Introduction

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History of changes

v1.2	**draft**	**02.10.2002**	**SC**	**comments and changes of SC**
v1.1	**draft**	**23.09.2002**	**WG Op&Sec**	**comments and changes of WG**

Current status

The "Union for the Co-ordination of Transmission of Electricity" (UCTE) is the association of transmission system operators in continental Europe, providing a reliable market base by efficient and secure electric "power highways".

50 years of joint activities laid the basis for a leading position in the world which the UCTE holds in terms of the quality of synchronous operation of interconnected power systems. Through the networks of the UCTE, 400 million people are supplied with electric energy; annual electricity consumption totals approx. 2100 TWh.

This new "UCTE operation handbook" is an up-to-date summary of operation principles and rules for the transmission system operators in continental Europe. In the internet on the address:

`http://www.ucte.org/`

you can find additional references for UCTE's operation and security rules and recommendations as well as a list of publications, public statistics and information about UCTE's structure and activities in general.

Hier sollte ein allgemeiner Vermerk "Entwurf / nicht verabschiedet / inoffiziell" untergebracht werden!

A. UCTE's basic needs for an Operation Handbook

The Union for the Co-ordination of Transmission of Electricity (UCTE) co-ordinates the operational activities of transmission system operators in 20 European countries. Their common objective is the security of operation of the interconnected power system. 50 years of joint activities laid the basis for a leading position in the world which the UCTE holds in terms of the quality of synchronous operation of interconnected power systems.

Close co-operation of member companies is required to make the best possible use of benefits offered by interconnected operation. For this reason, the UCTE has developed a number of technical and organisational rules and recommendations in the past that constitute a common reference for smooth operation of the power system. The "UCTE Operation Handbook" is the successor of these set of rules and recommendations, that have been continually developed during the decades of construction and extension of the power system since 1950 and reflecting the changes in the technical and political framework.

Only the consistent maintenance of the high demands on quality will permit in the future to set standards in terms of security and reliability as in the past. Moreover, the strong interconnections in the UCTE grid requires common understandings for grid operation, control and security in terms of fixed technical standards and procedures. They are comprised in this "UCTE Operation Handbook" in an organised form, to make consultation easier for members and the general public.

B. Target audience for the Operation Handbook

The "UCTE Operation Handbook" may serve for different parties at the same time, mostly for the following:

- **Transmission System Operators (TSOs) / Grid Operators**. Every TSO in the UCTE interconnected network (SYNCHRONOUS AREAS) has declared to follow the technical standards and procedures that are comprised in this "UCTE Operation Handbook". This operation handbook therefore serves as the reference ("legislation") for the grid operation by the TSOs and guarantees the UCTE's quality and reliability standards.
- **Generation Companies (GENCOs)**. Every party operating a generation unit in the UCTE interconnected network (SYNCHRONOUS AREAS) makes use of the transmission network and may provide system services that are indispensable for the secure and stable grid operation. This operation handbook sets standards for the requirements and capabilities for generation that contribute to the operation of the grid by the TSOs.
- **Traders, Customers, Politicians and Decision Makers**. Operation of an interconnected transmission system is bound to physical principles and technical constraints, that differ significantly from other well-known technical or financial systems. This operation handbook explains these differences and characteristics in a transparent manner to the public for a better understanding.

C. Main characteristics of the Operation Handbook

The "UCTE Operation Handbook" has some main characteristics that serve as a guideline for the development and set-up of the handbook:

- **Transparency**. Technical and physical principles of transmission grid operation in the UCTE are clearly described for non-experts in the Operation Handbook.

- **Liability**. Following the signed statutes of the UCTE the standards and recommendations of the Operation Handbook were developed as binding for all (associated) members (TSOs) of the UCTE and their operation of the grid.
- **Unambiguousness**. All standards and recommendations of the Operation Handbook are written to be straightforward and unmistakable for the processes of secure operation of the UCTE SYNCHRONOUS AREA(S). All terms used in the handbook are defined only once.
- **Relevance to the present**. Standards and recommendations included in the Operation Handbook are continually adapted to the changed technical and legislative environment. A version history clearly shows the status of each part of the handbook.
- **Redundancy**. The Operation Handbook is written to have only the minimum of redundancy that is required. For this purpose, references to other chapters within the handbook are used instead.
- **Modularity**. Each chapter / policy / rule / guideline of the Operation Handbook can be seen as a separate document that may be revised independently of the other parts. All chapters use a similar layout and internal structure.

D. Main scope of the Operation Handbook

The main scope of the "UCTE Operation Handbook" as a comprehensive collection of all relevant technical standards and recommendations is the support for the technical operation of the UCTE interconnected grid (SYNCHRONOUS AREAS), including operation policies for generation control, performance monitoring and reporting, reserves, security criteria and special operational measures.

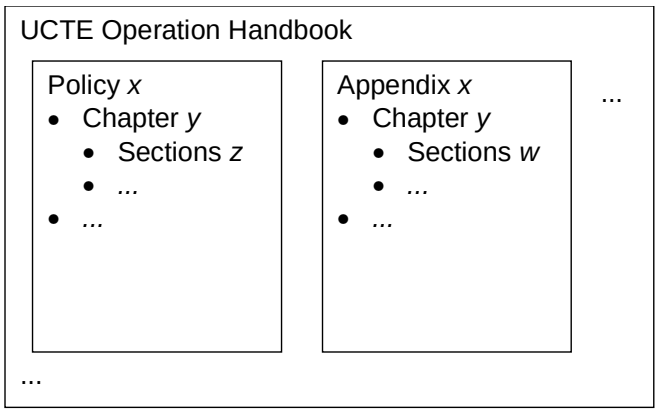
Standards for network access of customers, network tariffs, accounting of inadvertent interchanges / deviations (commercial part), billing procedures and market rules are not in the scope of this Operation Handbook.

