricity transmission network:

1) appointment of responsible parties to operate the control equipment and manipulate the switching equipment, which must be available at any time,
2) authorization for MEPSO to give orders for the operating regime of the user facilities (active and reactive power) and manipulation of switching equipment
3) detailed description of the responsibilities for operational control of the EE system, between the user and MEPSO,
4) performing on/off operations in normal operation and in case of faults in the system and
5) implementation of legislative measures and security measures.

III.5. Additional requirements for connection to the electricity transmission network

Article 80

(1) The user has the obligation to fulfill the requirements for connecting generation units to the electricity transmission network provided in *APPENDIX 3 – ADDITIONAL REQUIREMENTS FOR CONNECTION OF GENERATION UNIT*.
(2) The user is obliged to meet additional requirements to connect demand facilities to the electricity transmission network provided in *APPENDIX 4 – ADDITIONAL REQUIREMENTS FOR CONNECTING THE DEMAND FACILITY*.

III.6. Compliance Testing

Compliance testing

Article 81

(1) MEPSO has the right to monitor if the user's facility complies with the requirements of these Network Codes, relevant laws, including other appropriate rules over the entire lifetime of the user's facility.

(2) MEPSO has the right to require conduction of compliance tests in accordance with procedure specified by MEPSO. The compliance testing shall be conducted:

1) For new connection of the electricity transmission network users during testing period
2) For already connected electricity transmission network users in case of fault, change or replacement of equipment that may affect compliance of the facility with the requirements of these Network Codes, relevant laws or agreements
3) For already connected electricity transmission network users in the scope of routine testing or testing upon MEPSO's request

(3) MEPSO defines the requirements, related to the process of compliance that the user has to meet, in particular:

1) General requirements related to procedures for preparation, harmonization and approval of compliance testing, as well as the timeline for conduction;
2) Technical requirements related to details of the technical data of the user's facility that are relevant for the connection, preconditions for testing, parameters that shall be recorded, sampling resolution of recordings, eventual usage of manufacturer certificates, provisions for compliance simulations in case that certain tests cannot be performed and criteria for testing results;
3) Requirements for detailed testing protocol considering its specific technical characteristics;
4) Requirements for on-site testing in accordance with adopted testing protocols;
5) Requirements for creation of testing report

(4) The electricity transmission network user is responsible for carrying out the tests in accordance with the conditions laid down in compliance testing procedure, specified by MEPSO.

(5) MEPSO may participate in the compliance testing either on site or remotely. For that purpose, the facility owner shall provide the monitoring equipment necessary to record all relevant test signals and measurements as well as ensure that the necessary representatives are available on site for the entire testing period. The signals specified by MEPSO for the selected tests will be provided if MEPSO uses its own performance recording equipment. MEPSO can participate in the on-site testing.

III.7. Derogations

General provisions

Article 82

(1) The user can request a connection by applying one or more requirements for connection to an electricity transmission network established in article 80 of these Network Codes.

(2) A derogation from paragraph (1) of this article can be requested by a new and existing user of the electricity transmission network.

Request for a derogation

Article 83

(1) The user submits the derogation request in written form to MEPSO, which should contain:

1) A user identification data, and a contact person for any communications,

2) a description of the power-generating module or demand units for which a derogation is requested,

3) a reference to the provisions of additional requirements for connecting to the electricity transmission network specified in Article 80 of these Network Code from which a derogation is requested and a detailed description of the requested derogation,

4) detailed reasoning, with relevant supporting documents and cost-benefit analysis and the benefits made in accordance with the regulations adopted on the basis of the Law on Energy;

5) demonstration that the requested derogation would have no adverse effect on cross-border trade.

(2) MEPSO will confirm that the derogation request is complete within 15 days of receiving the request. If MEPSO considers that the request is incomplete, the user shall submit the additional required information within 30 days from the receipt of the request for additional information. If the user, does not supply the requested information within that time limit, the request for a derogation shall be deemed receiptn.

Evaluation of the derogation request

Article 84

(1) MEPSO shall assess the request for a derogation and the provided cost-benefit analysis, taking into account the criteria determined and according to the Law on Energy and will prepare a detailed analysis and assessment of the same.

(2) The MEPSO shall forward the request to the Energy Regulatory Commission and submit the prepared assessment(s) within six months of receipt of a request for a derogation.

IV. ELECTRICITY METERING

IV.1. Introduction

Article 85

(1) Provisions of the Network Code which refer to the measurement of electricity regulate the rights and responsibilities of MEPSO and the users of the electricity transmission system, as well as, all electricity market players.

(2) These provisions regulate:

1) technical and technological conditions for creation of the metering point that MEPSO delivers/receipts electricity from transmission system users on the basis of the transparent and non-discriminatory principles;
2) conditions and a manner of usage of the metering point from both sides on the basis of the transparent and non-discriminatory principles;
3) technical and other conditions for safe and reliable functioning of the metering system and ensuring quality of service;
4) responsibility and competence of MEPSO and transmission system users;
5) technical and technological characteristics of the metering devices;
6) fulfilment of the metering services;
7) Ownership of the metering equipment.

(3) These provisions also define the control of the metering data in the process of:

1) metering of the electricity in metering points
2) reading, collection and data archiving of the executed electricity measurements from electricity meters;
3) processing and distribution of the data necessary for MEPSO and market operation;
4) data storage of the executed electricity metering.

(4) MEPSO is obliged to perform accurate, fast and efficient procedures for ensuring and processing the metering data of the active and reactive energy and power for billing and payment of delivered/receipt amount of the electricity.

IV.2. Objectives and areas of application

Article 86

(1) Purpose of measuring EE:

1) ensure necessary metering data and establish the procedure for their exchange between relevant energy players;
2) define the metering values that need to be measured;
3) define the requirements related to the electricity metering accuracy;

4) define the conditions for metering and registration of measured quantities of electricity, used for the settlement of agreements on electricity exchange, transmission system exploitation, imbalance and ancillary services;
5) efficient controlling and supervision of the metering (CSM) in all metering points of MEPSO;
6) establish responsibilities related to installation, testing, maintenance, acquisition and control of metering systems.

(2) The provisions of these Network Codes are applicable on the:

1) metering points in the transmission system facilities of MEPSO and in the user's facilities that are directly connected to the electricity transmission network;
2) metering points in the transformer's bays with transmission voltages of 400/110 kV, 110/35/20/10 kV;
3) metering points on the electricity generation facility's facilities that are connected to the electricity transmission network of MEPSO;
4) metering points for self consumption in the electricity transmission facilities of MEPSO and metering points for self consumption in the users' facilities.

IV.3. Metering and connection points

IV.3.1 Definitions and general requirements

Article 87

(1) Metering point represents the physical place (point) in the system where the metering of electricity is registered and electricity quantities are measured.

(2) Metering point can be located in facilities, or in the parts of facilities, owned by:

1) MEPSO,
2) Electricity generation facility,
3) Distribution system operator (DSO), or
4) demand facilities directly connected to an electricity transmission network.

(3) The connection point is the point in which generation units, demand facilities and distribution systems are connected to the electricity transmission network in which MEPSO delivers/receipts electricity to/from the electricity transmission system user.

(4) The metering point and connection point are defined in the Study for connection to the electricity transmission network and in the Agreement on connection to the electricity transmission network.

(5) If the Study for connection to the electricity transmission network does not exist, MEPSO defines the location of the metering point the connection point to the network as well as the location of the users accounting and controlling metering device.

(6) If the metering point and the connection point are not at the same voltage level, or are at the same voltage level but are at the distance when the electricity losses cannot be neglected, the corrections of the metering data should be done considering the losses of the electricity from the connection point to the metering point related to the connection point. In that case the correction is included in the accounting procedure.

(7) The Coefficient of the correction is determined by MEPSO on the basis of the technical characteristics of the equipment, transformers' ratio and the calculation of the losses between the connection point and the metering point under the conditions of the average exploitation of the facility. The Coefficient of the correction is bilaterally agreed by MEPSO and the user in the Agreement on access and usage of the electricity transmission network, as well as the manner and the conditions for changes of the coefficient of the correction.

IV.3.2 Metering points location

Interconnections

Article 88

(1) Metering point is the point for the delivery/receipt of the electricity from/to the neighboring power systems (interconnection metering point) that is located at the 400/x kV or 110/x kV transformer station, owned by MEPSO.

(2) MEPSO is responsible for the installation, maintenance, regular control and gauging of the accounting and controlling metering device (meter). The accounting and controlling metering devices (meters), are installed in the same metering point. The technical characteristics of the accounting and controlling metering device (meter) must be identical.

(3)Technical characteristics of the voltage and current measuring transformers and the metering devices (meters) should meet the requirements provided in the Synchronous Area Framework Agreement (SAFA).

(4) Interconnection metering of the deliver/receipt electricity are regulated by the appropriate agreements with the operators of the neighboring power systems.

Generation units

Article 89

(1) The metering point is the point of the receipt/delivery of the electricity by the generation facility to the electricity transmission network and it is defined in the Study for connection to the electricity transmission network.

(2) For all new transmission network users, the accounting and metering device (meter) are installed in the same metering point, have identical technical characteristics and are in the ownership of MEPSO.

(3) MEPSO is responsible for installation, maintenance, regular control and gauging of the main accounting and metering device (meter), unless it is otherwise stated in the Agreement on connection to the electricity transmission network.

(4) The generation facility is obliged to install and maintain additional controlling metering device, in its' ownership, for metering the deliver/receipt electricity at the radial connection line in the transformer station, as reserve to the accounting and controlling meters of MEPSO.

(5) Details, specifications and technical characteristics on metering devices for generation units shall be defined within Study for connection to the electricity transmission network.

Electricity Distribution System

Article 90

(1) The metering point is the point of the delivery/receipt of the electricity from MEPSO to the DSO defined in the Study for connection to the electricity transmission network.

(2) Accounting metering device (meter) is in the MEPSO ownership and it is installed at the HV side (connections) of the power transformer. In the case when a distribution system is connected to the electricity transmission network through a radial connection, the accounting device is installed on the output field in the substation of MEPSO.

(3) MEPSO is responsible for the installation, maintenance, regular control and gauging of the accounting metering device (meter).

(4) DSO is obliged to install and maintain additional controlling metering device (meter), for metering deliver/receipt of the electricity. This metering device is installed at the lover voltage side of the power transformer. DSO is obliged to provide MEPSO with remote access to additional controlling metering device.

(5) Additional controlling metering device (there is possibility for more devices, depending to the transformation) is in the ownership of the DSO, and DSO is responsible for the installation, maintenance, regular control and gauging of these devices.

(6) Details, specifications and technical characteristics on metering devices for distribution systems shall be defined within Study for connection to the transmission network.

Demand facilities connected to the transmission network

Article 91

(1) The metering point and the connection point of the delivery/receipt of the electricity from MEPSO to the demand facility directly connected to the electricity transmission network are defined in the Study for connection to the electricity transmission network.

(2) MEPSO owns the accounting metering device (meter) and MEPSO is responsible for the installation, maintenance, periodical control and gauging of the accounting metering device (meter).

(3) Demand facility directly connected to the electricity transmission network is obliged to install and maintain additional controlling metering device (meter), in its ownership, for metering deliver/receipt of the electricity, as reserve to the accounting metering device. The demand facility is obliged to provide MEPSO with remote access to the additional controlling metering device.

(4) The demand facility directly connected to the electricity transmission network is responsible for the installation, maintenance, regular control and gauging of additional controlling metering device.

(5) Details, specifications and technical characteristics on metering devices for demand facilities shall be defined within Study for connection to the electricity transmission network.

IV.4. Metering equipment

IV.4.1 Composing parts of the metering equipment

Article 92

(1) At each metering point the metering equipment is composed of:

1) metering transformers;
2) secondary measurement electrical circuits;
3) electricity meters (metering devices);
4) auxiliary devices (box for connecting and reconnecting the meters, fuses, protection devices, power supply devices, etc.)
5) devices for signalization and supervision;
6) communication devices.

IV.4.2 Metering transformers

Introduction

Article 93

(1) At each metering point for accounting and controlling metering of the electricity, Voltage metering transformers (VMT) and Current metering transformers (CMT) should be installed that have to comply with the valid standards.

(2) The metering transformers should have factory testing protocol and the stamp of the authorized governmental institution (hereinafter: Bureau of Metrology) with validity certificate.

Accuracy class

Article 94

(1) Accuracy class of the metering transformers is provided at Table 1

Table 1 - Accuracy class of the metering transformers

Metering point	Accuracy class	
	CMT	VMT
Interconnected power line	0,2 + 0,2*	0,2
Electricity generation	0,2 +0,2*	0,2

Power facility for electricity distribution	0,2	0,2
Demand facility (>10 GWh/ annualy)	0,2	0,2
Demand facility (≤10 GWh/ annualy)	0,5	0,5
Power facility for auxiliary power supply	0,5	0,5

(*) two measuring cores

Current metering transformers

Article 95

(1) Rated primary current of the CMT is determined in accordance with the rated current of other equipment in the bay where CMT is located.

(2) MEPSO defines the ratio of the primary sides of CMT to be connected. The user is obliged to execute the MEPSO's request that is delivered with official note or is already defined in Study for connection to the electricity transmission network.

(3) The rated value of the secondary current of the CMT should be 1 A.

(4) To the metering core of the CMT only electricity meters are connected.

(5) The terminal clamps of the secondary side of the CMT should be protected with a MEPSO seal for preventing the un-authorized access. Each or any intervention to the secondary metering circuits should be documented, and the report should be delivered to MEPSO.

(6) To the interconnection metering points and the metering points of electricity generation, CMT should have two metering cores with identical technical characteristics. To the first core is connected only accounting meter, and to the second metering core only controlling meter.

(7) Detailed technical characteristics of the CMT are defined in the Study for connection to the electricity transmission network.

Voltage metering transformers

Article 96

(1) To the metering core of the VMT, as a rule, only electricity meters are connected.

(2) In specific conditions and with MEPSO's permit, other devices could be connected to the metering core, only if the total load of the core does not exceed its rated power.

(3) VMT must be with secondary rated phase voltage of 100/√3 V.

(4) Detailed technical characteristics of the VMT are defined in the Study for connection to the electricity transmission network.

(5) MEPSO reserves the right for additional requirements related to the VMT depending on the network system opportunities.

Combined metering transformers

Article 97

(1) The combined metering transformer consists of both current and voltage metering transformer. All requirements defined for current and voltage metering transformers in Articles 95 and 96 shall apply to combined metering transformers.

IV.4.3 Electricity metering devices

Article 98

(1) Metering devices should register the active and reactive EE and must be in accordance with the national metering regulations and the General conditions for access and use of the electricity transmission network made in accordance with the Electricity Supply Rules. The meters must meet the basic applicable standards.

(2) The meters should be static, three-systems, two-directional, four-wired, four-tariff for metering of the active EE, reactive energy and power, with the possibility of remote data acquisition.

(3) Metering devices should have the possibility for the local and remote reading at different tariffs for: kW, kWh, kVAr, kVArh and cumulative consumption, events registration and the time of event.

(4) Metering devices must include metering registers for each metered quantity.

(5) Metering devices have two official labels. The first label is the seal of the Bureau of metrology, and the second label is the seal of MEPSO and the seal of the user. On the cover of the meter's terminals and on the reset button, the seals of MEPSO and the user are set up.

(6) MCB (metering connection box) is sealed by MEPSO thus preventing an un-authorized access.

(7) For the metering device additional external auxiliary source of supply should be provided.

(8) At the interconnection metering points and at the electricity generation metering points, besides the accounting meter, a necessary installation of the controlling meter with the same technical characteristics and accuracy class as accounting meter is needed. For accounting the data obtained by accounting meter are used.

(9) In the case of the failure (malfunction) of the accounting meter or a part of the metering system, for billing of the delivered/receipt EE and power, the quantities read from the controlling meter will be used.

(10) The accuracy class of the meters is provided in the Table 2

Table 2 - Accuracy class of the metering transformers

Metering point	Accuracy class	
	Active energy	Reactive energy

Interconnection power line	0,2s + 0,2s*	2+2*
Electricity generation	0,2s + 0,2s* or 0,5s + 0,5s*	2+2*
Power facility for electricity distribution	0,2s or 0,5s	2
Demand facility (>10 GWh/ annually)	0,2s or 0,5s	2
Demand facility (≤10 GWh/ annually)	0,5s	2(3)
Power facility for auxiliary power supply	0,5s	2(3)

(*) Obligatory installation of the accounting and controlling metering device

(11) Detailed technical characteristics of the metering devices are defined in the Study for connection to the electricity transmission network.

(12) Each metering device must be labelled by a unique number (identification number).

(13) Identification number, together with technical characteristics and specifications, must be made available to MEPSO for their insertion in the metering register.

IV.4.4 Signalization and supervision

Article 99

(1) In the control object or at other appropriate place at least the following alarms should be displayed:

1) an absence of metering voltage
2) auxiliary supply interruption
3) operational failure of the metering device

(2) All alarms in paragraph (1) must be registered with the time and data in the events list in the metering device.

(3) If the user register appearance of any alarm from voltage or current metering circuits or any metering anomaly (un-authorized access to the connection terminals of the metering device,

absence of any voltage or current, failure in establishing the metering system, etc.), it is obliged to forward that information to MEPSO as soon as possible.

IV.4.5 Communication

Communication protocol and communication interface

Article 100

(1) All metering quantities and all data that are registered with the metering device must be read locally and remotely in accordance with one of the following international standard protocols:

1) MKC EN 62056 – exchange of electricity metering data;
2) MKC EN 62056-21:2010 or IEC 61107 – data exchange for meter reading, tariffs and load control –Part 21: direct exchange of local data (identical with EN 62056-21:2002);
3) DLMS - device-to-device messaging language specification (messaging line specification)

(2) Communication interface (physical level of communication with metering device) should have the following standards:

1) MKC EN 62056-21:2010 – direct exchange of local data
2) MKC ISO 8482:2015 telecommunications and information exchange between systems - connections between multiple points through a twisted pair.
3) Ethernet port.

Communication media

Article 101

(1) For all metering quantities that are registered by the metering device, and that are read remotely, two methods of communication must be ensured of which one via wired and the other via wireless connection:

1) wired connection: private telecommunication infrastructure or leased line from an external telecom provider (Ethernet or RS-232 standard)
2) wireless connection: leased service from an external telecom provider (GSM/GPRS or better mobile telecommunication system)

IV.5. Procurement, installation and putting into operation and un-mounting of the metering equipment

Article 102

(1) Procurement, installation, and putting into operation of the metering equipment is defined in the Study for connection to the electricity transmission network.

(2) If the Study for connection to the electricity transmission network does not exists, the owner, or the legal user of the connection, is responsible for procurement, installation, and putting into operation of the metering equipment.

(3) the metering equipment under paragraph (2) from this Article includes:

1) metering transformers;
2) connectivity cables between metering devices and the secondary terminals of the metering transformers;
3) auxiliary power supply and protection devices;
4) metering devices;
5) communication equipment (communicating cable, communicating receiver and communicating media);
6) equipment for signalization and supervision;
7) user interface and integration of the metering equipment in the AMR/MDM system of MEPSO.

(4) If the user creates an accounting metering point, it has the obligation to inform MEPSO in written form about commissioning of the metering equipment. User is obliged to submit to MEPSO all testing protocols, measuring equipment configuration data and site acceptance test (SAT). MEPSO can participate in technical acceptance and commissioning of the measuring equipment, if it deems that as necessary.

(5) In accordance with the submitted technical documentation from the paragraph (4) of this Article and/or presence of SAT, MEPSO shall notify the user in written if the created accounting metering point is acceptable or not for MEPSO. If MEPSO declares negatively, the remarks are submitted to the user in written. The user is obliged to act according to the remarks made by MEPSO.

(6) When MEPSO in its possession takes over the connection to the electricity transmission network or only the measuring equipment from an investor, MEPSO performs the following activities:

1) checking all testing protocols from the vendor and the operations contractor;
2) checking of all documentation, in point 1 of this Article, submitted by the investor;
3) checking of the metering device configuration;
4) controlling of the secondary current and voltage circuits;
5) checking of the communication and communication links;
6) controlling the remote communication of the metering device with the AMR/MDM system of MEPSO.
7) controlling the validity of all seals of the metering equipment;
8) record of the metering equipment and metering point in the unique Register of the metering points of MEPSO.

(7) After commissioning, any un-authorized changes to the metering equipment are not allowed without written permit issued by MEPSO.

IV.6. Parameterization of the metering equipment

Article 103

(1) Parameterization of the metering equipment means:

1) defining transformer's ratio of the metering transformers at the metering point,
2) parameterization of the metering device that will be mounted at the metering place.
3) defining communication settings

(2) Characteristics of the metering transformers and transformer's ratio are defined by MEPSO in accordance with the rated voltage level and the transmission capacity of the equipment.

(3) Parameterization as activity considers internal characteristics of the metering device that should be in accordance with the technical characteristics of the metering equipment. Parameterization of the metering device can be primary or secondary depending on whether the meter will display primary or secondary accounting quantities.

(4) Basic parameters of the metering device: transformer's ratio of the current metering transformers, voltage metering transformers, accounting coefficient etc. are entered in MEPSO register of the metering points.

(5) MEPSO defines parameters of the metering device at each metering point.

(6) Only MEPSO is authorized to change the configuration of the parameters of the metering device.

(7) MEPSO is responsible for updating and maintenance of the parameterization of the metering device.

(8) MEPSO notifies the user in written form about the changes of metering device parameters.

(9) MEPSO parameterizes metering device on primary side. If the metering device is parameterized on secondary side, then accounting coefficients for EE and power should be entered in the accounting algorithm in a clear and explicit manner. Their changes are possible only with written notification from MEPSO.

(10) MEPSO make evidence and archive in its documentation all parameterization data for metering devices and accounting coefficients for the EE and power.

IV.7. Inspection and controlling of the metering devices

IV.7.1 Introduction

Article 104

(1) In order to provide accuracy and reliability of the metering devices operation, their appropriate checking is necessary. Inspections, control and periodic verification of the metering devices are performed by MEPSO.

(2) If MEPSO and the user are suspicious that the accuracy of a certain metering device is not in the accuracy limits determined by these Network Codes, an exceptional inspection of that metering device should be done.

(3) If the inspections confirm that the inspected metering device is not in the appropriate accuracy class, all cost for exceptional inspections should be covered by MEPSO. MEPSO is obliged to replace

the inspected metering device with another one with the same technical characteristics as the inspected metering device. MEPSO is obliged to perform verification of the metering device.

(4) if during the inspection it is confirmed that the tested meter is in the appropriate class of accuracy, the costs of the exceptional inspection shall be borne by the submitter of the Request for the exceptional inspection. The applicant has the obligation to pay the costs for the verification of the same.

(5) If the inspection is performed by etalon device locally, the inspections are performed in the presence of authorized personal from the Bureau of metrology, MEPSO and the user.

IV.7.2 Inspections of the metering devices performed by MEPSO

Article 105

(1) MEPSO is obliged to inspect the correctness of the accuracy of the metering device operation on each accounting metering point, at least, once in two years.

(2) MEPSO has a right to extend or shortened the time period between two successive inspections of the metering system depending on obtained data for the metering system operation. The period cannot be longer that the verification period determined by the Bureau of metrology.

(3) The other metering equipment could also be inspected if MEPSO consider that it is necessary.

(4) The inspection of the metering device is in accordance with MEPSO's testing procedures.

(5) If MEPSO find the metering device failure, it should be recorded in its database and replaced with a new one in a shortest period of time.

(6) If MEPSO or the user is suspicious about the correctness of the metering device operation, MEPSO is obliged to organize, in the shortest period of time, exceptional inspection of the metering device on site.

(7) All costs for the exceptional inspection of the metering device should be covered by MEPSO if inspections prove the metering device failure. If the failure is not proven the costs should be covered by the inspection applicant.

(8) The results from the interventions on the metering devices are entered in the MEPSO's metering devices database.

IV.7.3 Inspections of the metering devices by the Bureau of metrology

Article 106

(1) Bureau of metrology, in authorized laboratory, performs periodical inspections and verification of the metering devices in time intervals determined with the law or rule book, in accordance with the metering device type and declared accuracy class.

(2) MEPSO has an obligation that all metering devices on accounting and controlling points should be verified with valid seal of the Bureau of metrology.

IV.7.4 Metering device testing for electricity transmission network users

Article 107

(1) The electricity transmission network user, shall perform control and supervision of the operation of its metering equipment. If the alarm or signal appears reporting about the failure of the metering device operation, the user immediately informs MEPSO that the failure has occurred.

IV.8. Access, protection and maintenance of the metering equipment

IV.8.1 Access and protection of the metering equipment

Article 108

(1) MEPSO is obliged, on user request, to enable free access in its own facilities for local reading off the accounting and controlling metering devices, as well as, inspection of all metering equipment. The MEPSO and user presence is mandatory.

(2) The user is obliged, on MEPSO request, to enable free access in its own facilities for local reading off the accounting and controlling metering devices, as well as, inspection of all metering equipment. The MEPSO and user presence is mandatory.

(3) After installation and putting into operation, the metering equipment (metering devices, metering connection boxes, and other equipment that could influence the accuracy and correctness of the metering and accounting of the EE) should be protected with a seal which is installed by MEPSO. The seal should be placed at the designed places for sealing of the metering equipment.

(4) The seal must contain the MEPSO stamp and to be install in the way preventing the influence to the metering and/or to the accounting of EE and/or power.

(5) The access to the data from the accounting metering point (local or remote) must be protected with the in advance assigned right for access of MEPSO for:

1) metering data acquisition;
2) time and date changes;
3) setting up the parameters for configuration, tariff program and other functions;
4) communication protocols and communication parameters.

(6) Measuring equipment should be placed in measuring cabinets or in a suitable room and place for this purpose, to protect against unsuitable temperature conditions, dust, humidity, vibration, strong electromagnetic radiation and other influences.

(7) MEPSO and user are obliged to register any violation of the elements of the metering point and seal.

IV.8.2 Maintenance of the metering equipment

Article 109

(1) MEPSO and the users have the obligation for maintenance of the metering equipment providing accuracy and reliability of the operation.

(2) In the case when one and more parts of the metering equipment have technical characteristics that not correspond with the ones approved with connection, the user is obliged, as soon as possible to replace the failed part of the equipment. If there is an equipment failure with redundancy, this period could be no more than 30 days from the day of determining.

(3) Each change, regular or irregular controlling or intervention to any part of the metering equipment could be done only in a presence of the authorized staff by MEPSO and the user. For this activity a record signed by the present staff is complied, while each side takes one sample of the record.

(4) MEPSO is obliged, on its own costs, to take care for the metering equipment in its ownership.

(5) MEPSO maintains the metering equipment in paragraph 4 from this Article, in accordance with the law, technical regulations and with the provisions of these Network Codes.

(6) In particular metering points the metering equipment could be in user ownership (VMT, CMT, secondary connections, etc.)

(7) The user is responsible for maintenance of the metering equipment to be in a correct condition, in accordance with the law, technical regulations and with the provisions of these Network Codes, and as stated in paragraph 6 of this Article.

(8) Any intervention or failure recovering of the equipment, as stated in paragraph 6, the user informs MEPSO in written for the intervention and the type of a failure within 15 days from the day of the intervention or removal of the defect.

(9) If the user replaces a particular part of the metering equipment in its ownership, he is obliged to inform MEPSO in a period of 15 days, in written note for the replacement.

(10) Written note/information in connection with the paragraph 9 of this Article should contain:

1) the cause for the replacement;
2) the type of the equipment that is replaced and the equipment that is in function;
3) factory testing protocols for the accuracy class and testing protocol from the inspections of the equipment performed by authorized person;
4) testing protocol for putting into operation of the equipment.

IV.9. Irregular functioning and repairs in the metering system

IV.9.1 Controlling and supervision of the metering

Article 110

(1) MEPSO is obliged to conduct efficient controlling and supervision of the metering in all accounting metering points, with the following activities:

1) controlling the three phase metering system;

2) detecting of any metering anomaly;
3) physical controlling of the metering point;
4) checking and confirmation of the accuracy of the metering data;
5) archiving and storage of the documentation for accounting metering points .

(2) If MEPSO determines failure, or it is being informed about existing failure in any part of the metering system, MEPSO has obligation to:

1) inform the user after receiving such information;
2) if it is necessary to conduct local acquisition of the metering data;
3) detect and repair the problem in the part of the system in its ownership.

IV.9.2 Repairs in the metering system

Article 111

(1) If the failures are detected in the accounting metering device, or in any other part of the metering system, caused by the user, MEPSO has obligation to inform the user. The user has obligation as soon as possible to repair such failures in the part of the system in its ownership.

(2) If the user determines the failure in any part of the metering system in its ownership at the accounting metering point, the user has an obligation to inform MEPSO in 48 hours for the failure that occurred.

(3) The user has obligation to repair the failure in a part of the metering system that is in his ownership as soon as possible, and to inform MEPSO for such activity.

(4) If the failure is detected in the three phase metering system, lack of any electrical quantity, registration of the EE in a wrong register, etc., the user has obligation to inform MEPSO in 48 hours and, as soon as possible, to repair the failure in a part of the system that is in its ownership.

(5) The metering system must be brought into proper operation in the period of 15 days in case when the failure affects the billing.

(6) MEPSO informs the user for putting the metering system into regular operation after repairing the failure.

IV.10. Metering data

Article 112

(1) On each metering point the following metering is conducted:

- delivered active EE (A-);
- receipt active EE (A+);
- delivered reactive EE (Q+);
- receipt reactive EE (Q-);

(2) The direction of the delivered (-) and receipt (+) EE is from MEPSO's perspective.

(3) On each metering point the load diagram is registered as average 15 minutes active power (kW), as well as reactive power (kVAr) for each accounting period.

(4) Daily period begins at 00:00h according to CET for the interconnected metering points and ends at 24:00h. For all other metering points, the daily period begins at 00:00h according to local national time and ends at 24:00h local national time.

(5) The accounting period for the interconnected metering points is calendar month with reading of the accounting metering device first day in a month at 00:00h and the last day at 24:00h according to CET. For all other metering points, the period begins with reading the first day in the month at 00:00h and ends the last day at 24:00h local national time.

(6) Each metering information/data is accompanied with time stamp (minute, hour, day, year). These data are stored in the metering device for the needs of the remote readings.

(7) Acquired data for delivered/receipt EE from the registers in the metering device for the accounting period and the data for 15-minutes power diagrams are the basic accounting metering data.

(8) Each metering device should enable reading off the following data (displayed at the metering devices):

1) current cumulative condition of the metering device's registers for active energy (kWh) and reactive energy (kVArh) for each configured direction of the EE;
2) maximal 15-minutes average active (kW) and reactive (kVAr) power for each configured direction of the EE for the current accounting period and for the previous accounting period;
3) quadrant for the actual directions of the active and reactive power;
4) the presence of the metering voltages ;
5) current time and the date at the metering device;
6) the code of the metering quantity that is currently displayed on the metering device;
7) currently active tariff.

IV.11. The usage of the metering data

Article 113

(1) According to these Network Codes the obtained metering data are the basis for the following business activities:

1) balance sheets for EE for all entries, as well as, outputs from the electricity transmission network in a particular accounting period. The balance sheets could be specified for the metering point, voltage level, and in the case off the interconnected connection, reduced amounts at the border;
2) realized power diagram, as well as energy, that entered in the transmission network for particular accounting period, counted as the sum of the diagrams of the powers (15-minutes average values) on all entries in the transmission network. This diagram could consist of the diagram of the generation facilities, interconnection entries, etc.;

3) realized power diagram, as well as energy, that exited off from the transmission network at particular accounting period, counted as the sum of the diagrams of the powers (15-minutes average values) on all exits in the transmission network. This diagram could consist of the diagram of the generation facilities, interconnection entries, etc.;
4) diagram of the energy loses in transmission network for particular accounting period;
5) reports for exchange of the electricity in MEPSO;
6) data for total losses in the transmission network for particular accounting period that are necessary for determination of the dynamics of the procurement of the EE for covering such losses.
7) billing off the access to the electricity transmission network for each network user;

IV.12. Processing the metering data

IV.12.1 Metering database

Article 114

(1) MEPSO manages the database and the metering quantities obtained by the metering devices at all metering points that are under the scope of these Network Codes.

(2) The database consists of:

1) the title of the user of the transmission system;
2) location of the facility connected to the transmission system;
3) connected feeder (line) of the user;
4) type of the metering device;
5) communication pathway;
6) communication protocol and
7) database/registers formatting.

(3) MEPSO is processing the data obtained by the metering devices for its own needs and fo the needs of the users of transmission system.

(4) Every moment the origin of the each metering information should be known in accordance with the Code.

(5) Metering database should consist all values that are collecting remotely or locally from the metering devices and the corrections of the data corrected for the electricity losses in the transmission and transformation, if any.

(6) Database enables:

- metering device identification and the metering equipment;
- determination of the metering type ((kW, kWh, kVAr, kVArh);
- unique and clear identification of the source value;
- connection with source value for each corrected value;
- time stamp for the date of acquisition of the source value.

(7) MEPSO makes available to the users for their own needs all metering and accounting data from the metering database. The user can see and take over only the data which is related to him.

(8) The users get access to the metering and accounting data by *web* server that provides all data obtained with remote reading of the metering devices, as well as, all accounting results for the user. The user can access only those data that are related to him.

(9) The allowed time period, from the date of putting into operation of the metering device or any change (replacement) of the metering equipment, to the date of up-dating the database is up to 15 days.

(10) Data that is older than 12 months is stored in database archive. Time period for saving the data in the archive is 5 years.

IV.12.2 Metering data acquisition

Article 115

(1) The metering data include:

1) metered time-depending values of active and reactive energy from the metering points;
2) the counted values by MEPSO on the base of the measured data;
3) evaluated and changed or replaced data in the case of false or lost data and
4) data and values that are used for accounting purposes.

(2) MEPSO is obliged to collect data from the metering points, with the usage of protocols referred to in Article 100 from these Network Codes. MEPSO must confirm, process and input the collected data in a metering database and to keep them protected for billing purposes, market transactions and charges for usage of the system.

(3) The user in its facility, must provide reliable operation of the communication link for remote transmission of the data.

(4) If, for any reason, the remote reading is not possible (or collecting), MEPSO and the user must provide local data acquisition.

(5) Obtained data on the manner, as it is described in paragraph 4 of this Article, MEPSO transmit them directly into the metering database. This procedure is performed in a period that enables all necessary metering data to be available for accounting.

(6) Time interval for acquisition is, as a rule, at least one day, and at the most one month.

Data validation

Article 116

(1) MEPSO checks and confirms the credibility of the acquired metering data and makes validation of the metering data before entering into metering database.

(2) The goals of checking of the validity of the data obtained with metering are as follow:

1) to check out if there are some missing data or are incomplete after reading the metering devices;

2) to check out if during the reading some interventions are made to the metering equipment, repairs etc.;
3) to determine if there is some deviation of the metering device's local time related to the reference time during the all of the accounting period;
4) to determine if some of the devices from the supervision are signaling that there is lack of auxiliary power supply or lack of any metering quantities
5) to determine if all acquired data are real and in accordance with the loads in that particular metering point.

(3) During the validation, metering data obtained by accounting and the controlling metering device are compared, and then the comparison of the energy obtained by difference of the energy status in the register and the energy obtained by integration on the load diagram. These data could be compared with the data of the previous accounting period or with the data for the same accounting period in last years.

(4) Allowed difference between the values registered with the accounting and the controlling metering device should be in the limits defined with the accuracy of the metering device.

