GRID CODE – BALANCING CODE

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Chapter 6: Balancing Code

1 Introduction

1.1.1.1 This **balancing code** covers real time operation and the processes and procedures that the **TSMO** will use to balance the system. This covers active power flows, control of frequency and control of voltage and reactive power.

1.1.1.2 This **balancing code** is not a single entity but is made up of the following sub-codes (hereafter referred to as codes):

- Dispatch Code
- Frequency control code
- Voltage control code

2 Dispatch Code

2.1 Introduction

2.1.1.1 This **dispatch code** sets out the procedures for the following:

- The procedure for the **TSMO** to issue **dispatch instructions** to **generators** in respect of their **generating units** that participate in the balancing market and/or provide **ancillary services**;
- The procedure for the **TSMO** to dispatch consumers that participate in the balancing market and/or provide **ancillary services**;
- The procedure for balancing the system in real time utilising the balancing market and **ancillary services**;
- The procedure for the **TSMO** to co-ordinate and manage exchanges with **externally interconnected parties**;
- Organisation of the synchronous parallel operation to meet the associated UCTE security and reliability criteria.

2.2 Objective

2.2.1.1 The overall objectives of this **balancing code** are twofold. Firstly to ensure that at all times **generation** is matched to **demand** and secondly to maintain the appropriate margin of reserve to ensure, as far as possible, the integrity of the electricity system and the security and quality of supply of the Kosovan **power system** by:

- Monitoring the operation of user's equipment against the relevant schedules;
- Controlling the power flows;
- Giving **dispatch instructions** to **generating units**;
- Issuing **dispatch Instructions** to **users** in relation to **demand control**;
- Taking account of **system constraints**;
- Maintaining an appropriate level of **operating margin**;
- Dealing with unexpected **events**.

2.2.1.2 The dispatch process should aim to allow the **electricity market** to function fully, flexibly and transparently while maintaining **power system** security and stability.

2.3 Scope

2.3.1.1 This **dispatch code** applies to the following:

- **TSMO**;
- **Generators** with **generating units** having a registered capacity of at least 5MW;
- **DSO**s
- **Balancing mechanism** participants;
- **Ancillary services** providers:

2.3.1.2 In conjunction with the provisions of this **balancing code** the procedure for dispatch with externally **interconnected parties** is set out in the UCTE OH and the respective **interconnection agreements**.

2.3.1.3 Licensed Parties are entitled to act on behalf of **users** in accordance with the **market rules**.

2.4 Procedure

2.4.1 Responsibilities of Users

2.4.1.1 The various **users** must meet their obligations as set out in the following paragraphs.

2.4.1.2 Each **market participant** participating in the **electricity market** shall have full responsibility for its scheduled **generation**, exchanges and consumption, subject to any modifications by **dispatch instructions** issued by the **TSMO** under this **dispatch code**.

2.4.1.3 The **market participants** that are providing **ancillary services** must fulfil the terms of their **ancillary services agreements** and operate to all their registered technical parameters unless otherwise modified by agreement with the **TSMO**;

2.4.1.4 **Market participants** that are participating in the **balancing market**, must comply with the relevant **market rules** for the balancing market, and operate to all their registered technical parameters unless otherwise modified by agreement with the **TSMO**.

2.4.2 Audit

2.4.2.1 The **TSMO** will ensure that all **dispatch instructions** will be retained in a readily useable electronic form for a period of at least 5 [five] years. Any **market participant** may request access to this information, solely in respect of their own **plant and apparatus**, or in regards to a **dispatch instruction** to another party that had a significant impact on their assets. This access will only be granted upon agreement of the **TSMO** and the **Regulator** as the result of a reasonable request.

2.4.2.2 The **TSMO** and all **users** are obliged to make available all records of **dispatch instructions** and their execution for the purposes of a joint investigation, disputes or legal proceedings on the request of relevant authorities. In providing this information they will take suitable measures to preserve the confidentiality of data, where this is necessary.

2.4.3 Real Time Dispatch

2.4.3.1 The control of the power balance in the Kosovan **power system** will be carried out on the basis of the daily schedule as determined under the **dispatching code**. The **generating units** in normal conditions are required to adhere to the given daily schedule of **generation** and instructed **ancillary services** supply based on **ancillary services agreements** or other provisions of this code.

2.4.3.2 The management of parallel operation is carried out on the basis of maintaining the balance of agreed exchanges of electrical energy and power with **externally interconnected parties** as defined by the **approved schedule**.

2.4.3.3 The consumers of electric energy are required to independently control the fulfilment of their obligations for the daily schedule both regarding power consumption and the electric energy in accordance with the concluded agreements.

2.4.3.4 **Generators** are required to independently control delivery to the **power system** of electrical energy and electric power of the appropriate quality, in accordance with the concluded agreements and the provisions of the **grid code**.

2.4.3.5 The **TSMO** is responsible for procurement of active power/energy for compensation of **inadvertent deviations** under the transparent and non-discriminatory conditions and in accordance with **market rules**. It is also responsible to schedule and control off-take/injection of contracted active power/energy quantities for compensation of **inadvertent deviations** based on the **approved schedule**.

2.4.4 Balancing Arrangements

2.4.4.1 The **TSMO** controls and manages any imbalance in the **power system** in real time utilising the declared balancing market capability, in accordance with the **market rules** to meet operational standards as set out in **frequency control code** and the **voltage control code**.

