POLICY 3

OPERATIONAL SECURITY

P3 – Policy 3: Operational Security [E]

Policy Subsections

Introduction

System safety is the primary goal of the operation of the interconnected network. In an interconnected system there exist numerous inter-dependencies of the networks forming part of the system. In addition, there are impacts attributable to the usage of the system by market players. In an unbundled environment, network operators are not allowed to interfere with market forces unless system safety is at stake. The operation of the interconnected network is founded on the principle that each partner is responsible for its own network. In order to give practical application to the basic principle of the interconnection that each TSO is responsible for its control area, one of the purposes of the Operation Handbook is to define the methods of co-operation also in operational situations when factors outside of the control area can reduce the ability of a TSO to operate its system within the security limits, according to the UCTE rules. To harmonise the operating methods for the interconnected network, UCTE has since the beginning worked out rules, instructions and suggestions, to which the operation of each network has to make reference in order to ease inter-operability.

TSOs are in charge of managing the security of operation of their own networks in a subsidiary way. The most relevant rules for the security of interconnected operation are related mainly to the functioning of interconnections. TSOs cooperatively adapt continuously such common rules for inter-operability to be applied mainly at the borders of their CONTROL AREAS and consequently at the borders of countries / blocks. These rules create favourable conditions for cross-border exchanges at destination of network users and of TSOs themselves. All these co-ordinating rules complement any other existing national commitments for network access (legal and contractual) for the transmission networks when they exist. The control of performances of facilities connected to networks remains under the responsibility of TSOs to the extent of their national commitments.

This policy specifies the requirements for operating the TRANSMISSION system to maintain security. Each CONTROL AREA and TRANSMISSION SYSTEM OPERATOR - TSO - is responsible of procedures for reliable operation over a reasonable future time period in view of real-time conditions, with CONTINGENCY and emergency conditions, and of their preparation. Co-ordination between TSOs contributes to enhance the common solidarity (to cope with risks) resulting from the operation of interconnected networks, to prevent disturbances, to provide assistance in the event of failures with a view to reducing their impact and to provide resetting strategies after a collapse. This co-ordination is intensively developed covering today new aspects related to market mechanisms.

History of changes

v1.3	**final draft**	**20.07.2004**	**OH team**	**Final wording**
v1.2	**final draft**	**18.06.2004**	**OH team**	**revision after consultation**

Current status

This policy focuses only on security aspects in operation and does not deal with long-term planning. The commercial rules are out of the scope accordingly (see section I-D in the introduction of the handbook). It is to be linked with Policy 5 “emergency procedures” in preparation.

This policy will cancel and replace previous UCTE ground rules and recommendations related to operational security. This version of the document (version 1.3, level E, dated 20.07.2004) has "final policy" status.

A. N-1 Security (operational planning and real-time operation)

Introduction

The N-1 SECURITY section refers to the requirements placed upon the operation of the POWER SYSTEM of the SYNCHRONOUS AREA with a view to maintaining the security of the entire interconnected network at any time in operational planning and in real-time conditions. Long-term planning requirements are not dealt with in this context. Secure operation of the interconnected network has made it possible to attain such a good quality of service that in the large majority of cases the outage of any power station or TRANSMISSION element has no influence on the supply of consumers. The "N-1CRITERION" is of major importance to prevent disturbances. This rule applied by all TSOs is combined with an appropriate choice of generation and TRANSMISSION facilities, and the determination of a sufficient reserve.

With an organisation of operation based on anticipation, dangerous situations can be identified in due time, and it is possible to take preventive action. Different CONTINGENCIES can occur:

- loss of interconnecting elements without any impact on network users or with consequences on commercial power exchanges;
- loss of load with immediate consequences for consumers;
- loss of interconnected operation, with possible worse consequences.

According to the safety, operational and planning standards used by TSOs, the highest importance is attached to the calculation of the TOTAL TRANSFER CAPACITY and the TRANSMISSION RELIABILITY MARGIN based upon the electrical and physical realities of the network.

Criteria

C1. "N-1" CRITERION: Any probable single event leading to a loss of POWER SYSTEM elements should not endanger the security of interconnected operation, that is, trigger a cascade of trippings or the loss of a significant amount of CONSUMPTION. The remaining network elements, which are still in operation should be able to accommodate the additional load or change of generation, voltage deviation or transient stability regime caused by the initial failure.
It is acceptable that in some cases TSOs allow a loss of CONSUMPTION in their own area on condition that its amount is compatible with a secure operation, predictable and locally limited.