(5) Allowed difference between EE obtained as cumulative registered value and the energy accounted by the load diagram in particular accounting period, provided that time synchronization is performed, must be less than 0.1%.

Substitution of data

Article 117

(1) In the case of non-validated data or failure determination, MEPSO will make substitution of such metering data, as well as, the data that are missing.

(2) MEPSO will make substitution of the non-validated data according to the following schedule:

1) with the data obtained by controlling metering device if it exists and is a part of the metering equipment, and if it has been checked;
2) with the data obtained by the user metering device related to the accounting metering place, considering average losses in transformation or in a power line;
3) data obtained by certain MEPSO accounting algorithm, on the basis of the validities metered or determined electrical quantities

(3) MEPSO documents the substitution of the metering data for internal revision and controlling the accounting.

(4) If, during the inspection or regular or irregular controlling of the metering equipment, it is determined that the metering was incorrect, then the metering data in the metering database will be substituted according to the rules for substitution by this Article for the period:

1) from the day of failure occurrence, if it could be determined;
2) to be determined on the basis of the available data.

(5) If the substitution of the metering data is done after the finished accounting, then it is necessary to make the correction of the accounting and such data to be delivered to the user.

Access to metering data

Article 118

(1) Direct access to the metering data obtained by metering devices throughout local or remote communication is allowed only to the authorized person from MEPSO that are in charge for configuration, maintenance, acquisition, validation and substitution of the data and to the users but only for the metering data related to their metering point.

(2) the users of the metering data are:

1) the users of the transmission system or their representatives;
2) distribution system operator/s;
3) market operator;
4) suppliers of the users of MEPSO;
5) balancing responsible parties and
6) other persons authorized by act that regulates the rules for the work of the EE market operators.

(3) MEPSO is responsible for organizing and issuing appropriate licenses for access to the metering data and defines the level of access according to the needed security of the metering data and the database.

(4) MEPSO delegates the right for remote access to the metering data from the metering device, that way defining the list of the authorized users of the metering data. MEPSO assigns the time of access according to the needs for acquisition and the needs of the user on the base on the non- discriminatory principles.

(5) Not respecting the assigned time for access to the metering data will lead to denied right for the access.

(6) MEPSO assigns to the user of the metering data the right for self-reading with a password for the access to the metering device and time interval in which such communication could be done.

(7) The obligation of the user is to use only licensed applications for communication and data transferring. Only the user can use the passwords for access assigned by MEPSO.

(8) the user of the electricity transmission network is obliged to provide MEPSO with access to the metering systems and the data from the metering systems.

(9) MEPSO has obligation to assure security of the data in the metering devices registers, as well as security of the metering data database. All metering data inside the metering system must be protected from local or remote access electronically, with the appropriate password.

(10) MEPSO has no authorization to change the data in the metering devices registers, except during the time of metering device inspection. For each intervention on the metering device on site, a protocol is noted with all data for the un-registered or mistakenly registered energy.

V. POWER SYSTEM OPERATION

V.1. General

Article 119

(1) For the purpose of safeguarding operational security, frequency quality and the efficient use of the interconnected systems and capacities, this chapter of the Network Codes lays down detailed guidelines on:

1) requirements and principles concerning operational security
2) rules and responsibilities for the coordination and data exchange in operational planning and in close to real-time operation
3) rules for training and certification of MEPSO's employees
4) requirements on outage coordination
5) planning and ensuring operational security between the control areas of the transmission system operators of the synchronous zone of continental Europe, and
6) criteria for providing ancilary services

V.2. Operational security

V.2.1 System states

Classification of system states

Article 120

(1) A transmission system shall be in normal state when all of the following conditions are fulfilled:

1) voltage and power flows are within the operational security limits
2) frequency meets the following criteria:
   - the steady state system frequency deviation is within the standard frequency range, and
   - the absolute value of the steady state system frequency deviation is not larger than the maximum steady state frequency deviation and the system frequency limits established for the alert state are not fulfilled
3) active and reactive power reserves are sufficient to withstand contingencies from the outage list without violating operational security limits

4) operation of the concerned MEPSO's control area is and will remain within operational security limits after the activation of remedial actions following the occurrence of a outage from the outage list

(2) A transmission system shall be in the alert state when:

1) voltage and power flows are within the operational security limits, and

2) the MEPSO's reserve capacity is reduced by more than 20 % for longer than 30 minutes and there are no means to compensate for that reduction in real-time system operation, or

3) frequency meets the following criteria

- the absolute value of the steady state system frequency deviation is not larger than the maximum steady state frequency deviation; and
- the absolute value of the steady state system frequency deviation has continuously exceeded 50 % of the maximum steady state frequency deviation for a time period longer than the alert state trigger time or the standard frequency range for a time period longer than time to restore frequency; or

4) at least one outage from the outage list leads to a violation of the MEPSO's operational security limits, even after the activation of remedial actions.

(3) A transmission system shall be in the emergency state when at least one of the following conditions is fulfilled:

1) there is at least one violation of a MEPSO's operational security limits

2) frequency does not meet the criteria for the normal state and for the alert state

3) at least one measure of MEPSO's system defense plan is activated

4) there is a failure in the functioning of tools, means and facilities, resulting in the unavailability of those tools, means and facilities for longer than 30 minutes

(4) A transmission system shall be in the blackout state when at least one of the following conditions is fulfilled:

1) loss of more than 50 % of consumption in the concerned MEPSO's control area.

2) total absence of voltage for at least three minutes in the concerned MEPSO's control area, leading to the triggering of system restoration plans.

(5) A transmission system shall be in the restoration state when a MEPSO, being in the emergency or blackout state, has started to activate measures of its system restoration plan.

Monitoring and determination of system states

Article 121

(1) MEPSO shall, in real-time operation, determine the state of its transmission system.

(2) MEPSO shall monitor the following transmission system parameters in real-time in its control area, based on real-time measurements or on calculated values from its observability area:

1) active and reactive power flows in the transmission system
2) voltage values on busbars in the electricity transmission network facilities,
3) managing of area control error,
4) indication signals and alarms in the electricity transmission network's facilities and the user's facilities,
5) generation units active and reactive power,
6) active and reactive power reserves,
7) status of the switching equipment,
8) positions of transformers' regulating switch, and
9) alarms and signals validating measured values, protective devices operation, communication status, etc.

(3) In order to specify the system state, MEPSO shall perform outage analysis in real-time system operation, monitoring the transmission system's parameters defined in accordance with paragraph (2) of this Article, operational security limits defined in accordance with Article 124, and the criteria for system states defined in accordance with Article 120 from these Network Codes.

(4) MEPSO shall inform all TSOs about the system state of its transmission system via an IT tool for the exchange of real-time data at pan-European level (EAS) and provide with additional information on its transmission system elements which are part of the observability area of other TSOs

Remedial actions in system operation

Article 122

(1) MEPSO shall design, prepare and activate remedial actions taking into account their availability, the time and resources needed for their activation and any conditions external to the transmission system which are relevant for each remedial action.

(2) MEPSO shall give preference to remedial actions which make available the largest cross-border capacity, while satisfying all operational security limits.

(3) MEPSO shall use the following categories of remedial actions:

1) modify the duration of a planned outage or return to service transmission system elements to achieve the operational availability of those transmission system elements;
2) actively impact power flows by means of:
   - tap changes of the power transformers;
   - tap changes of the phase-shifting transformers;
   - modifying topologies of the electricity transmission network

3) control voltage and manage reactive power by means of:
    - tap changes of the power transformers;
    - switching of the capacitors and reactors;
    - switching of the power-electronics-based devices used for voltage and reactive power management;
    - instructing transmission-connected DSOs and significant network users to block automatic voltage and reactive power control of transformers or to activate on their facilities the remedial actions set out in the previous three paragraphs if voltage deterioration jeopardizes operational security or threatens to lead to a voltage collapse in the transmission system;
    - requesting the change of reactive power output or voltage setpoint of the transmission-connected synchronous Power generating modules;
    - requesting the change of reactive power output of the converters of transmission-connected non-synchronous Power generating modules;
4) re-calculate day-ahead and intraday cross-border capacities;
5) redispatch transmission or distribution-connected system users within the MEPSO's control area or between MEPSO and other TSOs;
6) countertrade between two or more control areas;
7) activate frequency deviation management procedures in accordance with system defense plan;
8) curtail the already allocated cross-zonal capacity in an emergency situation where using that capacity endangers operational security, all TSOs at a given interconnector agree to such adjustment, and re-dispatching or countertrading is not possible; and
9) where applicable, include the normal or alert state, manually controlled load-shedding.
10) Where is necessary and justified in order to maintain operational security, MEPSO may prepare and activate additional remedial actions.

(4) MEPSO shall prepare and activate remedial actions to prevent the system state from deteriorating on the basis of the following elements:

1) the monitoring and determination of system states
2) the outage analysis in real-time operation
3) the outage analysis in operational planning

(5) MEPSO prepares remedial actions as a part of operational planning procedure and system defense plan.

Availability of TSO's means, tools and facilities

Article 123

(1) MEPSO shall ensure the availability, reliability and redundancy of the following tools, means and facilities:

1) facilities for monitoring the system state of the transmission system, including state estimation applications and facilities for load-frequency control;
2) means to control equipment which serves to manage the transmission system elements;
3) means to communicate with the control rooms of other TSOs and RSCs;
4) tools for operational security analysis; and
5) tools and communication means necessary for TSOs to facilitate cross-border market operations.

V.2.2 Operational security limits

Article 124

(1) MEPSO shall specify the operational security limits for each element of its transmission system, taking into account at least the following physical characteristics:

1) voltage limits in accordance with Article 126;
2) short-circuit current limits according to Article 127; and
3) current limits in terms of the permissible load including the transitory admissible overloads.

(2) When defining the operational security limits, MEPSO shall take into account the capabilities of SGUs to prevent that voltage ranges and frequency limits in normal and alert states lead to their disconnection.

(3) In case of changes of one of its transmission system elements, MEPSO shall validate and where necessary update the operational security limits.

(4) For each interconnector MEPSO shall agree with the neighboring TSO, on common operational security limits in accordance with paragraph 1 of this Article.

V.2.3 Frequency control and active power control

Article 125

(1) MEPSO shall endeavour to ensure that during the normal state the system frequency remains within the standard frequency range of ±50 mHz

(2) MEPSO shall endeavour to ensure that, after the occurrence of a disturbance, the frequency remains, within maximum instantaneous frequency deviation of 800 mHz and maximum steady-state frequency deviation of ±200 mHz.

(3) MEPSO shall ensure active power reserve, with adequate volume and time response, in order to fulfill its obligation regarding frequency quality parameters of the Continental Europe synchronous area.

(4) If system frequency is outside the ranges defined in paragraph 1 of this Article, MEPSO shall apply frequency control and active power management remedial actions in accordance with Article 122 (remedial actions) of these Network Codes in order to restore system frequency within the range specified in paragraph (1) from this Article.

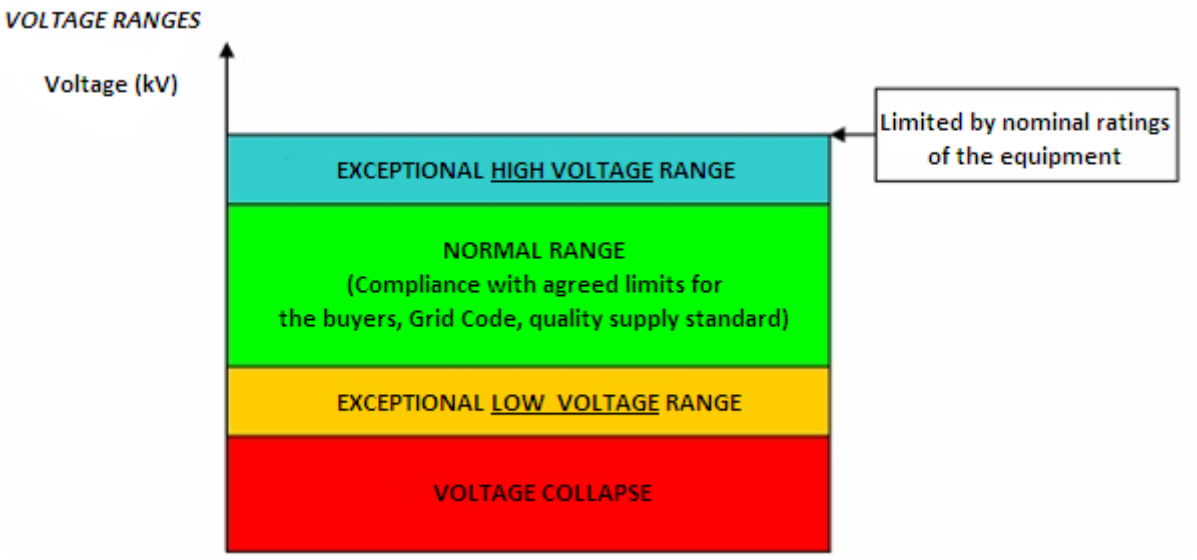
V.2.4 Voltage and reactive power control

Article 126

(1) MEPSO shall endeavour to ensure that during the normal state the voltage remains in steady-state at the connection points of the transmission system within the ranges:

1) 400 kV voltage level: between 360 kV and 420 kV
2) 110 kV voltage level: between 99 kV and 123 kV

(2) MEPSO shall endeavour to ensure that, during the normal state and after the occurrence of a outage, the voltage remains, at least within wider voltage ranges for limited times of operation as presented in Picture 1 and Table 3.



Picture 1 – Principle of defining voltage limits

Table 3 – Allowed voltage intervals in the transmission system

Voltage level	Voltage intervals under normal conditions [kV]		short-term intervals of extremely low voltages in disturbance regimes [kV]	short-term intervals of extremely high voltages in disturbance regimes [kV]
	Unlimited		60 minutes	60 minutes
110	99	123	93.5 – 99	123 – 126.5
400	360	420	340 - 360	420 – 440

(3) If voltage at a connection point to the transmission system is outside the ranges defined in paragraph 1 of this Article, MEPSO shall apply voltage control and reactive power management remedial actions in accordance with Article 122 of these Network Codes in order to restore voltage at the connection point within the range specified in paragraph 1 of this Article and within time range specified in paragraph 2 of this Article.

(4) MEPSO shall ensure reactive power reserve, with adequate volume and time response, in order to keep the voltages within its control area and on interconnectors within the ranges set out in paragraph 1 of this Article.

(5) MEPSO shall jointly specify the adequate voltage control regime with neighboring TSOs in order to ensure that the common operational security limits are respected.

(6) MEPSO shall be entitled to use all available transmission-connected reactive power capabilities within its control area for effective reactive power management and maintaining the voltage ranges set out in paragraph 1.

(7) MEPSO shall, directly or indirectly in coordination with the transmission-connected DSO where applicable, operate reactive power resources within its control area, including the blocking of automatic voltage/reactive power control of transformers, voltage reduction and low voltage demand facilities disconnection, in order to maintain operational security limits and to prevent a voltage collapse of the transmission system.

(8) MEPSO shall determine the voltage control actions in coordination with the transmission-connected users and DSOs and with neighboring TSOs.

V.2.5 Short-circuit current control and treatment

Article 127

(1) MEPSO shall determine:

1) the maximum short-circuit current at which the rated capability of circuit breakers and other equipment is exceeded; and

2) the minimum short-circuit current for the correct operation of protection equipment and other equipment.

(2) MEPSO shall perform short-circuit current calculations in order to evaluate the impact of neighboring TSOs and transmission-connected users and transmission-connected distribution systems including closed distribution systems on the short-circuit current levels in the transmission system.

(3) MEPSO shall apply operational or other measures to prevent deviation from the maximum and minimum short-circuit current limits at all time-frames and for all protection equipment. If such a deviation occurs, MEPSO shall activate remedial actions or apply other measures to ensure that the limits are re-established. A deviation from those limits is allowed only during switching sequences.

V.2.6 Treatment of neutral point

Article 128

(1) The treatment of the neutral point of the transmission system is the responsibility of MEPSO.

(2) The concept of grounding of the neutral point in the transmission system is based on criteria for allowed short circuits listed in Article 127 of these Network Codes and insulation coordination in 400 kV and 110 kV networks.

(3) MEPSO sets relevant technical specifications for grounding the neutral point for the voltage levels of the transmission system (400 kV and 110 kV) and also in the neutral points that belong to the users of the transmission system.

(4) At 110 kV and higher voltage level, transformers and other equipment owned by the user of the transmission system, which have a neutral point must have a possibility for grounding.

(5) The method for treatment of neutral points that do not belong to MEPSO must be analyzed in detail for each case specified in the study for connection to the electricity transmission network.

V.2.7 Power flow control

Article 129

(1) MEPSO shall maintain power flows within the operational security limits defined when the system is in normal state and after the occurrence of a outage from its outage list.

(2) In the (N-1)-situation, in the normal state, MEPSO shall maintain power flows within the transitory admissible overloads, having prepared remedial actions to be applied and executed within the time-frame allowed for transitory admissible overloads.

V.2.8 Outage analysis

Article 130

(1) MEPSO shall establish an outage list, including the internal and external outages of its observability area, by assessing whether any of those outages endanger the operational security of the MEPSO's control area.

(2) To establish an outage list, MEPSO shall classify each outage on the basis of whether it is ordinary, exceptional or out-of-range, taking into account the probability of occurrence.

(3) The following events are considered as ordinary outages:

1) outage of a single Power generating unit,
2) outage of a single power line or cable,
3) outage of a single transformer unit, or two transformer units connected to the same bus,
4) outage of a single shunt element,
5) outage of a single HVDC line,
6) outage of a single power flow control device
7) outage of power line with two or more circuits mounted on the same transmission towers, if MEPSO considers this outage as part of normal operational planning procedure.

(4) Following events are considered as Exceptional contingencies:

1) outage of power line with two or more circuits mounted on the same transmission towers, if MEPSO does not consider this outage as part of normal operational planning procedure,
2) outage of a single busbar system,
3) outage of more than one Power generating units or power plants,
4) outage of more than one HVDC line.

(5) Following events are considered as Out-of-range contingencies:

1) outage of two power lines simultaneously and without a common cause,
2) outage of a substation with more than one busbar system,
3) outage of more than one Power generating units without a common cause.

(6) MEPSO shall coordinate its outage analysis in terms of coherent outage lists at least with the TSOs from its observability area.

(7) MEPSO shall inform the TSOs in its observability area about the external outages included in its outage list.

(8) MEPSO shall inform, sufficiently in advance, the TSOs concerned in its observability area of any intended topological changes on its electricity transmission network elements, which are included as external outages in the outage lists of the TSOs concerned.

(9) MEPSO shall perform outage analysis in its observability area in order to identify the outages which endanger or may endanger the operational security of its control area and to identify the remedial

actions that may be necessary to address the outages, including mitigation of the impact of exceptional outages.

(10) MEPSO shall ensure that potential violations of the operational security limits in its control area which are identified by the outage analysis do not endanger the operational security of its transmission system or of interconnected transmission systems

(11) MEPSO shall perform outage analysis based on the forecast of operational data and on real-time operational data from its observability area. The starting point for the outage analysis in the N-Situation shall be the relevant topology of the transmission system which shall include planned outages in the operational planning phases.

(12) MEPSO shall assess the risks associated with the outages after simulating each outage from its outage list and after assessing whether it can maintain its transmission system within the operational security limits in the (N-1) state.

(13) In case of an (N-1) state caused by a disturbance, MEPSO shall activate a remedial action in order to ensure that the transmission system is restored to a normal state as soon as possible.

(14) MEPSO shall not be required to comply with the (N-1) criterion at any time for double-sided fed substations.

V.2.9 Protection

Article 131

(1) MEPSO shall operate its transmission system with primary and backup protection equipment in order to automatically prevent the propagation of disturbances that could endanger the operational security of its own transmission system and of the interconnected system.

(2) At least once every 5 years, MEPSO shall review its Transmission system protection plan and concepts and update them where necessary to ensure the correct functioning of the protection equipment and the maintenance of operational security.

(3) Each MEPSO shall specify setpoints for the protection equipment of its transmission system that ensure reliable, fast and selective fault clearing, including backup protection for fault clearing in case of malfunction of the primary protection system.

(4) Before commissioning or before any change to the primary or back-up protective equipment, MEPSO shall agree with the neighboring TSOs on the definition of protection setpoints for the interconnectors.

(5) If decided, MEPSO shall apply special protection schemes to operate the transmission system within the operational security limits

V.2.10 Dynamic stability

Article 132

(1) MEPSO shall monitor the dynamic stability of the transmission system by preparing studies. MEPSO shall exchange the relevant data for monitoring the dynamic stability of the transmission system with the other TSOs of the Continental Europe synchronous area.

(2) MEPSO shall perform a dynamic stability assessment within national system defense plan and within transmission development study.

(3) Where the dynamic stability assessment indicates that there is a violation of stability limits in MEPSO's control area, MEPSO shall design, prepare and activate remedial actions to keep the transmission system stable.

(4) MEPSO should ensure that the fault removal time calculated in the dynamic stability assessment that leads to the instability of the electricity transmission system over a wide area is shorter than the critical fault removal time.

V.2.11 EE quality

Article 133

(1) Under normal operating conditions, in a period of one week, indicators for short term flicker Pst and long term flicker Plt, caused by voltage variations should not exceed the limits at the point of connection, as shown in Table 4.

Table 4 - Limits of flicker intensity in the transmission system

Voltage level	P_{st}	P_{lt}
400 kV	0.8	0.6
110 kV	1	1

(2) In normal operating conditions for a period of one week, 95% of the 10 minute effective values of individual harmonics of the voltage at the point of connection should be smaller or equal to the values shown in Table 5.

Table 5 - Limits on levels of higher harmonics in the transmission system.

Harmonic (h)	Value (%)
2	1.5
3	2
4	1
5	2
6	0.5
7	2
8	0.4
9	1
10	0.4
11	1.5
12	0.2
13	1.5
14	0.2
15	0.3
16	0.2
17	1
18	0.2
19	1
20	0.2
21	0.2
22	0.2
23	0.7
24	0.2
25	0.7
h>25	0.2
Odd harmonics which are not multiplied by 3 (>25)	0.2+0.5 (25/h)
THD	3

(3) In normal operating conditions for a period of one week, 95% of the 10 minute effective value of the negative (inverse) phase component of the voltage should be in the range of 0% to 2% of the positive (direct) phase component voltage.

(4) MEPSO can change the allowed values of phase asymmetry for individual cases in normal operation.

V.2.12 Indexes of continuity in the electricity transmission network

Article 134

(1) ENS (Energy Not Supplied) is the index for delivered electricity to demand facilities and generation facilities, parts of distribution systems and closed distribution systems that are connected to the electricity transmission network, due to unplanned interruptions in the EE supply, expressed in (MWh) on an annual basis.

$$ENS = \sum_{i} (P_{ki} * W_{dki})$$

i - number of interruptions;

W_{dki} - average daily energy calculated according to the consumption of demand facilities and generation facilities, parts of distribution systems and closed distribution systems that are connected to the electricity transmission network for a period of 5 days without interruption, which precedes the day of the interruption;

P_{ki} - part of the day when demand facilities and generation facilities, parts of the distribution systems and closed distribution systems that are connected to the electricity transmission network remained without power, and is calculated according to the following formula:

$$P_{ki} = \frac{\mathrm{tki}}{\mathrm{Td}}$$

$\mathbf{t_{ki}}$ - duration of the interruption at demand facilities and generation facilities, parts of the distribution systems and closed distribution systems that are connected to the electricity transmission network, expressed in (min);

$\mathbf{T_d}$ = 1440 min - duration of the day expressed in minutes;

AIT(Average Interruption Time) is an index for the average duration of interruption of electricity supply to demand facilities and generation facilities, parts of distribution systems and closed distribution systems that are connected to the electricity transmission network, expressed in hours per year;

$$AIT = \frac{ENS}{Epren} * \mathrm{T_{god}}$$

E_{pren} -total transferred EE for the needs of domestic consumption for the considered period, including losses in the electricity transmission network (MWh).

T_{god} =8760 ч = number of hours per year;

MEPSO records interruptions in the delivery of EE and submits them to ERC once a year no later than March 31st of the current year for the previous calendar year, in the form and content given in the table:

TABLE

Interruptions									
Ordinal No.	Star t		End		Duration of the interruption	Caus e	element of the electricity transmission network that caused the interruption	**Wdki (MWh)**	ENS
1									
2									
3									
4									
5									
Total duration of interruption s					Total Unsupplied Energy (MWh)				

V.3. Data exchange

V.3.1 General requirements

Article 135

(1) MEPSO shall gather the following information about its observability area and shall exchange this data with all other TSOs to the extent that it is necessary for carrying out the operational security analysis in accordance with operational planning and close to real-time operation.

(2) the data from paragraph (1) of this article are:

1) generation;

2) consumption;

3) plans for EE transaction schedules;

4) compliance information on transaction schedules;

5) planned outages and substation topologies; and

6) EE generation and consumption forecasts.

(3) MEPSO shall represent the information in paragraph (2) of this article to create an individual network model (IGM).

(4) MEPSO in coordination with DSO, operators of closed distribution systems and users of the electricity transmission system determine the applicability and scope of data exchange based on the following categories:

1) structural data,

2) planned and forecasted data and,

3) real time data.

(5) MEPSO will jointly agree with other transmission system operators on key organizational requirements, roles and responsibilities regarding data exchange, in accordance with the applicable requirements of ENTSO-E.

(6) MEPSO, in cooperation with users, will establish effective, efficient and proportionate processes for securing and managing data exchange,

(7) Users connected to the electricity transmission network should have access to data related to their installations at the connection point.

(8) MEPSO and the users shall jointly agree on the need and scope for the exchange of additional information relating to their installations at the connection point.

V.3.2 Data exchange between MEPSO and other TSOs

Structural and forecast data exchange

Article 136

(1) MEPSO shall exchange with its neighboring TSOs at least the following structural information related to the observability area:

1) the regular topology of substations and other relevant data, by voltage level;

2) technical data on transmission lines;

3) technical data on power transformers;

4) the maximum and minimum active and reactive power of Power generating modules;

5) technical data on phase-shifting transformers;

6) technical data on HVDC systems;

7) technical data for reactive power compensation devices

8) operational security limits defined by each TSO.

(2) To coordinate the protection of its transmission system, MEPSO shall exchange with its neighboring TSOs the protection setpoints of the lines for which the contingencies are included as external contingencies in their outage lists.

(3) MEPSO, for the purpose of coordination and assessment of dynamic stability, exchanges the following data with other TSO's from the same synchronous zone:

1) the topology of the electricity transmission network (400kV and 110kV voltage level);
2) a model or an equivalent of the electricity transmission network with voltage below 110 kV with significant impact on the electricity transmission network;
3) the thermal limits of the electricity transmission network elements; and
4) a realistic and accurate forecasted aggregate amount of generation and consumption, per primary energy source, at each node of the electricity transmission network, for different time-frames.

(4) For the coordination of operational security analyzes and the formation of a common (CGM) network model, MEPSO shall exchange with the other TSOs of the same synchronous area or of its relevant part the following data:

1) Relevant data concerning Power generating modules (generating unit model, excitation system model, power system stabilizer model and turbine-governor system model)
2) the data on type of regulation and voltage regulation range concerning tap changers, including the description of existing on-load tap changers, and the data on type of regulation and voltage regulation range concerning step-up and network transformers; and
3) the data concerning HVDC systems and FACTS devices on the dynamic models of the system or the device and its associated regulation suitable for large disturbances.

Real-time data exchange

Article 137

(1) MEPSO shall exchange with the other TSOs of the same synchronous area, as well as TSOs within LFC Block, the following data on the system state of its transmission system using the IT tool for real-time data exchange at pan-European level (EAS) as provided by ENTSO-E:

1) frequency;
2) frequency restoration control error;
3) measured active power interchanges between LFC areas;
4) aggregated generation infeed;
5) system state according to chapter V.2.1;
6) setpoint of the load-frequency controller; and
7) power interexchange via virtual tie-lines.

(2) MEPSO shall exchange with the other TSOs in its observability area the following data about its transmission system using real-time data exchanges between the TSOs' supervisory control and data acquisition (SCADA) systems and energy management systems:

1) actual substation topology;
2) active and reactive power of connection fields,
3) residual current circuit breakers of transformers, including phase-shifting transformers;
4) measured or estimated busbar voltage;
5) restrictions on active and reactive power supply capabilities with respect to the observability area.

V.3.3 Data exchange between MEPSO and DSO

Structural data exchange

Article 138

(1) The structural information provided by each DSO to MEPSO shall include at least:
1) substations relevant for electricity transmission network;
2) 110kV transmission lines that connect substations from point 1) of this paragraph, and are not part of the electricity transmission network;
3) transformers from the substations referred to in point (1 of this paragraph and
4) reactive power compensation devices connected to substations from point (1 of this paragraph.

Real-time data exchange

Article 139

(1) Each DSO shall provide MEPSO with real-time data like:
1) current switching state of the substations;
2) the active and reactive power in the line bay;
3) the active and reactive power in the transformer bay;
4) the active and reactive power in the Power generating plant field;
5) the regulatory tap positions of transformers connected to the electricity transmission network;
6) the busbar voltages;
7) the reactive power in the compensating device field;
8) the best available data for aggregated generation per primary energy source in the DSO area; and

9) the best available data for aggregated consumption of EE in the DSO area.

V.3.4 Data exchange between MEPSO and Power generating modules connected to the electricity transmission network

Structural data exchange

Article 140

(1) Each Power generating facility owner connected to the electricity transmission network shall provide MEPSO with at least the following data:

1) general data of the Power generating module, including installed capacity and primary energy source;
2) turbine data and EE generation capacity;
3) data for short-circuit current calculation;
4) Power generating facility transformer data;
5) FCR data of Power generating modules offering or providing that service;
6) FRR data of Power generating modules offering or providing that service;
7) data necessary for restoration plan of the transmission system;
8) data and models necessary for performing dynamic simulation;
9) protection data;
10) data necessary for determining the costs of remedial actions;
11) voltage and reactive power control capability.

(2) MEPSO may request the Power generating facility owner of a Power generating Moduleconnected to the electricity transmission network to provide further data where appropriate for operational security analysis.

Scheduled data exchange

Article 141

(1) Each Power generating facility owner of a Power generating Moduleconnected to the electricity transmission network shall provide MEPSO with at least the following data:

1) active power output and active power reserves amount and availability, on a day-ahead and intra-day basis;
2) scheduled unavailability or active power restriction;
3) other data in accordance with the Rules for the form, content and dynamics of data submission and publication.

Real-time data exchange

Article 142

(1) Unless otherwise provided by MEPSO, each Power generating facility owner connected to the electricity transmission network shall provide MEPSO, in real-time, at least the following data:

1) Real time position of the switching devices at the connection point;
2) active and reactive power, current, voltage and frequency at the connection point;
3) Current values of local high and low active power limits for all generating units participating in control of aFRR.

V.3.5 Data exchange between MEPSO and DSOs concerning significant Power generating modules connected to the electricity transmission network

Structural data exchange

Article 143

(1) Unless otherwise specified by MEPSO, each DSO shall provide to MEPSO the following information concerning relevant Power generating modules connected to the electricity transmission network, to the level of detail required by MEPSO:

1) general data of the Power generating module, including installed capacity and primary energy source or fuel type;
2) FCR data for Power generating facilities offering or providing the FCR service;
3) FRR data for Power generating facilities offering or providing the FRR service;
4) protection data;
5) reactive power control capability;
6) capability of remote access to the circuit breaker;
7) data necessary for performing dynamic simulation; and
8) voltage level and location of each Power generating module.

Scheduled data exchange

Article 143

(1) Unless otherwise specified by MEPSO, each DSO shall provide to MEPSO the following information concerning relevant Power generating modules connected to the electricity transmission network, to the level of detail required by MEPSO:

1) its scheduled unavailability, scheduled active power restriction and its forecasted scheduled active power output at the connection point;
2) any forecasted restriction in the reactive power control capability;

Real-time data exchange

Article 144

(1) Unless otherwise specified by MEPSO, each DSO shall provide to MEPSO the following information concerning relevant Power generating modules connected to the electricity transmission network, to the level of detail required by MEPSO:

1) status of the switching devices and circuit breakers at the connection point; and
2) active and reactive power flows, current, and voltage at the connection point.

(2) MEPSO shall define in coordination with the responsible DSOs which SGUs may be exempted from providing the real-time data listed in paragraph 1 directly to MEPSO. In such cases, MEPSO and DSO shall agree on the aggregated real-time data of the SGUs concerned to be delivered to the MEPSO in real time.

V.3.6 Data exchange between MEPSO and transmission-connected demand facilities

Article 146

(1) Each transmission-connected demand facility shall provide the following structural data to MEPSO:

1) electrical data of the transformers connected to the electricity transmission network;
2) characteristics of the load; and
3) characteristics of the reactive power control capability of the demand facility.

(2) Each transmission-connected demand facility shall provide the following planning data to MEPSO:

1) active and reactive power consumption for a time frame day ahead and intra-day, including any changes in plans or forecast;
2) any forecasted restriction in the reactive power control capability;
3) in case of participation in the balance energy market, a plan to limit the minimum and maximum range of active power regulation.

(3) Each transmission-connected demand facility shall provide the following real-time data to MEPSO:

1) active and reactive power, current, voltage and frequency at the connection point and
2) the minimum and maximum power range that can be limited.

V.4. Compliance

V.4.1 Roles and responsibilities

Responsibility of the user of the electricity transmission network

Article 147

(1) The electricity transmission network user is obliged to notify MEPSO about any planned modification of its technical capabilities which could have an impact on its compliance with the operational security requirements, within 90 days before implementing the modification.

(2) The electricity transmission network user is obliged to notify MEPSO about any operational disturbance in its facility which could have an impact on its compliance with the requirements of these Network Codes as soon as possible after its occurrence.

(3) MEPSO has the right to participate in the compliance tests in order to be able to record the characteristics of the user's operation.

(4) Upon request from MEPSO, the user shall carry out compliance tests and simulations in accordance with these Network Codes at any time throughout the lifetime of its facility and in particular after any fault, modification or replacement of any equipment, which could have an impact on the facility's compliance with the requirements of these Network Codes regarding the capability of the facility to achieve the values declared, the time requirements applicable to those values and the availability or contracted provision of ancilary services.

Responsibility of MEPSO regarding system operation

Article 148

(1) MEPSO shall be responsible for the operational security of its control area and, in particular, it shall:

1) development and implement network operation tools that are relevant for its control area and related to real-time operation of the power system and the process of operational planning;
2) development and deploy tools and solutions for the prevention and resolution of disturbances;

3) provision and use of services by third parties, through procurement when applicable, such as redispatching or countertrading, congestion control, generation reserves and other ancillary services;

4) comply with the incidents classification scale methodology adopted by ENTSO-E

5) monitor on an annual basis the appropriateness of the network operation tools required to maintain operational security.

(2) MEPSO shall identify any appropriate improvements to network operation tools in accordance with paragraph 1 of this Article, taking into account the annual reports prepared by ENTSO-E.

Operational testing

Article 148

(1) MEPSO may perform operational testing of its electricity transmission network elements under simulated operational conditions and for a limited period of time. When doing so, MEPSO shall provide notification in due time and prior to the test launch and shall minimize the effect on real-time system operation.

(2) The results of operational testing shall be used by MEPSO in order to ensure correct functioning of electricity transmission network elements, to maintain the existing and develop new operational practices, to ensure fulfilment of ancilary services, as well as to acquire information about performance of the electricity transmission network elements and users under any operating conditions.