E. Basic structure of the Operation Handbook

The "UCTE Operation Handbook" clearly separates between policies, technical appendixes, training documents and data collections and basically is structured as follows:

- Preface, general information (UCTE history, organisation,...)
- Overview, table of contents, versions, history
- Introduction, UCTE's structure, organisation
- Basics, operational framework, glossary, procedures
- Operating policies (common structure, list of policies for transmission and ANCILLARY SERVICES)
- Technical appendixes (technical criteria, definitions)
- Training documents (calculation methods, theory)
- Collections of data

The formal structure of the handbook into policies and appendixes with chapters and sections is shown in the following figure.



The policies themselves have a clear internal structure of standards, rules, criteria, requirements, rights and obligations. The following list of operational standards / policies is currently under development:

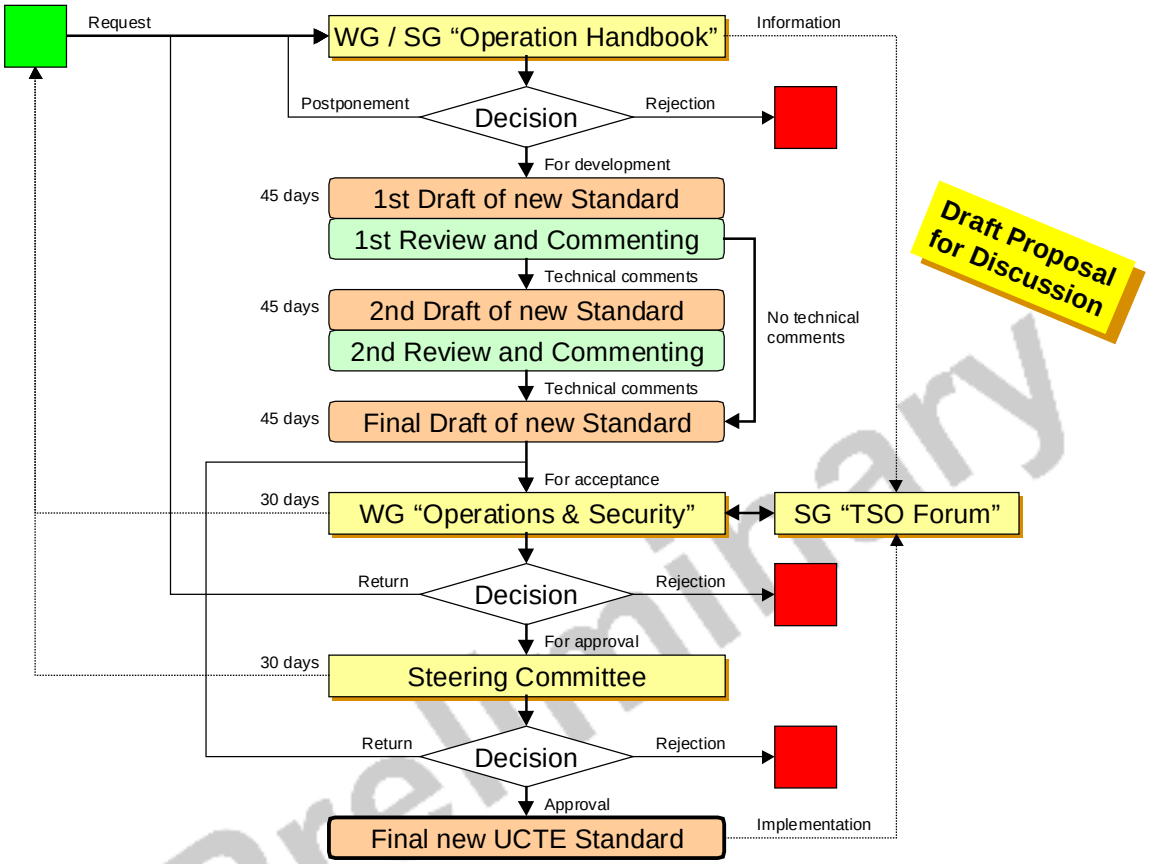
1. Load-Frequency-Control and Performance
2. Scheduling and Accounting
3. Operational Security

The policies of the operation handbook themselves are organised in the following sections:

- **Criteria**. Criteria introduce or define specific values or a specific naming as given facts, that may be used or cited within the policy.
- **Requirements**. Requirements are (technical or organisational) prerequisites that are used within a policy. They have to be fulfilled in total before any standard can be applied.
- **Standards**. Standards define rules that are fixed and binding for the addressees, subject to the specific situation. Standards are usually the core part of a policy.
- **Guidelines**. Guidelines describe practical ways for typical operation or usage as recommendations, as they may be used by the addressees.
- **Procedures**. Procedures introduce fixed methods and alternatives for operation or usage as common practice.
- **Measures**. Measures name the actions to be taken, e.g. if a requirement is not fulfilled, a standard is violated by an addressee or a procedure is not used.

F. Proposed procedure for handbook development

The following flow chart shows the procedure that is proposed for the development of new standards and the revision of existing standards, initiated by requests from the SC or the WG. Please note that this is a draft figure for discussion only.