2.4.4.2 The **TSMO** shall use the available **generation**, as specified under the **dispatching code**, to maintain the generation-load balance on the Kosovan **power system**. The **TSMO** will control the **power system** and will manage as far as possible the exchanges with **externally interconnected parties** so that they are maintained within the tolerances that have been agreed with the **externally interconnected party**. The **TSMO** will utilise the LFC to manage **area control error** to meet UCTE OH requirements as more fully set out in the **frequency control code**. Where a **generating unit** fails to maintain its scheduled target then the **TSMO** will issue a **dispatch instruction** as per section 2.4.5.

2.4.5 Dispatch Instructions

2.4.5.1 The **TSMO** has the responsibility for issuing **dispatch instructions** for services offered to the balancing market and under **ancillary services agreements** in order to maintain **power system** active power/energy balance and to manage the **transmission system** voltage profiles, as far as is possible, within the agreed tolerances.

2.4.5.2 Additional factors that the **TSMO** will also take into account in instructing changes to the **approved schedules** are detailed in the following paragraphs:

- **Dispatch unit** has failed to comply with a **dispatch Instruction** or deviated from daily scheduled values;
- Variations between **demand forecast** and actual **demand** including variations in **demand** reduction actually achieved by **users**;
- The need for **generating units** to be operated for monitoring, testing or investigation purposes under the testing and monitoring code or, at the request of a **user** under the testing and monitoring code, for commissioning or acceptance tests;
- Changes in the required level of operating reserve, or **operating margin**, as defined by the **TSMO**;
- Instructions for **demand control** under the **demand control code** and **power system** defence or restoration measures under the **contingency planning code**;

- Dealing with exceptional or unexpected **events** such as system faults and/or significant changes in weather conditions.

2.4.6 Issuing of Dispatch Instructions

2.4.6.1 **Dispatch instructions** relating to the **day of physical dispatch** can be issued by the **TSMO** at any time during the period beginning immediately after the approval of the daily schedules in respect of that day.

2.4.6.2 The **TSMO** will issue **dispatch instructions** to the responsible person that has been nominated by the **balancing mechanism participant** or **ancillary services provider**, as the case may be, for the dispatch of the associated **dispatch unit**. In those circumstances where a **user** is managing more than one **dispatch unit**, it will inform the **TSMO** of the respective action being undertaken in response to the **dispatch instruction**. It is accepted that where this relates to a single **connection point** more than one **dispatch unit** can be managed by the user to meet the scheduled off-take or injection, as the case may be.

2.4.6.3 The **TSMO** will issue **dispatch Instructions** directly to the responsible person at the respective **power plant's** control centre, for **dispatch instructions** relating to emergency actions.

2.4.6.4 In addition to instructions relating to the dispatch of **active power**, the **dispatch Instructions** may include some or all of the following:

- Time to synchronise;
- Provision of operating reserve;
- Provision of cold reserve;
- **Reactive power** (instructions may include MVAr output, Target Voltage levels, tap changes, maximum MVAr output, or maximum MVAr absorption);
- Operation at maximum operating level (Maxgen);
- Future dispatch requirements;
- Request for details of **generating unit** step-up transformer tap positions;
- Instructions for tests;
- **Generating unit** operation in LFC mode;

- Details of adverse conditions that may impact on the operation of the **power system**, such as forecast or actual bad weather;

- Emergency actions.

2.4.7 Dispatch Instructions for Active Power

2.4.7.1 As specified under the **frequency control code** the **TSMO** is responsible for the management of system frequency. **Users** who receive instructions from the **TSMO** for regulation of **active power** shall follow them precisely.

2.4.7.2 The **TSMO** will use services that are provided under the balancing market and/or **ancillary services agreements** to ensure load-frequency control and the provider will meet the requirements of the associated **market rules framework agreement** and/or **ancillary services agreement**.

2.4.8 Dispatch Instructions for Reactive Power

2.4.8.1 As specified under the **voltage control code** the **TSMO** is responsible for the management of **reactive power** and voltage. The **users** who receive instructions from the **TSMO** for regulation of **reactive power** shall follow them precisely.

2.4.8.2 The instruction given by the **TSMO** to a **generator** or **demand customer** may refer to a single **generating unit** or a total **power plant**, or another **user** offering this service. The **dispatch instruction** given by the **TSMO** may involve a change in the **reactive power** output of a **generating unit** or an instruction to maintain the local busbar volts at a specified target level. These requirements may be achieved by altering the **generating unit reactive power** output or by transformer tap changing as appropriate.

2.4.8.3 The **TSMO** will use services that are provided under **ancillary services agreements**, covering voltage regulation, and the **ancillary services provider** will meet the requirements of the associated **ancillary services agreement** and the **market rules**.

2.4.9 Dispatch of Reserve

2.4.9.1 The **TSMO** will use services as set out under the **frequency control code** and that are provided under the balancing market and/or **ancillary services agreements**, to manage reserves and the provider will meet the requirements of the associated **ancillary services agreement** and the **market rules**.

2.4.9.2 When a **generation** contingency has occurred or is occurring, **primary reserve** will be provided automatically and no **TSMO** involvement is required. Also the **TSMO** will use automated **systems** to instruct the provision of **secondary reserve** without

any manual intervention. The **SCADA** data and/or information provided manually would alert the **TSMO** to the fact that a contingency has occurred. The **TSMO** will use the information available and will, in the changed situation and as required, dispatch **tertiary load-frequency control reserves** and cold reserves to replace the lost **generation** capacity.