(3) MEPSO shall ensure that operational testing does not endanger the operational security of its electricity transmission network. Any operational testing may be postponed or interrupted due to unplanned system conditions, or due to safety of personnel, of the general public, of the plant or apparatus being tested, or of the electricity transmission network elements or of the facilities of the DSO or SGU.

(4) MEPSO retains the right to test a transmission network user's compliance with the requirements of these Network Codes, the transmission user's input and output and the transmission network user's contracted provision of ancilary services at any time throughout the lifetime of the facility.

V.5. Training

Article 150

(1) MEPSO shall develop and adopt training programs for the continuous training of its employees in charge of real-time operation of the transmission system, operational planning and system balancing in accordance with valid ENTSO-E requirements.

V.6. Operational Planning

V.6.1 Introduction

Article 151

(1) Activities related to power system operation planning include the following:

1) operational security analysis,
2) outage coordination,
3) adequacy analysis,
4) scheduling.

V.6.2 Operational security analysis

Article 152

General provisions regarding individual and common network models

(1) To perform operational security analysis, MEPSO shall prepare individual network models for each of the following time-frames:

1) year-ahead;
2) where applicable, week-ahead;
3) day-ahead; and
4) intraday.

(2) The individual network models shall include the structural information and data set out in Article 135.

(3) MEPSO shall build the individual network models and regional security coordinator shall contribute to building the common network models.

Article 153

Year-ahead scenarios

(1) MEPSO shall jointly with other TSOs develop a common list of year-ahead scenarios against which they assess the operation of the interconnected transmission system for the following year in accordance with ENTSO-E procedures.

(2) The scenarios shall include the following variables:

1) Electricity consumption;
2) the conditions related to the contribution of renewable energy sources;
3) determined import/export positions, including agreed reference values allowing the merging task;
4) generation model, with a fully available EE production park model;
5) the year-ahead network development.

(3) in the event that the data from paragraph (2) of this article cannot be provided, MEPSO together with other TSO's will use the following reference scenarios:

1) winter maximum, third Wednesday of January for the current year, at 10:30h,
2) winter maximum, second Saturday of January for the current year, at 03:30h,
3) spring maximum, third Wednesday of April for the current year, at 10:30h,
4) spring minimum, second Saturday of April for the current year, at 03:30h
5) summer maximum, third Wednesday of July for the previous year, at 10:30h
6) summer minimum, second Saturday of July for the previous year, at 03:30h
7) autumn maximum, third Wednesday of October for the previous year, at 10:30h
8) autumn minimum, second Saturday of October for the previous year, at 03:30h

Article 154

Year-ahead individual and common network models

(1) MEPSO shall determine a year-ahead individual network model for each of the scenarios using its best estimates of the variables. MEPSO shall publish its year-ahead individual network models on the ENTSO-E operational planning data environment.

(2) MEPSO shall include in its year-ahead individual network models the aggregated power outputs for Power generating facilities connected to distribution networks. Those aggregated power outputs shall:

1) be consistent with the structural data;
2) be consistent with the scenarios developed in accordance with Article 152; and
3) distinguish the type of primary energy source.

(3) MEPSO shall have the right to request from another TSO any information on modifications to the transmission network topology or on operational arrangements, such as protection setpoints or system protection schemes, single line diagrams and configuration of substations or additional network models.

(4) MEPSO has to update its individual network model in case of changes to the variables used to create the model for the year-ahead, and it is obliged to publish it on the ENTSO-E data platform for operational planning.

Article 155

Week-ahead individual and common network models

(1) Where it's necessary, MEPSO shall jointly with other TSOs determine the most representative scenarios for coordinating the operational security analysis of its transmission system for the week-ahead time-frame and shall jointly develop a methodology for merging the individual network models.

(2) MEPSO shall establish or update its week-ahead individual network models pursuant to determined scenarios.

(3) MEPSO or the Regional security coordinator to which the task referred to in paragraph 1 has been delegated, shall build the week-ahead common network models.

Article 156

Methodology for building day-ahead and intraday common network models

(1) MEPSO shall create day-ahead and intraday individual network models and publish them on the ENTSO-E operational planning data environment.

(2) When creating the day-ahead or intraday individual network models, MEPSO shall include:

1) up-to-date load and generation forecasts;
2) the available results of the day-ahead and intraday market processes;
3) the available results of the scheduling tasks;
4) for Power generating facilities connected to distribution systems, aggregated active power output differentiated on the basis of the type of primary energy source, in line with data provided in accordance with Articles 134, 137, 138, 142, 143 and 144 from these Network Codes;
5) up-to-date topology of the electricity transmission network.

Article 157

Common network model building

(1) Regional security coordinator shall check the quality of the individual network models in order to contribute to building the common network model for each time-frame mentioned in Article 151.

(2) MEPSO shall make available to its regional security coordinator the individual network model necessary to build the common network model for each time-frame through the ENTSO-E operational planning data platform.

(3) Where necessary, the regional security coordinator may ask MEPSO to correct its individual network model in order to achieve its conformity with the quality controls and for its improvement.

(4) MEPSO shall correct its individual network models, after verifying the need for correction if applicable, on the basis of the requests of the regional security coordinator or another TSO.

(5) Regional security coordinator has an obligation to prepare the common network model for each time-frame and store it on the ENTSO-E operational planning data platform.

Article 158

Operational security analysis in the operational planning process

(1) MEPSO shall perform coordinated operational security analyses for at least the following time-frames:

1) year-ahead;
2) week-ahead, when applicable;
3) day-ahead; and
4) intraday.

(2) When performing a coordinated operational security analysis, MEPSO shall apply the methodology developed in accordance with an up-to-date ENTSO-E methodology.

(3) To perform operational security analyses, MEPSO shall, in the N-State, simulate each outage from its outage list and verify that, in the (N-1)-state, the operational security limits defined in accordance with Article 124 are not exceeded..

(4) MEPSO shall perform its operational security analyses using the common network models and shall take into account the planned outages when carrying out those analyses.

(5) MEPSO shall share the results of its operational security analysis with at least the TSOs whose elements are included in the MEPSO's observability area and are affected according to that operational security analysis, in order to allow those TSOs to verify that operational security limits are respected within their control areas.

Article 159

Year-ahead up to and including week-ahead operational security analysis

(1) MEPSO shall perform year-ahead and, where applicable, week-ahead operational security analyses in order to detect at least the following constraints:

1) power flows and voltages exceeding operational security limits;
2) violations of stability limits of the electricity transmission network; and
3) violations of short-circuit thresholds.

(2) When MEPSO detects a possible constraint, it shall design remedial actions. If remedial actions without costs are not available and the constraint is linked to the planned unavailability of some relevant elements, the constraint shall constitute an outage planning incompatibility and MEPSO shall initiate outage coordination depending of the time of the year when this action is initiated.

Article 160

Day-ahead, intraday and close to real-time operational security analysis

(1) MEPSO shall perform day-ahead, intraday and close to real-time operational security analyses to detect possible constraints and prepare and activate the remedial actions with any other concerned TSOs and, if applicable, affected DSOs or SGUs.

(2) MEPSO shall monitor load and generation forecasts. When those forecasts indicate a significant deviation in load or generation, MEPSO shall update its operational security analysis.

(3) When performing close to real-time operational security analysis in its observability area, MEPSO shall use the tools for estimation of the system state within its SCADA/EMS system.

Article 161

Regional operational security coordination

(1) MEPSO shall provide the regional security coordinator with all the information and data required to perform the coordinated regional operational security assessment, including at least:

1) the updated random outages list;
2) the updated list of possible remedial actions; and
3) the operational security limits established in accordance with Article 124 from these Network Codes.

V.6.3 Outage coordination

Article 162

Outage coordination objective

(1) MEPSO shall, with the support of the regional security coordinator for the instances specified in these Network Codes, perform outage coordination in order to monitor the availability status of the relevant elements and coordinate the availability plans to ensure the operational security of the electricity transmission network.

Article 163

Regional coordination

(1) All TSOs of an outage coordination region shall jointly develop a regional coordination operational procedure, aimed at establishing operational aspects for the implementation of the outage coordination in each region, which includes:

1) frequency, scope and type of coordination for, at least, the year-ahead and week-ahead time-frames;
2) provisions concerning the use of the assessments carried out by the regional security coordinator;
3) protocols for the validation of the year-ahead relevant network element availability plans, as required by Article 175.

(2) MEPSO shall participate in the outage coordination of its outage coordination region and apply the regional coordination operational procedures established in accordance with an up-to-date ENTSO-E methodology for coordination of outages.

(3) If outage planning incompatibilities arise between different outage coordination regions, MEPSO shall jointly with other TSOs and regional security coordinators of those regions coordinate to resolve those outage planning incompatibilities.

(4) MEPSO shall provide to the other TSOs from the same outage coordination region all relevant information at its disposal on the infrastructure projects related to the electricity transmission network, distribution network, Power generating modules, or demand facilities that may have an impact on the operation of the control area of another TSO within the outage coordination region.

(5) MEPSO shall provide the transmission-connected DSOs located in its control area with all relevant information at its disposal on the infrastructure projects related to the transmission network that may have an impact on the operation of the distribution system of these DSOs.

(6) MEPSO shall provide the regional security coordinator with the information necessary to detect and solve regional outage planning incompatibilities, including at least:

1) the availability plans of its internal relevant elements, stored on the ENTSO-E operational planning data platform;

2) the most recent availability plans for all non-relevant elements of its control area which are:

   - capable of influencing the results of the outage planning incompatibility analysis;
   - modelled in the individual network models which are used for the outage incompatibility assessment;

3) scenarios on which the outage planning incompatibilities have to be investigated and used to build the corresponding common network models derived from the common network models for different time-frames.

(7) Regional security coordinator shall perform regional operational security analyses on the basis of the information provided by MEPSO and other relevant TSOs in order to detect any outage planning incompatibility. It shall provide all TSOs of the outage coordination region with a list of detected outage planning incompatibilities and the solutions it proposes to solve those outage planning incompatibilities.

(8) MEPSO shall take into account the results of the assessment provided by the regional security coordinator in accordance with paragraph 6 and paragraph 7 of this Article.

Article 164

Lists of relevant Power generating modules and relevant demand facilities

(1) On the basis of an up-to-date ENTSO-E methodology, MEPSO shall jointly with other TSOs of its outage coordination region establish a single list of relevant Power generating modules and relevant demand facilities and make it available on the ENTSO-E operational planning data platform.

(2) MEPSO notifies ERC about the list from paragraph (1) of this Article within 30 days of its compliance.

(3) For each internal relevant element which is a Power generating Moduleor demand facility, MEPSO shall:

1) inform the owner of the relevant Power generating Moduleor relevant demand unit about its inclusion in the list;

2) inform DSOs about the relevant Power generating modules and the relevant demand units which are connected to their electricity distribution network;

Article 165

Lists of relevant electricity transmission or power distribution network elements

(1) MEPSO shall, jointly with other TSOs of its outage coordination region, establish a single list of relevant network elements located in a transmission or in a distribution network and make it available on the ENTSO-E operational planning data platform.

(2) MEPSO shall notify ERC about the list from paragraph (1) of this Article within 30 days of its compliance.

(3) For each internal relevant element which is a network element from the transmission or distribution network, MEPSO shall:

1) inform the owner of the relevant network element about its inclusion in the list;

2) inform DSOs about the relevant network elements which are connected to their distribution system;

Article 166

Updating the lists

(1) MEPSO shall, jointly with other TSOs of the outage coordination region, re-assess the relevance for the outage coordination of Power generating units, demand facilities and network elements located in a transmission or distribution network.

(2) Where necessary, MEPSO shall, jointly with other TSOs of the outage coordination region, decide to update the list of relevant Power generating and demand units and the list of relevant network elements of that outage coordination region.

(3) MEPSO shall make the updated list available on the ENTSO-E operational planning data platform.

(4) MEPSO shall inform the parties referred to in Article 163(3) about the content of the updated list.

Article 167

Outage planning coordinator

(1) MEPSO is the outage planning coordinator for each relevant element of the electricity transmission network.

(2) The owners of other relevant elements appoint or act as outage planning coordinators of the respective relevant elements and inform MEPSO about the appointment.

Article 168

Dealing with the relevant elements located in the electricity transmission network

(1) MEPSO shall coordinate with the DSO the outage planning of internal relevant elements connected to its electricity distribution network.

(2) MEPSO, together with the operator of the closed electricity distribution system, coordinates the outage plans for the internal relevant elements that are connected to the closed electricity distribution network.

Article 169

Variations to deadlines for the year-ahead outage coordination

(1) MEPSO and other TSOs within a synchronous area may jointly agree to adopt and implement a time-frame for the year-ahead outage coordination provided that the outage coordination of other synchronous areas is not impacted.

Article 170

General provisions on availability plans

(1) The availability plans shall contain at least the following information:

1) the reason for the 'unavailable' status of a relevant element;
2) where such conditions are identified, the conditions to be fulfilled before applying the 'unavailable' status of a relevant element in real-time;
3) the time required to restore a relevant element back to service where necessary in order to maintain operational security.

(3) The availability status for each relevant element in the year-ahead time-frame should be defined on a daily basis.

(4) When generation schedules and demand schedules are submitted to MEPSO pursuant to Article 185 of these Network Codes, the time resolution of the availability statuses shall be consistent with those schedules.

Article 171

Long-term indicative availability plans

(1) No later than two years before the start of any year-ahead outage coordination, MEPSO shall assess the corresponding indicative availability plans for internal relevant elements, provided by users and DSO, and shall provide its preliminary comments including any detected outage planning incompatibilities to all affected users and DSO.

(2) MEPSO shall carry out the assessment concerning the indicative availability plans for internal relevant elements every year until the start of the year-ahead outage coordination.

Article 172

Provision of year-ahead availability plan proposals

(1) The electricity transmission network user, at the request of MEPSO, should submit to MEPSO an availability plan covering the following calendar year for each of its relevant elements. The availability plan is submitted to MEPSO no later than November 15 of the current year for the following year.

(2) MEPSO shall endeavour to examine the requests for amendment of an availability plan when received. Where this is not possible, it shall examine the requests for amendment of an availability plan after the year-ahead outage coordination has been finalized.

(3) MEPSO will examine the requests for amendments to the availability plan after the year-ahead outage coordination is finalized:

1) following the order in which the requests were delivered; and

2) taking into account the procedure defined in article 177 of these Network Codes.

Article 173

Year-ahead coordination of the availability status of relevant elements which are in ownership of transmission system user

(1) MEPSO shall assess on a year-ahead time-frame whether outage planning incompatibilities arise from the received availability plans.

(2) When MEPSO detects outage planning incompatibilities, it shall implement the following process:

1) inform each transmission system user of the conditions that must be fulfilled to mitigate the detected outage planning incompatibilities;

2) MEPSO may request that one or more transmission system users submit an alternative availability plan fulfilling the conditions referred to in point (1) of this ; and

3) MEPSO shall repeat the assessment pursuant to paragraph (1) of this Article to determine whether any outage planning incompatibilities remain.

(3) If at the request of MEPSO, in accordance with point 2) of paragraph (2), the users of the electricity transmission system do not fulfill the request for submission of alternative plans for availability, MEPSO prepares an alternative plan for availability and delivers it to the users for its implementation.

Article 174

Coordination of availability of relevant elements which are in ownership of MEPSO or DSO

(1) MEPSO shall plan the availability status of relevant network elements interconnecting different control areas in coordination with the TSOs of the same outage coordination region.

(2) MEPSO and DSO shall plan the availability status of the relevant network elements that are not interconnecting different control areas.

(3) Where MEPSO detects an outage planning incompatibility, MEPSO shall be entitled to propose a change to the availability plans of the internal relevant elements which belong to user and shall identify a solution in coordination with the users and DSOs concerned, using the means at its disposal.

(4) Where the 'unavailable' status of a relevant network element has not been planned after taking the measures in paragraph (3) of this Article and the absence of such planning would threaten operational security, MEPSO shall:

1) take the necessary actions to plan the 'unavailable' status while ensuring operational security, taking into account the impact reported to MEPSO by affected users;
2) informs all affected parties about the activities referred to in point 1); and
3) informs the affected DSOs if any and the affected users of the actions taken, including the rationale for such actions, the impact reported by affected users and the DSO.

(5) MEPSO will make available all information on the ENTSO-E data platform for operational planning on the conditions related to the electricity transmission network that need to be met, as well as the corrective measures that need to be prepared and activated, before the status "unavailable" is set for the relevant element of the electricity transmission network.

Article 175

Provision of preliminary year-ahead availability plans

(1) MEPSO shall provide to all other TSOs, via the ENTSO-E operational planning data platform, the preliminary year-ahead availability plans for the following calendar year for all the internal relevant elements from the electricity transmission network.

(2) MEPSO shall provide the DSO with the preliminary year-ahead availability plan.

Article 176

Validation of year-ahead availability plans within outage coordination regions

(1) In the absence of outage planning incompatibilities, MEPSO shall, jointly with other TSOs of the outage coordination region, validate the year-ahead availability plans for all relevant elements of that outage coordination region.

(2) If MEPSO detects an outage planning incompatibility in which it is involved, it shall, jointly with other TSOs of the outage coordination region, identify a solution using the means at their disposal. Where a solution is identified, all TSOs of the concerned outage coordination region shall update and validate the year-ahead availability plans for all relevant elements.

Article 177

Final year-ahead availability plans

(1) MEPSO shall:

1) finalize the year-ahead outage coordination of internal relevant elements; and
2) finalize the year-ahead availability plans for internal relevant elements and store them on the ENTSO-E operational planning data platform.

(2) MEPSO shall provide to the relevant DSO the final year-ahead availability plan for each internal relevant element located in a distribution system.

Article 178

Updates to the final year-ahead availability plans

(1) The user or DSO shall be able to launch a procedure for the amendment of the final year-ahead availability plan in the time between the finalization of the year-ahead outage coordination and its real-time execution.

(2) MEPSO shall acknowledge the request and assess as soon as reasonably practicable whether the amendment leads to outage planning incompatibilities;

(3) MEPSO shall prepare a proposal for amendment to the year-ahead availability plan, including an assessment of whether it could lead to outage planning incompatibilities and shall submit its proposal to all other TSOs of its outage coordination region;

Article 179

Real-time execution of the availability plans

(1) Where MEPSO identifies that executing an 'unavailable' status of a relevant element leads or could lead the transmission system out of normal state, MEPSO shall instruct the owner of the relevant element when it is connected to the transmission system, or the DSO if connected to a distribution system, to delay the execution of that 'unavailable' status of that relevant element according to its instructions and to the extent possible, while respecting the technical and safety limits.

V.6.4 Adequacy

Article 180

Forecast for control area adequacy analysis

(1) MEPSO shall make any forecast used for control area adequacy analyses available to all other TSOs through the ENTSO-E operational planning data platform.

Article 181

Control area adequacy analysis

(1) MEPSO shall perform control area adequacy analysis by assessing the possibility for the sum of generation within its control area and cross-border import capabilities to meet the total load within its control area under various operational scenarios, taking into account the required level of active power reserves.

(2) MEPSO conducts analyzes for the adequacy of its control area based on the following data:

1) plans for the availability of generation facilities:
2) forecasted electricity consumption;
3) forecast for electricity generation, including renewable energy sources.
4) forecast cross-border capacity and
5) possible demand response.

(3) based on the conducted analysis, MEPSO makes an assessment of the probability and expected duration of absence of adequacy and the expected undelivered energy as a result of such absence of adequacy.

Article 182

Control area adequacy up to and including week-ahead

(1) MEPSO shall contribute to the pan-European annual summer and winter generation adequacy outlooks applying the methodology for short-term adequacy of the system (STA - Short-term adequacy) adopted by ENTSO-E.

(2) Twice a year, MEPSO shall perform a control area adequacy analysis for the following summer and winter respectively, taking into account pan-European scenarios consistent with the pan-European annual summer and winter generation adequacy outlooks.

(3) MEPSO shall update its control area adequacy analyses if it detects any probable changes to the availability status of Power generating modules, load estimations, renewable energy sources estimations or cross border capacities that could significantly affect the expected adequacy.

Article 183

Control area adequacy in day-ahead and intraday

(1) MEPSO shall perform a control area adequacy analysis in a day-ahead and intraday time-frame on the basis of:

1) schedules referred to in Article 185 of these Network Codes;
2) forecasted load;
3) forecasted generation from renewable energy sources;
4) active power reserves;
5) control area cross-border import and export capacities;
6) abilities of Power generating modules and their availability statuses; and
7) ability of demand facilities with demand response and their availability statuses.

(2) MEPSO shall evaluate:

1) the minimum level of import and the maximum level of export compatible with its control area adequacy;
2) the expected duration of a potential absence of adequacy; and
3) the amount of energy not supplied in the absence of adequacy.

(3) Where adequacy is not fulfilled, MEPSO shall notify the absence of adequacy to ERC. MEPSO shall provide ERC with an analysis of the causes of the absence of adequacy and propose mitigating actions.

Article 184

Regional adequacy assessment

(1) MEPSO shall provide the regional security coordinator with the information necessary to perform the regional adequacy assessments, including:

1) the expected total load and available resources of demand response;
2) the availability of power generation modules; and
3) the operational security limits.

V.6.5 Scheduling

Article 185

Establishment of scheduling processes

(1) When establishing a scheduling process, MEPSO shall take into account and complement where necessary the operational conditions of the generation and consumption of electricity in accordance with the EU regulation on capacity allocation and congestion management (Regulation (EU) 2015/1222 Capacity Allocation and Congestion Management).

(2) For each Power generating facility and demand facility subject to requirements for scheduling according to a national legislation, the concerned owner shall appoint or act as a scheduling agent.

(3) Each market participant, subject to requirements for scheduling, shall appoint or act as a scheduling agent.

(4) Pursuant to the submitted transactions from paragraph (2) and paragraph (3) MEPSO shall establish for its control area scheduling processes necessary to process the transaction schedules submitted by the scheduling agent.

Article 186

Notification of schedules within scheduling areas

(1) Each scheduling agent, shall submit to MEPSO, if requested, the following schedules:

1) generation schedules;
2) demand schedules;
3) internal commercial trade schedules; and
4) external commercial trade schedules.

Article 187

Compliance of schedules

(1) MEPSO shall check whether the generation, consumption, external commercial trade schedules and external TSO schedules in its scheduling area are in sum balanced.

(2) For external TSO schedules, MEPSO shall agree on the values of the schedule with the respective TSO. In the absence of an agreement, the lower value shall apply.

Article 188

Provision of information to other TSOs

(1) At the request of another TSO, MEPSO shall calculate and provide:

1) aggregated netted external schedules; and
2) netted area AC position.

(2) When required for the creation of common network models, MEPSO shall provide any requesting TSO with:

1) generation schedules; and
2) demand schedules.

V.7. Ancillary services

V.7.1 Introduction

Article 189

(1) MEPSO is obliged to procure ancillary services necessary for the safe operation of the electricity power system, taking into account all planned outages, outages due to the disturbances and maintenance of frequency and voltage stability of the system.

(2) Under ancillary services it is assumed the following:

1) Frequency control - Active power services
   - Frequency containment process (FCR);

- Frequency restoration process ie Automatic Frequency Restoration Process (aFRR), Manual Frequency Restoration Process (mFRR),
- Replacement reserve process (RR).

2) Voltage control - Reactive power services
3) System restoration (Black start capability of the generators).

V.7.2 General provisions

Article 190

(1) With regard to active power and reactive power services, and in coordination with other TSOs where appropriate, MEPSO shall:

- design, set up and manage the procurement of ancillary services;
- monitor, on the basis of data provided by service providers, whether the level and location of available ancillary services allows ensuring operational security; and
- use all available economically efficient and feasible means to procure the necessary level of ancillary services

(2) MEPSO shall publish the levels of reserve capacity necessary to maintain operational security.

(3) MEPSO shall communicate the available level of active power reserves within LFC Block as well as to other TSOs upon request

(4) MEPSO shall cooperate with other TSOs in order to participate in establishment of relevant agreements of regional and pan-European cooperation, such as:

1) Synchronous area operational agreement (SAFA);
2) LFC block operational agreement;
3) Imbalance netting agreements (IN);
4) Cross-border FRR activation agreements;
5) Cross-border RR activation agreements;
6) Reserve sharing agreements;
7) Reserve exchange agreements;
8) Regional voltage control.

V.7.3 Frequency control

General

Article 191

(1) Frequency control in MEPSO comprises the following processes:

1) Frequency containment process (FCR), automatic response of power-generating units that provide frequency containment reserve,
2) Automatic frequency restoration process (aFRR), automatic response of power-generating units that provide automatic frequency restoration reserve,
3) Manual frequency restoration process (mFRR), manual response of power-generating units that provide manual frequency restoration reserve,
4) Reserve replacement process (RR), manual response of power-generating units that provide replacement reserve.

Frequency containment process (FCR)

Article 192

(1) Authorized body of ENTSO-E determines total volume of frequency containment reserve for MEPSO's control area on annual basis.

(2) MEPSO procures required volume of frequency containment reserve on generating units in North Macedonia's power system.

(3) MEPSO shall ensure that the combined reaction of FCR of a LFC area comply with the following requirements:

1) the activation of FCR shall begin as soon as possible after a frequency deviation;
2) in case of a frequency deviation equal to or larger than 200 mHz, at least 50 % of the full FCR capacity shall be delivered up to 15 seconds at the latest;
3) in case of a frequency deviation equal to or larger than 200 mHz, 100 % of the full FCR capacity shall be delivered up to 30 seconds at the latest;
4) in case of a frequency deviation equal to or larger than 200 mHz, the activation of the full FCR capacity shall rise at least linearly from 15 to 30 seconds; and
5) in case of a frequency deviation smaller than 200 mHz the related activated FCR capacity shall be at least proportional to the same conduct time specified in points 1, 2, 3 and 4 of this paragraph.

(4) MEPSO determines which Power generating units are involved in the frequency containment process (FCR) on the basis of the generation plan of a generation plant and requirements for safe operation of the transmission system.

(5) MEPSO shall monitor its contribution to the Frequency Containment Process and its Frequency Containment Reserve activation with respect to its obligation, including Frequency Containment Reserve providing units or groups. Each FCR provider shall make available to the reserve connecting MEPSO, for each of its FCR providing units and FCR providing groups, at least the following information:

1) time-stamped status indicating if FCR is on or off;
2) time-stamped active power data needed to verify FCR activation, including time-stamped instantaneous active power;

3) governor droop.

Frequency restoration process (FRR)

Article 193

(1) Functions on the frequency restoration process are:

1) restoring the frequency to its setup value,

2) realization of planned exchange programs between the Macedonian control area and neighboring control areas,

3) release of the frequency containment reserve (FCR) that was activated previously, so it will be again at disposal and

4) correction of synchronous time.

(2) MEPSO, as a member of LFC Block, shall set out FRR dimensioning rules in the LFC Block operational agreement within the process of allocation of responsibilities between TSOs in the LFC block for the implementation of the obligations to fulfil the target parameters and compliance with FRR dimensioning principles.

(3) MEPSO shall determine the ratio of automatic FRR, manual FRR, the automatic FRR full activation time and manual FRR full activation time in order to comply with the requirement to fulfill the target parameters within LFC Block.

(4) The ratio of automatic FRR and manual FRR reserve shall be determined by one of two following principles:

1) Probabilistic, which includes statistical analyses of historical data regarding deviations, or

2) Deterministic, which includes determination of aFRR according to empirical formula:

$$R = \sqrt{a \cdot Lmax + b^2} - b$$

Where:

R – Recommended automatic FRR

a and b – empirical parameters established for power system *(a=10; b=150)*

L_{max} – Maximum expected consumption

(5) MEPSO shall have the right to exchange frequency restoration reserve within a LFC Block or within a synchronous area of Continental Europe by signing operational agreement, defining the roles and responsibilities of the reserve connecting TSO, the reserve receiving TSO and the affected TSO for the exchange of FRR.

(6) MEPSO shall have the right to implement the imbalance netting process in the LFC block, between different LFC blocks within synchronous area CE or between different synchronous areas, by concluding an imbalance netting agreement.

(7) The FRR minimum technical requirements shall be the following:

1) FRR providing unit or FRR providing group shall activate FRR in accordance with the setpoint received from MEPSO;

2) the reserve instructing TSO shall be the reserve connecting TSO in case of cross-border cooperation between TSOs for FRR;

3) a FRR providing unit or FRR providing group for automatic FRR shall have an automatic FRR activation delay not exceeding 30 seconds;

4) Each FRR provider shall be capable of supplying real-time measurements concerning time-stamped scheduled and time-stamped instantaneous active power

5) a FRR providing unit or FRR providing group for automatic FRR shall be capable of activating its complete automatic reserve capacity on FRR within the automatic FRR full activation time specified by MEPSO

6) a FRR providing unit or FRR providing group for manual FRR shall be capable of activating its complete manual reserve capacity on FRR within the manual FRR full activation time specified by MEPSO

7) a FRR provider shall fulfil the FRR availability requirements, specified by MEPSO

(8) MEPSO shall develop a procedure for qualification and registration of FRR service providers and shall clarify and make publicly available its details within the Balancing Rules.

(9) A potential FRR provider shall demonstrate to MEPSO that it complies with the FRR minimum technical requirements in by completing successfully the qualification and registration process of potential FRR provider, described in the Balancing Rules.

(10) The qualification and registration of FRR providing units or FRR providing groups shall be re-assessed according to the Balancing Rules.

Reserve replacement process (RR)

Article 194

(1) MEPSO shall have the right to implement a reserve replacement process.

(2) MEPSO shall have the right to exchange RR within a LFC Block or within synchronous area of Continental Europe by signing operational agreement, defining the roles and responsibilities of the reserve connecting TSO, the reserve receiving TSO and the affected TSO for the exchange of RR.

(3) RR providing balancing units shall comply with the following minimum technical requirements:

1) a RR provider shall activate RR in accordance with the setpoint received from MEPSO;

2) the reserve instructing TSO shall be the reserve connecting TSO in case of cross-border cooperation between TSOs for RR;

3) activation and deactivation of complete reserve capacity on RR within the activation time defined by MEPSO;

4) each RR provider shall be capable of supplying real-time measurements concerning time-stamped scheduled and time-stamped instantaneous active power and

5) fulfillment of the RR availability requirements.

(4) MEPSO shall develop an RR prequalification process and shall clarify and make publicly available its details within the Balancing Rules.

(5) A potential RR provider shall demonstrate to MEPSO that it complies with the RR minimum technical requirements in by completing successfully the prequalification process of potential RR provider, described in the Balancing Rules.

(6) The qualification of RR providing units or RR providing groups shall be re-assessed at least once every 5 years, and where the technical or availability requirements or the equipment have changed.

V.7.4 Voltage control

Article 195

(1) MEPSO shall design, set up and manage the procurement of ancillary services for voltage control.

(2) MEPSO shall monitor, on the basis of data provided by ancillary service providers regarding their reactive power capabilities in connection point, whether the level of reserves and location of available providers allows ensuring operational security.

(3) MEPSO shall use all available economically efficient and feasible means to procure the necessary level of ancillary services.

(4) MEPSO shall have the right to take part in the voltage control process with neighboring TSOs to reduce cross-border reactive power flows on the minimum value.

(5) For each operational planning time-frame, MEPSO shall assess, whether its available reactive power ancillary services are sufficient to maintain the operational security of the transmission system.

(6) Within voltage control process, MEPSO shall monitor:

1) the available reactive power capacities of Power generating facilities;
2) the available reactive power capacities of transmission-connected demand facilities;
3) the available reactive power capacities of DSOs;
4) the available transmission-connected equipment dedicated to providing reactive power; and
5) the ratios of active power and reactive power at the interface between the transmission system and transmission connected distribution systems;

(7) MEPSO provides voltage control by:

1) Setting up required value of reactive power (in MVAr) or setting up required voltage level at the connection point to the transmission system respecting provided data about reactive power capabilities of the service provider;
2) adjusting transformers' tap ratios;
3) switching off/on reactive power compensators;
4) changing topology in the network.

V.7.5 System restoration after blackout

Article 196

(1) Black start capability is defined as ability of power-generating unit which is disconnected from the system to restore operation and begin power delivery without help from the power system.

(2) MEPSO activates and conducts ancillary service of a power-generating unit which is entitled for performing black start.

(3) Power-generating units that are able to restore operation after blackout must be always available and have to have at hand procedures for black star including qualified personal capable to execute the procedures.

(4) Power-generating units capable of black start must undergo tests of functionality at least once in three years. They are obliged to submit the results of the tests to MEPSO.

(5) MEPSO provides system restoration service with the help of power-generating units capable of black start by signing appropriate agreements with the generation facilities.

(6) Requirements for black start capability for Power generating units are defined in APPENDIX 3 – ADDITIONAL REQUIREMENTS FOR CONNECTION OF GENERATION UNITS

V.8. Power System Control

V.8.1 Control under normal operating condition

Article 197

(1) For control under normal operating condition MEPSO preforms the following activities:

1) supervision of power system operation in line with agreed daily plan;
2) activation of ancillary services;
3) communication between the operator in National Dispatching Center, operating technicians in the transmission system and user's facilities, and neighboring transmission system operators;
4) supervision of power system operation;
5) supervision of primary and secondary equipment condition and the auxiliary plants in the transmission system;
6) performing manipulations with the switching equipment;
7) choice of control regime, local or remote;
8) registering the quantities of operational parameters, alarm and position signals and the signals of the protection system;
9) coordination of departments for control and maintenance, and
10) exchange of other data necessary for control.

Supervision of power system operation

Article 198

(1) MEPSO performs supervision of the EPS operation with following information at disposal in real time:

1) system frequency;
2) voltage values on busbars in the transmission network facilities;
3) active and reactive power flows in the transmission system;
4) control with Area Control Error;
5) indication signals and alarms in the facilities of the electricity transmission network and of the users;
6) generation units active and reactive power;
7) status of the switching equipment;
8) positions of transformers' regulating switch, and
9) alarms and signals validating measured values, protective devices operation, communication status, etc.

(2) MEPSO performs supervision of operating parameters of the transmission system using:

1) SCADA/EMS in the National Dispatching Center of MEPSO
2) local systems for control and supervision in MEPSO's and user's facilities
3) information received by other means of communication with transmission system facilities, user's facilities and operators of neighboring systems.

Instructions

Article 199

(1) National Dispatching Center (NDC) of MEPSO issues dispatching instruction during control under normal operating conditions to:

1) Operate of the switching equipment in the transmission system,
2) activate ancillary services,

(3) NDC issues verbal instruction; instruction must be recorded on voice recorder or confirmed in written form, or any other way in line with internal procedures of MEPSO and with The contract for the use of the electricity transmission network concluded between MEPSO and the users.

(4) Operating technicians in the transmission system and user's facilities have the responsibility to carry out the instruction issued by NDC.

(5) Exceptionally, in case of instruction issued by NDC that may bring about peril to persons or compromise the facility, the subordinate personnel in terms of system control (operating technicians in transmission facilities and/or staff in control centers of transmission system users) doesn't have the obligation to carry out such an order subject to providing a justification for such action. On the other hand, such personnel is free to propose control actions to the competent NDC based on available data and information, bearing every responsibility for the accuracy of such data.

Intra-day Modifications of the Daily Power System Operation Plan

Article 200

(1) Balancing Responsible Party shall have a right to make a request for intra-day modification of its scheduled net position in line with the Balancing Rules. MEPSO verifies whether such request for modification:

1) jeopardizes preconditions for a normal power system operation,
2) interferes with electricity market activities, and
3) jeopardizes transmission system access for another transmission system users.