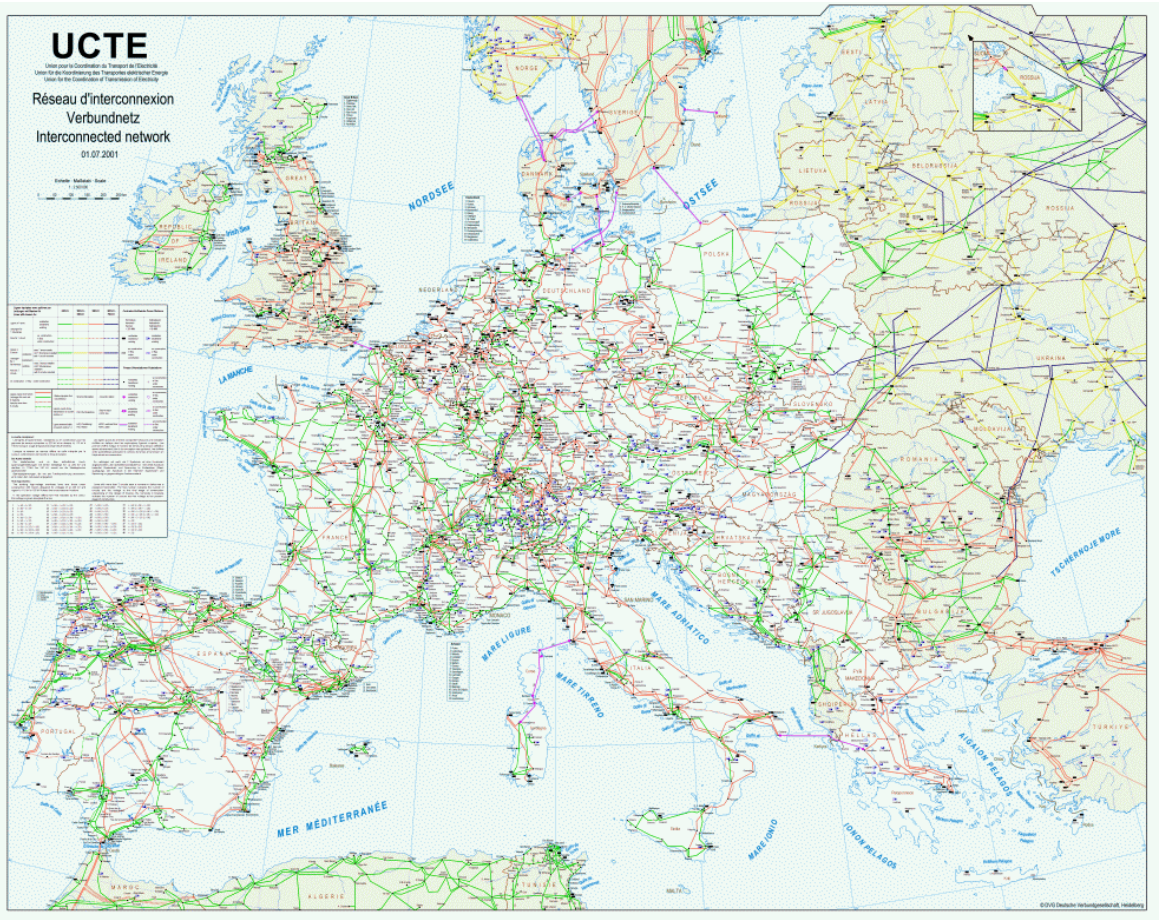
G. General conventions

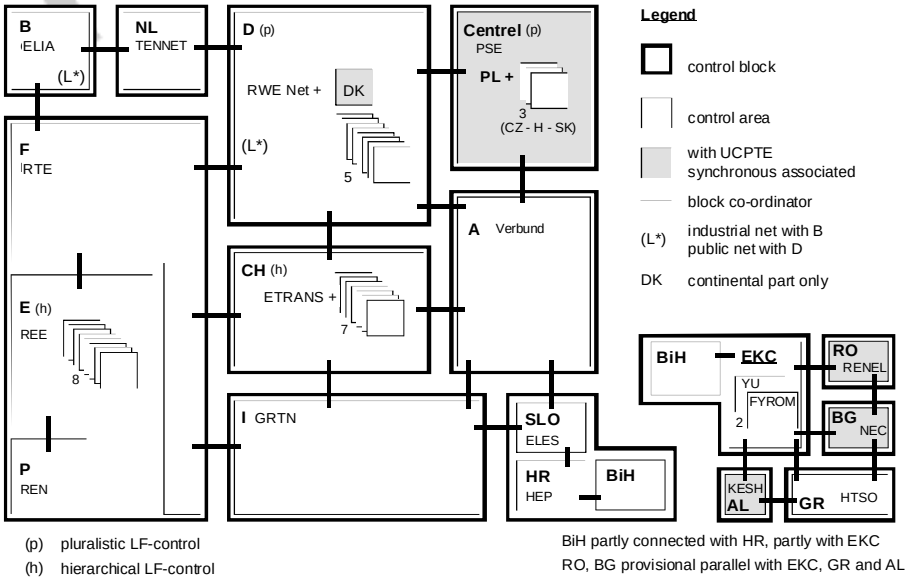
The general convention for the sign for power exchanges and deviation within this UCTE operation handbook is:

- A positive sign (positive absolute value) for power exchanges / deviations corresponds to power export.
- A negative sign (negative absolute value) for power exchanges / deviations corresponds to power import.