2.4.9.3 The overriding requirement should be to return the **power system** to its normal security standards as quickly as is reasonably possible.

2.4.9.4 In cases of significant loss of load, automatic **primary control** and **secondary control** will contribute to the frequency restoration. **Power system** balancing will be achieved by dispatching of available tertiary load-frequency control. If all above mentioned measures are not sufficient, **TSMO** may instruct directly reduction of output for **generating units** that concluded relevant **ancillary services agreement**s.

2.4.10 Communication

2.4.10.1 Communication facilities for issuing **dispatch instructions** will be as specified in the **ancillary services agreement**.

2.4.10.2 The format and content of the **dispatch instructions** shall be established by the **TSMO**, in accordance with this **dispatch code**.

2.4.10.3 The person receiving an order in the form of a **dispatch instruction**, shall repeat it back so that the person who issued the order can confirm that the understanding of the order is correct. The person receiving the order must only start to fulfil it after he has received confirmation from the person who issued the order.

2.4.10.4 A **dispatch Instruction** must be formally acknowledged by the **user** in respect of that **dispatch unit** immediately as received by the approved communication facility, or a reason for non-acceptance should be given immediately.

2.4.10.5 A **user** can only refuse a manual **dispatch instruction** on safety grounds - relating to personnel or plant - or because the **dispatch instruction** is not valid.

2.4.10.6 Under no circumstances can a valid **dispatch instruction** properly given by the **TSMO** to a **user** be ignored for commercial reasons.

2.4.10.7 For a **dispatch instruction** to be valid it must observe the limits of availability and operational characteristics as properly declared to the **TSMO** and relevant to the time and period, to which the **dispatch instruction** relates.

2.4.10.8 In the event that in carrying out the **dispatch instruction**, an unforeseen problem arises, caused on safety grounds – relating to personnel or plant – the **TSMO** must be notified immediately by telephone.

2.4.11 Loss of all Communications

2.4.11.1 In the event of a failure of all means of communication between the **TSMO** and a **user**, the affected **user** shall utilise the agreed plan as provided under the **connections code** and/or **ancillary services agreement** and continually make every effort to contact the **TSMO**. While communication is lost the **TSMO** and the affected **user** will conform to the **approved schedule**.

2.4.11.2 The **TSMO** and affected **users** operating as above shall also take into account the need to contribute to maintaining scheduled system frequency – in the event that the frequency schedule is missing, for any reason, the target frequency should be 50Hz – and voltage levels within normal operational limits determined in the **voltage control code**. At all times the **TSMO** and affected **users** will continue to act as **reasonable and prudent operators** and under no circumstances will operate plant outside its safe limits.

2.4.11.3 The failure to receive **dispatch instructions** arises not only as a result of disruption of all communication facilities but may also result during periods of unacceptable communications quality. In the event of disrupted or impaired communications, the affected **parties** will take all reasonable steps to re-establish communication by any appropriate means.

2.4.11.4 In case of disruption of the **TSMO** control facility, contingency plans will be initiated and alternative communication paths established, at such times all affected **users** will be informed of the new arrangements.

2.4.11.5 After the communications are restored to the normal facility, all affected **users** will be informed of the revised arrangements.

2.4.12 Action Required from Users

2.4.12.1 Each **user** will comply with all **dispatch instructions** correctly given by the **TSMO**.

2.4.12.2 Each user must utilise the relevant **dynamic dispatch parameters** when complying with **dispatch instructions**.

2.4.12.3 In the event that a **user** is unable to comply with **dispatch instructions**, it must notify the **TSMO** immediately. Where a **user** has not informed the **TSMO** of its inability or unwillingness to comply with a **dispatch instruction** but where the **TSMO** considers that the **user** is not in compliance with a **dispatch instruction** the

TSMO shall take such steps as it feels are necessary. Monitoring and testing are covered under the testing and monitoring code.

2.4.12.4 The responsible person of a **user** is not required to fulfil instructions given by the **TSMO** if to do so could endanger people or equipment.

2.4.13 Emergency Conditions

2.4.13.1 To preserve the security of the **transmission system** under emergency conditions, the **TSMO** may issue emergency instructions to **users**. This may request action outside of the **dynamic dispatch parameters**, other relevant data or notice to synchronise. Each **user** is required to use all reasonable endeavours to comply with emergency instructions, but when unable to do so the **user** must inform the **TSMO** immediately.

2.4.13.2 For the purposes of securing system security and stability the **TSMO** is authorised and responsible for managing exchanges of **active power** and energy with **externally interconnected parties**, as set out in the UCTE OH and the respective **interconnection agreement**.

2.4.13.3 The **TSMO** will be responsible for co-ordination related to the export, import, exchange and re-scheduling of **active power** and energy at the interconnections, and provision of **ancillary services** with **externally interconnected parties**.

2.4.14 Authority of the TSMO

2.4.14.1 While carrying out the dispatch process the **TSMO** has the rights set out in the following paragraphs.

2.4.14.2 To give operating instructions, aimed at maintaining the stable and reliable operation of the **power system**, the quality of supply to consumers and the conditions of modes of **generation** and consumption of electrical power and energy as stipulated by the **approved schedule**, which are mandatory for all **users**.

2.4.14.3 The **TSMO** shall take all measures necessary to deal with Imbalance as per the provisions of the balancing market and the **ancillary services agreements**.