(2) MEPSO has a right to refuse such request for modification if one of the criteria stated in paragraph (1) of this Article above are proved, and in that case other means are sought by MEPSO in collaboration with the transmission system user, in order to deal with the situation that called for the Daily operational plan modifications.

(3) In case of significant modifications in terms of deviation of consumption, generation or transmission capacities availability, MEPSO may independently modify the Daily power system operation plan.

Execution of operation in the electricity transmission network

Article 201

(1) The procedure governing execution of operation in the transmission system comprise following activities:

1) information exchange in line with Article 176 and Article 177 of this Code about any planned or emergency works and/or manipulations in transmission and user's facilities according to the Agreement on access and usage of the transmission network,
2) instructions issued by NDC for execution of manipulations in line with Article 204 of this Code,
3) confirmation of executed manipulation by the operating technician on duty in transmission system and user's facilities, and

4) instructions issued by NDC or operating technician on duty in the transmission system or user's facilities for execution of works on lines, following confirmation of executed manipulations.

(2) Upon disconnection requests and in line with daily plan and emergency disconnections, MEPSO performs disconnection of components in EPS.

Notification at execution of operation in the electricity transmission system

Article 202

(1) MEPSO and users are obliged to exchange timely information on reliable way about all planned or emergency disconnections in the transmission system.

(2) In case of execution of operations or manipulations for emergency interruptions in the transmission system, for which the security criteria N-1 is not fulfilled, by words or by fax or by electronic means, MEPSO is responsible to realize such interruptions with the shortest time period.

(3) The user must inform MEPSO of any planned operations or manipulations in the user's facility of part thereof which may compromise secure operation of the power system or operation of other users. In accordance with notification received from the user, MEPSO notifies other users as well as operators of neighboring transmission systems in line with ENTSO-E guidelines on joint operation in the interconnection.

(4) Information for planned and emergency disconnections comprises following data:

1) exact name of the element in EPS, subject to execution of operations/manipulation,
2) description of operations/manipulation,
3) approximate time for starting and completing the operations/manipulations, and
4) warning about possible consequences to secure operation to EPS and safety of user's supply.

Procedures governing execution of operations in the electricity transmission network

Article 203

(1) In case of execution of operations in part of the transmission system under its responsibility, MEPSO shall follow internal procedures regarding:

1) giving instructions and modality of their delivery,
2) description of confirmation content about executed manipulation and modality of its delivery, and
3) giving permits for execution of operations and description of their content.

(2) In the Agreement on access and usage of the transmission network, all procedures for execution the operations and manipulations in the user facilities are defined.

(3) Coordination of protection measures during operations between users and MEPSO are predefined in scope of the Agreement on access and usage of the transmission network.

Telecommunication systems

Article 204

(1) MEPSO enables continuous communication with the network users, electricity market player and other TSOs.

(2) Transmission system users through communication systems ensure continuous information exchange with the National Dispatching Center (NDC) and the Reserve Dispatching Center (RDC) in line with provisions predefined in Article 77 of these Network Codes.

(3) Telecommunication links must be available 24 hours a day.

(4) All devices for information exchange must be periodically inspected.

(5) All communication systems, that provide continuous exchange of information, must have appropriate backup in case of failure. The procedure for exchange of information in case of failure is defined in an Agreement on access and usage of the transmission network.

Technical Control System

Article 205

(1) Technical Control System of MEPSO enables supervision and control with power system in real time and extended real time.

(2) National Dispatching Center performs supervision and control of EPS in a real time trough access to all data (measurements, statuses, alarms etc.) necessary for reliable EPS operation.

(3) MEPSO has obligation to keep the data of the system for analyzing EPS performances.

(4) MEPSO must have Reserve Dispatching Center that will enable the supervision and control of EPS in a case of un-operability of the National Dispatching Center. All procedures for taking over the EPS control by the Reserve Dispatching Center are defined within the Defense plan.

Maintenance of the communication and transmission network control equipment

Article 206

(1) MEPSO and the transmission system user have the obligation to keep their communication and transmission system control equipment in a proper operating condition.

(2) The user is obliged to plan, develop and maintain all of the telecommunication infrastructure and the control equipment that is in its ownership.

(3) The maintenance works of communication and transmission system control equipment must be planned in the manner to avoid any interference with secure transmission system operation. The planning process of the maintenance works is carried out in collaboration with the system users and neighboring transmission system operator.

(4) Transmission system user must deliver all documentation to MEPSO relating to communication and transmission network control equipment installed at 400/110 kV part of the connection in its facility.

(5) In case of communication and/or transmission network control equipment fault, the transmission system user has the obligation to inform MEPSO.

Data Acquisition

Article 207

(1) MEPSO has obligation to collects all data required for planning and analysis of the power system operation as follows:

1) hourly exchange on interconnection lines,
2) hourly generation of active and reactive energy of all power plants,
3) hourly load on distribution transformers 110/X kV,
4) hourly consumption of demand facilities directly connected on the transmission network,
5) level of the accumulation and inflows in the hydro power plants,
6) information related to element's outages in the system comprising of cause of the outages, time of the outage with time resolution better than 10 msec and duration time of interrupted supply to specific demand area,
7) information related to power plant's outages stating the reason and recorded time of e outage,
8) voltage values in the relevant transmission network facilities, and
9) other relevant data for power system planning and analysis.

(2) The system users have obligation to submit to MEPSO all data listed in paragraph (1) of this Article, related to their facilities in the manner and form specified by MEPSO.

V.8.2 Control in Disturbed State

Article 208

(1) During control of EPS in disturbance operation mode, MEPSO has the obligation to execute measures for limiting the propagation of the disturbances as well as restoration of the power system operation.

(2) Secure and stable operation of the EPS and its restoration has priority over partial interests of the transmission system users.

(3) Power system control in disturbed state considers implementation of defense measures predefined in plans for EPS operation in emergency conditions.

(4) All local disturbances (faults) in transmission system are resolved by timely and selective operation of the Protection system.

(5) The plan for execution of preventive measures comprise all control measures at disposal to the National Dispatching Center for limiting the propagation of the disturbance and enable restoration of normal system operation without implementation of emergency curtailments.

(6) Whenever implemented preventive measures are inadequate or there is still danger for propagation of the disturbance, MEPSO has the responsibility to temporarily cut-off parts of the system in order to maintain secure system operation and prevent detrimental large scale consequences (total blackout). In disturbed operation regime instruction received from MEPSO must be executed without delay.

(7) Whenever there is a case of active power deficiency in the power system, voltage collapse, i.e. lack of reactive power in the system, overloading of transmission network components or any other disturbances threatening to jeopardize the system normal operation, the electricity delivery curtailment may be imposed throughout the system or in parts thereof by according to the Defense plan.

(8) In case of partial or total blackout of the power system, MEPSO and system user's competent control centers restore power system operation in line with the System Defense Plan.

(9) Whenever there is a case of any disturbance interfering with the secure operation of EPS and important for both responsible parties, MEPSO and the users must exchange information about the new situation.

(10) At MEPSO's request, the user must carry out specific checkout of its equipment connected to the transmission system under responsibility of MEPSO with the goal to analyze disturbances in the transmission system.

(11) MEPSO has obligation to prepare report after every significant disturbance in the transmission system relating to disturbance causing electricity supply cut-offs, load curtailment or suspension of contracted electricity exchanges.

(12) The report on significant disturbance includes the following data:

1) date, time of occurrence and disturbance duration,
2) location and cause of the disturbance,
3) information about suspension of contracted EE exchanges or reducing the delivery of EE, and
4) total suspended exchange/non-delivered EE.

V.8.3 Technical and other Requirements for System Operation in Interconnection

Article 209

(1) Cooperation between MEPSO and other transmission system operators implements on two levels:

1) in control block and

2) with other control blocks

(2) MEPSO has the obligation cooperate with neighboring transmission system operators to ensure coordinated voltage control at the ends of interconnection lines and reduce reactive power exchange.

(3) MEPSO has the obligation to supervise realization of planned active power exchange with other TSOs. Exchange is realized with the request to minimize deviation between agreed and actual exchange.

(4) MEPSO has the obligation to ensure reserve in transmission capacity between the Macedonian EPS and other systems enabling additional flow of power by operation of primary control during disturbance.

(5) MEPSO is obliged to take part in frequency control in line with ENTSO-E guidelines.

(6) On the border with the neighboring operator, MEPSO coordinates the following:

1) available local reactive power reserve,
2) minimal and maximal allowed voltages in continuous operation and their short-term violations,
3) reactive power exchange band and procedures during its violation,
4) joint actions for voltage control.

(7) MEPSO has the obligation to coordinate procedures for switching-on/switching-off of the interconnection lines with the neighboring TSOs.

(8) Accounting and compensation of un-intentional deviations is carried out in line with the ENTSO-E guidelines.

(9) MEPSO has the obligation to implement and adjust protection system in coordination with the neighboring TSOs.

(10) MEPSO has the obligation to coordinate with neighboring operators in terms of congestion control.

(11) MEPSO coordinates activities with neighboring transmission system operators in disturbed operation of the interconnection.

(12) According to the ENTSO-E recommendations, MEPSO has an obligation to sign bilateral operational agreements with neighboring TSOs, in which all other activities related to secure operation of the interconnection should be regulated.

V.8.4 System Operation Transparency

Article 210

(1) National Dispatching Center is obliged to keep a chronological operation log and reports which comprise all relevant data relating to transmission system control:

1) issued and received instructions,
2) outages and faults of transmission system components,
3) executed manipulations in the transmission system,

4) relevant events for operation of generation facilities,

5) relevant events for secure transmission system operation,

6) enforcement of suspended electricity delivery,

7) issues with control equipment,

8) protection system availability within transmission system,

9) operational documents,

10) received telegrams, and

11) other relevant data for power system planning and analysis.

(2) Pursuant to the operation log, archived data in the supervisory and control systems and data delivered by the users, MEPSO prepares periodic reports relating to transmission system operation. Transmission system operation report includes data on:

1) EE generation,

2) EE consumption,

3) EE exchange,

4) electricity transmission system losses,

5) activated ancillary services,

6) events in system operation,

7) duration of EE delivery cut-offs, and

8) other relevant data for EPS planning and analysis.

(3) MEPSO is obliged to deliver transmission system operation reports to the ERC at request.

(4) MEPSO is obliged to publish data on the Transparency platform in line with ENTSO-E requirements.

VI. EMERGENCY STATE AND SYSTEM RESTORATION

VI.1. General provisions

Article 211

(1) For the purposes of safeguarding operational security, preventing the propagation or deterioration of an incident to avoid a widespread disturbance and the blackout state, as well to allow for the efficient and rapid restoration of the electricity system from the emergency or blackout states, this section describes:

1) the management by MEPSO of the emergency, blackout and restoration states;
2) the coordination of interconnection operation in the emergency, blackout and restoration states;
3) the simulations and tests to guarantee a reliable, efficient and fast restoration of the interconnected transmission systems to the normal state from the emergency or blackout states;
4) the tools and facilities needed to guarantee a reliable, efficient and fast restoration of the interconnected transmission systems to the normal state from the emergency or blackout states.

(2) MEPSO shall follow guidelines and requirements set out in *Network code for electricity emergency and restoration defined by ENTSO-E* regarding development of relevant rules and plans.

VI.2. System defence plan

Article 212

(1) MEPSO shall develop a System Defense Plan in consultation with relevant DSOs, SGUs, ERC, neighboring TSOs and other relevant TSOs in its synchronous area.

(2) Development of system defense plan will cover the following aspects:

1) Design of the System Defense Plan,
2) Implementation of the System Defense Plan,
3) Activation of the System Defense Plan,
4) Inter-TSO assistance and coordination in emergency state.

(3) The System Defense Plan will contain the following measures:

1) Automatic under-frequency control scheme,
2) Automatic over-frequency control scheme,
3) Automatic scheme against voltage collapse,
4) Frequency deviation control procedure,

5) Power flow control procedure,

6) Assistance for active power procedure,

7) Manual load disconnection procedure.

VI.3. System Restoration plan

Article 213

(1) MEPSO shall develop a system restoration plan in consultation with relevant DSOs, SGUs, national regulatory authorities, neighboring TSOs and other relevant TSOs in its synchronous area.

(2) Development of system defense plan will cover the following aspects:

1) Design of the System Restoration Plan,

2) Implementation of the System Restoration Plan,

3) Activation of the System Restoration Plan,

(3) The System Restoration Plan will contain the following processes:

1) Re-energization, consisting of

- Re-energization procedure;
- Activation of re-energization procedure.

2) Frequency control, consisting of

- Frequency control procedure;
- Appointment of frequency leader;
- Frequency control after frequency deviation;
- Frequency control after synchronous area split.

3) Re-synchronization, consisting of:

- Re-synchronization procedure,
- Appointment of a re-synchronization leader,
- Re-synchronization strategy.

VI.4. System Market interactions

Article 214

(1) MEPSO may temporarily suspend one or more market activities in the following cases:

1) The transmission system is in blackout state, or

2) MEPSO has exhausted all options provided by the market and the continuation of market activities under the emergency state would deteriorate the state of the system.

3) the continuation of market activities would decrease significantly the effectiveness of the restoration process to the normal or alert state; or

4) tools and communication means necessary for the TSO to facilitate market activities are not available

(2) In case of suspension of market activities pursuant to paragraph 1, upon request of MEPSO, each SGU shall operate, where technically possible, at an active power set-point established by MEPSO.

VI.5. Information exchange and communication, tools and facilities

Article 215

(1) MEPSO shall follow guidelines and requirements set out in the *Network Code for electricity emergency and restoration* defined by ENTSO-E on information exchange and communication principles, as well as requirements on tools and facilities.

(2) When in the emergency, blackout or restoration states, MEPSO shall be entitled to gather the following information:

1) From relevant DSOs the necessary information about at least:
   - the part of their distribution network that is in island operation;
   - the ability to synchronize parts of their distribution network that is in island operation; and
   - the capability to start island operation.

2) From relevant SGUs and system restoration service providers, information about at least the following conditions:
   - the current status of the installation;
   - the operational limits;
   - the full activation time and the time to increase generation; and
   - the time critical processes.

(3) Each relevant DSO, SGU and system restoration service provider shall have a voice communication system in place with sufficient equipment redundancy and backup power supply sources to allow the exchange of the information needed for the system restoration plan for at least 24 hours, in case of total absence of external EE supply or in case of failure of any individual voice communication system equipment.

(4) MEPSO shall establish as part of the Agreement on access and usage of the transmission network and in consultation with each relevant DSO, SGU and system restoration service provider,

the technical requirements to be fulfilled by their voice communication systems as well as by the MEPSO's own voice communication system in order to allow their interoperability and to guarantee that the TSO's incoming call can be identified by the other party and answered immediately.

VI.6. Compliance and check-up

Article 216

(1) MEPSO shall periodically assess the proper functioning of all equipment and capabilities considered in the system defense plan and the system restoration plan. To this end, MEPSO shall periodically verify the compliance of such equipment and capabilities.

(2) MEPSO shall define a test plan in consultation with DSOs, relevant SGUs, defense service providers and restoration service providers. The test plan shall identify the equipment and capabilities relevant for the system defense plan and restoration plan that have to be tested.

(3) Test plan shall be defined as parts of the defense and restoration plans.

(4) DSOs, relevant SGUs, defense service providers and restoration service providers shall follow the test plan defined by MEPSO.

(5) The test plan shall include the terms and periods of the tests, following the minimum requirements outlined in the *Network Code for electricity emergency and restoration* defined by ENTSO-E.

(6) The plan will consist of following tests:

1) Compliance testing of MEPSO, DSO and SGU capabilities, consisting of:
    - Compliance testing of Power generating module capabilities,
    - Compliance testing of demand facilities providing demand side response,
    - Compliance testing of low frequency demand disconnection relays,
    - Testing of communication systems,
    - Testing of tools and facilities
2) Compliance testing and review of the system the defense plan,
3) Compliance testing and review of the system restoration plan.

VI.7. Implementation

Article 217

(1) MEPSO shall implement the measures from the defense and restoration plans that are to be implemented on the transmission system.

(2) MEPSO shall notify the transmission connected DSOs of the measures, including the deadlines for implementation, which are to be implemented on:

1) the DSO's installations;

2) the installations of restoration service providers connected to their distribution systems; and

(3) MEPSO shall notify the relevant SGUs and defense and restoration service providers directly connected to its transmission system of the measures that are to be implemented on their installations, including the deadlines for implementation.

(4) Where a TSO notifies a DSO in accordance with paragraph 2, the DSO shall notify in turn, without delay, the SGUs, restoration service providers and DSOs connected to its distribution system of the measures of the defense and restoration plans which they have to implement on their respective installations, including the deadlines for implementation.

(5) Each notified DSO, SGUs and defense and restoration service provider shall:

1) implement the measures no later than 12 months from the date of notification;

2) confirm the implementation of the measures by sending a notification to the competent System Operator, who shall, when he is not a TSO, notify MEPSO; and

3) maintain the measures implemented on its installations.

VII. ACCESS TO THE TRANSMISSION SYSTEM

VII.1. Introduction

Article 218

(1) The transmission system access is related to:

1) Transmission capacities access within MEPSO's control area,
2) Access to cross-border transmission capacities according to the procedure defined and published on MEPSO's web page.

(2) MEPSO regulates access to the transmission system within Agreement on access and usage of the transmission network.

VII.2. Objectives

Article 219

(1) MEPSO provides access to the users of the electricity transmission system through:

1) objective, transparent and non-discriminatory access;
2) optimization of transmission system capacities;
3) enabling reliable manner of supply,
4) enabling regional harmonization of the procedures for access to the cross-border transmission capacities.

VII.3. General provisions

Article 220

(1) MEPSO, based on approved tariffs, will enable access to the electricity transmission system in an objective and transparent manner that prevents discrimination of system users.
(2) MEPSO will provide priority for access to the electricity transmission system and priority in dispatching electricity, for generation facilities of electricity from renewable energy sources, taking into account the limitations arising from the operational capabilities of the electricity transmission system.
(3) MEPSO may take measures that significantly limit the priority of access and/or the priority in dispatching, of electricity generation facilities from renewable energy sources for the purpose of ensuring security of supply or stability of the electricity transmission system.

(4) MEPSO shall notify ERC of the measures taken from paragraph (3) within 30 days of the measures taken from paragraph (3) of this article, and with the report it shall submit information on the operation market-oriented measures that it will undertake in order to remove or reduce the restrictions with time dynamics.

(5) MEPSO is obliged, in accordance with these Network Rules and the Electricity Supply Rules, to provide access to the electricity transmission system to existing and new users:

1) in an objective, transparent and non-discriminatory manner,
2) based on the principle of regulated access to the third party, and
3) with the application of prices and tariffs previously approved by the ERC.

(6) MEPSO can refuse access to the electricity transmission system only in cases where:

1) no transmission capacity required,
2) providing access to a certain user may endanger the supply of electricity to other users who are already connected to the electricity transmission system, and
3) providing access to the electricity transmission system would prevent MEPSO from fulfilling its public service obligation.

(7) In the event that MEPSO refuses access for the cases referred to in paragraph (2) of this article, it shall adopt a Decision in which it states in detail and unequivocally the reasons for refusal, which must be based on technically and economically justified criteria.

(8) Users who are denied access to the transmission system or are dissatisfied with the system's access conditions can file a complaint to the ERC.

(9) MEPSO is obliged, in accordance with these Network Rules, the Energy Law and the Electricity Supply Rules, to provide access to the electricity transmission system to existing and new users in an objective, transparent and non-discriminatory manner, based on the principle of regulated third-party access and by applying prices and tariffs that are approved by the ERC before their publication.

(10) MEPSO has the right to refuse access to the electricity transmission system in accordance with Article 165 of the Law on Energy.

(11) MEPSO has an obligation to provide priority access in accordance with Article 163 of the Law on Energy.

(12) MEPSO has the obligation to promptly publish on its website the important data on the use of the electricity transmission system, capacities, congestions, as well as other data necessary for the operation of the EE market.

VII.4. The usage of transmission capacities within the control area of MEPSO

Article 221

(1) The users have right for the transmission system access according to the conditions in Agreement on access and usage of the transmission network, described in Article 64 of these Network Codes.

(2) Besides the conditions in Article 63 of these Network Codes, the Agreement on access and usage of the transmission network consists of:

1) all data for accounting metering points of delivery/receipt of electricity,

2) procedure for exchange and harmonization of metering data,
3) commercial conditions for enabling transmission service of electricity,
4) conditions for timely or permanently suspension of the transmission service of electricity whereby the user does not have right for damage compensation,
5) other.

(3) MEPSO has a right to prevent access to the transmission network in the case of disturbance conditions in transmission system in the way described in Agreement on access and usage of the transmission network.

(4) The usage of the transmission network of Republic of North Macedonia for cross-border exchange of electricity is regulated with multilateral Contract for compensation between TSOs on ENTSO-E level (ITC mechanism).

VII.5. The usage of the cross-border transmission capacities

Article 222

(1) Transmission system operator calculates net cross-border transmission capacity (NTC) under cooperation with system operators on the interconnection for every border in yearly, monthly, weekly and daily level.

(2) MEPSO calculates the net cross-border transmission capacity taking into account planned power system operation conditions in the region for appropriate time frame, as given in the ""Rules for allocation of cross-border transfer capacities".

(3) MEPSO carries out allocation of cross-border transmission capacities in line with Auction rules for allocation of cross-border transmission capacities. On its web page MEPSO publishes all information related to the values for yearly, monthly, weekly and daily net transmission capacities (NTC), already allocated capacities (AAC) and available transmission capacities (ATC) for each established time interval, as well as, other relevant data important for cross-border exchange of electricity.

(4) MEPSO is entitled to suspend partially or total already allocated cross-border transmission capacity in the following cases:
1) when neighboring transmission system operators implement measures for curtailment of cross-border transmission capacities,
2) when technical limitations in MEPSO's transmission system cannot be resolved by market activities, and
3) force majeure.

(5) MEPSO has the obligation to notify users as soon as possible about curtailment of already allocated transmission rights for utilization of transmission capacity and especially for the date for the start of application, duration, the level of reduction of the cross-border capacity and other.

VIII. CONSTRUCTION AND EXECUTION OF WORKS NEAR ENERGY FACILITIES

VIII.1. General

Article 223

(1) MEPSO establishes specific conditions for the construction or legalization of buildings and the execution of works near power facilities (under, above and beyond), in accordance with the Energy Law, other applicable standards, regulations, rulebooks and these Network Codes.

(2) The specific conditions referred to in paragraph (1) of this Article shall determine the distance and/or height, i.e. distance from the power facility, technical and projected solutions, safeguards and activities, in order to prevent undesirable effects, taking into account the specific regulations regarding:

1) protection at work;
2) fire protection;
3) protection of the environment and nature;
4) preventing the impact of power facilities on plants and installations of the network users, parts of utilities and other public infrastructure, and vice versa.

VIII.2. Safety zones

Article 224

(1) The surface and the space below, above and beyond the electricity transmission facilities, required for spatial planning, protection and maintenance thereof, in which works and constructions are not permitted without MEPSO's consent, constitute a safety zone for the electricity transmission facilities.

(2) The width of the safety zone shall be:

1) 15 meters from the longitudinal axis, for overhead line with a base voltage of 400 kV
2) 10 meters from the longitudinal axis, for overhead line with a base voltage of 110 kV
3) 7 meters from the longitudinal axis, for overhead line with a base voltage of 35 kV
4) 1,5 m from the longitudinal axis, for underground cable with base voltage of 110 kV
5) 5 meters from the outer edge of the fence or wall, for a transformer station with a rated voltage of 400 kV and 110 kV

(3) For underground cables, the width of the safety zone shall also apply to works performed below the surface of the earth.

(4) In case of construction or legalization of illegally constructed buildings as well as performing other activities within the safety zone, it is necessary for the user/owner, authorized legal entity or public institution to submit a request to MEPSO for the issuance of specific conditions, i.e. for MEPSO to issue written consent according to the submitted request.

(5) With the request for issuance of specific conditions, that is, consent for execution of works within the safety zone, the applicant shall be obliged to submit the appropriate documentation on the basis of which it plans to carry out these works, extract from the urban plan and property list.

(6) MEPSO is obliged to reply to the applicant referred to in paragraph (4) of this Article within 15 days from the day of receipt of the request.

(7) The conditions for carrying out works in the safety zone shall be determined in accordance with the provisions of the special laws, regulations, norms, rules of procedure and internal technical acts of MEPSO which governs the technical conditions of construction, operation and maintenance of the network.

(8) Work executor shall be obliged to timely notify MEPSO of the exact time of commencement and the plan for realization of the works, in accordance with the conditions issued or MEPSO's consent.

(9) Works performed inside the Safety zone shall be carried out in accordance with the prescribed specific conditions, i.e. the issued consent for execution of works.

(10) MEPSO has the right to take additional measures and activities in the safety zone on maintenance, cutting of vegetation and other similar activities if it considers that they are necessary for the safe operation of the transmission system, fire protection, nature protection, etc.

IX. DISPUTE SETTLEMENT

IX.1. Material Liability of MEPSO and the Users

Article 225

(1) Any liability of MEPSO or the transmission system user in their mutual relation in case of failure to carry out their responsibilities, resulting from these Network Codes, is limited to immediate material damage as a direct result of their behavior. This excludes collateral damages or profit loss, unless it is predefined in the agreement made between them.

IX.2. Dispute settlement

Article 226

(1) In the event of a dispute between MEPSO and the user, both parties will endeavor, in good faith, to resolve any dispute related to the provisions of these Network Codes amicably.

(2) In the event that an agreement is not reached, the disputing parties have the right to turn to the ERC in accordance with the Law on Energy.

X. TRANSITIONAL AND FINAL PROVISIONS

X.1. Amending and updating the Network Codes

Article 227

(1) MEPSO, users and power entities can take the initiative to amend and submit a proposal for amendments to these Network Codes. Users and power entities submit their proposals for amendments and additions to these Network Codes to MEPSO. Amendments and additions to these Network Codes are adopted according to the procedure for adoption of these Network Codes.

X.2. Compliance with the provisions of the Network Codes

Article 228

(1) The procedures for issuing Approvals for connection to the electricity transmission network started before the date of entry into force of these Network Codes, will be completed according to the provisions of the Network Codes for Electricity Transmission ("Official Gazette of the Republic of Macedonia" No. 12/2015).

(2) The issued Approval for connection to the electricity transmission network and the concluded Approval for connection in accordance with the Network Codes for the electricity transmission ("Official Gazette of the Republic of Macedonia" No. 12/2015) continue to be valid until the terms for which they were issued or concluded, unless otherwise determined in the ERC decision from Article 4 paragraph (1) of these Network Codes.

(3) MEPSO is obliged to prepare and submit to the ERC the preliminary qualitative analysis from Article 4 paragraph (4) of these Network Codes within 36 months from the day of entry into force of these Network Codes.

IX.3. Harmonization of general and other norms, consents and agreements

Article 229

(1) Within two years from the date of entry into force of these Network Codes, the Network Codes for the electricity transmission cease to be valid ("Official Gazette of the Republic of Macedonia" No. 12/2015).

(2) Until the entry into force of paragraph (1) of this article, the existing norms, consents and agreements remain in force.

X.4. Final provisions

Article 230

(1) With the entry into force of these Network Codes, the Network Codes for the electricity transmission of cease to be valid ("Official Gazette of the Republic of Macedonia" No. 12/2015).

(2) These Network Codes enter into force on the eighth day from the day of publication in the Official Gazette of the Republic of North Macedonia.

President of the Management Board

Orhan Murtezani

XI. APPENDIX 1 –OPERATIONAL NOTIFICATION PROCEDURE FOR CONNECTION OF USER'S INFRASTRUCTURE TO THE TRANSMISSION NETWORK

XI.1. Operational Notification Procedure for Connection of a New Transmission Network User

General

(1) The User of the transmission network shall demonstrate to MEPSO its compliance with the requirements referred to in *III.4 General requirements for connection to the transmission network* and *III.5 Requirements for connection to the generation units and transmission network demand facilities* from these Network Codes by completing successfully the operational notification procedure for connection as defined by MEPSO.

(2) The operational notification procedure for connection for each new user should contain:

1) Energization Operational Notification (EON);

2) Interim Operational Notification (ION);and

3) Final Operational Notification (FON).

Energization Operational Notification (EON)

(1) An Energization Operational Notification (EON) shall entitle the User to energize its internal network and auxiliaries by using the network connection that is defined by the Connection Point.

(2) The user submits a request in written form to energize the connection.

(3) The user is obliged to submit the necessary documentation defined in the operational notification procedure for the connection of a new user to the electricity transmission network.

(4) The user is obliged to sign the Contract for the use of the electricity transmission network before submitting the request from paragraph (2).

(5) The Energization Operational Notification (EON) is issued by MEPSO, after a positive report from an internal technical review of the connection by MEPSO and the user, within 60 days from the day of submission of a complete request from paragraph (2).

Interim Operational Notification (ION)

(1) The Interim Operational Notification (ION) it starts after the completion of the energization procedure, if it is requested by the user.

(2) With the Interim Operational Notification (ION) the user can switch on his facility (power generation module connected to the electricity transmission network, the demand facility plant connected to the electricity transmission network, the electricity distribution power plant connected to the electricity transmission network or the power distribution system) using the network connection for a limited period of time.

(3) The user submits a request in writing for the Interim Operational Notification.

(4) MEPSO issues the Interim Operational Notification (ION) for the purpose of checking and fulfilling the requirements of the Study for connection to the transmission network within 30 days of submitting a complete request from paragraph (2).

(5) Regarding the data for meeting the requirements from the Study for connection to the transmission network, MEPSO from the owner of the facility (power generation module connected to the electricity transmission network, the demand facility plant connected to the electricity transmission network, the electricity distribution power plant connected to the electricity transmission network or the power distribution system) may request the following documentation:

1) statement of compliance;

2) detailed technical data for the facility (power generation module connected to the electricity transmission network, the demand facility plant connected to the electricity transmission network, the electricity distribution power plant connected to the electricity transmission network or the power distribution system) relating to the network connection, as determined by MEPSO;

3) certificates for the facility's equipment (power generation module connected to the electricity transmission network, the demand facility plant connected to the electricity transmission network, the electricity distribution power plant connected to the electricity transmission network or the power distribution system), when they are considered to be required as part of the evidence of compliance;

4) simulation models, according to III.5. Requests for connecting generation units and demand facilities to the power transmission network (expected statistical and dynamic characteristics);

5) analyzes showing the expected steady-state and dynamic characteristics as prescribed in *Compliance Testing* and

6) details of planned compliance tests.

(6) the maximum period for the user to maintain ION status must not be:

1) longer than 9 months for an electricity generation module connected to a electricity transmission network in accordance with the Law on Energy. In the period when the period of interim work is extended according to the Law on Energy, all unresolved issues should be clearly explained.

2) longer than 24 months for the demand facility connected to the transmission network, the electricity distribution power plant connected to the electricity transmission network or the distribution system.

(7) An extension of the maximum period for the User to maintain Interim Operational Notification (ION) status may be granted upon request for derogation made to MEPSO, before the expiry of that period, in accordance with the derogation procedure defined in III.7 Derogations to these Network Codes, but respecting the provisions of the ERC.

Final Operational Notification (FON)

(1) A Final Operational Notification (FON) starts after completion of the procedure for energization and/or after completion of the procedure for interim operation.

(2) With the Final Operational Notification (FON) the user can energize its facility (power generation module connected to the electricity transmission network, the demand facility plant connected to the electricity transmission network, the electricity distribution plant connected to the electricity transmission network or the power distribution system) using the connection to the transmission network.

(3) The user submits a request in writing for a Final Operational Notification.

(4) The Final Operational Notification (FON) is issued by MEPSO within seven days after the submitted request from paragraph (3) if an Interim Operational Notification (ION) has not been issued.

(5) If notice is given for an Interim Operational Notification (ION), the Final Operational Notification (FON) shall be issued by MEPSO, upon prior removal of all incompatibilities identified for the purpose of the Interim Operational Notification (ION) to meet the requirements of the Study for connection to the transmission network as required by these Network Codes and national legislatives, the Statement of Compliance or other bilateral contract.

(6) in relation to the data for fulfilling the requirements of the Study for connection to the transmission network, the following documents should be submitted to MEPSO:

1) statement of compliance, and

2) updating applicable technical data, models for simulations and studies, including using actual measured values during testing.

(7) In case of incompatibility identified for the purpose of the granting of the Final Operational Notification (FON), derogation may be granted upon request made to MEPSO, in accordance with the derogation procedure (III.7 Derogations) from these Network Codes. A Final Operational Notification (FON) shall be issued by MEPSO, if the user is compliant with the provisions of the derogation. MEPSO will not issue an Final Operational Notification (FON) (power generation module connected to the electricity transmission network, the demand facility plant connected to the electricity transmission network, the electricity distribution plant connected to the electricity transmission network or the power distribution system) whose request for derogation is rejected, until a non-compliance resolution between the user and MEPSO is reached, which cannot be longer than the maximum term of the interim operation.

Limited Operational Notification (LON)

(1) the user to whom it is given a Limited Operational Notification (LON) shall inform MEPSO immediately in the following circumstances:

1) if the facility is temporarily subject to either a significant modification or loss of capability, due to which affects its operating characteristic; or

2) in case of equipment failures leading to non-compliance with some relevant requirements.

(2) The User shall apply to MEPSO request for a Limited Operational Notification (LON), if the User reasonably expects the circumstances from paragraph (1) to persist for more than 90 days.

(3) A Limited Operational Notification (LON) shall be issued by MEPSO with a clear identification of:

1) the unresolved issues justifying the granting of the Limited Operational Notification (LON);

2) the responsibilities and timescales for expected solution; and

3) a maximum period of validity which shall not exceed twelve months. The initial period granted may be shorter, with possibility for extension, if evidence to the satisfaction of the MEPSO has been made, which demonstrates that substantial progress has been made in terms of achieving full compliance.

(4) A further prolongation of the period of validity of the Limited Operational Notification (LON) may be granted upon request for a derogation made to MEPSO, before the expiry of that period, in accordance with the defined derogation procedure according to chapter *III.7 Derogation* from these Network Codes.

XII. APPENDIX 2 – METHODOLOGY FOR ASSESSMENT OF CONNECTION FEE

XII.1. Fee for construction of new connection, or upgrade of the existing one

Fixed part

(1) In general, fixed part of the fee for construction of the connection or upgrade of existing one comprises the following costs:

1) cost for preparation of network connection analysis

2) cost for preparation of study for connection to transmission network

3) cost for approval of technical documentation and

4) cost for supervision of construction and technical acceptance of the infrastructure of the transmission network, if the infrastructure is built by the user.

(2) The costs from point 1) to point 4) are calculated based on the number of involved engineers and necessary time-period for performing all activities, i.e. required number of man-months and determined price of man- month for performing activities for third parties by MEPSO. Numbers of man-month necessary for each of the activities, counted from point 1) to point 4) of paragraph (1), are presented in Table 6.

Table 6 - Number of hours for the execution of MEPSO's activities for the connection of a user to the electricity transmission network

Activity	Connection of new network users or changes of technical parameters on the existing facility with an impact on the transmission network	Minor changes of technical parameters on the existing facility
Network Connection Analysis	1740	1740
Study for connection to the transmission network	5220	1740
approval of the technical documentation	174	174
Supervision of construction of the necessary infrastructure	0.3*T	/
revision of the construction of the necessary infrastructure	50*T	50*T

T-planned construction time in months, or realized construction time in case of prolonged planned time

(3) the price per hour for the realization of activities towards third parties is determined based on the total amount of gross salaries of MEPSO approved by ERC divided by the number of employees in MEPSO approved by ERC divided by the average number of working hours in the year. For the current year in which the Request for approval for connection to the electricity transmission network was submitted.