H. UCTE system overview

The following figures show the structure and the organisation of the UCTE interconnection in the overview





I. Glossary of terms

[based on: UCTE ground rule for the co-ordination of the accounting and the organisation of the load-frequency control, 15.05.1999; articles of association of the UCTE, 17.05.2001, NERC glossary of terms, 08.1996, ETSO Definitions of Transfer Capacities in liberalised Electricity Markets, 04.2001]

Accounting (Energy Accounting, Accounting of Inadvertent Deviations)

[Policy 2]

After the EXCHANGE PROGRAMS have been validated during the scheduling phase, and taking into account the real-time observation of the INADVERTENT DEVIATIONS across a set of OBSERVATION LINES, the accounting is the organisational process in order:

- to collect the provisional and the final values of the exchanged energy for each time interval;
- to determine the energy INADVERTENT DEVIATIONS and to set-up the corresponding COMPENSATION PROGRAMS for their offsetting during the following week.

Accounting Co-ordination

[Policy 2]

Co-ordination service provided to the CONTROL BLOCKS, by the sites in charge to perform the ACCOUNTING CO-ORDINATION, with the purpose to carry out the ACCOUNTING. It consists of the following phases:

- acquisition and validation of the EXCHANGE PROGRAMS between the CONTROL BLOCKS during the scheduling phase;
- acquisition of the EMRs values of TIE-LINES[1] among CONTROL BLOCKS to compute the provisional energy exchanges;
- real-time observation across the previously defined OBSERVATION LINES;
- computation of the provisional and final INADVERTENT DEVIATIONS;
- computation of the COMPENSATION PROGRAMS for each CONTROL BLOCK.

If these tasks are performed at different locations, a very close co-operation must be then adopted among the centres who are responsible of these activities.

The responsibility for the correct accounting remains with the co-ordinators of the individual CONTROL BLOCKS and CONTROL AREAS. No delegation of responsibility for this matter can be made to the accounting co-ordination. The CONTROL BLOCKS and CONTROL AREAS are responsible for the resources required to provide the results of the accounting. In order to monitor and to supervise the operation of their CONTROL BLOCK or CONTROL AREA they all need to be provided with a real-time data acquisition system.

The ACCOUNTING CO-ORDINATION is provided with the necessary data to enable some checking at a global level and to give extra confirmation to the co-ordinators of the CONTROL BLOCKS and CONTROL AREAS that no major mistake has gone undetected or that if such an error should occur it would not stay undetected for a long time.

Active Power

Real power, in contrast to REACTIVE POWER.

Adjacent Control Area (or adjacent system)

[Policy 1]

[1] Including virtual tie-lines that may exist for the operation of jointly owned power plants.

An ADJACENT CONTROL AREA (or ADJACENT SYSTEM) is any CONTROL AREA (or system) either directly interconnected with or electrically close to (so as to be significantly affected by the existence of) another CONTROL AREA (or system).

Ancillary Services

ANCILLARY SERVICES are Interconnected Operations Services identified as necessary to effect a transfer of electricity between purchasing and selling entities (TRANSMISSION) and which a transmission provider must include in an open access transmission tariff.

Apparent Power

The product of the volts and amperes. It comprises both real and reactive power, usually expressed in kilovoltamperes (kVA) or megavoltamperes (MVA).

Already Allocated Capacity (AAC)

The Already Allocated Capacity, that is the total amount of allocated transmission rights, whether they are capacity or EXCHANGE PROGRAMS depending on the allocation method.

Area Control Error (ACE)

[Policy 1]

The AREA CONTROL ERROR is the instantaneous difference between the actual and the reference value (scheduled EXCHANGE PROGRAM) for the power interchange (INADVERTENT DEVIATION), taking into account the effect of the frequency bias for that CONTROL AREA according to the network power frequency characteristic of that CONTROL AREA and the FREQUENCY DEVIATION.

Automatic Generation Control (AGC)

[Policy 1]

AUTOMATIC GENERATION CONTROL is an equipment that automatically adjusts a CONTROL AREA's generation to maintain it's interchange schedule plus it's share of frequency regulation.

Availability

A measure of time a generating unit, transmission line, or other facility is capable of providing service, whether or not it actually is in service. Typically, this measure is expressed as a percent available for the period under consideration.

Available Transfer Capacity (ATC)

A measure of the transfer capability remaining in the physical transmission network for further commercial activity over and above already committed uses. The AVAILABLE TRANSMISSION CAPACITY, that is the part of NTC that remains available, after each phase of the allocation procedure, for further commercial activity. ATC is given by the following equation:

ATC = NTC- AAC

Blackstart Capability

The ability of a generating unit or station to go from a shutdown condition to an operating condition and start delivering power without assistance from the electric system.

Block Co-ordinator

The BLOCK CO-ORDINATOR is a single TSO that is responsible for the SECONDARY CONTROL of the whole block towards its interconnected neighbours, for the accounting of the CONTROL BLOCK; and for the organisation of the internal SECONDARY CONTROL within the CONTROL BLOCK and operates the CONTROL BLOCK.

Capacity

The rated continuous load-carrying ability, expressed in megawatts (MW) or megavolt-amperes (MVA) of generation, transmission, or other electrical equipment.

Consumption

See: DEMAND

Contingency

[Policy 3]

The unexpected failure or outage of a system component, such as a generator, transmission line, circuit breaker, switch, or other electrical element. A CONTINGENCY also may include multiple components, which are related by situations leading to simultaneous component outages.