2.4.14.4 The **TSMO** will exercise its other rights as specified in law and in this **balancing code**.

2.4.14.5 The **TSMO** may modify or override the scheduled values or the real time dispatch levels if it believes that **power system** stability or security or quality of supply is being or will be or might be compromised. In the event of the **TSMO** taking corresponding

actions, the **TSMO** will record the details and the reasons for its action for audit purposes and these shall be communicated to the **Regulator** if requested.

2.4.15 Performance Monitoring

2.4.15.1 The **TSMO** controls the management of the **power system** and is responsible for ensuring as far as is practically possible, the following:

- The modes of operation of **generating units** shall be based on the last **approved schedule**;
- The transition from one value of Power output, provided in the **approved schedule**, to another one must start no more than five minutes prior to the end of a dispatch period and must be completed no more than five minutes after the beginning of the next dispatch period.

2.4.15.2 Where **generating units** are operated by a **generator** in accordance with the **approved schedule**, the stipulations of 2.4.15.1 apply to the relevant **generator** accordingly.

2.4.15.3 The monitoring of **generating units** and subsequent requirements for testing are set out in the testing and monitoring code.

2.5 Dispatch under Conditions of Supply Scarcity

2.5.1 General

2.5.1.1 There are two separate instances of Supply scarcity that could occur. These two instances can be summarised as follows:

- Where circumstances arise such that it not possible to prevent the creation of a power shortage, such as if the imports, injections and balancing provisions cannot meet the total **demand**. Under these circumstances the provisions of the **dispatching code** and the **demand control code** will apply;
- Real time **demand generation** mismatch – where a shortage of **generation** to meet **demand** occurs during the real time dispatch process:

2.5.1.2 The **TSMO** will notify the **electricity market** of any period or potential period of supply scarcity with the expectation that **generators** with non-contracted and unoffered **generating units** and **demand customers** will take appropriate action.

2.5.2 Real Time Demand Generation Mismatch

2.5.2.1 The **TSMO** shall ensure the execution of the **approved schedule** and inform all **market participants** about supply scarcity problem:

- If the problems are caused by unforeseen forced reduction of **generation** or because of **transmission system** problems, the **TSMO** will dispatch the available reserve capacities in accordance with this **balancing code**;

- In the event of a **demand generation** mismatch in real time the first responsibility of the **TSMO** is to ensure the integrity of the **power system** and to that purpose the **TSMO** may also utilise assistance from **externally interconnected parties** if this is more appropriate or if internal control facilities are exhausted;

- Where necessary, the **TSMO** may instruct **generators** and other **ancillary services providers** to make additional reserves available, if so required to maintain or restore the integrity of the **power system**.

2.5.3 Warning of Supply Scarcity

2.5.3.1 In the event that a supply scarcity or potential supply scarcity occurs, the **TSMO** shall inform **generators** and other **users**. System warnings are specified in the operational liaison and event information supply code.

2.5.3.2 In the event of an emergency loss of considerable **generation**, **demand** or transmission capacity, the **TSMO** shall act according to the relevant contingency measures set out in **demand control code** and the **contingency planning code**.

2.5.4 Timekeeping

2.5.4.1 A key requirement to enable the correct functioning of the **electricity market** and the dispatch process is that all **users** operate to a reference time. The **users** must ensure that they maintain the time accurately within a maximum error of +/- one second.

2.5.4.2 The responsibility for this resides solely with the **users** who can adopt whatever method and equipment they wish to fulfil this obligation. A time synchronising signal will be sent from the **TSMO SCADA** system at regular time intervals. It is solely the decision of the **users** as to whether or not they make use of this signal.

2.6 Failure to Fulfil Commitments

2.6.1.1 All **market participants** during the dispatch process should strictly fulfil their commitments:

2.6.1.2 **Generators** shall operate within the approved tolerances for the power output or energy levels agreed in the **approved schedule.**

2.6.1.3 **Balancing mechanism participants** shall fulfil the terms of the **ancillary services agreements** for the provision of services to the **balancing mechanism**;

2.6.1.4 **Ancillary services providers** shall fulfil the terms of their **ancillary services agreements** for the provision of services for dispatch, power control and transmission of electrical energy via the **power system**;

2.6.1.5 All **parties** have a duty to respond to **dispatch instructions** within a tolerable time and accuracy and to fulfil their requirements under the self-commitment process as per section 2.4.3.

2.6.2 Duties of the TSMO as a Reasonable and Prudent Operator

2.6.2.1 The **TSMO** has the ultimate responsibility for facilitating the operation of the **electricity market** for the benefit of all **market participants** and ultimately electricity consumers as per the energy law, the electricity law, its transmission licence, the **market rules** and this **grid code**. The **TSMO** must operate the system as economically as the various constraints allow.

2.6.2.2 The **TSMO** must balance this requirement with the need to maintain the stability, security and quality of supply standards for the **power system**.

2.6.2.3 In order to fulfil this latter requirement the **TSMO** has the right to take any action that it reasonably feels is necessary in the circumstances that prevail at the time. However, in the event of a reasonable request, the **TSMO** will be required to explain its actions and report accordingly to the **Regulator**. At all times the **TSMO** shall act as a **reasonable and prudent operator**.

2.6.2.4 Only in exceptional circumstances may the stability, security and quality of supply standards be waived. The **TSMO** must detail the circumstances that would allow relaxation of these standards. The procedures to be followed must be developed in consultation with other **parties** and must take full note of the obligations of the **TSMO** to maintain **power system** security. These exceptional circumstances could include but are not limited to, the following:

- After an exceptional **event** – during restoration after a total **blackout**;
- After a significant **event** – as soon as reasonably possible whilst the system is being secured after a credible **event**.