(4) For each activity stated in the Table 1, MEPSO is issuing an invoice to the user based on the methodology for calculating the connection fee from these Network Codes. The user is obliged to pay to MEPSO for each invoice in the following way:

1) 75% of the value of the invoice for the preparation of the Connection Analysis after determining the input data from the Request for approval to connect to the transmission network, and the remaining 25% after the User submits the Analysis;

2) 75% of the value of the invoice for the preparation of the Study for connection to the transmission network after the submission of the request for the preparation of the Study by the user, and the remaining 25% after the submission of the Study by the user;

3) 100% of the value of the invoice for approval of technical documentation and construction audit after completion of the activities.

Variable part

(1) Variable part of fee for construction of new connection or upgrade of existing one is determined based on the following costs:

1) for the construction of a new connection or the upgrade of an existing connection contains the costs of providing the technical conditions necessary for connecting the user to the electricity transmission network, costs of purchasing equipment, devices and necessary materials, costs of installation of a connection,

2) costs for on-site verification of compliance of the technical characteristics of the built facility with the requirements given in the Approval for connection to the transmission network and costs for specific operation requirements.

XII.2. Participation fee for creation of technical conditions in the transmission system

(1) Costs for construction of new connection or upgrade of existing connection represents expenses for additional investments for transmission system strengthening as a result of applicant connection, and are not part of any direct connection or any MEPSO investment plan.

XII.3. Transmission system infrastructure for construction of a new connection

(1) Transmission system infrastructure consists of construction for new connection or expansion of existing one and investments to create technical conditions in the electricity transmission system for connecting new users.

(2) Technical conditions necessary for connection of the user to the transmission system comprise the following costs:

1) cost for preparation of technical documentation,
2) cost for issuing necessary approvals, permissions and other documentation,
3) cost for preparation works and resolving property and legal issues related to constructing the necessary infrastructure,
4) cost of procurement of equipment, devices and necessary materials,
5) cost for connection installation and cost of installing the equipment necessary for system control,
6) cost of performing all other necessary tasks in order to connect the facility to the transmission system in accordance with the rules and regulations of the Construction Law and
7) additional costs for connection to the transmission network.

(3) MEPSO calculates the costs for the implementation of the connection infrastructure and provides a specification of all the things necessary to ensure technical conditions for user connection in the Study for connection to the transmission network, which is an integral part of the Approval for connection to the transmission network.

(4) The user pays the fee according to the actual costs for the implementation of the connection infrastructure.

(5) The responsible parties for construction of the necessary infrastructure components are determined in the Contract for connection to the transmission network between the user and MEPSO.

(6) The user is obliged to pay the fee in accordance with the issued invoice by MEPSO according to the signed Contract for connection to the electricity network. In case of difference greater between the calculated and the actual cost, payment will be made according to the actual costs.

(7) For all parts of the transmission system infrastructure which will be constructed by the user in terms of the signed Contract for connection to the transmission network, the user is obliged to transfer the ownership to MEPSO.

XIII. APPENDIX 3 – ADDITIONAL REQUIREMENTS FOR CONNECTION OF GENERATION UNITS

(1) Considering the difference in behavior during disturbances in the network, a distinction is made between the following two types of power-generating modules:

1) Type 1: synchronous power-generating facilities connected directly to the network,
2) Type 2: power park modules.

(2) The sum of rated power of all generator units at the common network connection points is definitive for determining the rated capacity of a generating plant. This applies to cases where the generating plant consist of several individual power-generating units.

(3) The requirements for connecting production units refer to all electricity generation modules with a rated power over 10 MW connected to the power transmission network.

XIII.1. General requirements

XIII.1.1. Information exchange

(1) Power-generating facilities shall be capable of exchanging information with MEPSO in real time or periodically with time stamping, as specified by MEPSO;

(2) MEPSO shall specify the content of information exchanges including a precise list of data to be provided by the power-generating facility.

XIII.1.2 Synchronization

(1) When the a power-generating module is put into operation, the synchronization shall be performed by the power-generating facility owner only after authorization by the NDC;

(2) The power-generating module shall be equipped with the necessary synchronization equipment. The synchronization of power-generating modules shall be possible at frequencies within the ranges set out in Table 2;

(3) MEPSO and the power-generating facility owner shall agree on the settings of synchronization devices to be concluded prior to putting in operation the power-generating module. This agreement shall cover:

1) voltage;
2) frequency;
3) phase angle range;
4) phase sequence;
5) deviation of voltage and frequency.

XIII.1.3 Instrumentation

(1) The power-generating facilities shall be equipped with a device to provide fault recording and monitoring of dynamic system behavior. This facility shall record the following parameters:

1) voltage
2) active power

3) reactive power

4) frequency and

5) harmonics.

(2) MEPSO shall have the right to specify quality of supply parameters to be complied with on condition that reasonable prior notice is given.

(3) The settings of the fault recording equipment, including triggering criteria and the sampling rates shall be agreed with MEPSO.

(4) The dynamic system behavior monitoring shall include an oscillation trigger, specified by MEPSO, detecting poorly damped power oscillations.

(5) The equipment for quality of supply and dynamic system behavior monitoring they should have the possibility to access the information by MEPSO. The communications protocols for recorded data shall be agreed between the power generating facility owner and MEPSO.

XIII.1.4 Protection schemes and settings

(1) MEPSO shall specify the schemes and settings necessary to protect the network, taking into account the characteristics of the power-generating module. The protection schemes needed for the power- generating module and the network as well as the settings relevant to the power-generating module shall be coordinated and agreed between MEPSO and the power-generating facility owner. The protection schemes and settings for internal electrical faults must not jeopardize the performance of a power-generating module.

(2) Electrical protection of the power-generating module shall take precedence over operational controls, taking into account the security of the system and the health and safety of staff and of the public, as well as mitigating any damage to the power-generating module;

(3) Protection schemes may cover the following aspects:

1) external and internal short circuit,
2) asymmetric load (negative phase sequence),
3) stator and rotor overload,
4) over-/underexcitation,
5) over-/undervoltage at the connection point,
6) over-/undervoltage at the alternator terminals,
7) inter-area oscillations,
8) inrush current,
9) asynchronous operation (pole slip),
10) protection against inadmissible shaft torsions (for example, subsynchronous resonance),
11) power-generating module line protection,
12) unit transformer protection,
13) back-up against protection and switchgear malfunction,
14) overfluxing (U/f),
15) inverse power,
16) rate of change of frequency, and
17) neutral voltage displacement.

(4) Changes to the protection schemes needed for the power-generating module and the network and to the settings relevant to the power-generating module shall be agreed between the system

operator and the power-generating facility owner, and agreement shall be reached before any changes are made.

(5) The power-generating facility owner shall organize its protection and control devices in accordance with the following priority ranking (from highest to lowest):

1) network and power-generating module protection;
2) synthetic inertia, if applicable;
3) frequency control (active power adjustment);
4) power restriction; and
5) power stepwise constraint;

(6) With regard to loss of angular stability or loss of control, an power generating module shall be capable of disconnecting automatically from the network in order to help preserve system security or to prevent damage to the power generating module. The power-generating facility owner and MEPSO shall agree on the criteria for detecting loss of angular stability or loss of generation control.

(7) With regard to the installation of devices for system operation and devices for system security, if MEPSO considers that it is necessary to install additional devices in a power generating facility in order to preserve or restore system operation or security, MEPSO and the power generating facility owner shall investigate that matter and agree on an appropriate solution.

XIII.1.5 Simulation models

(1) MEPSO shall have the right to require of the power generating facility owner to provide simulation models, that shall properly reflect the behavior of the power generating module in both steady-state and dynamic simulations (50 Hz component) and, where appropriate and justified, in electromagnetic transient simulations.

(2) The decision for simulation model shall include:

1) format in which models shall be provided;
2) provision of documentation of models structure and block diagrams;
3) an estimate of the minimum and maximum short circuit capacity at the connection point, expressed in MVA, as an equivalent of the network;

(3) The models shall be verified against the results of compliance tests. They shall then be used for the purpose of verifying the requirements of these Network Codes including but not limited to compliance simulations and for use in studies for continuous evaluation in system planning and operation.

(4) For the purpose of dynamic simulations, the models provided shall contain the following sub-models, depending on the existence of the mentioned components:

1) Alternator and prime mover;
2) Speed and power control;
3) Voltage control, including, if applicable, Power System Stabilizer (PSS) function and excitation system;
4) Power generating Module protection models and
5) Converter models for Power Park Modules

(5) The power generating facility owner shall provide recordings of the power generating module's performance to MEPSO if requested. MEPSO may make such a request, in order to compare the response of the models with those recordings.

XIII.2. Specific requirements for synchronous generators connected directly to the network

XIII.2.1 Active power control and frequency stability

(1) When connecting a power-generating facility the following operating conditions must be allowed corresponding to synchronization of the generator:

1) start-up of the generator in normal conditions,
2) synchronization after transition to auxiliary load, if this type of operation is technically possible,
3) connection to a de-energized islanded sub-network for the purpose to energize it (only for hydro units).

(2) MEPSO shall specify, minimum and maximum limits on rates of change of active power output (ramping limits) in both up and down direction of change of active power output for a power-generating module. Constant power control requirement, specified by MEPSO shall be between 1 – 50% of the rated power per minute, taking into consideration the specific characteristics of the prime mover technology.

XIII.2.2 Frequency Stability

(1) With regard to frequency ranges, power-generating module shall be capable of remaining connected to the network and operate within the frequency ranges and time periods specified in Table 7;

Table 7 - minimum periods of time for which the power generation module should be able to operate at different frequencies, deviating from the rated value, without disconnecting from the network

Frequency range	Minimum time period for operation
47,5 Hz – 48,5 Hz	30 minutes
48.5 Hz – 49.0 Hz	60 minutes
49.0 Hz – 51.0 Hz	unlimited
51.0 Hz – 51.5 Hz	30 minutes

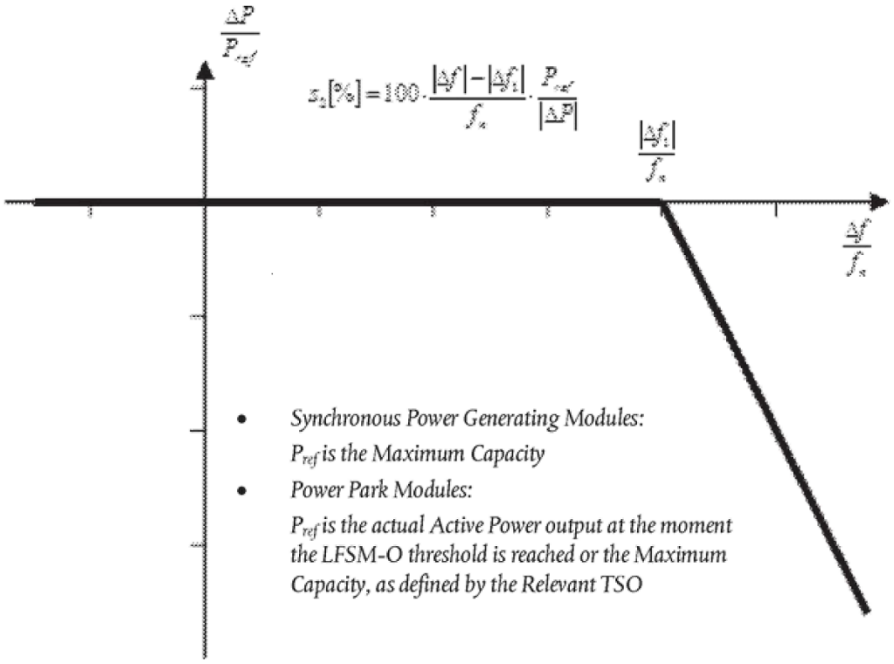
(2) Power generation modules must be able to reduce active power output under any operating conditions and from any operating point to the maximum power value specified by MEPSO. This reference set value is specified by MEPSO at the connection point and corresponds to the percentage value, which refers to the delivery of the current active power. The reduction of the power delivery to the signaled value should take place with at least 10% per minute of the capacity of the network connection, with a tolerance of 1% of the capacity of the network connection without the power generation module being disconnected from the network.

(3) In the event of a frequency drop in the transmission network below 49 Hz, the maximum power reduction rate of the power generation module must be limited to 2% of the maximum capacity at 50 Hz for a frequency drop of 1 Hz.

(4) Regarding limited frequency sensitive mode - overfrequency (LFSM-O), all power generation modules, when operating with a frequency higher than 50.2 Hz, must reduce the current active power according to Picture 1 and the drop must be within the range 2.12% according to the specified settings.

(5) The power generation module will have the ability to trigger frequency response with an initial delay as short as possible. If that delay is greater than two seconds, the owner of the power generation facility justifies the delay, providing technical evidence to MEPSO;

(6) The power generation module shall be capable of stable operation during LFSM-O operation. When LFSM-O is active, the setpoint from LFSM-O will override all active power setpoints.

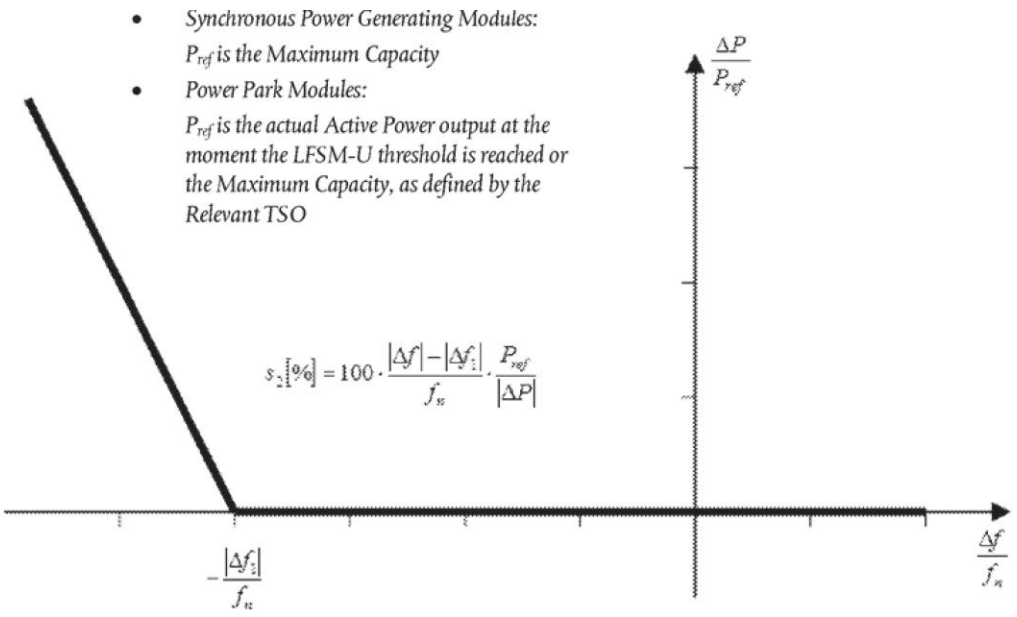


Picture 2 - active power response capability during frequency change of power generation modules in LFSM-O

(7) With regard to limited frequency sensitive mode – under-frequency (LFSM-U), during frequency failures in the system, all power generation modules should provide additional active power at a frequency threshold and with statics determined by MEPSO as follows:

1) the frequency threshold specified by MEPSO should be between 49.8 Hz and 49.5 Hz
2) Drop settings will be specified by MEPSO in the range of 2-12%.

This is represented graphically in Picture 2.



Picture 3 - Active power response capability during frequency change of power generation modules in LFSM-U

(8) In case of frequency deviation, any disconnection of the generating unit from the network is prohibited if the frequency change rate is less than 2Hz/s. The frequency should be measured using average values of 100ms.

(9) When a frequency value of 47.5 Hz or 51.5 Hz is reached, the automatic shutdown must be carried out preferably without delay.

(10) MEPSO and the owner of the power generation facility can agree on wider frequency ranges, longer minimum operating times or specific requirements for combined frequency and voltage deviations to ensure the best use of the technical characteristics of the power generation module, if this required to preserve or restore the system stability.

(11) In terms of the ability to withstand the rate of change of frequency, a power generation module is capable of remaining connected to the network and operating at a rate of change of frequency up to a value determined by MEPSO, unless a disconnection is triggered due to a reaction of network protection caused by high frequency change rate. MEPSO specifies the permissible rate of change of frequency.

(12) All power generation modules that meet the necessary technical and operational requirements can be used to provide FCR (frequency containment process), FRR (frequency restoration reserve) and RR (replacement reserve). For this purpose, a pre-qualification process must be carried out during which the control range, speed of power change, period of assurance, availability, etc. are checked.

(13) Regarding the ability to manage the active power and the range of regulation, the control system of the power generation module should have the ability to adjust the generation of the active power in accordance with the guidelines given by MEPSO.

(14) MEPSO will determine the period in which the set point for active power must be achieved. MEPSO will specify the tolerance (depending on the type of prime mover resource (turbine)) relating to the new operating point and the time in which it must be achieved. Manual local measures are permitted in cases where automatic remote control devices are not operational.

XIII.2.3 Frequency sensitive mode

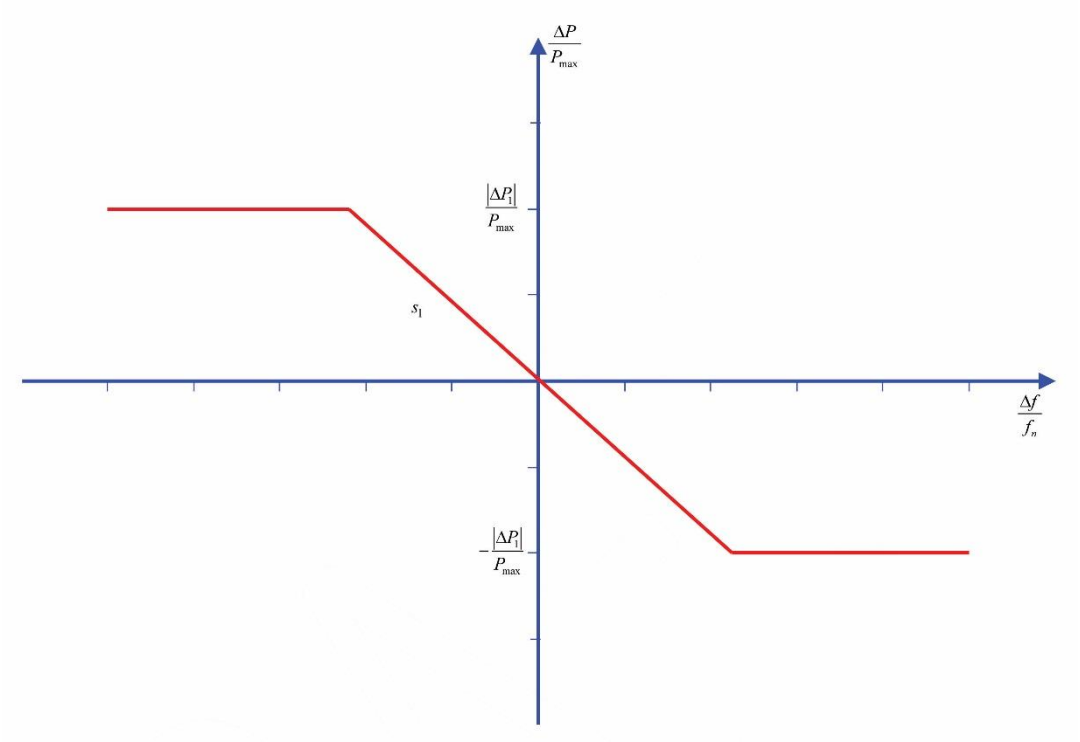
(1) All hydro power-generating modules, with installed capacity ≥10 MW and all thermal power-generating modules with installed capacity ≥30 MW must be able take part in the frequency containment control, previously known as primary control. Other hydro and thermal units (with installed capacity ≤ 10 MW for hydro and ≤30 MW for thermal) are obliged to activate the automatic speed regulation only if it is required by MEPSO.

(2) The power-generating module participating in frequency containment control shall be capable of providing active power frequency response in accordance with the parameters specified by MEPSO within the ranges shown in Table 1. In specifying those parameters, the MEPSO shall take account of the following facts:

1) in case of over-frequency, the active power frequency response is limited by the minimum regulating level,
2) in case of under-frequency, the active power frequency response is limited by maximum capacity,
3) the actual delivery of active power frequency response depends on the operating and ambient conditions of the power-generating module when this response is triggered, in particular limitations on operation near maximum capacity at low frequencies and available primary energy sources.

(3) MEPSO can exempt the individual generation unit from the obligation of taking part in the primary control in accordance with generator technology and primary fuel type.

(4) Power-generating module, operating in frequency response mode must be capable of providing active power frequency response in accordance with Picture 1 and with parameters in Table 8.



Picture 1 – Active power frequency response capability of power-generating modules in FSM illustrating the case of zero deadband and insensitivity

P_{max} – maximum capacity to which ΔP is related

f_n – rated frequency in the system (50 Hz)

Δf – frequency deviation

Δf_1 – frequency deviation when droop s1 activates

Δf_i – deadband range

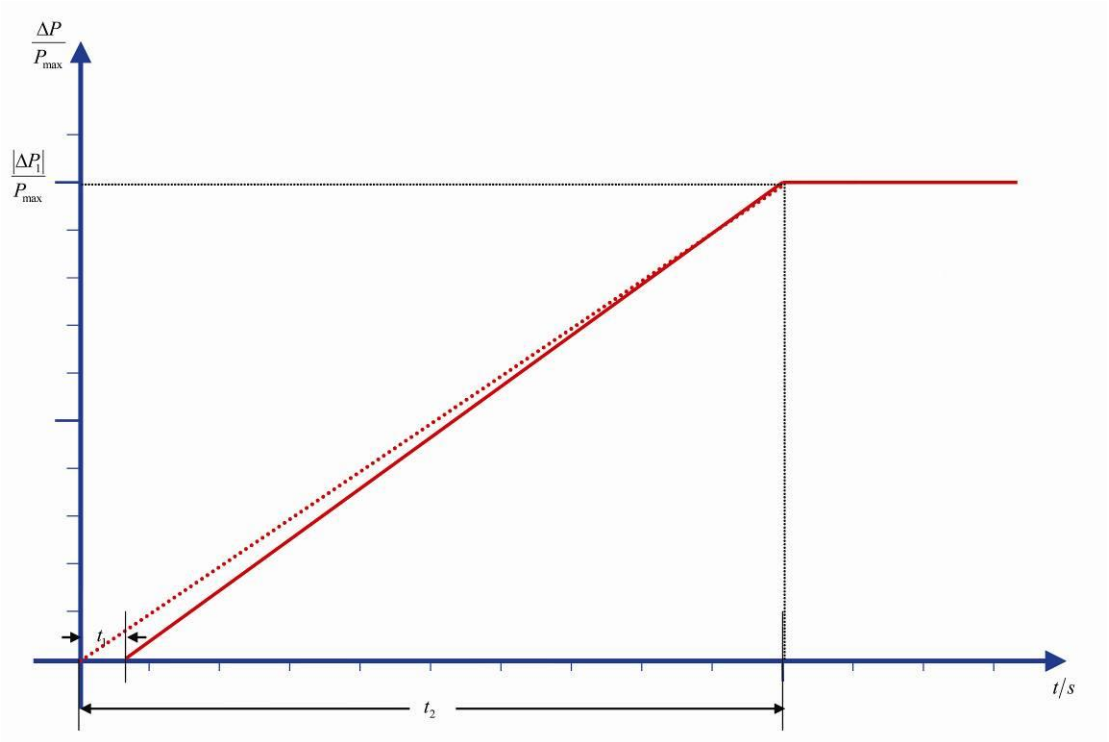
Table 8 – Parameters for active power/frequency response in frequency sensitive mode

Parameters	**Range (mHz)**	**Range (%)**
Active power range related to maximum capacity $\frac{\lvert\Delta P_1\rvert}{P_{\max}}$	-	1.5 – 10
Frequency response deadband	0 – 500	0.0 – 1.0
Frequency insensitivity range $\frac{\lvert\Delta f_i\rvert}{f_n}$	10 - 30	0.02 – 0.06
Droop s_1		2 – 12

(5) The accuracy of frequency measurements for active power/frequency response must be better than 10 mHz.

(6) The frequency response deadband of frequency deviation and droop are selected by MEPSO and must be able to be reselected subsequently within the given frames in the Table 2.

(7) In the event of a frequency step change, the power-generating module shall be capable of activating full active power frequency response at or above the full line shown in Picture 5 and in accordance with the parameters specified by MEPSO within the ranges in Table 9, which should aim to prevent active power oscillations for the power-generating module. The initial activation of active power frequency response required shall not be unduly delayed. The initial delay (t1) must be as short as possible. If initial delay time is greater than 2 seconds, operator of the generation unit must provide to MEPSO reasonable technical evidence for why a longer time is needed.



Picture 5 – Full activation of active power/frequency response reserve

Pmax is the maximum capacity to which ΔP relates.

ΔP is the change in active power output from the power- generating module. The power-generating module has to provide active power output ΔP up to the point ΔP1 in accordance with the times t1 and t2 with the values of ΔP1, t1and t2 being specified by MEPSO according to Table 2.

Table 9 – Parameters for full activation of active power frequency response resulting from frequency step change

Parameters	Range
Active power range related to maximum capacity $\frac{\lvert\Delta P_1\rvert}{P_{max}}$	1.5 – 10%
Initial delay t_1	≤ 2s
Full activation time t_2	≤ 30s

(8) To monitor the operation of active power frequency response, the communication interface shall be equipped to transfer in real time and in a secured manner from the power-generating facility to the network control center of MEPSO, at least the following signals:

1) status signal of FSM (on/off),
2) scheduled active power output,
3) actual value of the active power output,
4) actual parameter settings for active power frequency response,
5) droop and deadband;

(9) MEPSO shall specify additional signals to be provided by the power- generating facility by monitoring and recording devices in order to verify the performance of the active power frequency response provision of participating power-generating modules.

(10) in terms of FRR, the power generation modules shall fulfill the functional requirements of MEPSO in order to establish and maintain the frequency in the range of rated values, or to maintain the exchange of powers between the control areas and their planned values.

XIII.2.4 Voltage stability and reactive power control

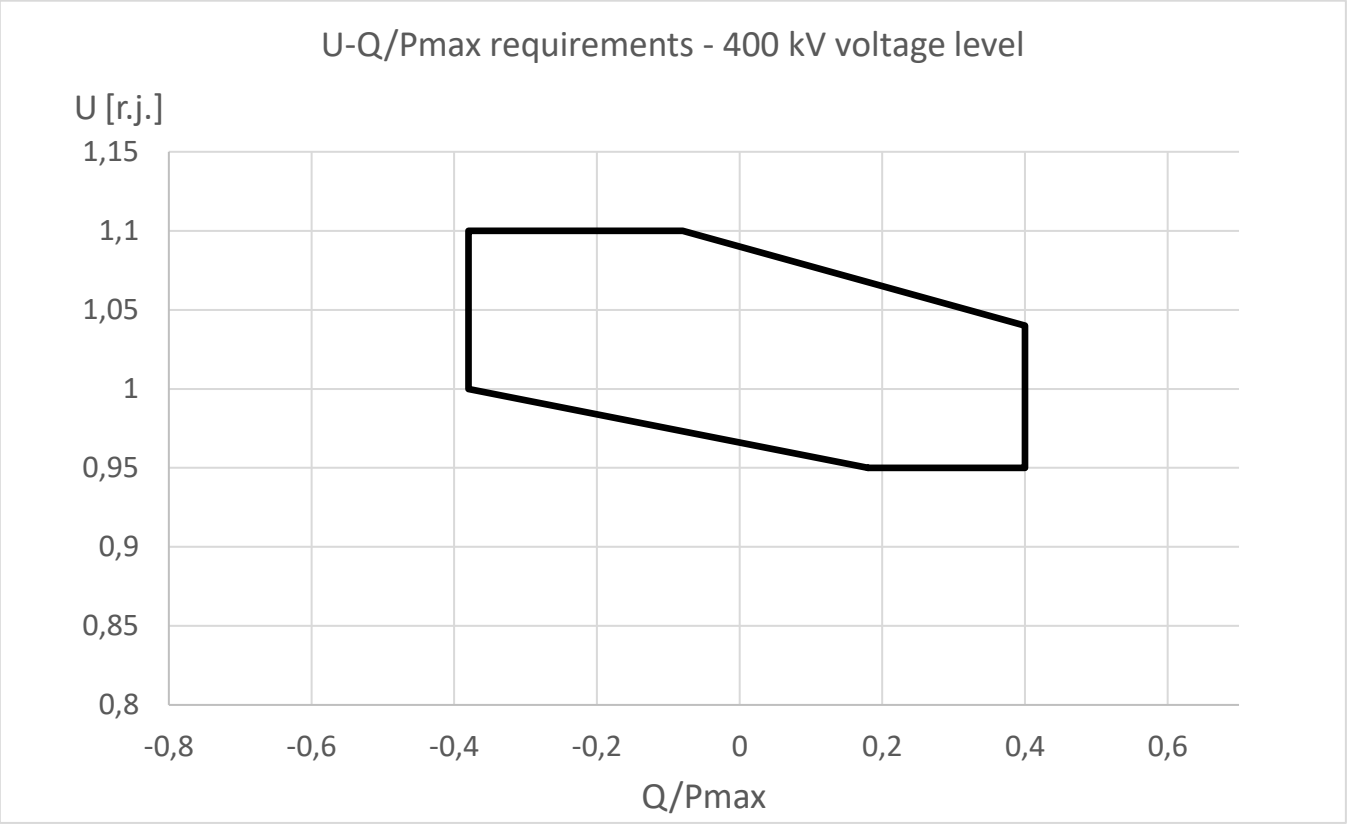
(1) MEPSO specifies a U-Q/Pmax-profile within the limits of which the synchronous power-generating module shall be capable of providing reactive power at its maximum capacity. The specified U-Q/Pmax profile may take any shape, having regard to the potential costs of delivering the capability to provide reactive power generation at high voltages and reactive power consumption at low voltages;

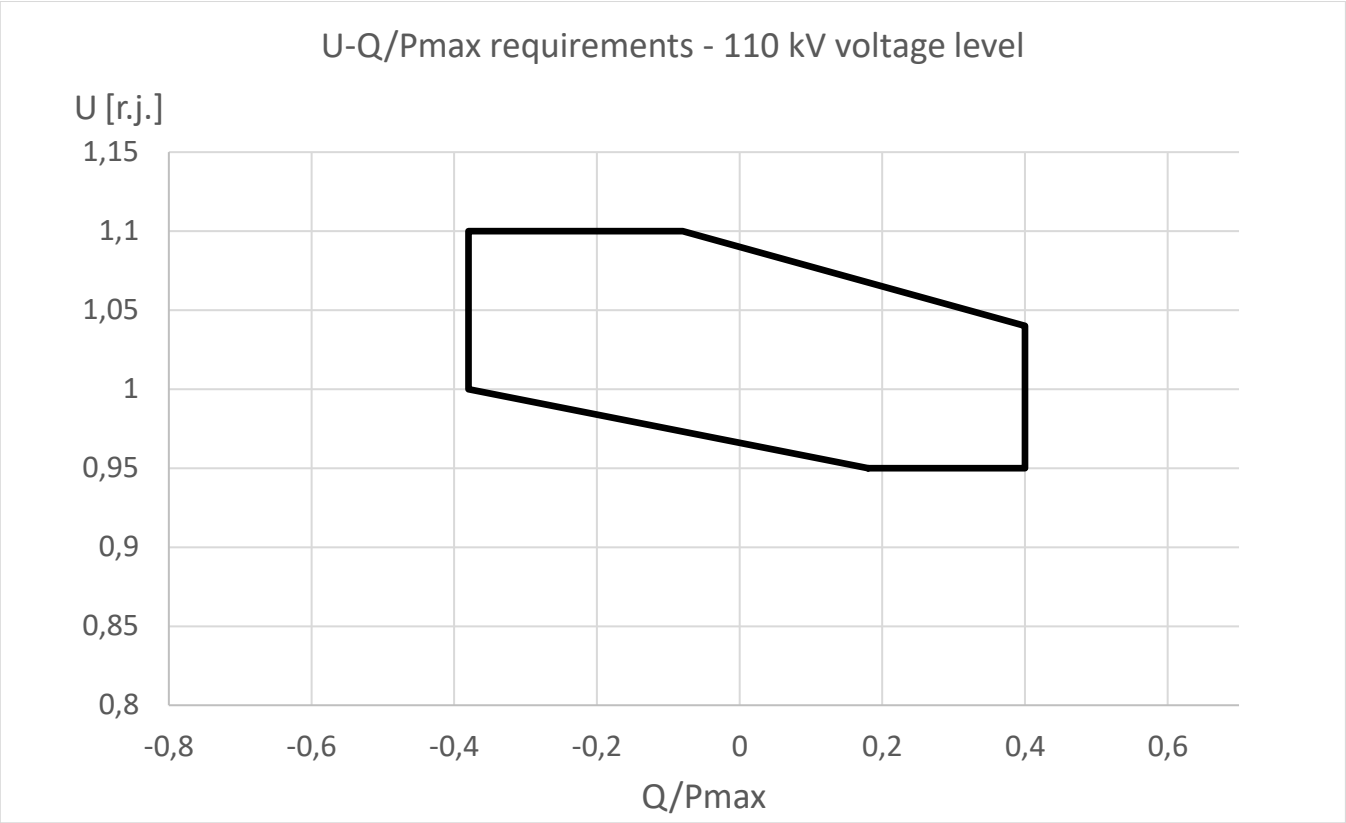
(2) The step-up or power transformer must be fitted with a tap changer, which must be harmonized with the properties of the generation unit (control range and step size).

(3) The synchronous power-generating unit shall be capable of moving to any operating point within its U-Q/P_{max} profile in timescales determined by the requirements of reactive power control. MEPSO shall have the right at any time to change the reactive power target value within the agreed or decided reactive power range.

(4) In the case of online specification of set-point value, the respective new specifications for the operating point of the reactive power exchange must be realized at the connection point within one minute.

(5) Each generation unit must fulfil, as a basic requirement, at the network connection point the range of reactive power provision shown in Picture 6. As an additional requirement MEPSO can, in justified cases, agree an extended or different reactive power exchange.





Picture 6 – Requirements for U-Q/P_{max} profile for 400 kV and 110 kV voltage level

(6) The reactive power exchange between each power-generating unit and the network must be technically configured to achieve MEPSO's specified set-point values.

(7) When operating at an active power output below the maximum capacity (P<Pmax), the synchronous power generating modules shall be capable of operating in every possible operating point in the U-Q/P_{max} profile of the alternator of this synchronous power-generating module at least down to minimum stable operating level. Even at reduced active power output, reactive power supply at the connection point shall fully correspond to U-Q/P_{max} profile of the alternator of this synchronous power generating module, taking the auxiliary supply power and the active and reactive power losses of the step-up transformer, if applicable, into account.

(8) The operating point for the steady state reactive power exchange at the active power output is defined by MEPSO in the issued connection approval depending on the requirements of the network. MEPSO specifies one of the following three possibilities:

1) power factor (cos φ),
2) reactive power injection (Q in Mvar), or
3) voltage range (U in kV).

(9) The operating points are defined by:

1) agreement of a value or, if necessary, by drafting the appropriate plan or
2) online set-point value specification.