Control Area (CA)

[Policy 1]

A CONTROL AREA is a coherent part of the UCTE interconnected system (usually coincident with the territory of a company or a country, physically demarcated by the position of points for measurement of the interchanged power to the remaining interconnected network), operated by a single TSO, with physical loads and controllable generation units connected within the CONTROL AREA. A CONTROL AREA may be a coherent part of a CONTROL BLOCK that has it's own subordinate control in the hierarchy of SECONDARY CONTROL)

Each CONTROL AREA must be operated by an individual TSO that has (among others) the following responsibility for the transmission system operation:

- availability, operation and provision of PRIMARY CONTROL within the CONTROL AREA,
- availability, operation and provision of SECONDARY CONTROL within the corresponding CONTROL BLOCK to maintain the power interchange of this CONTROL AREA at the scheduled value and to restore frequency deviations caused by power imbalances in that CONTROL AREA,
- metering and accounting of power exchanges across the border (on tie-lines) of the CONTROL AREA.

In order to assume this responsibility, generation resources are to be made available to the TSOs within each CONTROL AREA by generation companies.

Control Block (CB)

[Policy 1]

A CONTROL BLOCK is composed by one or more CONTROL AREAS, working together in the SECONDARY CONTROL function, with respect to the other CONTROL BLOCKS of the SYNCHRONOUS AREA. A CONTROL BLOCK is:

- able to maintain the total interchange schedule of the CONTROL BLOCK towards all other CONTROL BLOCKS of the SYNCHRONOUS AREA;
- not responsible for PRIMARY CONTROL of the whole block, if the block is composed by different CONTROL AREAS, as this remains within the responsibility of the individual CONTROL AREAS;

- responsible for accounting within its territory;
- organises the internal SECONDARY CONTROL within the CONTROL BLOCK according to one of the following schemes (basically, the type of internal organisation must not influence the behaviour or quality of SECONDARY CONTROL between the interconnected blocks):
  - **centralised**: LFC for the CONTROL BLOCK is performed centrally by a single controller (as one CONTROL AREA); the operator of the block has the same responsibilities as the operator of a CONTROL AREA.
  - **pluralistic**: LFC is performed in a decentralised way with more than one CONTROL AREA; a single TSO, the BLOCK CO-ORDINATOR, regulates the whole block towards its neighbours with its own controller and regulating capacity, while all the other TSOs of the block regulate their own CONTROL AREAS in a decentralised way by their own;
  - **hierarchical**: LFC is performed in a decentralised way with more than one CONTROL AREA; a single TSO, the BLOCK CO-ORDINATOR, operates the superposed block controller which directly influences the subordinate controllers of all CONTROL AREAS of the CONTROL BLOCK; the BLOCK CO-ORDINATOR may or may not have regulating capacity on its own.

Control Block Operator

The operator of a CONTROL BLOCK, usually a TSO.

Control Program

[Policy 2]

The schedule of the total programmed exchange of a CONTROL AREA / BLOCK, the sum of EXCHANGE PROGRAM and COMPENSATION PROGRAM.

Curtailment

A reduction in the scheduled capacity or energy delivery.

Defence Plan

[Policy 3]

The DEFENCE PLAN summarises all technical and organisational measures to prevent the propagation or deterioration of a power system incident in order to avoid a collapse.

Demand

The (remaining) demand (or consumption) is the rate at which electric energy is delivered to or by a system or part of a system, generally expressed in kilowatts or megawatts, at a given instant or averaged over any designated interval of time. DEMAND should not be confused with LOAD (a LOAD is usually a device).

Disturbance

An unplanned event that produces an abnormal system condition.

Droop of a Generator

The DROOP OF A GENERATOR is one of the parameters set on the primary speed controller of a GENERATING SET (generator and turbine), identical with the quotient of the relative quasi-steady-state FREQUENCY OFFSET on the network and the relative variation in power output from the generator

associated with the action of the PRIMARY CONTROLLER. This ratio without dimension is generally expressed as a percentage.

Electrical Energy

The generation or use of electric power by a device over a period of time, expressed in kilowatt-hours (kWh), megawatt-hours (MWh), or gigawatt-hours (GWh).

Electric System Losses

Total electric energy losses in the electric system. The losses consist of transmission, transformation, and distribution losses between supply sources and delivery points. Electric energy is lost primarily due to heating of transmission and distribution elements.

Energy Meter Readings (EMRs)

Actual energy exchanges on TIE-LINES[2] between CONTROL BLOCKS (of CONTROL AREAS) to carry out the accounting function (e.g.: to compute, together with scheduled exchanges, the inadvertent deviation s for each time interval):

- EMRs values, when acquired in real-time and transmitted immediately after each hour or after each 15 minutes mark, are also sometimes utilised in the on-line LFC observation phase to perform a reciprocal cross-check with real-time power flow telemeasurements (TMs); some EMRs values may not be available in real-time; in this case they may be acquired through other procedures (e.g.: by fax the following day); this applies also if data acquisition system is missing or in case of teletransmission failures;
- care should be given to secure great reliability for data collection and error detection;
- ability to perform well should be maintained even if a few data are missing;
- EMRs data acquisition system at CONTROL AREA or at CONTROL BLOCK level must be automatic;
- provisional, on-line acquired, EMR values must be validated by the involved TSOs before their utilisation in the accounting procedure.

Exchange Program

[Policy 2]

scheduled energy interchange between two CONTROL AREAS, see SCHEDULE.

Frequency Bias

see: NETWORK POWER FREQUENCY CHARACTERISTIC

Frequency Control

See: PRIMARY CONTROL.

Frequency Deviation

[Policy 1]

A departure of the actual SYSTEM FREQUENCY from the scheduled frequency.