3 Voltage Control Code

3.1 Introduction

3.1.1.1 This **voltage control code** specifies the requirements and criteria with respect to voltage control and the technical facilities for voltage and **reactive power** control. This **voltage control code** should be read in conjunction with the **connections code**.

3.1.1.2 This **voltage control code** also details the allocation of obligations and responsibilities with respect to voltage and **reactive power** control and defines the procedure and relations between the **TSMO** and **users** with regard to the process for voltage and **reactive power** control.

3.2 Objective

3.2.1.1 The objectives of this section are as follows:

- To enable the **TSMO** - as far as is possible - to set out the associated responsibilities for achieving voltage profiles on the **transmission system** and associated **user** systems in order to meet the relevant legal and license standards at minimum **transmission** losses;
- to enable the **DSOs** to achieve suitable voltage profiles on their **distribution systems**;
- to maintain the stability, security and integrity of the **transmission system**;
- to avoid damage to the **transmission system** and to **user** plant;
- to maintain voltages at **user connection points** within the limits specified in this **voltage control code**:

3.3 Scope

3.3.1.1 This section applies to the following:

- The **TSMO**;
- **Distribution system operators** (**DSO**s);
- **Generators** including **generators** with **generating units** connected to the **distribution system**;

- **demand customers** directly connected to the **transmission system**:

3.4 Criteria and Strategies

3.4.1 General

3.4.1.1 The **TSMO** is responsible for the maintenance of optimum voltage levels on the **transmission system** and the **DSO**s are responsible for their **distribution systems**. This means that voltages at all nodes on the **system,** including the remote ends of radial transmission feeders, shall be within the range specified in paragraph 3.4.2 of this **voltage control code**.

3.4.1.2 Voltage control of the Kosovan **Power System** is necessary to fulfil the following requirements:

- Ensure that the MVAr **demand** is met;
- Provide sufficient dynamic voltage control capability to cover changes in the MVAr **demand** on the electricity system in order to:
  - Facilitate controlled voltage adjustment;
  - Limit the duration and extent of voltage fluctuations under fault conditions:
- Provide static and dynamic **reactive power** reserve capability:

3.4.1.3 In order to achieve these aims and to control voltages on the **transmission system** the **TSMO** will use a variety of methods of dynamic and static **reactive power** control.

3.4.2 Voltage Limits

3.4.2.1 In order to avoid damage to facilities and ensure stable parallel operation of the Kosovan **Power System** and all affected **users**, the electricity system voltage levels[1] shall conform to the **electricity standards code** and shall be within the admissible ranges as indicated in the following table.

Nominal Voltage	**Normal Circumstances**	**Exceptional Circumstances**
400kV	reference voltage +/- [5%]	+/- [10%]

[1] UCTE operation Handbook Policy 3B – Guidelines - article G1

220kV	reference voltage +/- [5%]	+/- [10%]
110kV	reference voltage +/- [10%]	[88 to 130kV]

3.4.2.2 The reference voltage for most nodes is normally the nominal voltage but may be defined by the **TSMO** depending on the **reactive power** balance and **power system** characteristics.

3.4.2.3 The maximum values are derived from the technical characteristics of the primary equipment and the minimum values shall be calculated and set by the **TSMO** in order to ensure stable parallel operation of the system and all the **generating units**.

3.4.3 Reactive Power Flows

3.4.3.1 The overriding aims of voltage and **reactive power** control are two fold as follows:

- limit **reactive power** flows in order to achieve the minimum losses of **active power**;
- provide sufficient **reactive power** to maintain system voltages and thus the stability and security of the **transmission system**:

3.4.3.2 In view of the above the balance between the **reactive power** generated and **reactive power** consumed will take place on a regional level because of the technical and operational characteristics of the system.

3.4.4 Voltage Control Options

3.4.4.1 The options for voltage control that can be utilised by the **TSMO** include but are not limited to the following:

- **Transmission system**:
  - Transformer tap-changing;
  - Reactor and capacitor switching;
  - **Static var compensators** (**SVC**);
- **Generation** plant:
  - **Generating unit** reactive power capability;

- Tap-changing on generating unit transformers:

- **Demand customer** plant:

  - Power factor correction:

3.4.5 Voltage Control Strategies

3.4.5.1 The aim of voltage control is to control the system voltage in order to optimise **reactive power** flows. In order to achieve this the most suitable voltage profiles and target voltage settings have to be adopted. The strategies for achieving this include the following:

- Optimisation as per the tertiary voltage control procedures, as per paragraph 3.6.4, using off-line tools;

- On-line studies and solutions resulting from the **SCADA**/EMS system:

3.5 Generating Unit Requirements

3.5.1 AVR

3.5.1.1 All synchronous **generating units** must have an excitation system[2] controlled by an automatic voltage regulator (**AVR**) in service and operating at all times in an automatic mode while synchronised unless relieved of that duty by the **TSMO**. The requirements are specified in the **connections code**.

3.5.2 Disabling of an AVR

3.5.2.1 A **generator** may only disable or restrict **AVR** action in the following cases:

- Where the action is essential for the safety of personnel and/or plant;

- In order to secure the reliability of the **generating unit**;

- Where the restriction is agreed between the **TSMO** and the **generator** in advance:

3.5.2.2 In the event of a **generating unit** not operating under **AVR** control the **TSMO** may impose restrictions on the operation of the **generating unit** to the extent necessary to provide for safe and secure operation of the electricity system and operation within prescribed standards. This will include where necessary instructing the **generator** to

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[2] The operational and technical requirements for the excitation system and the **AVRs** are specified in the **connections code**.

de-energise the **generating unit**. If the **TSMO** takes such action, then the **TSMO** shall consult with the **generator** as soon as practicable in order to determine a safe operating regime that causes minimum restriction on the operation of the **generating unit**.