(10) In the case of online specification of set-point value, the respective new specifications for the operating point of the reactive power exchange must be realized at the connection point within one minute.

(11) A power-generating module shall be capable of staying connected to the network and operating within the ranges of the network voltage at the connection point, expressed by the voltage at the connection point related to the reference 1 pu voltage, and for the time periods specified in Tables 4 and 5;

(12) In case of a deviation of the network voltage at the connection point from its rated value, any automatic disconnection from the network of a generation unit due to the deviation is prohibited within the ranges of the network voltage at the connection point, expressed by the voltage at the connection point related to the reference 1 pu voltage, and for the time periods specified and within the time periods specified by Tables 10 and 11.

(13) MEPSO may specify shorter periods of time during which power-generating modules shall be capable of remaining connected to the network in the event of simultaneous overvoltage and underfrequency or simultaneous undervoltage and overfrequency;

Table 10 – The minimum time periods within each generation unit has to operate for voltages deviating from the rated value at the connection point without disconnecting from the network for 400 kV voltage level

Voltage range	Time period
0.85 – 0.9 pu	60 minutes
0.9 – 1.05 pu	unlimited
1.05 – 1.1 pu	60 minutes

Table 11 – The minimum time periods within each generation unit has to operate for voltages deviating from the rated value at the connection point without disconnecting from the network for 110 kV voltage level

Voltage range	Time period
0.85 – 0.9 pu	60 minutes
0.9 – 1.118 pu	unlimited
1.118 – 1.15	60 minutes

(14) The electrical protection of the generating plant is superimposed on the operational controllers (voltage regulator, excitation system) and can disconnect the generation unit from the system in the event of unacceptable operating conditions.

(15) Wider voltage ranges or longer minimum time periods for operation may be agreed between MEPSO and the power-generating facility owner. If wider voltage ranges or longer minimum times for operation are economically and technically feasible, the power-generating facility owner shall not unreasonably withhold an agreement;

(16) MEPSO shall have the right to specify voltages at the connection point at which a power-generating module is capable of automatic disconnection. The terms and settings for automatic disconnection shall be agreed between the MEPSO and the power-generating facility owner.

(17) With regard to the voltage control system, a synchronous power-generating module shall be equipped with a permanent automatic excitation control system in order to provide constant alternator connection at a selectable setpoint without instability over the entire operating range of the Synchronous Power generating Module.

(18) With regard to steady-state voltage control, the automatic voltage regulator ("AVR") shall limit the change at the generating unit terminal to not more than a percentage of rated connection specified by MEPSO, when the output signal is gradually changed from zero to rated Apparent Power at rated voltage, active power and frequency.

(19) For a step change from 90 to 100 % of the rated voltage at the power-generating unit terminal, with the unit on open circuit, the excitation system response shall have a damped oscillatory characteristic. For this characteristic, the time for the power-generating unit connection to reach 100 % shall be less than a value specified by the MEPSO. The time to settle within 5 % of the voltage change shall be specified by MEPSO.

(20) To ensure that adequate synchronizing power is maintained, when the power-generating unit is subject to a large voltage disturbance, the exciter whose output is varied by the AVR shall be capable of providing its achievable upper and lower limit ceiling voltages to the power-generating unit field in a time not exceeding that specified by MEPSO. The lower and upper limits of the voltage threshold may depend on the voltage disturbance.

(21) The exciter shall be capable of attaining an excitation system on load peak positive excitation voltage specified by MEPSO.

(22) The corresponding current threshold shall be delivered for at least 10 seconds when responding to a sudden drop in voltage of 10 % or more.

(23) The field voltage of a synchronous power-generating unit with a static excitation system should be capable of attaining a negative threshold level specified by MEPSO after the stepwise regulation when responding to a sudden drop in voltage of 10 % or more at the power-generating unit terminals.

XIII.2.5 Characteristics of the Excitation System

Underexcitation Limiter

(1) The underexcitation limiter shall prevent the automatic voltage regulator from reducing the alternator excitation to a level which would endanger synchronous stability. The underexcitation limiter shall operate when the excitation system is providing automatic control. The underexcitation limiter shall respond to changes in the active power and the reactive power, and to the square of the alternator voltage in such a direction that an increase in voltage will permit an increase in leading reactive power. The characteristic of the underexcitation limiter shall be substantially linear from no-load to the maximum capacity output of the power-generating unit at any setting and shall be readily adjustable.

(2) The resulting maximum overshoot in response to a step injection which operates the underexcitation limiter shall not exceed 4 % of the maximum capacity of the power-generating unit. The operating point of the power-generating unit shall return to a steady-state value at the limit line and the final settling time shall not be greater than 5 seconds.

(3) When the step change AVR reference voltage is reversed, the field voltage should begin to respond without any delay and should not be held down by the underexcitation limiter. Operation into or out of the preset limit levels shall ensure that any resulting oscillations are damped so that

the disturbance is within 0.5 % of the rated rated power of the power-generating unit within a period of 5 seconds.

Overexcitation Limiter

(1) The settings of the overexcitation limiter shall ensure that the alternator excitation is not limited to less than the maximum value that can be achieved whilst ensuring the power-generating unit is operating within its design limits. Any operation beyond the overexcitation limit shall be controlled by the overexcitation limiter without tripping the power-generating unit.

(2) The alternator overexcitation limiter shall also not restrict any overexcitation of the alternator when the excitation system is under manual control, other than what is necessary to ensure the power-generating unit is operating within its design limits.

Damping of power oscillation

(1) An excitation system of Power generating unit should have a PSS function to attenuate power oscillations, if the synchronous power-generating unit size is above a value of maximum capacity defined by the MEPSO.

(2) The arrangements for the supplementary control signal shall ensure that the PSS output signal relates only to changes in the supplementary control signal and not the steady-state level of the signal. Additionally the PSS shall not react to non-oscillatory power changes.

(3) The output signal from the PSS shall be limited to not more than a value of the power-generating unit connection signal at the AVR input specified by MEPSO. The stability margins shall be defined by the MEPSO (e. g. phase margin, delay margin, gain margin).

(4) The PSS shall not react to non-oscillatory changes in active power, such as changes in steady state power or changes caused by response to variations in system frequency.

(5) The PSS shall have the possibility to achieve optimized damping for at least 2 frequencies (e.g. local mode and inter area mode).

(6) The PSS shall include elements that limit the bandwidth of the output signal. The bandwidth limiting shall ensure that the highest frequency of response cannot excite torsional oscillations on other power-generating units connected to the network. The bandwidth limit shall be specified by MEPSO.

XIII.2.6 Operation of generation facility during disturbances

(1) The phase shift or the power oscillations should not trigger the generating unit protection or a loss of generation capacity. The generating unit control system should not actuate phase shift or power oscillations. Stability-related variables of turbine and generator control systems must be mutually agreed between the operator of the generation unit (transmission system user) and MEPSO.

(2) If required, power system stabilizer (PSS), for damping of the phase shift hunting or the power oscillations should be installed. When required, MEPSO mutually agrees with the generation unit operator the configuration of the necessary equipment. It has to ensure that the static stability for every operating point within the generator capability chart is guaranteed and that steady state operation is possible when there is rated short circuit power on the high voltage side of at least

four times the generating unit's rated active power and a voltage on the high voltage side of at least the network rated voltage.

(3) Following a fault clearance in the transmission system and in the case of automatic three-pole reclosure, the transmission system user must expect that the voltages in MEPSO's transmission system and at the user connection point can be asynchronous. The operator of the generation unit must take measures himself to ensure that the automatic reconnection in the MEPSO's transmission system does not lead to damage of his generation unit.

(4) A disturbance is not considered as terminated with the fault clearing, but until the generating plant has resumed its normal operation.

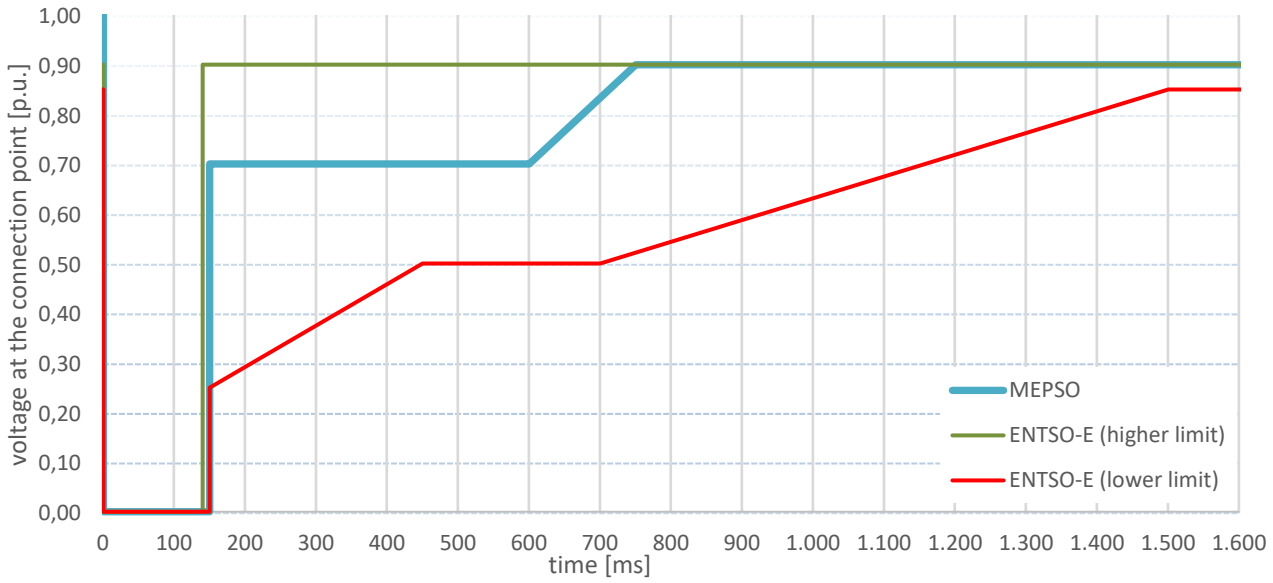
Fault Ride Through Capability

(1) MEPSO requires the lower limit curve for the voltage (phase-to-phase)/time pattern on the network voltage level at the connection point in the case of a three-phase short circuit, above which Type 1 generation unit must not be disconnected from the network and must not become unstable. This requirement applies to the entire operating range of the generation unit. The required parameters are given in the Table 12 and shown on Picture 7.

(2) The limit line values (voltage, time) are required as well for unsymmetrical faults with reference to the direct system.

Table 12 – Parameters for Picture 6 for fault-ride-through capability of synchronous power-generating modules

Voltage parameters [pu]		Time parameters [seconds]	
U_{ret}:	0	t_{clear}:	0,15
U_{clear}:	0,7	t_{rec1}:	t_{clear}
U_{rec1}:	U_{clear}	t_{rec2}:	0,6
U_{rec2}:	0.9	t_{rec3}:	0,75



Picture 7 – Fault ride through profile in the connection point for Type 1 generators

XIII.2.7 System restoration

Transition to the Auxiliary Power and Quick Re-synchronization capability

(1) In case of disconnection of the power-generating module from the network, the power-generating module shall be capable of quick re-synchronization in line with the protection strategy agreed between the MEPSO and the power-generating facility.

(2) A power-generating module with a minimum re-synchronization time greater than 15 minutes after its disconnection from any external power supply must be designed to trip to houseload from any operating point in its U-Q/P_{max} profile. In this case, the identification of houseload operation must not be based solely on the system operator's switchgear position signals.

(3) Power-generating modules shall be capable of continuing operation following tripping to houseload, irrespective of any auxiliary connection to the external network. The minimum operation time shall be specified by MEPSO, taking into consideration the specific characteristics of prime mover technology.

(4) After transition to household, power-generating unit must be capable to operate for at least 3 hours with only the auxiliary load.

(5) The function of the transition to houseload mode must be proven during commissioning, and must be examined following the significant modifications of the power-generating unit.

Island Operation

(1) Transition into island operation should be ensured when power-generating unit is disconnected from the system in accordance with the agreed protection concepts when faults occurs in the network.

(2) Power-generating modules shall be capable of taking part in island operation if required by the MEPSO and:

1) the frequency limits for island operation shall be those established in accordance with frequency ranges defined in the chapter for Frequency Stability in this Appendix.

2) the voltage limits for island operation shall be those established in accordance with voltage ranges defined in the chapter for Voltage Stability in this Appendix, where applicable;

(3) The power-generating unit operating in island operation shall be capable of operating in frequency sensitive mode (FSM).

(4) The method for detecting a change from interconnected system operation to island operation shall be agreed between the power-generating facility owner and MEPSO. The agreed method of detection must not rely solely on the system operator's switchgear position signals.

The following conditions are applied here:

1) the power-generating unit shall be able to regulate the frequency under the precondition that the resulting capacity deficit is not greater than the frequency containment reserve in the island mode.
2) In the event of a power surplus, the power-generating module shall be capable of reducing the active power output from a previous operating point to any new operating point within U-Q/P_{max} profile. In that regard, the power-generating module shall be capable of reducing active power output as much as inherently technically feasible, but to at least 55 % of its maximum capacity;
3) it must be possible to maintain island operation for several hours. The details are agreed between the transmission system user (operator of the power plant) and MEPSO; and
4) in island operation, power-generating unit shell be able to balance sudden load changes to as much as 10 % of the rated capacity of the Power generating units, currently in operation but not higher than 50 MW.

(5) The interval between two consecutive load connections should be at least 5 minutes.

Black Start Capability

(1) Power-generating facility owners shall, at the request of MEPSO, provide a quotation for providing black start capability. MEPSO may make such a request if it considers system security to be at risk due to a lack of black start capability in its control area.

(2) Operation of the power-generating unit in the case of power system restoration without any external energy supply is regulated by the contract between MEPSO and power-generating facility.

(3) A power-generating module with black start capability shall be capable of starting from shutdown without any external electrical energy supply within a time frame specified by MEPSO.

(4) The Power generating Module shall be able to synchronize within the frequency limits and voltage limits defined by the MEPSO where applicable.

(5) A power-generating module with black start capability shall:

1) be capable of starting up without external energy supply, within the specified time, according to the power system restoration procedures,
2) be capable of connection to the voltage-free busbar,
3) be capable of maintaining requested level of production during system restoration,
4) be capable of regulating load connections in block load,
5) be capable of operating in FSM,

6) control frequency in case of overfrequency and underfrequency within the whole active power output range between minimum regulating level and maximum capacity as well as at houseload level,
7) be capable of parallel operation of a few power-generating modules within one island, and
8) control voltage automatically during the system restoration phase;

(6) Within the service agreement, MEPSO agrees with power plant operator about the plant behavior in the event of major faults and accordingly trains the involved personnel.

XIII.3. Additional requirements for power park modules

XIII.3.1 Active power control and frequency stability

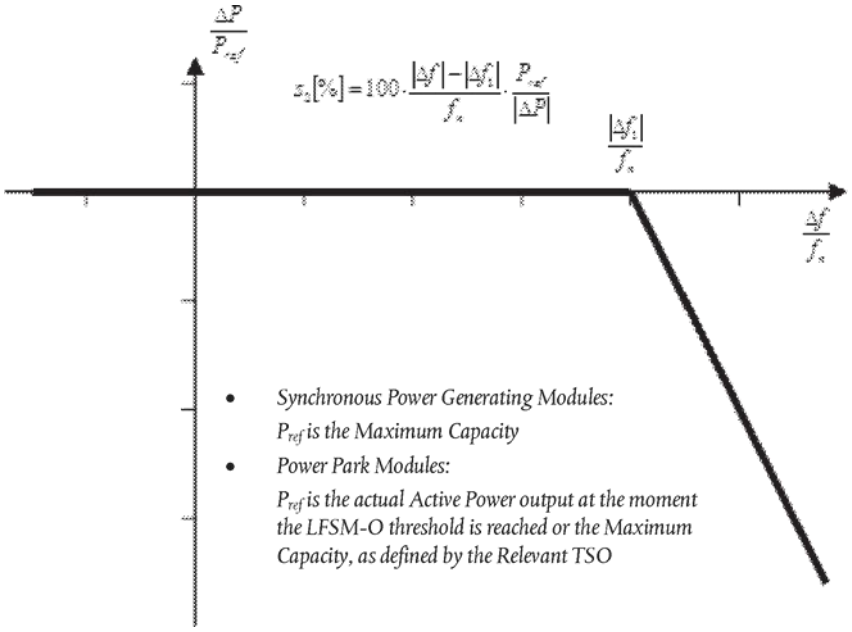
(1) As an additional requirement, participation in generation control may be necessary in order to ensure reliable operation and to protect equipment from damage. Renewable generation units must be capable to reduce the active power output in any operating condition and from any operating point to a maximum power value specified by MEPSO. This reference set value is specified by MEPSO in the connection point and it corresponds to a percentage value referred to the active power output which is currently available. The reduction of the power output to the signaled value must take place with at least 10 % of the network connection capacity per minute with tolerance of 1% of network connection capacity without the plant being disconnected from the network.

(2) In the case of frequency deviation in the transmission network, maximum power reduction rate of generation unit must be limited to 2% of the maximum capacity at 50 Hz per 1 Hz of frequency drop below 49 Hz.

(3) With regard to Limited Frequency Sensitive Mode – Overfrequency (LFSM-O), all renewable generation units, when operated at a frequency of more than 50.2 Hz, must reduce the current active power according to Picture 8 and droop settings specified within range 2-12%.

(4) The power park module shall be capable of activating a power frequency response with an initial delay that is as short as possible. If that delay is greater than two seconds, the power-generating facility owner shall justify the delay, providing technical evidence to the MEPSO;

(5) The power park module shall be capable of operating stably during LFSM-O operation. When LFSM-O is active, the LFSM-O setpoint will prevail over any other active power setpoints.



Picture 8: Active power frequency response capability of power-generating modules in LFSM-O

Pref is the reference active power to which ΔP is related and may be specified differently for synchronous power- generating modules and power park modules.

ΔP is the change in active power output from the power-generating module. fn is the rated frequency (50 Hz) in the network and Δf is the frequency deviation in the network. At overfrequencies where Δf is above Δf1, the power-generating module has to provide a negative active power output change according to the droop S2.

(6) If network frequency deviates from its rated value, any automatic disconnection of a generation unit from the transmission system shall be prohibited due to a deviation within the frequency ranges and time periods specified in Table 13.

Table 13 - Minimum time period for operation of each generation unit for different frequency deviations without disconnecting from the system

Frequency range	**Minimum time period for operation**
47,5 Hz – 48,5 Hz	30 minutes
48.5 Hz – 49.0 Hz	90 minutes
49.0 Hz – 51.0 Hz	unlimited
51.0 Hz – 51.5 Hz	30 minutes

(7) MEPSO and the power-generating facility owner may agree on wider frequency ranges, longer minimum times for operation or specific requirements for combined frequency and voltage deviations to ensure the best use of the technical capabilities of a power- generating module, if it is required to preserve or to restore system security. The power-generating facility owner shall not unreasonably withhold consent to apply wider frequency ranges or longer minimum times for operation, taking account of their economic and technical feasibility.

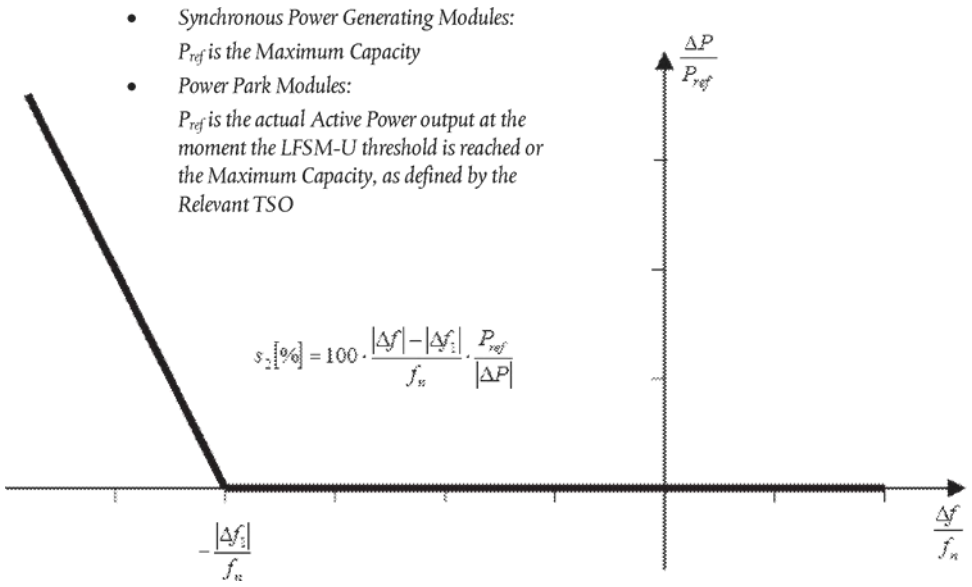
(8) With regard to the rate of change of frequency withstand capability, a power-generating module shall be capable of staying connected to the network and operate at rates of change of frequency up to 2 Hz/s for a period of 1.25 seconds, unless disconnection was triggered by rate-of-change-of-frequency-type loss of mains protection.

(9) When frequency value of 47.5 Hz or 51.5 Hz is reached, automatic disconnection must take place preferably without delay.

(10) With regard to limited frequency sensitive mode – underfrequency (LFSM-U), if required, MEPSO may require that, during the frequency drop events in the system, all power park modules provide additional active power at a frequency threshold and with a droop specified by MEPSO in coordination with TSOs of the same synchronous area as follows:

1) the frequency threshold specified by the MEPSO shall be between 49,8 Hz and 49,5 Hz inclusive,
2) the droop settings specified by the MEPSO shall be in the range 2-12 %.

This is represented graphically in Picture 9.



Picture 9- Active power frequency response capability of power-generating modules in LFSM-U

(11) MEPSO shall have the right to specify that power park modules be capable of providing synthetic inertia during very fast frequency deviations. The operating principle of control systems installed to provide synthetic inertia and the associated performance parameters shall be specified by MEPSO.

XIII.3.2 Voltage Stability and Reactive Power Control

(1) In case of a deviation of the network voltage at the connection point from its rated value, any automatic disconnection from the network of a generation unit is prohibited due to the deviation within the voltage ranges and within the time periods specified by Tables 14 and Table 15.

Table 14 – The minimum time periods within each generation unit has to operate for voltages deviating from the rated value at the connection point without disconnecting from the network for 400 kV voltage level

Voltage range	Time period
0.85 – 0.9 pu	60 minutes
0.9 – 1.05 pu	unlimited
1.05 – 1.1 pu	60 minutes

Table 15 – The minimum time periods within each generation unit has to operate for voltages deviating from the rated value at the connection point without disconnecting from the network for 110 kV voltage level

Voltage range	Time period
0.85 – 0.9 pu	60 minutes
0.9 – 1.118 pu	unlimited

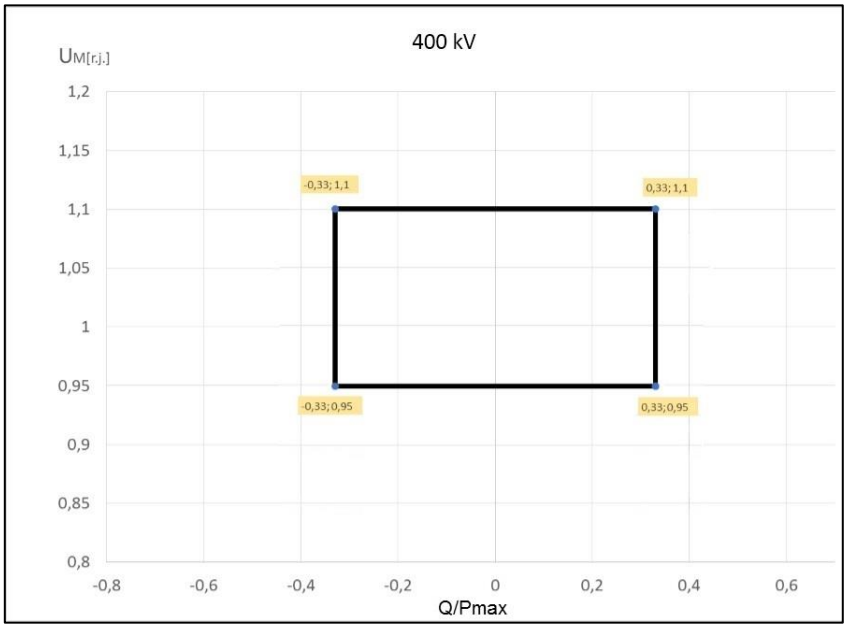
1.118 – 1.15	60 minutes

(2) The MEPSO may specify shorter periods of time during which power-generating modules shall be capable of remaining connected to the network in the event of simultaneous overvoltage and underfrequency or simultaneous undervoltage and overfrequency.

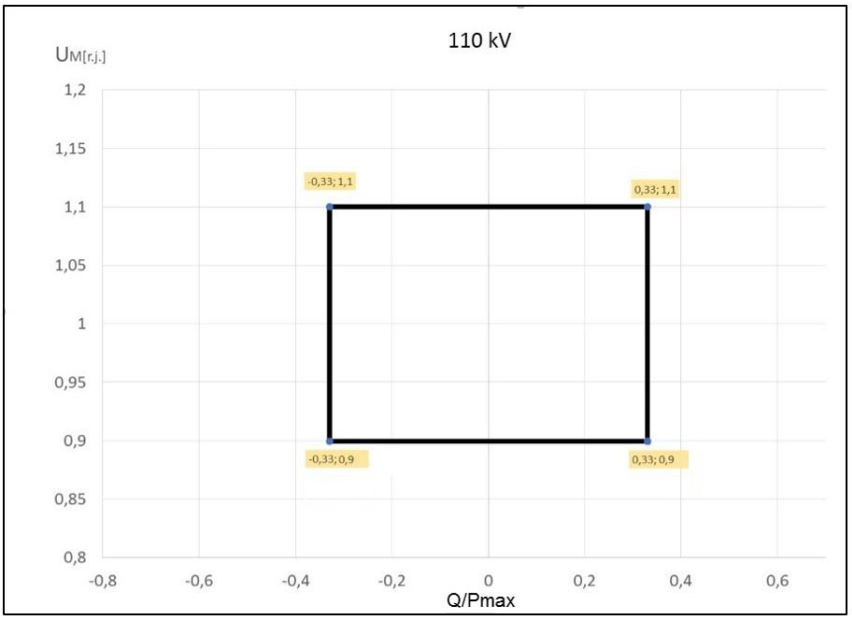
(3) Wider voltage ranges or longer minimum time periods for operation may be agreed between the MEPSO and the power-generating facility owner. If wider voltage ranges or longer minimum times for operation are economically and technically feasible, the power-generating facility owner shall not unreasonably withhold an agreement;

(4) MEPSO shall have the right to specify voltages at the connection point at which a power-generating module is capable of automatic disconnection. The terms and settings for automatic disconnection shall be agreed between MEPSO and the power-generating facility owner.

(5) With regard to Reactive Power capability, U-Q/Pmax-profile requirements are shown in Picture 10 and Picture 11.



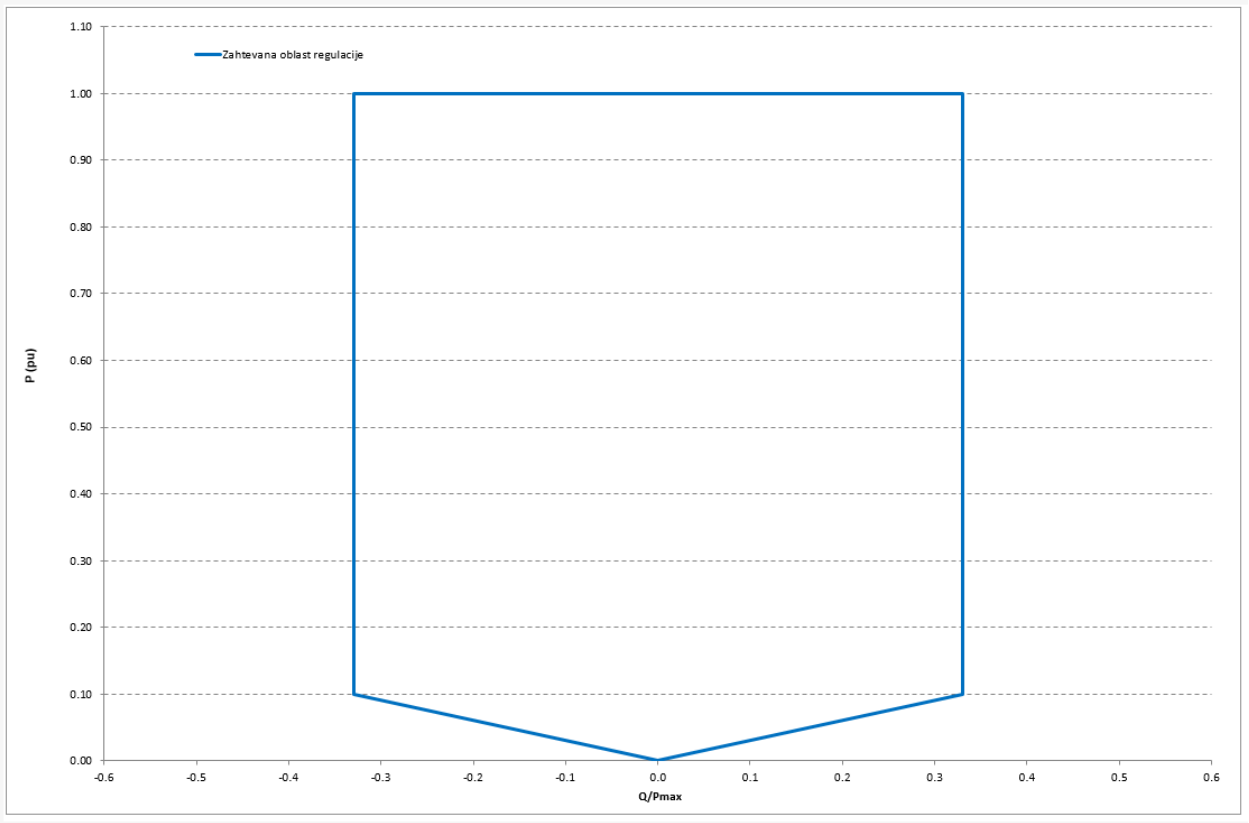
Picture 10 **– Proposed U-Q/P_{max}-profile of a power park module connected to 400 kV voltage level**



***Picture 11* – Proposed U-Q/P_{max}-profile of a power park module connected to 110 kV voltage level**

(6) With regard to reactive power capability below maximum capacity, MEPSO specifies a U-Q/P_{max}-profile (Picture 12);

(7) The Power Park Module shall be capable of moving to any operating point within its U-Q/P_{max} profile in timescales determined by the requirements of reactive power control.



***Picture 12* –Proposed U-Q/Pmax-profile of a power park module**

(8) The power park module shall be capable of providing reactive power automatically by either voltage control mode, reactive power control mode or power factor control mode.

(9) For the purposes of voltage control mode, the power park module shall be capable of contributing to voltage control at the connection point by provision of reactive power exchange with the network with a setpoint voltage covering 0,95 to 1,05 pu in steps no greater than 0,01 pu, with a slope having a range of at least 2 to 7 % in steps no greater than 0,5 %. The reactive power output shall be zero when the network voltage value at the connection point equals the voltage setpoint;

(10) The setpoint may be operated with or without a deadband selectable in a range from zero to ± 5 % of reference 1 pu network voltage in steps no greater than 0,5 %;

(11) Following a step change in voltage, the power park module shall be capable of achieving 90 % of the change in reactive power output within 5 seconds, and must settle at the value specified by the slope within 60 seconds, with a steady-state reactive tolerance no greater than 5 % of the maximum reactive power.

(12) For the purpose of reactive power control mode, the power park module shall be capable of setting the reactive power setpoint anywhere in the reactive power range, with setting steps no greater than 5 MVAr or 5 % (whichever is smaller) of full reactive power, controlling the reactive power at the connection point to an accuracy within plus or minus 5 MVAr or plus or minus 5 % (whichever is smaller) of the full reactive power.

(13) MEPSO shall specify the target power factor value, its tolerance and the period of time to achieve the target power factor following a sudden change of active power output. The tolerance of the target power factor shall be expressed through the tolerance of its corresponding reactive power. This reactive power tolerance shall be expressed by either an absolute value or by a percentage of the maximum reactive power of the power park module.

(14) MEPSO and with the power park module owner, shall specify which of the above three reactive power control mode options and associated setpoints is to apply, and what further equipment is needed to make the adjustment of the relevant setpoint operable remotely.

(15) With regard to prioritizing active or reactive power contribution, MEPSO shall specify whether active power contribution or reactive power contribution has priority during faults for which fault-ride-through capability is required.

(16) if priority is given to the active power contribution, this provision should be established no later than 150ms from the onset of the fault.

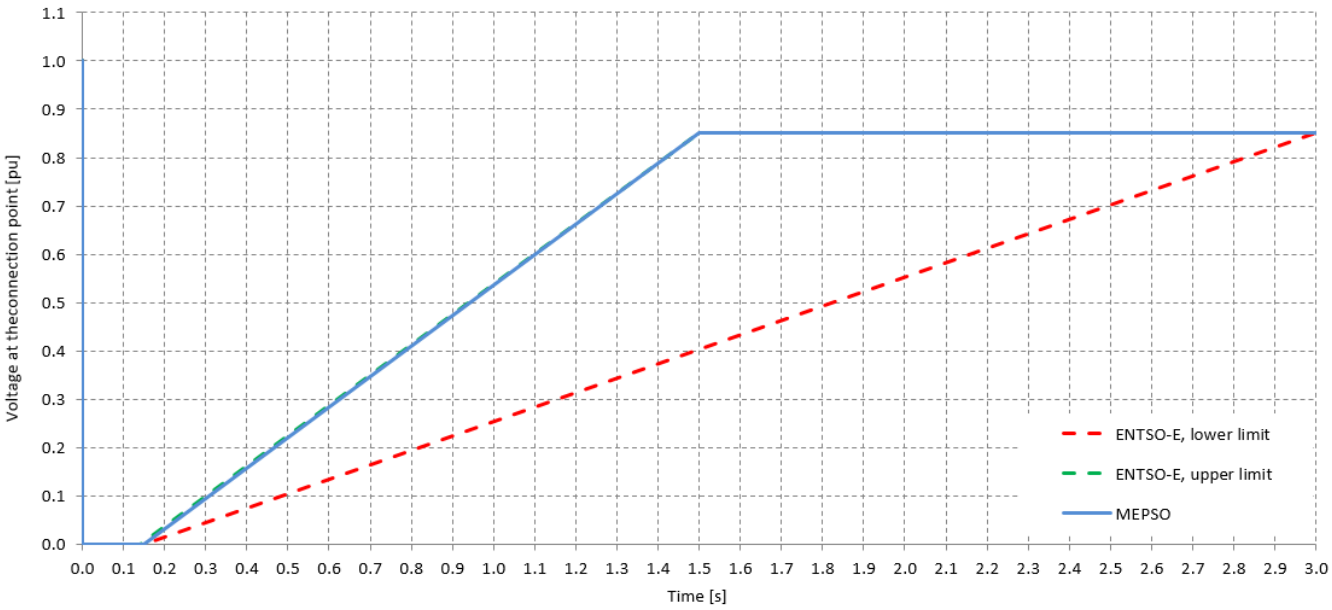
(17) With regard to power oscillations damping control, if specified by MEPSO a power park module shall be capable of contributing to damping power oscillations. The voltage and reactive power control characteristics of power park modules must not adversely affect the damping of power oscillations.