[2] Including virtual tie-lines that may exist for the operation of jointly owned power plants.

Frequency Offset

[Policy 1]

A difference between the actual and the nominal / rated SYSTEM FREQUENCY in order to correct the synchronous time, not identical with the FREQUENCY DEVIATION.

Generation Set

[Policy 1]

The set of a generator (and its driving apparatus) and a turbine of a generation unit.

Inadvertent Deviation (Unintentional Deviation)

[Policy 1]

In the SECONDARY CONTROL function, the INADVERTENT DEVIATION is the difference between the actual energy exchange that has taken place in a given time interval (unintended physical power exchange of a CONTROL AREA) and the scheduled EXCHANGE PROGRAM of a CONTROL AREA (or a CONTROL BLOCK), without taking into account the effect of the frequency bias (see: AREA CONTROL ERROR), following the sign convention.

Interconnected System

A system consisting of two or more individual electric systems that normally operate in synchronism and have connecting TIE-LINES.

Interconnection

An INTERCONNECTION is a transmission link (TIE-LINE) which connects two CONTROL AREAS:

Intra-Control Area Transaction

A transaction from one or more generating sources to one or more delivery points where all the sources and delivery points are entirely within the metered boundaries of the same CONTROL AREA.

Island

[Policy 1]

A portion of a power system or of several power systems that is electrically separated from the interconnection due to the disconnection of transmission system elements.

k-Factor

[Policy 1]

A value, usually given in megawatts per Hertz (MW/Hz), usually defined for a (single) CONTROL AREA that defines the FREQUENCY BIAS of that CONTROL AREA for SECONDARY CONTROL (especially to assure the functionality of the NETWORK CHARACTERISTIC METHOD), not to be confused with NETWORK POWER FREQUENCY CHARACTERISTIC.

Load

An end-use device or customer that receives power from the electric system. LOAD should not be confused with DEMAND, which is the measure of power that a load receives or requires. LOAD is often used as a synonym for DEMAND.

Load-Frequency Control (LFC)

See: SECONDARY CONTROL

Load-Shedding

...

Loop Flows

See: PARALLEL PATH FLOWS.

Metering

The methods of applying devices that measure and register the amount and direction of electrical quantities with respect to time.

Minute Reserve

See: TERTIARY CONTROL RESERVE

N-1 Criterion

[Policy 3]

If a network operating element should fail (a line or transformer, or in certain instances a bus-bar), the elements remaining in operation must be capable of accommodating the additional load caused by the failure.

Net Transfer Capacity (NTC)

The NET TRANSFER CAPACITY is defined as:

NTC = TTC-TRM

NTC is the maximum EXCHANGE PROGRAM between two areas compatible with security standards applicable in both areas and taking into account the technical uncertainties on future network conditions.

Network Characteristic Method

[Policy 1]

The properties required for SECONDARY CONTROL are produced by the NETWORK CHARACTERISTIC METHOD. The purpose of SECONDARY CONTROL is to move the overall system deviation of the CONTROL AREA / BLOCK considered towards zero.

The NETWORK CHARACTERISTIC METHOD (to be applied to all CONTROL AREAS in the same way and at the same time) assures the control of two variables at the same time with one set-point value, as long as the NETWORK POWER FREQUENCY CHARACTERISTIC is used.

Network Power Frequency Characteristic

[Policy 1]

A physical link / sensitivity, usually given in megawatts per Hertz (MW/Hz), usually associated with a (single) CONTROL AREA / BLOCK or of the entire SYNCHRONOUS AREA that relates the difference between scheduled and actual frequency to the amount of generation required to correct the power imbalance for that CONTROL AREA (or, vice versa, the stationary change of the frequency in case of a disturbance of the generation-load equilibrium in the CONTROL AREA without being connected to other

CONTROL AREAS), not to be confused with K-FACTOR. The NETWORK POWER FREQUENCY CHARACTERISTIC includes all active PRIMARY CONTROL and SELF-REGULATION OF LOAD and changes due to changes in the generation pattern and the DEMAND.

Observation Line

[Policy 2]

Conventional border line separating a part of the SYNCHRONOUS ZONE from the rest of the system with the purpose of real-time error detection and preliminary calculation of INADVERTENT DEVIATIONS. It must run along the borders of CONTROL BLOCKS and must not split any CONTROL BLOCK.

Offsetting of Inadvertent Deviations

Procedure to carry out the compensation in energy of INADVERTENT DEVIATIONS, by a corresponding energy EXCHANGE SCHEDULE, to be delivered to (or imported from), the rest of the system during the following week according to the Standards.

On-line Observation of Inadvertent Deviations

This task is performed in an autonomous and independent way by each CONTROL BLOCK according to the Standards established.

A second level is present through the real-time observation of the INADVERTENT DEVIATIONS across previously defined OBSERVATION LINES. This function allows to improve detecting, as early as possible, any error concerning on-line telemeasurements (TMs), any misunderstanding which may occur in setting the EXCHANGE PROGRAMS, etc., in order to implement without delay the appropriate corrective actions. This function may be performed in one or more locations which must then work in a close co-operation.

Operating Policies

The doctrine developed for interconnected systems operation. This doctrine consists of criteria, standards, requirements, guides, and instructions and apply to all CONTROL AREAS.

Operating Procedures

A set of policies, practices, or system adjustments that may be automatically or manually implemented by the system operator within a specified time frame to maintain the operational integrity of the interconnected electric systems.