3.6 Provision of Voltage and Reactive Power Control

3.6.1 General

3.6.1.1 The provision of voltage and **reactive power** control can be divided into three separate types – primary, secondary and tertiary. These are detailed in paragraphs 3.6.2, 3.6.3 and 3.6.4.

3.6.2 Primary Voltage Control

3.6.2.1 Primary voltage control is the real time minute by minute control of voltage and **reactive power**. In most cases the control is provided by the automatic operation of the plant involved.

3.6.2.2 Primary voltage control is provided mainly by **generating unit AVR**s.

3.6.2.3 **Generating units** have the capability of initiating a rapid variation in their excitation and thus a rapid change in their **reactive power** output when they detect a voltage variation across their terminals.

3.6.2.4 Joint voltage control or var sharing is utilised in some **power plants** in order to regulate voltage at specific points on the **transmission system**. This provides the optimum distribution of **reactive power** among the **generating units** operating in parallel within that **power plant**. These schemes normally operate with reference to the voltage on the associated HV busbars.

3.6.2.5 **Generators** have a requirement to ensure that their **generating units** connected to the **transmission system** provide the mandatory requirements for primary voltage control.

3.6.3 Secondary Voltage Control

3.6.3.1 Secondary voltage control consists of actions that can be taken manually on the instruction of the **TSMO** in order to co-ordinate the effects of all the voltage and **reactive power** control devices. The methods used for primary voltage control can also be used for secondary voltage control together with shunt reactors, capacitors and on-load tap changing on transformers and autotransformers.

3.6.3.2 The overall aim is to maintain the required voltage levels and **reactive power** reserves throughout the **transmission system** and at the boundaries with the **distribution system**.

3.6.3.3 The **TSMO** and all **users** must ensure that their plant is capable, at all times, of meeting the requirements of secondary voltage control provision.

3.6.4 Tertiary Voltage Control

3.6.4.1 Tertiary voltage control involves a longer-term process, within the operational timescale, of optimisation using real time measurements particularly with respect to **demand** side requirements. This process will look at the system wholly and separately in order to determine the optimal settings and service position of the associated voltage control devices - **AVR**s, tap changer settings, shunt reactor and capacitor settings.

3.6.4.2 The result of this process will be an optimised arrangement for the provision of the required **reactive power** reserve for the purposes of exercising secondary voltage control when needed.

3.6.4.3 The responsibility for carrying out this process resides with the **TSMO**.

3.7 Technical Facilities for Voltage and Reactive Power Control

3.7.1.1 The **transmission system** is planned and operated by the **TSMO** to be secure against credible losses at all times[3]. A key element in dealing with credible **events** is the provision of sufficient reserves of **reactive power**.

3.7.1.2 The **TSMO** has the responsibility for ensuring that at times of high **demand** the **system** must be able to accommodate such **events** with adequate **reactive power** reserves in order to maintain the system voltage within the required range. A similar principle applies to the converse at times of low **demand** when adequate **reactive power** absorption reserves must be available.

3.8 TSMO Instructions

3.8.1.1 The **TSMO** will issue instructions to **users** and carry out switching as follows:

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[3] Under extreme conditions the **transmission system** may be operated in a manner that does not conform to the normal security standards. This could include situations arising during restoration after a major fault or total or partial blackout.

- To **generators** to maintain target voltage levels by altering **generating unit reactive power generation** or absorption until exhaustion of the regulated **reactive power** range;
- Switching in/out of shunt reactors and capacitors directly connected to the **transmission system**;
- Altering the tap positions of transformers and auto-transformers;
- Changes in the mode of operation and voltage set point of synchronous and static var compensators:

3.9 Voltage Schedule

3.9.1.1 The **TSMO** shall produce every three months a voltage schedule containing at least the following information:

- The period under consideration;
- The mode of operation of the **transmission system**;
- The voltage set point at the specific points;
- The settings of the tap changers of transformers and auto transformers;
- Countermeasures to be adopted in the event of a **reactive power** imbalance between supply and **demand**;
- Any other necessary items for voltage and **reactive power** control:

3.9.1.2 Voltage schedule produced and issued by the **TSMO** according to the 3.9.1.1 above will be updated on a weekly basis and accordingly distributed to all relevant **parties**.

3.9.1.3 **TSMO** will monitor compliance of **users** with voltage schedules and **TSMO** instructions in regards with voltage/reactive power control. In the case of non-compliance **TSMO** is entitled to engage other voltage/reactive power control facilities (eg based on **ancillary services agreements**) on the account of the relevant **user** that failed to execute its obligation.

3.9.1.4 For a persistent failure to meet the mandatory requirements the **TSMO** will warn the **user** and will report the failure to the **Regulator**.

3.9.2 Responsibility of Generators

3.9.2.1 **Generators** shall be responsible for maintaining the voltage level, at the point of **connection** of their **power plants** and **generating units** to the **electricity system**, in accordance with the voltage schedule. This requirement must be fulfilled as far as the technical limits of their plant permits.

3.9.2.2 Any deviation from the admissible voltage limits shall be reported as an event in accordance with the **operational liaison and event information supply code**.