XIII.3.3 Operation of the generation facility during fault

(1) power-generating modules shall be capable of staying connected to the network and continuing to operate stably after the power system has been disturbed by secured faults. That capability shall be in accordance with a voltage-against-time profile at the connection point for fault conditions specified by MEPSO in the Table 16 and Picture 13.

Table 16 – Parameters for Picture 12 for fault-ride-through capability of power park modules

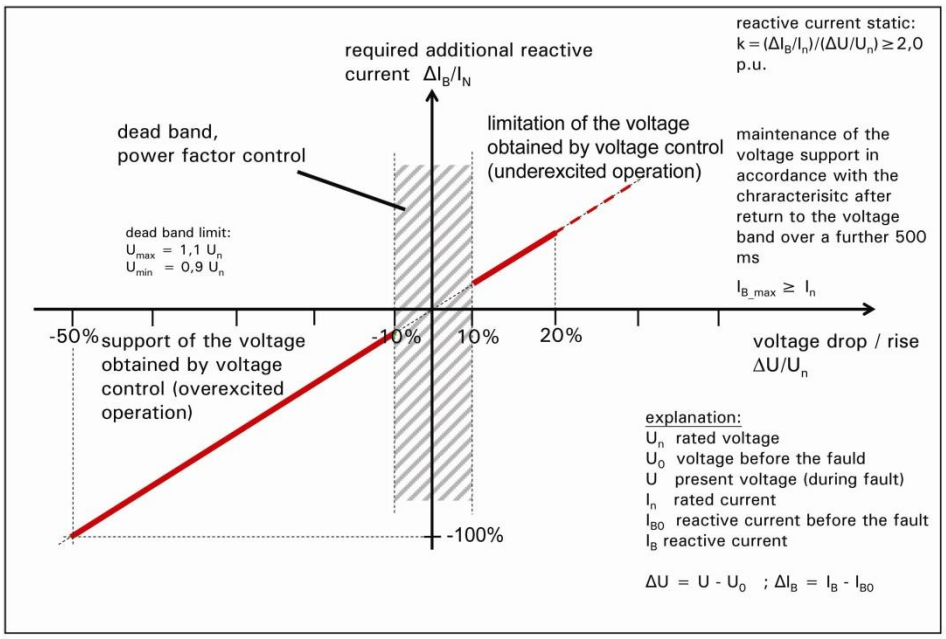
Voltage parameters [pu]		Time parameters [seconds]	
U_{ret}:	0	t_{clear}:	0,15
U_{clear}:	0	t_{rec1}:	0,15
U_{rec1}:	0	t_{rec2}:	0,15
U_{rec2}:	0.85	t_{rec3}:	1,5



Picture 13 - Fault-ride-through profile of a power park module

(2) The generation units must support the transmission system voltage with additional reactive current during a voltage dip. In order to ensure this, the voltage control must be activated as shown in Picture 14 in the event of a voltage dip of more than 10 % of the effective value of the generator voltage.

(3) The Power Park Module shall be capable of feeding the required reactive current no later than 40 milliseconds after the fault inception into the network (control response time) allowing voltage to be measured at the terminal of the units generating electricity inside the Power Park Module. If necessary, power park module shell be capable of feeding reactive current with at least 100% of rated current.



Picture 14 – The principle of voltage control in normal operation and voltage support in case of disturbances

(4) After the voltage returns to the permissible range, the voltage support must be maintained for a further 500 ms in accordance with the specified characteristic. The transient balancing procedures following the voltage return must be completed after 300 ms. If the generating plant's generators are too far away from the transmission system connection point, resulting in the voltage support being ineffective, MEPSO requires measurement of the voltage dip at the connection point and the voltage support there as a function of this measured value.

XIII.3.4 System restoration

Renewable generation units are exempted from the requirement of ability for islanded operation. The operator of a renewable generation plant can offer this ability as an option.

XIII.4 COMPLIANCE

XIII.4.1 Compliance monitoring

Responsibilities of the EE generation facility owner

(1) The owner of the EE generation facility shall ensure that each EE generation module complies with the requirements applicable under the Network Rules throughout the lifetime of the facility.

(2) before any planned change to the technical capabilities of the EE generation module that may affect its compliance with the requirements applicable under this Regulation, the owner of the EE generation facility shall notify MEPSO.

(3) The owner of the EE generation facility shall, without undue delay, notify MEPSO of any operational incidents or defects of the EE generation module affecting its compliance with the requirements of these Network Rules, after the occurrence of those incidents.

(4) The owner of the EE generation facility shall notify MEPSO in a timely manner prior to publication of the planned test plans and procedures for verifying the compliance of the EE generation module with the requirements of the Network Rules. MEPSO approves pre-planned test schedules and procedures. Such approval by MEPSO shall be given in a timely manner and shall not be unreasonably withheld.

(5) MEPSO can participate in the tests and record the performances of the EE generation modules.

Responsibilities of MEPSO

(1) MEPSO assesses the compliance of the EE generation module with the requirements applicable under the Network Rules throughout the lifetime of the EE generation facility. The owner of the EE generation facility will be informed of the outcome of this assessment.

(2) MEPSO can accept equipment certificates issued by an authorized certifier.

(3) MEPSO has the right to require the owner of the EE generation facility to carry out compliance tests and simulations according to a recurring plan or general scheme or after any failure, modification or replacement of any equipment that may affect the compliance of the EE generation module with the requirements of the Network Rules.

(4) The owner of the EE generation facility is informed of the outcome of these compliance tests and simulations.

(5) MEPSO will publicly publish a list of information and documents to be provided, as well as requirements to be fulfilled by the owner of the EE generation facility within the compliance process. The list includes at least the following information, documents and requirements:

1) all documentation and certificates to be provided by the owner of the EE generation facility;
2) details of the technical data for the EE generation module relevant to the connection;
3) model for stationary and dynamic analyzes of the system;
4) time frame for providing the data needed to perform the analyses;
5) analyzes by the owner of the EE production facility for steady state and dynamic performance in accordance with the requirements set forth in XIII.4.4 and XIII.4.5;
6) conditions and procedures, including content, for registration of equipment certificates; and
7) the conditions and procedures according to which the owner of the EE generation facility uses appropriate equipment certificates issued by an authorized certifier.

(6) MEPSO publishes the allocation of responsibilities between the owner of the EE generation facility and MEPSO for testing, simulation and compliance monitoring.

(7) MEPSO may, partially or fully, delegate the performance of compliance monitoring to third parties. In such cases, MEPSO continues to guarantee compliance with Article 6 Information and confidentiality of data, including the conclusion of confidentiality agreements with the proxy.

(8) If the compliance tests or simulations cannot be performed as agreed between MEPSO and the owner of the EE generation facility, for reasons attributable to MEPSO, then MEPSO will not unreasonably withhold the Final operational notification (FON).

Common provisions for compliance testing

(1) Testing of the performance of individual EE generation modules within an EE generation facility is intended to demonstrate that the requirements of the Network Rules are met.

(2) despite the minimum requirements for compliance tests set out in the Network Rules, MEPSO has the right to:

1) to allow the owner of the EE generation facility to carry out alternative set of tests, provided that those tests are effective and suffice to demonstrate that the EE generation module complies with the requirements of the Network Rules.

2) to require the owner of the EE generation facility to carry out additional or alternativeset of tests in cases where the information provided to MEPSO in relation to compliance testing under the provisions of XIII.4.2 and XIII.4.3 is not sufficient to demonstrate compliance with the requirements of the Network Rules ; and

3) require the owner of the EE generation facility to carry out appropriate tests to demonstrate the efficiency of the EE generation module when operating on alternative fuels or fuel combinations. MEPSO and the owner of the EE generation facility will agree on which types of fuel should be tested.

(3) the owner of the EE generation facility is responsible for conducting tests in accordance with the conditions specified in XIII.4.2 and XIII.4.3. MEPSO shall cooperate and must not unduly delay the performance of the tests.

(4) MEPSO can participate in compliance testing on-site or remotely from the NDC. For that purpose, the owner of the EE generation facility shall provide the monitoring equipment necessary to record all relevant test signals and measurements, as well as ensure that necesary representatives of the owner of the EE generation facility are available on site for the entire testing period. Signals specified by MEPSO shall be provided if, for selected tests, MEPSO wishes to use its own equipment to record performance. MEPSO has sole discretion to decide about its participation.

Common Provisions for Compliance Simulations

(1) the simulation of the performance of the individual EE generation modules within the EE generation facility aims to prove that the requirements of the Network Rules are met.

(2) Notwithstanding the minimum requirements set out in the Network Rules for compliance simulation, MEPSO is entitled to:

1) allow the owner of the EE generation facility to carry out alternative simulations, provided that those simulations are effective and sufficient to demonstrate that the EE generation module complies with the requirements of the Network Rules or national legislation; and

2) require the owner of the facility to perform additional or alternative simulations in cases where the information submitted to MEPSO regarding the compliance simulation according to the provisions of XIII.4.4 and XIII.4.5 is not sufficient to demonstrate compliance with the requirements of the Network Rules.

(3) to demonstrate compliance with the requirements of the Network Rules, the owner of the EE generation facility shall submit a report with simulation results for each individual EE generation module within the EE generation facility. The owner of the EE generation facility prepares and provides a valid simulation model for each EE generation module. The content of simulation models is set out in XIII.1 - Simulation Models.

(4) MEPSO shall have the right to check that the EE generation module complies with the requirements of these Network Rules, by carrying out its own compliance simulations based on the provided simulation reports, simulation models and compliance test measurements.

(5) MEPSO shall provide the technical data and simulation model of the network to the owner of the EE generation facility in the detail necessary to perform the necessary simulations in accordance with XIII.4.4 and XIII.4.5.

XIII.4.2 Conformance tests for synchronous EE generation modules

(1) owners of EE generating facilities perform compliance tests for LFSM-O response in connection with synchronous EE generating modules.

(2) instead of carrying out appropriate tests to prove compliance with the requirements, owners of EE generation facilities can submit equipment certificates issued by an authorized certifier. In this case, the equipment certificates are submitted to MEPSO.

(3) the following requirements apply to the LFSM-O response test:

1) to demonstrate the technical capability of the EE generation module to continuously modulate the active power to contribute to frequency regulation in the event of a large frequency rise. Steady-state control parameters, such as static and deadband, and dynamic parameters, including frequency step response, are checked;

2) the test is performed by simulating sudden and continuous frequency changes large enough to cause a change in active power of at least 10% of the maximum capacity, taking into account the settings for the drop and the deadband. If necessary, the simulated frequency deviation signals are sent simultaneously to the speed regulator and the load regulator of the control systems, taking into account the settings of these control systems;

3) The test is considered successful if the following conditions are met:

- the test results, for both dynamic and static parameters, meet the requirements set out in XIII.2.2 and XIII.2.3;
- no disturbed oscillations appear after the frequency change.

(4) The following requirements apply to the LFSM-U response test:

1) it must be demonstrated that the EE generation module is technically capable of continuously modulating active power at operating points below maximum capacity to contribute to frequency regulation in the event of a large frequency drop in the system;

2) the test is conducted by simulating appropriate active power load points, with transient and continuous frequency changes large enough to cause an active power change of at least 10% of maximum capacity, taking into account static and deadband settings. If necessary, simulated frequency deviation signals are sent simultaneously to the reference values of the speed controller and the load controller;

3) the test is considered successful if the following conditions are met:

- the test results, for both dynamic and static parameters, meet the requirements set out in XIII.2.2 and XIII.2.3;
- no disturbed oscillations appear after the frequency change.

(5) the following requirements apply to the FSM response test:

1) it must be demonstrated that the EE generating module is technically capable of continuously modulating the active power over the entire operating range between the

maximum power and the minimum regulation level contributing to frequency regulation. Steady-state control parameters such as static, deadband and dynamic parameters are checked, including stability in response to sudden frequency change and large, rapid frequency deviations;

2) the test is performed by simulating sudden and continuous frequency changes large enough to cause activation of the entire active power frequency response range, taking into account static and deadband settings, as well as the ability to increase or decrease the active power from the appropriate operating point. If necessary, the simulated frequency deviation signals are sent simultaneously to the speed controller and load controller reference values of the unit or plant control system;

3) the test is considered successful if the following conditions are met:

- the activation time of the entire frequency response range of the active power as a result of a sudden change in frequency should not be longer than the time required in XIII.2.3 Frequency sensitive mode (FSM);
- no disturbed oscillations appear after the response of the sudden change;
- the initial delay time is in accordance with XIII.2.3 Frequency Sensitive Mode (FSM);
- the drop settings are available in the range specified in XIII.2 Specific requirements for synchronous power generation modules connected to the transmission network, and the deadband (threshold) is not higher than the specified value; and
- the insensitivity of the active power frequency response at any relevant operating point does not exceed the requirements set out in XIII.2.3 Frequency Sensitive Mode (FSM).

(6) Regarding the Frequency Restoration Reserve (FRR) test, the following requirements apply:

1) the technical capability of the EE generation module to participate in frequency restoration will be demonstrated and the operation in the FSM will be checked;

2) the test is considered successful if the results, both for the dynamic and for the static parameters, are in accordance with the requirements of XIII.2.

(7) in relation to the test for the black start capability, the following requirements apply:

1) for EE generation modules with black start capability, this technical capability from start to stop without external EE power supply should be demonstrated;

2) the test is considered successful if the start time is within the time frame established in paragraph 3 of XIII.2.7 *Black start capability*.

(8) In relation to testing the transition to self-consumption power supply, the following conditions apply:

1) to demonstrate the technical ability of EE generation modules to switch to self-consumption and stable operation in it;

2) the test is carried out at the maximum capacity and nominal reactive power of the EE generation module before unloading;

3) MEPSO has the right to establish additional conditions, taking into account XIII.2.7 System restoration, and

4) The test is considered successful if the transition to self-consumption powering is successful, the stable operation of self consumption is proven for the period determined in XIII.2.7 System restoration and the successful resynchronization with the network.

(9) The following requirements apply to the reactive power generation capability test:

1) the technical capability of the EE generation module to provide capacitive and inductive reactive power in accordance with XIII.2.4 Voltage stability and reactive power control should be demonstrated;

2) the test is considered successful if the following conditions are met:

- the EE generation module must operate at maximum reactive power, capacitive and inductive, for at least one hour, at:
  - minimum stability level,
  - maximum capacity,
  - active power operating point between maximum and minimum level;
- to demonstrate the ability of the EE generating module to switch to any target value within the agreed or specified reactive power range.

XIII.4.3 Compliance tests for power park modules

(1) Owners of EE generation facilities carry out LFSM-O compliance tests on power park modules.

(2) Instead of the appropriate tests, the owner of the EE generation facility may use equipment certificates issued by an authorized certifier to demonstrate compliance with the appropriate requirements. In this case, the equipment certificates are submitted to MEPSO.

(3) The LFSM-O response tests reflect the control plan selected by MEPSO.

(4) The following requirements apply to the LFSM-O response tests:

1) to demonstrate the technical capability of the power park module to continuously modulate the active power to contribute to frequency regulation in case of system frequency increase. Steady-state control parameters such as static and deadband and dynamic parameters are checked.

2) the test is performed by simulating sudden and continuous frequency changes large enough to cause a change in active power of at least 10% of the maximum capacity, taking into account the settings for drop and deadbands. To perform this test, simulated frequency deviation signals are injected simultaneously into the control system references.

3) the test shall be considered successful if the test results comply with the requirements specified in XIII.3.1 Active Power Control and Frequency Stability.

(5) The following requirements apply to active power management and range control tests:

1) the technical capability of the power park module to operate at a load level below the set point determined by MEPSO must be demonstrated;

2) the test is considered successful if the following requirements are met:

- the load level of the power park module is maintained below the set point;
- the set point is implemented according to the requirements established in XIII.3.1 Active power control and frequency stability; and

- the accuracy of the regulation is in accordance with the value specified in XIII.3.1 Active power control and frequency stability.

(6) the following requirements apply to the LFSM-U response test:

1) the technical ability of the power park module to continuously modulate the active power must be demonstrated, in order to contribute to the frequency regulation in case of a large frequency drop in the system;

2) the test is carried out by simulating sudden and continuous frequency changes large enough to trigger at least 10% of the maximum active power change capacity with a starting point of not more than 80% of the maximum capacity, taking into account the drop and deadband;

3) the test is considered successful if the following requirements are met:

- the test results, both for the dynamic and for the static parameters, meet the requirements established in XIII.3.1 Active power control and frequency stability; and
- no undamped oscillations appear in response to the change in frequency.

(7) Regarding the test of FSM mode, the following requirements apply:

1) the technical capability of the power park module to continuously modulate the active power within the operating range between the maximum capacity and the minimum control level contributing to frequency regulation must be demonstrated. Steady-state control parameters such as insensitivity, drop, deadband and control area are checked, as well as dynamic parameters, including frequency response;

2) the test is performed by simulating sudden and continuous frequency changes large enough to stimulate the entire frequency response range of the active power, taking into account the drop and the deadband settings. To perform the test, the simulated frequency deviation signals are injected.

3) the test is considered successful if the following conditions are met:

- the activation time of the entire frequency response range of the active power as a result of a sudden change in frequency shall not be longer than required in XIII.3.1 Active power control and frequency stability;
- no undamped oscillations appear as a response to the change in frequency;
- the initial delay is in accordance with XIII.3.1 Active power control and frequency stability;
- drop settings are within the limits specified in XIII.3.1 Active power control and frequency stability;
- and the deadband (threshold) is not higher than the value selected by MEPSO; and
- the insensitivity of the frequency response of the active power does not exceed the condition established in XIII.3.1 Active power control and frequency stability;

(8) The following requirements apply to the frequency restoration reserve (FRR) test:

1) the technical capability of the power park modules to participate in the frequency restoration (FRR) process, or tertiary regulation, should be demonstrated. Frequency Sensitive Mode (FSM) and Frequency Restoration Reserve (FRR) will also be checked.

2) the test will be considered successful, for the dynamic and static parameters, if the results are in accordance with the requirements of XIII.3.1 Active power control and frequency stability.

(9) The following requirements apply to the reactive power generation capability test:

1) the technical ability of the power park module to provide capacitive and inductive reactive power in accordance with c should be demonstrated;

2) the test should be performed with maximum reactive power, capacitive and inductive, while checking the following parameters:

- 30 minutes of operation with more than 60% of the maximum capacity;
- 30 minute operation with 30% to 50% of the maximum capacity;
- 60 minute operation with 10% to 20% of maximum capacity;

3) the test is considered successful if the following criteria are met:

- the power park module operates for a duration not shorter than the required duration with maximum reactive power, inductive and capacitive, in each parameter specified in paragraph 9 (2);
- the ability of the power park module to switch to any target value within the agreed or specified reactive power range; and
- there is no protection operation within the operating limits determined by the reactive capacity generation capability diagram.

(10) the following requirements apply to the voltage control mode test:

1) the ability of the power park module to operate in the voltage control mode specified in the conditions specified in XIII.3.2 Voltage stability and reactive power control should be demonstrated;

2) the voltage control test shall verify the following parameters:

- the implemented slope and deadband are in accordance with XIII.3.2 Voltage stability and reactive power control;
- the accuracy of the regulation;
- regulation insensitivity;
- reactive power activation time;

3) the test is considered successful if the following criteria are met:

- the regulation range and the drop and deadband adjustments are in accordance with the agreed or adopted characteristic parameters established in XIII.3.2 Voltage stability and reactive power control;
- the insensitivity of the voltage counter is not greater than 0.01pu, in accordance with XIII.3.2 Voltage stability and reactive power control; and
- after a change in the voltage, 90% of the change in the reactive power output is achieved within the time and tolerances specified in XIII.3.2 Voltage stability and reactive power control.

(11) In relation to the reactive power regulation mode test, the following requirements apply:

1) the capability of the power park module to operate in reactive power regulation mode shall be demonstrated, in accordance with XIII.3.2 Voltage stability and reactive power control.

2) the reactive power regulation mode test shall complement the reactive power generation capability test;

3) with the reactive power regulation mode test, the following parameters are checked:
   - reactive power operating point range and rise;
   - the accuracy of the regulation;
   - the reactive power activation time.

4) the test is considered successful if the following conditions are met:
   - the range and variation of reactive power set point are provided in accordance with XIII.3.2 Voltage stability and reactive power control; and
   - the accuracy of the regulation is in accordance with the conditions established in XIII.3.2 Voltage stability and reactive power control.

(12) The following conditions apply to the power factor control mode test:

1) the ability of the power park module to operate in power factor control mode in accordance with XIII.3.2 Voltage stability and reactive power control;

2) the power factor control mode test checks the following parameters:
   - the power factor operating value range;
   - the accuracy of the regulation; and
   - the response of reactive power due to change in the active power;

3) the test is considered successful if the following conditions are cumulatively met:
   - range and power factor operating point rise are provided in accordance with XIII.3.2 Voltage stability and reactive power control;
   - the activation time of the reactive power as a result of the change of the active power does not exceed the condition established in XIII.3.2 Voltage stability and reactive power control; and
   - the accuracy of the regulation is in accordance with the value specified in XIII.3.2 Voltage stability and reactive power control.

(13) Regarding the tests mentioned in paragraphs 10, 11 and 12, MEPSO can choose only one of the three control modes to perform the test.

XIII.4.4 Compliance simulations for synchronous EE generation modules

(1) Owners of EE generation facilities should conduct response simulations of synchronous EE generation modules.

(2) instead of the corresponding simulations, the owner of the EE generation facility may use equipment certificates issued by an authorized certifier to demonstrate compliance with the corresponding requirement. In that case, the equipment certificates are submitted to the relevant system operator.

(3) Regarding the response simulation in LFSM-O mode, the following requirements apply:

1) the ability of the EE generation module to modulate the active power at a higher frequency in accordance with XIII.2.2 Frequency stability shall be demonstrated by means of simulation.

2) the simulation is carried out with high frequency changes and ramps that reach the regulation level, taking into account drop and deadband settings;

3) the simulation is considered successful if:

- to verify the validity of the EE generation module simulation model against the compliance test for LFSM-O response described in XIII.4.2 Compliance tests for synchronous EE generation modules; and
- to demonstrate compliance with the requirement in XIII.2.2 Frequency stability.

(4) Regarding the response simulation in LFSM-U mode, the following requirements apply:

1) the ability of the EE generating module to modulate active power at low frequencies shall be demonstrated in accordance with XIII.2.2 Frequency stability;
2) simulation is performed using low frequency changes and maximum capacity ramps, taking into account drop and deadband settings;
3) the simulation is considered successful if:

- to verify the validity of the EE generation module simulation model against the LFSM-U response compliance test described in XIII.4.2 Frequency stability; and
- to demonstrate compliance with the requirement in XIII.2.2 Frequency stability.

(5) with regard to the simulation of the fault operability of synchronous EE generation modules, the following requirements shall apply:

1) the capability of the EE generation module to operate during a fault in accordance with the conditions set out in XIII.2.6 Operation of a generation capacity during disturbances should be demonstrated.
2) the simulation is considered successful if compliance with the requirement established in XIII.2.6 Operation of generation capacity during disturbances is demonstrated.

(6) with regard to the simulation of restoration of active power after a fault, the following requirements apply:

1) the ability of the EE generation module to provide restoration of active power after a fault according to the requirements set out in XIII.2.7 System restoration shall be demonstrated;
2) the simulation is considered successful if it demonstrates compliance with the requirements established in XIII.2.7 System restoration;

(7) Regarding the response simulation in FSM of operation, the following requirements apply:

1) the ability of the EE generation module to modulate the active power over the entire frequency range shall be demonstrated, in accordance with XIII.2.3 Frequency Sensitivity Mode (FSM);
2) the simulation is performed with stepwise and continuous frequency changes large enough to trigger the entire active power frequency response range, taking into account drop and deadband settings;
3) the simulation is considered successful if:

- the validity of the simulation model of the EE generation module against the FSM response compliance test described in XIII.4.2: and
- demonstrate compliance with the requirements established in XIII.2.3 Frequency Sensitivity Mode (FSM).

(8) In terms of island simulation, the following requirements apply:

1) the performance of the EE generation module during island operation, specified in the requirements established in XIII.2.7 System restoration, shall be demonstrated;

2) the simulation is considered successful if the EE generation module decreases or increases the active EE generation from the previous operating point to any new operating point within the U-Q/P_{max} profile within the limits specified in XIII.2.7 System restoration without disconnection of the EE generation module from the island due to under-frequency or over-frequency.

(9) In relation to the simulation of reactive power generation capability, the following requirements apply:

1) the ability of the EE generation module to ensure the generation of capacitive and inductive reactive power in accordance with the requirements established in points XIII.2.4 Voltage stability and control of reactive power should be demonstrated.

2) the simulation is considered successful if the following conditions are met:

- validate the simulation model of the EE generating module against the reactive power capability compliance test described in XIII.4.2 Compliance tests for synchronous EE generating modules; and
- compliance with the requirements of XIII.2.4 Voltage stability and reactive power control should be demonstrated.

(10) In terms of simulation of power oscillation damping control, the following requirements apply:

1) it shall be demonstrated that the EE generating module in relation to its control PSS system is capable of damping active power oscillations in accordance with the requirements specified in XIII.2.5;

2) tuning must result in improved damping of the corresponding active power response of the AVR itself;

3) the simulation is considered successful if the following conditions are cumulatively met:

- The PSS dampens the existing active power oscillations of the EE generation module in the frequency range specified by MEPSO. That frequency range includes the local oscillatory mode frequencies of the EE generation module and expected network oscillations; and
- a sudden load reduction of the EE generating module from 1 pu to 0.6 pu of the maximum capacity does not lead to disturbed oscillations in the active or reactive power of the EE generating module.

XIII.4.5 Compliance simulations for power park modules

(1) power park modules are subject to compliance simulations.

(2) Instead of all or part of those simulations, the owner of the EE generation facility may use equipment certificates issued by an authorized certifier, which he must provide to MEPSO.

(3) the following requirements apply to the response simulation in LFSM-O:

1) the ability of the power park module to modulate the active power at a higher frequency should be demonstrated in accordance with XIII3.1 Active power control and frequency stability;

2) the simulation is performed by simulating stepwise and continuous frequency changes that cause a minimum regulation level, taking into account drop and deadband settings;

3) the simulation is considered successful if:

- the validity of the simulation model of the EE generation module has been confirmed against the LFSM-O mode response compliance test set out in XIII.4.3 Compliance tests for power park modules; and
- demonstrate compliance with the requirements established in XIII.3.1 Active power control and frequency stability.

(4) Regarding the response simulation in LFSM-U mode, the following requirements apply:

1) the ability of the power park module to modulate active power at low frequencies shall be demonstrated in accordance with XIII.3.1 Active power control and frequency stability;

2) the simulation is performed by simulating stepwise and continuous frequency changes reaching maximum capacity, taking into account drop and deadband settings;

3) the simulation will be considered successful if:

- validate the power park module simulation model against the LFSM-U mode response compliance test set out in XIII.4.3 Power Park Module Compliance Tests; and
- demonstrate compliance with the requirements set forth in XIII.3.1 Active power control and frequency stability.

(5) The following requirements apply to the simulation for fast fault current injection:

1) the ability of the power park module to provide fast current injection in accordance with the conditions set out in XIII.3.3 Operation of generation capacity during a fault shall be demonstrated;

2) the simulation is considered successful if it demonstrates compliance with the requirements set forth in XIII.3.3 Operation of a generation facility during a fault.

(6) the following requirements apply to the fault tolerance of power park modules:

1) the fault operation capability of the power park module in accordance with the requirements set out in XIII.3.3 Operation of generation capacity during a fault shall be demonstrated by a simulation;

2) the simulation is considered successful if it demonstrates compliance with the requirements set forth in XIII.3.3 Operation of generation capacity during a fault.

(7) Regarding the simulation of restoration of active power after a fault, the following requirements apply:

1) the ability of the power park module to ensure restoration of active power after a fault in accordance with the requirements set out in XIII 3.4 Restoration of the system shall be demonstrated.

2) the simulation is considered successful if it demonstrates compliance with the requirements set forth in XIII.3.4 System Restoration is demonstrated.

(8) in relation to the response simulation in FSM mode, the following requirements apply:

1) the ability of the power park module to modulate the active power over the entire frequency range shall be demonstrated, as specified in XIII.3.1 Active power control and frequency stability;

2) the simulation is performed by simulating stepwise and continuous frequency changes large enough to trigger the entire active power frequency response range, taking into account drop and deadband settings;

3) the simulation will be considered successful if:

- verify the validity of the power park module simulation model against the compliance test for response in FSM mode, set out in XIII.4.3 Compliance tests for power park modules; and
- demonstrate compliance with the requirements specified in XIII3.1 Active power control and frequency stability.

(9) if the user offers the possibility of island work, the following requirements apply in relation to the simulation of island work:

1) the efficiency of the power park module during island operation should be demonstrated and whether it complies with the requirements specified in XIII.2.7 System restoration;

2) the simulation is considered successful if the power park module reduces or increases the active EE generation from the previous operating point to any new operating point within the U-Q/P_{max} profile and within the limits specified in XIII.2.7 without shutting down the power park module from the island due to under-frequency or over-frequency.

(10) with regard to the simulation of the ability to provide virtual inertia, the following requirements apply:

1) the capability model of the power park module to provide virtual inertia at low frequency, as specified in XIII.3.1 Active power control and frequency stability, shall be demonstrated;

2) the simulation will be considered successful if the model proves to be in accordance with the conditions specified in XIII.3.1 Active power control and frequency stability.

(11) with regard to the simulation of reactive power generation capability, the following requirements apply:

1) the power park module shall prove that it can provide capacitive and inductive reactive power, as determined in XIII.3.2 Voltage stability and reactive power control;

2) the simulation is considered successful if the following requirements are cumulatively met:

- verify the validity of the power park module simulation model against the reactive power compliance tests set out in XIII.4.3 Compliance tests for power park modules; and
- the requirements specified in XIII.3.2 Voltage stability and reactive power control are respected.

(12) the following requirements apply to the power oscillation damping simulation:

1) the model of the power park module shall prove that it can provide the ability to damp active power oscillations, in accordance with XIII.3.2 Voltage stability and reactive power control;
2) the simulation is considered successful in case the model shows compliance with the requirements described in XIII.3.2 Voltage stability and reactive power control.

XIV. APPENDIX 4 – REQUIREMENTS FOR DEMAND CONNECTION

XIV.1. General provisions

(1) This chapter establishes requirements for network connection of:

1) transmission – connected demand facilities,
2) transmission – connected distribution facilities,
3) distribution systems,
4) demand units, used by demand facility or a distribution system to provide demand response services to MEPSO.

XIV.2. Connection of demand facilities, distribution facilities and distribution systems to the transmission network

XIV.2.1 General frequency requirements

(1) Transmission-connected demand facilities, transmission-connected distribution facilities and distribution systems shall be capable of remaining connected to the network and operating at the frequency ranges and time periods specified in table 17:

Table 17 – Minimal operation time periods of the demand facilities and distribution networks for different frequency deviations, without disconnection from the system

Frequency range	Minimal periods of operation
47,5 Hz – 48,5 Hz	30 minutes
48.5 Hz – 49.0 Hz	60 minutes
49.0 Hz – 51.0 Hz	Unlimited
51.0 Hz – 51.5 Hz	30 minutes

(2) The transmission-connected demand facility owner or the DSO may agree with the MEPSO on wider frequency ranges or longer minimum times for operation. If wider frequency ranges or longer minimum times for operation are technically feasible, the consent of the transmission-connected demand facility owner or DSO shall not be unreasonably withheld.

XIV.2.2 General voltage requirements

(1) Transmission-connected demand facilities, transmission-connected distribution facilities and transmission-connected distribution systems shall be capable of remaining connected to the network and operating at the voltage ranges and time periods specified in Table 18.

(2) Equipment of distribution systems connected at the same voltage as the voltage of the connection point to the transmission system shall be capable of remaining connected to the network and operating at the voltage ranges and time periods specified in Table 2.

Table 18 – Minimal time periods that each demand facility could operate for different deviations from the rated voltage at the connection point, without disconnection from the 110 kV voltage level

Voltage range	Time period
0.9 – 1.118 pu	Unlimited
1.118 – 1.15 pu	20 minutes

(3) The voltage range at the connection point shall be expressed by the voltage at the connection point related to reference 1 per unit (pu) voltage.

(4) Transmission-connected demand facility, a transmission-connected distribution facility, or a transmission-connected distribution system shall be capable of automatic disconnection at specified voltages, if it is required by MEPSO. The terms and settings for automatic disconnection shall be agreed between MEPSO and the transmission-connected demand facility owner or the DSO.

XIV.2.3 Short circuit requirements

(1) Based on the rated short-circuit withstand capability of its transmission network elements, MEPSO shall specify the maximum short-circuit current at the connection point that the transmission-connected demand facility or the transmission-connected distribution system shall be capable of withstanding.

(2) MEPSO shall deliver to the transmission-connected demand facility owner or the transmission-connected distribution system operator an estimate of the minimum and maximum short-circuit currents to be expected at the connection point as an equivalent of the network.

(3) After an unplanned outage, MEPSO shall inform the affected transmission-connected demand facility owner or the affected transmission-connected distribution system operator as soon as possible and no later than one week after the unplanned outage, of the changes above a threshold for the maximum short-circuit current that the affected transmission-connected demand facility or the affected transmission-connected distribution system shall be able to withstand from the MEPSO's network in accordance with paragraph 1.

(4) The threshold set in paragraph 3 shall either be specified by the transmission-connected demand facility owner for its facility, or by the transmission-connected distribution system operator for its network.

(5) Before a planned event, MEPSO shall inform the affected transmission-connected demand facility owner or the affected transmission-connected distribution system operator, as soon as possible and no later than one week before the planned event, of the changes above a threshold

for the maximum short-circuit current that the affected transmission-connected demand facility or the affected transmission-connected distribution system shall be able to withstand from the MEPSO's network, in accordance with paragraph 1.

(6) The threshold set in paragraph 5 shall either be specified by the transmission-connected demand facility owner for its facility, or by the transmission-connected distribution system operator for its network.

(7) MEPSO shall request information from a transmission-connected demand facility owner or a transmission-connected distribution system operator concerning the contribution in terms of short-circuit current from that facility or network. As a minimum, the equivalent modules of the network shall be delivered and demonstrated for zero, positive and negative sequences.

(8) After an unplanned outage, the transmission-connected demand facility owner or the transmission-connected distribution system operator shall inform MEPSO as soon as possible and no later than one week after the unplanned outage, of the changes in short-circuit contribution above the threshold set by MEPSO, and takes measures to limit the short-circuit current in the transmission network to a previously agreed value.

(9) If it is determined, in the process of planning of demand facility development or distribution, that planned changes in object of transmission system user leads to increased short-circuit currents in the transmission network and endanger equipment of the other transmission system users, the transmission system user that plans the change, shall inform MEPSO and take measures to limit the short-circuit current in the transmission network to a previously agreed value.