Operating Security Limits

[Policy 3]

OPERATING SECURITY LIMITS define the acceptable operating boundaries (thermal, voltage and stability limits). The TSO must have defined OPERATING SECURITY LIMITS for its own network. The TSO shall ensure adherence to these OPERATING SECURITY LIMITS. Violation of OPERATING SECURITY LIMITS for prolonged time could cause damage and/or an outage of another element that can cause further deterioration of system operating conditions.

Parallel Path Flows

The difference between the scheduled and actual power flow, assuming zero inadvertent interchange, on a given transmission path in a meshed grid. Similar terms are: loop flows, unscheduled power flows, and circulating power flows.

Power System

The power system comprises all installations of generation, of consumption and of network connected together through the meshed network.

Power Deviation

[Policy 1]

A power deficit (as a negative value) or a surplus (as a positive value) in a CONTROL AREA / CONTROL BLOCK or a SYNCHRONOUS AREA, measured at the borders, with respect to the scheduled exchanges.

Primary Control

[Policy 1]

PRIMARY CONTROL maintains the balance between generation and demand in the network using turbine speed governors. PRIMARY CONTROL is an automatic decentralised function of the turbine governor to adjust the generator output of a unit as a consequence of a FREQUENCY DEVIATION / OFFSET in the SYNCHRONOUS AREA:

- PRIMARY CONTROL should be distributed as evenly as possible over units in operation in the SYNCHRONOUS AREA;
- the global PRIMARY CONTROL behaviour of an interconnection partner (CONTROL AREA / BLOCK), may be assessed by the calculation of the equivalent droop of the area (basically resulting from the DROOP OF ALL GENERATORS and the SELF-REGULATION OF THE TOTAL DEMAND).

By the joint action of all interconnected undertakings the PRIMARY CONTROL system ensures the operational reliability for the power system of the SYNCHRONOUS AREA.

Primary Control Power

[Policy 1]

The power output of a GENERATION SET due to PRIMARY CONTROL.

Primary Control Range

[Policy 1]

The PRIMARY CONTROL RANGE is the range of adjustment of PRIMARY CONTROL POWER, within which PRIMARY CONTROLLERS can provide automatic control, in both directions, in response to a FREQUENCY DEVIATION. The concept of the PRIMARY CONTROL RANGE applies to each generator, each CONTROL AREA / BLOCK, and the entire SYNCHRONOUS AREA.

Primary Control Reserve

[Policy 1]

The PRIMARY CONTROL RESERVE is the (positive / negative) part of the PRIMARY CONTROL RANGE measured from the working point prior to the disturbance up to the maximum PRIMARY CONTROL POWER (taking account of a limiter). The concept of the PRIMARY CONTROL RESERVE applies to each generator, each CONTROL AREA / BLOCK, and the entire SYNCHRONOUS AREA.

Primary Controller

[Policy 1]

The PRIMARY CONTROLLER is a decentralised control equipment for a GENERATION SET (generator and turbine) to control the speed of the generator (for synchronous generators directly coupled to the electric SYSTEM FREQUENCY), see PRIMARY CONTROL.

Insensitivity is defined by the limit frequencies between which the controller does not respond. This concept applies to the complete primary controller-generator unit. A distinction is drawn between unintentional insensitivity associated with structural inaccuracies in the unit and a dead band set intentionally on the controller of a generator.

Primary Frequency Control (PFC)

See: PRIMARY CONTROL

Reactive Power

The portion of electricity that establishes and sustains the electric and magnetic fields of alternating-current equipment, usually expressed in kilovars (kvar) or megavars (Mvar). REACTIVE POWER must be supplied to most types of magnetic equipment, such as motors and transformers and causes reactive losses on transmission facilities. REACTIVE POWER is provided by generators, synchronous condensers, or electrostatic equipment such as capacitors and directly influences the electric system voltage.

Real Power

The rate of producing, transferring, or using electrical energy, usually expressed in kilowatts (kW) or megawatts (MW).

Ramp Period

[Policy 1]

The time between ramp start and end times usually expressed in minutes.

Reliability[3]

[Policy 3]

The degree of performance of the elements of the bulk electric system that results in electricity being delivered to customers within accepted standards and in the amount desired. RELIABILITY on the transmission level may be measured by the frequency, duration, and magnitude (or the probability) of adverse effects on the electric supply / transport / generation. Electric system RELIABILITY can be addressed by considering two basic and functional aspects of the electric system:

Adequacy — The ability of the electric system to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements.

Security — The ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system elements.

Schedule

[Policy 2]

An agreed-upon transaction size (megawatts), start and end time, beginning and ending RAMP PERIODS, and type (e.g. firmness) required for delivery and receipt of power and energy between the contracting parties and the CONTROL AREA(S) involved in the transaction.

3 To a great extent, the overall RELIABILITY of the electric power supply (for customers being connected to the distribution grid), that is usually measured, is defined by the RELIABILITY of the power distribution instead of the transmission or generation.

Secondary Control

[Policy 1]

In an interconnected network, quasi-steady-state FREQUENCY DEVIATIONS and power interchange deviations will exist (in relation to set point values) between the various CONTROL AREAS / BLOCKS as a result of corrective action by PRIMARY CONTROL in response to a sudden variation in consumption or generation.

SECONDARY CONTROL is a centralised automatic function to regulate the generation in a CONTROL AREA based on SECONDARY CONTROL RESERVES in order

- to maintain its interchange power flow at the EXCHANGE PROGRAM with all other CONTROL AREAS (and to correct the loss of capacity in a CONTROL AREA affected by a loss of production) and, at the same time,
- (in case of a major FREQUENCY DEVIATION, particularly after the loss of a large generation unit) to restore the frequency in case of a FREQUENCY DEVIATION to its set value in order to free the capacity engaged by the PRIMARY CONTROL (and to restore the PRIMARY CONTROL RESERVES).