3.10 Ancillary Services Agreements

3.10.1.1 Besides the mandatory requirements placed on all **generators** to provide **reactive power** for voltage control additional **reactive power** capability can be offered to the **TSMO** by **users** under the terms of an **ancillary services agreement**.

3.11 Interconnection aspects of voltage control

3.11.1.1 **Reactive power** flows over the tie-lines with neighbouring **power systems** should be kept as close to zero as possible. Depending on operational conditions which could jeopardise the interconnected system operation, adjacent **TSO**s can agree on the amount of **reactive power** that may be exchanged during normal operation or when a contingency occurs

3.11.1.2 Voltage levels at **interconnector** substations should be kept as close as possible to pre-set values agreed between neighbouring **TSO**s. Those values can differ from the margins determined in this **balancing code** if they do not affect the rest of the Kosovan **power system**.

4 Frequency control code

4.1 Introduction

4.1.1.1 This **frequency control code** specifies the requirements and criteria with respect to the provision of **frequency control** on the Kosovan **power system**. **Frequency control** is carried out according to the provisions of the interstate agreements, when operating in parallel with these neighbouring states, by the **TSMO**, the **TSO**s of the neighbouring **power systems**, UCTE control area/block co-ordinator and the UCTE co-ordination centre South in Laufenburgh. This **frequency control code** should be read in conjunction with the **connections code** and the **contingency planning** and the **demand control code** within the **operations code**.

4.2 Objective

4.2.1.1 The objective of this section is to enable the **TSMO** - as far as is possible - to achieve the following:

- maintain the system frequency to the requirements of the frequency standards detailed in the **electricity standards code**;
- maintain the interconnector flows at the agreed levels:

4.3 Scope

4.3.1.1 This section applies to the following:

- the **TSMO**;
- **Generators** including **generators** with **generating units** connected to the **distribution system**;
- **DSO**s;
- **Demand customers** directly connected to the **transmission system**:

4.4 Procedure

4.4.1 General

4.4.1.1 Each participant of the **electricity market** is responsible for fulfilling the daily consumption and/or **generation** schedule submitted to the **TSMO**.

4.4.1.2 The **TSMO** is responsible for enabling load-frequency control in the Kosovan **power system** either using its own resources or in co-operation with other regional TSOs.

4.4.1.3 In the event of violations the **TSMO** shall take all necessary steps as per this **grid code** in order to prevent and remove any failures in the electricity system. Any instruction given by the **TSMO** under this **frequency control code** to **market participants** is mandatory.

4.4.1.4 Load-frequency control consists of primary control, secondary control and tertiary control – fast and slow – and the functions and requirements of these are detailed in the following paragraphs. In the Kosovan **power system** frequency and active power control shall be provided by the following:

- Automatic response from **generating units** operating in a free governor frequency sensitive mode;
- **Automatic generation control** of **generating units** equipped with automatic load frequency control:
- **Demand control** using the ABC rota load shedding for normal day to day operation and other **demand control** means as detailed in the **demand control code** for emergency situations:

4.4.2 Primary Control

4.4.2.1 **Primary control** should begin immediately following a quazi steady-state frequency deviation of more then +/- 200 mHz, and take full effect not more than 30 seconds later.

4.4.2.2 **Primary reserve** is the amount of operating reserve that is sufficient to provide – automatically by use of turbine speed governors – the normal regulating margin of synchronous area frequency. Minimum value of primary load-frequency control is determined for each **power system** based on 'joint action principle' in the UCTE interconnection.

4.4.2.3 All **generating units** must be capable of providing primary load-frequency control while operating at all times unless relieved of this obligation by the **TSMO** under the terms of a **derogation**.

4.4.2.4 The **TSMO** may give express permission for **generating units** to operate in a frequency insensitive mode on occasions with due regard to the frequency sensitive capability available from the remaining synchronised **generating units**.

4.4.2.5 A system frequency induced change in the **active power** output of **generating units** that assists the recovery to target frequency must not be overridden by a **generator** except where it is done purely on safety grounds (relating to personnel or plant).

4.4.3 Secondary Control

4.4.3.1 **Secondary control reserve** is an additional amount of operating reserve sufficient to reduce **area control error** (**ACE**) automatically by means of secondary controller and contribute – particularly after a major contingency such as the loss of a large **generating unit** – to the restoration of the frequency to its set value in order to restore the system to its previous secure state. Frequency and **active power** flows must begin to return to their set point values as a result of **secondary control** after 30 seconds with the process of correction being completed after 15 minutes with a reasonable ramp rate and without overshoot.

4.4.3.2 Minimum value of the **Secondary control reserve** in the Kosovan **power system** is determined with the following formula:

$$R = \sqrt{a\,L_{\max} + b^2} - b$$

where:
R = minimum value of secondary load-frequency reserve in MW
$Lmax$ = the maximum anticipated load in MW for the regulated area
a = 10 MW and
b = 150 MW

4.4.3.3 The **TSMO** may determine different values of **secondary control reserve** for different daily or hourly periods depending on operational conditions of the Kosovan **power system**.

4.4.3.4 All hydro power plants with an output greater then 20MW must be capable of delivering **secondary control reserve** and be equipped accordingly.

4.4.3.5 **Secondary control reserve** may be delivered only by the **generating units** that fulfil all technical requirements and have been pre-qualified by the **TSMO** for such system service.

4.4.3.6 All **generating units** participating in automatic **secondary control reserve** will do so under the terms of an **ancillary services agreement**.