XIV.2.4 Reactive power requirements

(1) Transmission-connected demand facilities and transmission-connected distribution systems shall be capable of maintaining their steady-state operation at their connection point within a reactive power range specified by MEPSO, according to the following conditions:

1) for transmission-connected demand facilities, the actual ratio of reactive and active power shall not be wider than 0.48 (0,90 power factor import or export of active power), for each fifteen minute interval of measurement, except in situations where either technical or financial system benefits are demonstrated, for transmission-connected demand facilities, by the transmission-connected demand facility owner and accepted by MEPSO;

2) for transmission-connected distribution systems (i.e for the corresponding distribution substation), the actual reactive and active power ratio shall not be wider than:

   - 0.48 (i.e. 0,90 power factor) for each fifteen minute interval of measurement during reactive power import (consumption); and
   - 0.48 (i.e. 0,90 power factor) of for each fifteen minute interval of measurement during reactive power export (generation);

except in situations where either technical or financial system benefits are proved by MEPSO and the transmission-connected distribution system operator through joint analysis;

3) MEPSO and the transmission-connected distribution system operator shall agree on the scope of the analysis, which shall address the possible solutions, and determine the optimal solution for reactive power exchange between their systems, taking adequately into consideration the specific system characteristics, variable structure of power

exchange, bidirectional flows and the reactive power capabilities in the distribution system;

4) MEPSO may establish the use of metrics other than power factor in order to set out equivalent reactive power capability ranges;

5) the reactive power range requirement values shall be met at the connection point;

6) where a connection point is shared between a power generating module and a demand facility, equivalent requirements shall be met at the point defined in relevant agreements.

(2) MEPSO may require that transmission-connected distribution systems have the capability at the connection point to not export reactive power (at reference 1 pu voltage) at an active power flow of less than 25 % of the maximum import capability at the connection point.

(3) MEPSO may require the transmission-connected distribution system to actively control the exchange of reactive power at the connection point for the benefit of the entire system. MEPSO and the transmission-connected distribution system operator shall agree on a method to carry out this control, to ensure the justified level of security of supply for both parties.

XIV.2.5 Protection requirements

(1) MEPSO shall specify the devices and settings required to protect the transmission network in accordance with the characteristics of the transmission-connected demand facility or the transmission-connected distribution system. MEPSO and the transmission-connected demand facility owner or the transmission-connected distribution system operator shall agree on protection schemes and settings relevant for the transmission-connected demand facility or the transmission-connected distribution system.

(2) Electrical protection of the transmission-connected demand facility or the transmission-connected distribution system shall take precedence over operational controls while respecting system security, health and safety of staff and the public.

(3) Protection scheme devices may cover the following elements:

1) external or internal short circuit currents,

2) non-symmetric load,

3) under and overvoltage protection in the connecting point,

4) robust in relation to the power oscillations (eg. phase and voltage stability),

5) under and over frequency protection,

6) protection of the demand facility's circuits,

7) protection of the power transformers,

8) breaker failure protection and

9) protection from the big magnetic flux.

10) back-up against protection and switchgear malfunction.

(4) MEPSO and the transmission-connected demand facility owner or the transmission-connected distribution system operator shall agree on any changes to the protection schemes relevant for the transmission- connected demand facility or the transmission-connected distribution system, and on the arrangements for the protection schemes of the transmission-connected demand facility or the transmission-connected distribution system.

(5) Specific requirements will be defined in individual agreements and contracts between MEPSO and the transmission-connected demand facility owner or the transmission-connected distribution system operator.

XIV.2.6 Control requirements

(1) MEPSO and the transmission-connected demand facility owner or the transmission-connected distribution system operator shall agree on the schemes and settings of the different control devices of the transmission- connected demand facility or the transmission-connected distribution system relevant for system security.

(2) The agreement from paragraph 1 shall cover at least the following elements:

1) isolated (network) operation;
2) damping of oscillations;
3) disturbances to the transmission network;
4) automatic switching to emergency supply and restoration to normal topology;
5) automatic circuit-breaker re-closure (on 1-phase faults).

(3) MEPSO and the transmission-connected demand facility owner or the transmission-connected distribution system operator shall agree on any changes to the schemes and settings of the different control devices of the transmission-connected demand facility or the transmission-connected distribution system relevant for system security.

(4) With regard to priority ranking of protection and control, the transmission-connected demand facility owner or the transmission-connected distribution system operator shall set the protection and control devices of its transmission- connected demand facility or its transmission-connected distribution system respectively, in accordance with the following priority order starting from the highest importance:

1) transmission network protection;
2) transmission-connected demand facility or transmission-connected distribution system protection;
3) frequency control (active power adjustment);
4) power restriction.

(5) Specific requirements will be defined in individual agreements and contracts between MEPSO and the transmission-connected demand facility owner or the transmission-connected distribution system operator.

XIV.2.7 Information exchange

(1) Transmission-connected demand facilities shall be equipped according to the standards specified by MEPSO in order to exchange information between TSO and the transmission-connected demand facility within a certain time frame. MEPSO shall make the specified standards publicly available.

(2) Transmission-connected distribution system shall be equipped according to the standards specified by MEPSO in order to exchange information between the TSO and the transmission-connected distribution system within a certain time frame. MEPSO shall make the specified standards publicly available.

(3) MEPSO shall specify the information exchange standards. MEPSO shall make publicly available the precise list of data required.

XIV.2.8 Automatic frequency load-shedding

(1) MEPSO and every big demand facility, specified as such by TSO, is obliged to create configuration enabling automatic frequency unloading in percentage of the consumption, specified by MEPSO.

(2) The consumption that should be disconnected will depend on the conditions that prevail in that moment and could be more or less than planned. Planned consumption in amount of load to be disconnected will be evaluate on the netted basis – i.e. actual consumption including consumption with dispersed generation, using convenient planning methods and criteria agreed periodically between TSO and DSO. The geographical location of such load distribution for disconnection should be wisely equable and accepted by MEPSO.

(3) Under-frequency relays disconnect the consumption in steps (phases) for range of frequencies. Numbers of steps (phases), their operational frequencies and percentage of the consumption to be disconnect, for each frequency is specified by MEPSO in accordance with the plan for frequency unloading.

(4) The scheme of frequency load shedding should have following functional possibilities and operates at rated AC power supply specified by MEPSO:

1) frequency range to be at least 47-50 Hz in steps of 0.1 - 0.2 Hz,
2) operating time for execution of unloading should not be larger than 150 ms,
3) possibility voltage blocking to be chosen in the range 30-90 % of the rated voltage,
4) operation of the facility at minimum five frequency stages,
5) operating time: 100 ms for low frequency, 250 ms for frequency deviation and
6) the direction of the active power.

XIV.2.9 Tap changer blocking

(1) To avoid voltage collapse, on each power transformer in the connecting point with the transmission network, MEPSO could require automatic or manual tap changer position blocking, prevention of unwanted operation of the regulation switch due to an error.

XIV.2.10 Demand disconnection and demand reconnection

(1) All transmission-connected demand facilities and transmission-connected distribution systems shall fulfil the following requirements related to low frequency demand disconnection functional capabilities:

1) each transmission-connected distribution system operator and, where specified by the MEPSO, transmission-connected demand facility owner, shall provide capabilities that enable automatic 'low frequency' disconnection of a specified proportion of their consumption. MEPSO may specify a disconnection trigger based on a combination of low frequency and rate-of-change-of-frequency;
2) the low frequency demand disconnection functional capabilities shall allow for disconnecting demand in stages for a range of operational frequencies;

3) the low frequency demand disconnection functional capabilities shall allow for operation from a rated Alternating Current ('AC') input to be specified by the relevant system operator, and shall meet the following requirements:

- frequency range: at least between 47-50 Hz, adjustable in steps of 0,05 Hz;
- operating time: no more than 150 ms after triggering the frequency setpoint;
- voltage lock-out: blocking of the functional capability shall be possible when the voltage is within a range of 30 to 90 % of reference 1 pu voltage;
- provide the direction of active power flow at the point of disconnection;

4) the AC voltage supply used in providing low frequency demand disconnection functional capabilities, shall be provided from the network at the frequency signal measuring point, as used in providing functional capabilities in accordance with paragraph 1, point 3, so that the frequency of the low frequency demand disconnection functional capabilities supply voltage is the same as the one of the network.

(2) With regard to low voltage demand disconnection functional capabilities, the following requirements shall apply:

1) MEPSO may specify, in coordination with the transmission-connected distribution system operators, low voltage demand disconnection functional capabilities for the transmission-connected distribution facilities;

2) MEPSO may specify, in coordination with the transmission-connected demand facility owners, the functional possibilities of their disconnection at low voltage;

3) based on the MEPSO's assessment concerning system security, the implementation of on load tap changer blocking and low voltage demand disconnection shall be binding for the transmission-connected distribution system operators;

4) if DSO decides to implement a low voltage demand disconnection functional capability, the equipment for both on load tap changer blocking and low voltage demand disconnection shall be installed in coordination with MEPSO;

5) the method for low voltage demand disconnection shall be implemented by relay or the Dispatching Center;

6) the low voltage demand disconnection functional capabilities shall have the following features:

- the low voltage demand disconnection functional capability shall monitor the voltage by measuring all three phases;
- blocking of the relays' operation shall be based on direction of either active power or reactive power flow.

(3) With regard to blocking of on load tap changers, the following requirements shall apply:

1) if required by MEPSO, the transformer at the transmission-connected distribution facility shall be capable of automatic or manual on load tap changer blocking;

2) MEPSO may specify the automatic on load tap changer blocking functional capability.

(4) All transmission-connected demand facilities and transmission-connected distribution systems shall fulfil the following requirements related to disconnection or reconnection of a transmission-connected demand facility or a transmission-connected distribution system:

(5) with regard to the capability of reconnection after a disconnection, MEPSO shall specify the conditions under which a transmission-connected demand facility or a transmission-connected distribution system is entitled to reconnect to the transmission system. Installation of automatic reconnection systems shall be subject to prior authorization by MEPSO;

(6) with regard to reconnection of a transmission-connected demand facility or a transmission-connected distribution system, the transmission-connected demand facility or the transmission-connected distribution system shall be capable of synchronization for frequencies within the ranges set out in general frequency requirements. MEPSO and the transmission-connected demand facility owner or the transmission-connected distribution system operator shall agree on the settings of synchronization devices prior to connection of the transmission-connected demand facility or the transmission-connected distribution system, including voltage, frequency, phase angle range and deviation of voltage and frequency;

(7) a transmission-connected demand facility or a transmission-connected distribution facility shall be capable of being remotely disconnected from the transmission system when required by MEPSO. If required, the automated disconnection equipment for reconfiguration of the system in preparation for block loading shall be specified by MEPSO. MEPSO shall specify the time required for remote disconnection.

XIV.2.11 Power quality

(1) Transmission-connected demand facility owners and transmission-connected distribution system operators shall ensure that their connection to the network does not result in a determined level of distortion or fluctuation of the supply voltage on the network, at the connection point. The level of distortion shall not exceed that allocated to them by MEPSO. MEPSO shall coordinate their power quality requirements with the requirements of neighboring TSOs.

XIV.2.12 Simulation models

(1) Transmission-connected demand facilities and transmission-connected distribution systems shall fulfil the requirements set out in paragraphs 3 and 4 related to the simulation models or equivalent information.

(2) MEPSO may require simulation models or equivalent information showing the behavior of the transmission- connected demand facility, or the transmission-connected distribution system, or both, in steady and dynamic states.

(3) MEPSO shall specify the content and format of those simulation models or equivalent information. The content and format that MEPSO may request shall include:

1) steady and dynamic states, including 50 Hz component;
2) electromagnetic transient simulations at the connection point;
3) structure and block diagrams.

(4) For the purpose of dynamic simulations, the simulation model or equivalent information referred to in paragraph 3 shall contain the following sub-models or equivalent information:

1) power control;

2) voltage control;

3) transmission-connected demand facility and transmission-connected distribution system protection models;

4) the different types of consumption, that is to say electro technical characteristics of the consumption; and

5) converter models.

(5) MEPSO shall specify the requirements of the performance of the recordings of transmission-connected demand facilities or transmission-connected distribution facilities, or both, in order to compare the response of the model with these recordings.

XIV.3. Connection of demand units in a demand facility or a closed power distribution system to provide demand response services

XIV.3.1 General requirements

General provisions

(1) The demand response services that can be offered to MEPSO by demand units in the demand's facility or closed electricity distribution system are divided into the following categories:

(2) remotely controlled:

- demand response active power control;
- demand response reactive power control;
- demand response transmission constraint management.

(3) autonomously controlled:

1) demand response system frequency control;

2) demand response very fast active power control;

(4) Demand facilities and closed distribution systems may provide demand response services for the needs of MEPSO. Demand response services can include, jointly or separately, upward or downward modification of consumption.

(5) The categories listed in paragraph (1) are not exclusive and these Network Rules do not prevent other categories from being developed. These Network Rules refer to demand response services for the purposes of MEPSO.

Specific provisions for demand units with demand response active power control, reactive power control and transmission constraint management

(1) Demand facilities and closed distribution systems may offer demand response active power control, demand response for reactive power control, or demand response for transmission constraint management for the needs of MEPSO.

(2) Demand units with demand response active power control, demand response reactive power control, or demand response for transmission constraint management, individually or collectively as part of a demand aggregation through a third party, should be in accordance with the following requirements:

1) Be capable of operating across the frequency range and extended range specified in XV.2.1 General frequency requirements;

2) be capable of operating across the voltage range specified in XV.2.2 General frequency requirements, if connected at a voltage level of 110 kV or above;

3) be capable of operating within the normal operating voltage range of the system at the connection point, specified by the relevant system operator, if connected at a voltage level below 110kV;

4) be capable of controlling the power consumption from the network in the agreed range, directly or indirectly through a third Party, by MEPSO.

5) be equipped to receive instructions, directly or indirectly through a third Party, by MEPSO to modify their consumption and transfer the necessary information. MEPSO shall make publicy available the necessary technical specifications and conditions to enable this transfer of information;

6) to be able to fully execute the order issued by MEPSO to modify the power consumption to the limits of the electrical protection safeguards to the level of the electrical protection safety instructions;

7) once a modification to power consumption has taken place and for the duration of the requested modification, only modify the consumption used to provide the service if required by MEPSO to the limits of the electrical protection safeguards, unless a contractually agreed method is in place with MEPSO for the replacement of their contribution (including aggregated demand facilities' contribution through a third party). Instructions to modify power consumption may have immediate or delayed effects;

8) notify MEPSO of the modification of demand response capacity. MEPSO determines the method and means of notification;

9) where MEPSO directly or indirectly through a third Party, commands the modification of demand response capacity, enable the modification of a part of its consumption in response to an instruction by MEPSO, within the limits agreed with the demand facility owner or the CDSO and according to the demand unit settings;

10) have the withstand capability to not disconnect from the system due to the rate-of-change-of-frequency up to a value specified by MEPSO. With regard to this withstand capability, the value of rate-of-change-of-frequency shall be calculated over a 500 ms time frame;

11) where modification to the power consumption is specified via frequency or voltage control, or both, and via pre-alert signal sent by MEPSO, be equipped to receive, directly or indirectly through a third party, the instructions from MEPSO, to measure the frequency or voltage value, or both, to command the demand trip and to transfer the information. MEPSO shall specify and publish the technical specifications approved to enable this transfer of information;

(3) For voltage control with disconnection or reconnection of static compensation facilities, each transmission-connected demand facility or transmission-connected closed distribution system shall be able to connect or disconnect its static compensation facilities, directly or indirectly, either individually or commonly as part of demand aggregation through a third party, in response to an instruction transmitted by MEPSO, or in the conditions set forth in the contract between the relevant TSO and the demand facility owner or the CDSO.

Specific provisions for demand units with demand response system frequency control

(1) Demand facilities and CDSOs may offer a demand response system frequency control to MEPSO.

(2) Demand units with demand response system frequency control, individually or collectively as part of a demand aggregation through a third Party, shall comply with the following requirements:

1) be capable of operating across the frequency range and across the extended frequency range specified in XI.2.1 General frequency requirements;

2) be capable of operating across the voltage ranges specified in XV.2.2 General voltage requirements, if connected at a voltage level at or above 110 kV;

3) be capable of operating across the normal operational voltage range of the system at the connection point, specified by the relevant system operator, if connected at a voltage level below 110 kV.

4) be equipped with a control system that is insensitive within a dead band around the nominal system frequency of 50,00 Hz, of a width to be specified by MEPSO in consultation with the TSOs in the synchronous area of Continental Europe.

5) be capable of, upon return to frequency within the dead band specified in paragraph 2(4), initiating a random time delay of up to 5 minutes before resuming normal operation. The maximum frequency deviation from nominal value shall be specified by MEPSO in coordination with the TSOs in the synchronous area of Continental Europe.

6) be equipped with a controller that measures the actual system frequency. Measurements shall be updated at least every 0,2 seconds;

(3) be able to detect a change in system frequency of 0,01 Hz, in order to give overall linear proportional system response, with regard to the demand response system frequency control's sensitivity and accuracy of the frequency measurement and the consequent modification of the consumption. The demand unit shall be capable of a rapid detection and response to changes in system frequency, to be specified by the MEPSO in coordination with the TSOs in the synchronous area of Continental Europe. An offset in the steady-state measurement of frequency shall be acceptable up to 0,05 Hz.

Specific provisions for demand units with demand response very fast active power control

(1) MEPSO in coordination with the relevant system operator may agree with a demand facility owner or a CDSO (including, but not restricted to, through a third party) on a contract for the delivery of demand response very fast active power control.

(2) If the agreement referred to in paragraph 1 takes place, the contract referred to in paragraph 1 shall specify:

1) a change of active power related to a measure such as the rate-of-change-of-frequency for that portion of its consumption;

2) the operating principle of this control system and the associated performance parameters;

3) the response time for very fast active power control, which shall not be longer than 2 seconds.

XIV.3.2 Operational notification procedure

General provisions

(1) The operational notification procedure for demand units used by a demand facility or a closed distribution system to provide demand response to MEPSO shall be distinguished between:

1) demand units within a demand facility or a closed distribution system connected at a voltage level of or below 1 000 V;

2) demand units within a demand facility or a closed distribution system connected at a voltage level above 1 000 V.

(2) Each demand facility owner or CDSO, providing demand response shall confirm to MEPSO, directly or indirectly through a third party, its ability to satisfy the technical design and operational requirements as referred to in XV.3.1 General requirements of these Network Codes.

(3) The demand facility owner or the CDSO shall notify, directly or indirectly, through a third party, MEPSO in advance of any decision to temporary or permanently cease offering demand response.

(4) The relevant system operator shall specify further details concerning the operational notification procedure.

Procedures for demand units within a demand facility or a closed distribution system connected at a voltage level of or below 1 000 V

(1) The operational notification procedure for a demand unit within a demand facility or a closed distribution system connected at a voltage level of or below 1 000 V shall comprise an installation document.

(2) The installation document template shall be provided by the relevant system operator, and the contents agreed with MEPSO, either directly or indirectly through a third party.

(3) Based on an installation document, the demand facility owner or the CDSO shall submit information, directly or indirectly through a third party, to the relevant system operator or MEPSO. The date of this submission shall be prior to the offer in the market of the capacity of the demand response by the demand unit. The requirements set in the installation document shall differentiate between different types of connections and between the different categories of demand response services.

(4) For subsequent demand units with demand response, separate installation documents shall be provided.

(5) The content of the installation document of individual demand units may be aggregated by the relevant system operator or MEPSO.

(6) The installation document shall contain the following items:

1) the location at which the demand unit with demand response is connected to the network;

2) the maximum capacity of the demand response installation in kW;

3) the type of demand response services;

4) the demand unit certificate and the equipment certificate as relevant for the demand response service, or if not available, equivalent information;

5) the contact details of the demand facility owner, the closed distribution system operator or the third party aggregating the demand units from the demand facility or the closed distribution system.

Procedures for demand units within a demand facility or a closed distribution system connected at a voltage level above 1 000 V

(1) The operational notification procedure for a demand unit within a demand facility or a closed distribution system connected at a voltage level above 1 000 V shall comprise a demand unit installation documentation. The relevant system operator, in coordination with the MEPSO, shall specify the content required for the demand unit installation documentation. The content of the demand unit installation documentation shall require a statement of compliance which contains the information in XIV.4 Compliance, but the compliance requirements in XIV.4 Compliance can be simplified to a single operational notification stduy. The demand facility owner or CDSO shall provide the information required and submit it to the relevant system operator. Subsequent demand units with demand response shall provide separate demand unit installation document.

(2) Based on the demand response installation document, the relevant system operator shall issue a FON to the demand facility owner or CDSO.

XIV.4 Compliance

XIV.4.1 General provisions

Responsibility of the demand facility owner, the distribution system operator and the closed distribution system operator

(1) Transmission-connected demand facility owners and DSOs shall ensure that their transmission-connected demand facilities, transmission-connected distribution facilities, or distribution systems comply with the requirements provided for in these Network Codes. A demand facility owner or a CDSO providing demand response services to relevant system operators and relevant TSOs shall ensure that the demand unit complies with the requirements provided for in these Network Codes.

(2) Where the requirements of these Network Codes are applicable to demand units used by a demand facility or a closed distribution system to provide demand response services to relevant system operators and MEPSO, the demand facility owner or the CDSO may totally or partially delegate to third parties tasks such as communicating with the relevant system operator or relevant TSO and gathering the documentation from the demand facility owner, the DSO or the CDSO evidencing compliance. Third parties shall be treated as single users with the right to compile relevant documentation and demonstrate compliance of their aggregated demand facilities or aggregated closed distribution systems with the provisions of these Network Codes. Demand facilities and closed distribution systems providing demand response services to relevant system operators and MEPSO may act collectively through third parties.

(3) Where obligations are fulfilled through third parties, third parties shall only be required to inform the relevant system operator of changes to the total services being offered, taking account of location specific services.

(4) Where the requirements are specified by MEPSO, or are for the purpose of the operation of the transmission system, alternative tests or requirements for test result acceptance for these requirements may be agreed with MEPSO.

(5) Any intention to modify the technical capabilities of the transmission-connected demand facility, the transmission-connected distribution facility, the distribution system, or the demand unit, which has impact on compliance with the requirements provided for in Title XIV.4 Compliance, shall be notified to MEPSO, directly or indirectly through a third party, prior to pursuing such modification, within the time frame provided by MEPSO.

(6) Any operational incidents or failures of the transmission-connected demand facility, the transmission-connected distribution facility, the distribution system or the demand unit, which have an impact on compliance with the requirements provided for in Title XIV. 4 Complance, shall be notified to MEPSO, directly or indirectly through a third party, as soon as possible after the occurrence of such an incident.

(7) Any planned test schedules and procedures to verify compliance of the transmission-connected demand facility, the transmission-connected distribution facility, the distribution system, or the demand unit, with the requirements of these Network Codes, shall be notified to MEPSO within the time frame specified by MEPSO.

(8) The relevant system operator may participate in such tests and may record the performance of the transmission-connected demand facility, the transmission-connected distribution facility, the distribution system, and the demand unit.

Tasks of MEPSO

(1) MEPSO shall assess the compliance of a transmission-connected demand facility, a transmission-connected distribution facility, a distribution system, or a demand unit, with the requirements of these Network Rules throughout the lifetime of the transmission-connected demand facility, the transmission-connected distribution facility, the distribution system, or the demand unit. The demand facility owner, the DSO or the CDSO shall be informed of the outcome of this assessment. The compliance of a demand unit used by a demand facility or a closed distribution system to provide demand response services to MEPSO, shall be jointly assessed by MEPSO and the relevant system operator, and if applicable in coordination with the third party involved in demand aggregation.

(2) MEPSO shall have the right to request that the demand facility owner, the DSO or the CDSO carries out compliance tests and simulations according to a repeat plan or general scheme or after any failure, modification or replacement of any equipment that may have an impact on the compliance of the transmission-connected demand facility, the transmission-connected distribution facility, the distribution system, or the demand unit with the requirements of these Network Rules. The demand facility owner, the DSO or the CDSO shall be informed of the outcome of those compliance tests and simulations.

(3) MEPSO shall make publicly available the list of information and documents to be provided as well as the requirements to be fulfilled by the demand facility owner, the DSO or the CDSO in the frame of the compliance process. The list shall cover at least the following information, documents and requirements:

1) all documentation and certificates to be provided by the demand facility owner, the DSO or the CDSO;

2) details of the technical data required from the transmission-connected demand facility, the transmission-connected distribution facility, the distribution system, or the demand unit, with relevance to the network connection or operation;

3) requirements for models for steady-state and dynamic system studies;

4) timeline for the provision of system data required to perform the studies;

5) studies by the demand facility owner, the DSO or the CDSO for demonstrating expected steady-state and dynamic performance referring to the requirements set forth in XIV.4.3 Compliance Simulation;

6) conditions and procedures including scope for registering equipment certificates;

7) conditions and procedures for the use of relevant equipment certificates issued by an authorised certifier by the demand facility owner, the DSO or the CDSO.

(4) MEPSO shall make public the allocation of responsibilities to the demand facility owner, the DSO or the CDSO and to the system operator for compliance testing, simulation and monitoring.

(5) MEPSO may totally or partially delegate the performance of its compliance monitoring to third parties. In such cases, MEPSO operator shall continue ensuring compliance with Article 6, including entering into confidentiality commitments with the assignee.

(6) If compliance tests or simulations cannot be carried out as agreed between MEPSO and the demand facility owner, the DSO or the CDSO due to reasons attributable to MEPSO, then the relevant system operator shall not unreasonably withhold the final operational notification (FON).

XIV.4.2 Compliance testing

Common provisions on compliance testing

(1) Testing of the performance of a transmission-connected demand facility, a transmission-connected distribution facility, or a demand unit with demand response active power control, demand response reactive power control or demand response transmission constraint management, shall aim at demonstrating that the requirements of these Network Rules have been complied with.

(2) Notwithstanding the minimum requirements for compliance testing set out in these Network Rules, MEPSO is entitled to:

1) allow the demand facility owner, the DSO or the CDSO to carry out an alternative set of tests, provided that those tests are efficient and suffice to demonstrate that a demand facility or a distribution system complies with the requirements of these Network Rules; and

2) require the demand facility owner, the DSO or the CDSO to carry out additional or alternative sets of tests in those cases where the information supplied to MEPSO in relation to compliance testing under the provisions of XIV.4.2 Compliance testing, is not sufficient to demonstrate compliance with the requirements of these Network Rules.

(3) The demand facility owner, the DSO or the CDSO is responsible for carrying out the tests in accordance with the conditions laid down in Title XIV4.2 Compliance testing. MEPSO shall cooperate and not unduly delay the performance of the tests.

(4) MEPSO may participate in the compliance testing either on site or remotely from the system operator's dispatching center. For that purpose, the demand facility owner, the DSO or the CDSO shall provide the monitoring equipment necessary to record all relevant test signals and measurements as well as ensure that the necessary representatives of the demand facility owner, the DSO or the CDSO are available on site for the entire testing period. Signals specified by MEPSO operator shall be provided if, for selected tests, MEPSO wishes to use its own equipment to record performance. MEPSO has sole discretion to decide about its participation.

Compliance testing for disconnection and reconnection of transmission-connected distribution facilities

(1) The transmission-connected distribution facilities shall comply with the requirements for disconnection and reconnection referred in *Chapter XIV.2.10 Demand disconnection and demand reconnection* and shall be subject to compliance tests.

(2) With regard to testing of the capability of reconnection after an incidental disconnection due to a network disturbance, reconnection shall be achieved through a reconnection procedure, preferably by automation, authorised by MEPSO.

(3) With regard to the synchronisation test, the technical synchronisation capabilities of the transmission-connected demand facility shall be demonstrated. This test shall verify the settings of the synchronisation devices. This test shall cover the following matters: voltage, frequency, phase angle range, deviation of voltage and frequency.

(4) With regard to the remote disconnection test, the transmission-connected demand facility's technical capability for remote disconnection at the connection point or points from the transmission system when required by MEPSO and within the time specified by MEPSO shall be demonstrated.

(5) With regard to the low frequency demand disconnection relays test, the transmission-connected demand facility's technical capability to operate from a nominal AC input shall be demonstrated in accordance with *Chapter XIV.2.10 Demand disconnection and demand reconnection*.

(6) With regard to the low voltage demand disconnection test, in accordance with *Chapter XIV.2.10 Demand disconnection and demand reconnection*, the transmission-connected demand facility's technical capability to operate in a single action with on load tap changer blocking shall be demonstrated in accordance with *Chapter XIV.2.10 Demand disconnection and demand reconnection*.

(7) An equipment certificate may be used instead of part of the tests provided for in paragraph 1, on the condition that it is provided to MEPSO.

Compliance testing for information exchange of transmission-connected demand facilities

(1) With regard to information exchange between MEPSO and the transmission-connected demand facility owner in real time or periodically, the transmission-connected demand facility's technical

capability to comply with the information exchange standard established pursuant to *Chapter XIV.2.7 Information exchange* shall be demonstrated.

(2) An equipment certificate may be used instead of part of the tests provided for in paragraph 1, which should be submitted to and accepted by MEPSO.

Compliance testing for demand units with demand response active power control, reactive power control and transmission constraint management

(1) With regard to the demand modification test:

1) the technical capability of the demand unit used by a demand facility or a closed distribution system to provide demand response active power control, demand response reactive power control or demand response transmission constraint management to modify its power consumption, after receiving an instruction from the relevant system operator or MEPSO, within the range, duration and time frame previously agreed and established in accordance with *XIV.3.1 General requirements*, shall be demonstrated, either individually or collectively as part of demand aggregation through a third party;

2) the test shall be carried out either by an instruction or alternatively by simulating the receipt of an instruction from the relevant system operator or MEPSO and adjusting the power demand of the demand facility or the closed distribution system;

3) the test shall be deemed passed, provided that the conditions specified by the relevant system operator or MEPSO pursuant to XIV.3.1 General requirements;

4) an equipment certificate may be used instead of part of the tests provided for in paragraph 1, on the condition that it is submitted to and accepted by MEPSO.

(2) With regard to the disconnection or reconnection of static compensation facilities test:

1) the technical capability of the demand unit used by a demand facility owner or closed distribution system operator to provide demand response active power control, demand response reactive power control or demand response transmission constraint management to disconnect or reconnect, or both, its static compensation facility when receiving an instruction from the relevant system operator or MEPSO, in the time frame expected in accordance with *XIV.3.1 General requirements*, shall be demonstrated, either individually or collectively as part of demand aggregation through a third party;

2) the test shall be carried out by simulating the receipt of an instruction from the relevant system operator or MEPSO and subsequently disconnecting the static compensation facility, and by simulating the receipt of an instruction from the relevant system operator or MEPSO and subsequently reconnecting the facility;

3) the test shall be deemed passed, provided that the conditions specified by the relevant system operator or MEPSO pursuant to *XIV.3.1 General requirements* are fulfilled.

XIV.4.3 Compliance simulation

Common provisions on compliance simulations

(1) Simulation of the characteristics of a transmission-connected demand facility, a transmission-connected distribution facility, or a demand unit with demand response very fast active power control within a demand facility or a closed distribution system shall result in demonstrating whether the requirements of these Network Codes have been fulfilled or not.

(2) Simulations shall be run in the following circumstances:

1) a new connection to the transmission system is required;

2) a new demand unit used by a demand facility or a closed distribution system to provide demand response very fast active power control to MEPSO has been contracted in accordance with *XIV.3.1 General requirements*;

3) a further development, replacement or modernisation of equipment takes place;

4) alleged incompliance by MEPSO with the requirements of these Network Rules.

(3) Notwithstanding the minimum requirements for compliance simulation set out in these Network Rules, MEPSO is entitled to:

1) allow the demand facility owner, the DSO or the CDSO to carry out an alternative set of simulations, provided that those simulations are efficient and suffice to demonstrate that a demand facility or a distribution system complies with the requirements of these Network Rules or with national legislation; and

2) require the demand facility owner, the DSO or the CDSO to carry out additional or alternative sets of simulations in those cases where the information supplied to MEPSO in relation to compliance simulation under the provisions of *XIV.4.3 Compliance simulation*, is not sufficient to demonstrate compliance with the requirements of these Network Rules.

(4) The transmission-connected demand facility owner or the transmission-connected distribution system operator shall provide a report with the simulation results for each individual transmission-connected demand facility or transmission-connected distribution facility. The transmission-connected demand facility owner or the transmission-connected distribution system operator shall produce and provide a validated simulation model for a given transmission-connected demand facility or transmission-connected distribution facility. The scope of the simulation models is set out in *XIV.2.12 Simulation models*.

(5) MEPSO shall have the right to check that a demand facility or a distribution system complies with the requirements of these Network Rules by carrying out its own compliance simulations based on the provided simulation reports, simulation models and compliance test measurements.

(6) MEPSO shall provide the demand facility owner, the DSO or the CDSO with technical data and a simulation model of the network, to the extent necessary to carry out the requested simulations in accordance with *XIV.4.3 Compliance simulation*.

Compliance simulations for transmission-connected distribution facilities

(1) With regard to the reactive power capability simulation of a transmission-connected distribution facility:

1) a steady-state load flow simulation model of the network of the transmission-connected distribution system shall be used in order to calculate the reactive power exchange under different load and generation conditions;

2) a combination of steady-state minimum and maximum load and generation conditions resulting in the lowest and highest reactive power exchange shall be part of the simulations;

3) calculating the reactive power export at an active power flow of less than 25 % of the maximum import capability at the connection point shall be part of the simulations in accordance with *XIV.2.4 Reactive power requirements*.

(2) MEPSO may specify the method for compliance simulation of the active control of reactive power set out in *XIV.2.4 Reactive power requirements*.

(3) The simulation shall be deemed passed if the results demonstrate compliance with the requirements set out in *XIV.2.4 Reactive power requirements*.

Compliance simulations for transmission-connected demand facilities

(1) With regard to the reactive power capability simulation of a transmission-connected demand facility:

1) the transmission-connected demand facility without onsite generation's reactive power capability at the connection point shall be demonstrated;

2) a load flow simulation model of the transmission-connected demand facility shall be used to calculate the reactive power exchange under different load conditions. Minimum and maximum load conditions resulting in the lowest and highest reactive power exchange at the connection point shall be part of the simulations;

3) the simulation shall be deemed passed if the results demonstrate compliance with the requirements set out in *XIV.2.4 Reactive power requirements*.

(2) With regard to the reactive power capability simulation of a transmission-connected demand facility with onsite generation:

1) a load flow simulation model of the transmission-connected demand facility shall be used to calculate the reactive power exchange under different load conditions and under different generation conditions;

2) a combination of minimum and maximum load and generation conditions resulting in the lowest and highest reactive power capability at the connection point shall be part of the simulations;

3) the simulation shall be deemed passed if the results demonstrate compliance with the requirements set out in *XIV.2.4 Reactive power requirements*.

Compliance simulations for demand units with demand response very fast active power control

(1) The model of the demand unit used by a demand facility owner or a closed distribution system operator to provide demand response very fast active power control shall demonstrate the technical capability of the demand unit to provide very fast active power control to a low frequency event in the conditions set out in *XIV.3.1 General requirements*.

(2) The simulation shall be deemed passed provided that the model demonstrates compliance with the conditions set out in *XIV.3.1 General requirements*.

XIV.4.4 Compliance monitoring

Compliance monitoring for transmission-connected distribution facilities

(1) With regard to compliance monitoring of the reactive power requirements applicable to transmission-connected distribution facilities:

1) the transmission-connected distribution facility shall be equipped with necessary equipment to measure the active and reactive power, in accordance with *XIV.2.4 Reactive power requirements*; and

2) the relevant system operator shall specify the time frame for compliance monitoring.

Compliance monitoring for transmission-connected demand facilities

(1) With regard to compliance monitoring of the reactive power requirements applicable to transmission-connected demand facilities:

1) the transmission-connected demand facility shall be equipped with necessary equipment to measure the active and reactive power, in accordance with *XIV.2.4 Reactive power requirements*; and

2) MEPSO shall specify the time frame for compliance monitoring.