In order to fulfil these functions, SECONDARY CONTROL operates by the NETWORK CHARACTERISTIC METHOD. SECONDARY CONTROL is applied to selected generator sets in the power plants comprising this control loop. SECONDARY CONTROL operates for periods of several minutes, and is therefore dissociated from PRIMARY CONTROL. This behaviour over time is associated with the PI (proportional-integral) characteristic of the SECONDARY CONTROLLER.

Secondary Control Range

[Policy 1]

The SECONDARY CONTROL RANGE is the range of adjustment of the secondary control power, within which the SECONDARY CONTROLLER can operate automatically, in both directions at the time concerned, from the working point of the secondary control power.

Secondary Control Reserve

[Policy 1]

The SECONDARY CONTROL RESERVE is the positive part of the SECONDARY CONTROL RANGE between the working point and the maximum value. The portion of the SECONDARY CONTROL RANGE already activated at the working point is the secondary control power.

Secondary Controller

[Policy 1]

Single centralised TSO-equipment per CONTROL AREA / BLOCK for SECONDARY CONTROL.

Self-Regulation of Load

[Policy 1]

The SELF-REGULATION OF LOAD is defined as the sensitivity of consumers' demand to variations in frequency, generally expressed in % / Hz.

Stability

[Policy 3]

The ability of an electric system to maintain a state of equilibrium during normal and abnormal system conditions or disturbances.

Small-Signal Stability — The ability of the electric system to withstand small changes or disturbances without the loss of synchronism among the synchronous machines in the system while having a sufficient damping of system oscillations (sufficient margin to the border of stability).

Transient Stability — The ability of an electric system to maintain synchronism between its parts when subjected to a disturbance of specified severity and to regain a state of equilibrium following that disturbance.

Supervisory Control and Data Acquisition (SCADA)

A system of remote control and telemetry used to monitor and control the electric system.

Synchronous Area

[Policy 1]

A SYNCHRONOUS AREA is an area covered by INTERCONNECTED SYSTEM UNDERTAKINGS whose CONTROL AREAS are synchronously interconnected with CONTROL AREAS of members of the association. Multiple SYNCHRONOUS AREAS may exist in parallel on a temporal or permanent basis.

Tertiary Control

[Policy 1]

TERTIARY CONTROL is any automatic or manual change in the working points of generators (mainly by re-scheduling), in order to restore an adequate SECONDARY CONTROL RESERVE at the right time.

Tertiary Control Reserve

[Policy 1]

The power which can be connected automatically or manually under TERTIARY CONTROL, in order to provide an adequate SECONDARY CONTROL RESERVE, is known as the TERTIARY CONTROL RESERVE or MINUTE RESERVE. This reserve must be used in such a way that it will contribute to the restoration of the SECONDARY CONTROL RANGE when required.

The restoration of an adequate SECONDARY CONTROL RANGE may take, for example, up to 15 minutes, whereas TERTIARY CONTROL for the optimisation of the network and generating system will not necessarily be complete after this time.

Tie-Line

A circuit connecting two or more CONTROL AREAS or systems of an electric system.

Time Deviation

The TIME DEVIATION normally is the integrated FREQUENCY DEVIATION. In practice, an electrical clock that follows the system frequency is compared with the astronomical time.

Total Transfer Capacity (TTC)

The TOTAL TRANSFER CAPACITY, that is the maximum EXCHANGE PROGRAM between two areas compatible with operational security standards applicable at each system (e.g. GridCodes) if future network conditions, generation and load patterns were perfectly known in advance.

Transmission

TRANSMISSION is the transport of electricity on the extra high or high voltage network with a view to its delivery to final customers or to distributors, including the tasks of system operation concerning the management of energy flows, reliability of the system and availability of all necessary system services.

Transmission Reliability Margin (TRM)

The TRANSMISSION RELIABILITY MARGIN which is a security margin that copes with uncertainties on the computed TTC values arising from:

- Unintended deviations of physical flows during operation due to the physical functioning of SECONDARY CONTROL
- Emergency exchanges between TSOs to cope with unexpected unbalanced situations in real time
- Inaccuracies, e. g. in data collection and measurements

Transmission System Operator (TSO)

A TRANSMISSION SYSTEM OPERATOR is an undertaking that is responsible for operating, maintaining and developing the transmissions system for a CONTROL AREA and its interconnections:

UCTE Synchronous Area

[Policy 1]

A UCTE synchronous area is a part of a SYNCHRONOUS AREA covered by interconnected system undertakings / TSOs which are members of the association. Different UCTE SYNCHRONOUS AREAS may exist in parallel on a temporal or permanent basis.

J. Acronyms

AAC Already Allocated Capacity
ACE Area Control Error
AGC Automatic Generation Control
ATC Available Transmission Capacity
BRP Balance Responsible Party
CA Control Area
CB Control Block
CC Control Centre
CoC Co-ordination Centre
EIC
EMR Energy Meter Reading
GPS Global Positioning System
LFC Load-Frequency Control
NTC Net Transfer Capacity
PFC Primary Frequency Control
SCADA Supervisory Control and Data Acquisition
TM Telemeasurement
TSO Transmission System Operator
TRM Transmission Reliability Margin

TTC Total Transfer Capacity

UCTE Union for the Co-ordination of Electricity Transmission