4.4.3.7 The **TSMO** is obliged to deliver **secondary control reserve** signals to the **generating units** participating in automatic **secondary control reserve**. **Generating**

units when providing this service are obliged to provide an efficient, precise and reliable response to these signals.

4.4.3.8 The **TSMO** has the right to monitor the performance of the **generating units** participating in automatic **secondary control reserve** and to suspend this service at any time if quality of service is below quality performance indicators stated in the **ancillary services agreements**.

4.4.3.9 If the case described under paragraph 4.4.3.8 occurs, the **TSMO** is entitled to acquire additional amount of secondary load-frequency control from another source.

4.4.4 Tertiary Control

4.4.4.1 In order to enable smooth regulation of the **power system** and sustainable tertiary reserve, further stipulations under this chapter will be split into assessment of Fast tertiary control and slow tertiary control in respect of start up and total deployment time.

4.4.4.2 **Tertiary control reserve** is used to compensate for both loss of **generation** and loss of load. Loss of **generation** is a more frequent event on the **power system** and is followed by more serious consequential operational conditions. Because of this the main consideration in this chapter is dedicated to this case. However, loss of load should also be accordingly treated in operational planning procedures and balancing market operations in terms of enabling downwards **tertiary control reserve**.

4.4.4.3 Fast **tertiary control reserve** should be fully available within 15 minutes from the moment it is activated and enables the **primary reserve** and **secondary reserve** to be released. Fast **tertiary control** should be provided as part of an **ancillary services agreement**. The activation of fast **tertiary control reserve** should be available at any time and reserve must be sustainable for a minimum of eight hours.

4.4.4.4 The amount of fast tertiary load-frequency control in the Kosovan **power system** must be sufficient to compensate for the loss of the largest **generating unit** connected to the **power system** at all times.

4.4.4.5 **Slow tertiary control** is designed to release fast **tertiary control** and stabilise power balance and frequency in the long run. It must be fully deployed after a maximum of eight hours from the moment of its activation and must be sustainable for a minimum of 48 hours. **Slow tertiary control** should be provided as part of an **ancillary services agreement**.

4.4.4.6 The amount of slow tertiary load-frequency control in the Kosovan **power system** must be sufficient to compensate for the loss of the largest **generating unit** connected to the **power system** at all times.

4.4.4.7 Fast and/or slow **tertiary control** may be obtained from the following sources:

- **Generating units** in the Kosovan **power system**;
- Dispatchable loads in the Kosovan **power system**;
- Other **power systems**

4.4.5 Time control

4.4.5.1 The **TSMO** is responsible for the co-ordination of the time control process in the Kosovan **power system**. For that purpose the **TSMO** will receive a frequency set-point from the higher UCTE organisational level[4]. (control area/block) and distribute it on a day-ahead basis to all **users** operating in a frequency sensitive mode.

4.4.5.2 The **TSMO** is authorised to override common UCTE frequency set-point only in cases where the Kosovan **power system** is separated from the rest of the interconnection, or in cases of partial or total blackout.

4.4.5.3 **Users** are responsible to strictly follow frequency set-point instructed by the **TSMO** at all times.

4.5 Requirements

4.5.1 Generating Unit requirements

4.5.1.1 For **primary control** purposes the accuracy of local frequency control measurements must not exceed +/- 10 mHz.

4.5.1.2 For **secondary control** purposes the accuracy of local frequency control measurements must be within the range +/- 1 to 1.5 mHz.

4.5.1.3 The **primary control** range shall be at least + or – 2 % of the nominal output power.

4.5.1.4 The droop setting of the **primary control** equipment should not exceed 6 %.

4.5.1.5 The response error of turbine speed regulators may not exceed 5%.

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[4] This is common information in the UCTE interconnection provided by 'Time monitor' – Etrans from Switzerland – and distributed via the TSOs.

4.5.1.6 The governor deadband of turbine rotation speed regulators should be no greater than +/- 10 mHz.

4.5.1.7 In general the requirements detailed in Policy 1 of the UCTE OH must be met.

4.5.2 High Frequency Response

4.5.2.1 The **TSMO** has the responsibility to ensure that there is sufficient downwards reserve on the system to enable a regulating frequency service to be provided in the event of a positive frequency deviation from the target frequency.

4.5.2.2 If system frequency rises to 50.50 Hz, all **power plants** shall take part in the lowering of the frequency within the limits of their technological limitations based on the instruction from the **TSMO**. This is a mandatory requirement and must be provided free of charge by all **generating units**.

4.5.2.3 The plant specifically providing high frequency response will be specified by the **TSMO**

4.5.2.4 In addition to plants providing high frequency response as specified in 4.5.2.3 above, the **TSMO** may also conclude ancillary services contracts with dispatchable loads for the provision of tertiary downwards regulation in order to maintain system balancing in the long run.

4.6 Rights of Inspection

4.6.1.1 The **TSMO** has the right to conduct inspections of **electricity market** participants to confirm that they are fulfilling their technical requirements. These inspections shall be organised and carried out in accordance with the **connections code**.

5 Resources and Documents

5.1 Resources

Nr.	Name of Document
1.	Law on Electricity
2.	Transmission System Operator License
3.	
4.	

5.2 Documents and forms

5.3 Revision Information

Version	Date	Description	Preservation time
1.1	27.01.2007	Edition 1, Revision 1	1 year
2.0	14.01.2008	Edition 2	2 years
2.1	10.09.2010	Edition 2, Revision 1	