C1.1. Loss of an element. The loss of any POWER SYSTEM element (generating set, compensating installation or any TRANSMISSION circuit, transformer) must not jeopardise the security of operation of interconnected networks as a result of limits being reached or exceeded for current, VOLTAGE magnitude, STABILITY, etc., and accordingly cannot cause cascade tripping of installations with interruptions in supply. These harmful consequences must be avoided in the system directly supervised by the TSO and also in ADJACENT SYSTEMS. Particular attention is required for TIE-LINES or in the vicinity of borders between different TSOs.
The loss of any element according to this "N-1 CRITERION", however, could affect radially supplied areas (and the output of their local power plants) and as such these areas are excluded from this rule.

C1.1.1. **Frequency deviations**. The loss of elements in the POWER SYSTEM must not cause a FREQUENCY DEVIATION outside acceptable limits according to those referred to in Policy 1 (see ⏩P1-A-C2).

C1.1.2. **VOLTAGE deviation**. The loss of elements in the POWER SYSTEM must not cause a VOLTAGE drop which may lead to VOLTAGE instability.

C1.1.3. **INTERCONNECTED SYSTEM STABILITY.** The loss of an element in the POWER SYSTEM must not cause a loss of INTERCONNECTED SYSTEM STABILITY.

C1.1.4. **Cascading outages.** A loss of an element in the POWER SYSTEM must not cause cascading outages of other elements in the CONTROL AREA as a result of exceeded operation SECURITY LIMITS.

Requirements

R1. Monitoring of the N-1 CRITERION

R1.1. Monitoring: TSOs monitor at any time the N-1 CRITERION for their own system through observation of the interconnected system (their own system and some defined parts of ADJACENT SYSTEMS) and carry out security computations for risk analysis.

R1.2. Violation of the N-1 CRITERION: In real time, after a CONTINGENCY, each TSO returns its POWER SYSTEM to N-1 compliant condition as soon as possible, and in case of a possible delay, it will immediately inform other TSOs affected.

R2. Most probable contingencies

R2.1. TSOs define the set of most probable CONTINGENCIES in operational planning and in real-time conditions and implement measures to comply with the N-1 CRITERION. Each TSO is directly responsible for coping with the N-1 CRITERION by taking account of the loss of one or multiple network elements (N-k elements when such situations can occur with a sufficient probability to threaten the security of operation: e.g. N-2 lines for some double-circuit lines when appropriate). The specific case of a loss of bus-bars is considered by taking into account an acceptable level of loss of CONSUMPTION predicted and locally limited or not taken into account (due to the extremely low probability of fault and due to the necessity of topology switching by coupling or separating the bus-bars).

R2.2. The screening of situations with CONTINGENCIES covers the loss of single or multiple elements of generation or TRANSMISSION equipment at any time. This screening takes also account of temporary weather conditions or weakness of a single network equipment.

R3. Bottlenecks. In normal conditions, no restrictions of the TRANSMISSION capacity should occur on the network. If a network operating element fails, necessary measures are taken in the internal network to limit the consequences of such BOTTLENECKS that may adversely affect interconnected operation. In normal operation, any ancillary equipment associated with a TRANSMISSION line, a fortiori with a TIE-LINE, are designed to match the TOTAL TRANSFER CAPACITY so that TSOs do not face capacity limitation. TSOs agree between themselves on a common TOTAL TRANSFER CAPACITY limit for common borders.

R3.1. All ancillary equipment associated with a transmission line or a transformer, such as current transformers, disconnectors, power circuit breakers, high frequency chokes, intensity and voltage measurement devices, are designed to match the maximum transmission capacity of the line or transformer, so that they do not represent a bottleneck.

R4. Operational Network Reserve. TSOs estimate their operational reserve, i.e. ACTIVE POWER reserve, REACTIVE POWER reserve, acceptable VOLTAGE profile, line loads within acceptable limits, STABILITY margins etc, depending on operating conditions, to securely withstand a first CONTINGENCY. Following the first CONTINGENCY in the network causing a lack of operational network reserve, this immediate deterioration does not lead to rapid deterioration of system operating conditions and is predicted.

Standards

S1. **Application of the N-1** SECURITY POLICY**.** Each TSO initially applies the N-1 security policy to its own network on its own responsibility; adjacent TSOs shall be informed about potential problems in the application of this rule. The TSOs concerned jointly verify the respect of the N-1 rule in consideration of cross-border power transfers. The tripping of TIE-LINES at other borders is also considered when appropriate.

S2. **Network margin at boundary.** The entire network, including TIE-LINES, is operated in such a way that sufficient transmission capacity is available for the delivery of reserve power for PRIMARY CONTROL towards the areas which respectively may be affected by the most severe single CONTINGENCY, in the scope of the TRM.

S3. **Data Exchanges.**

S3.1. **Completion of real-time and forecast calculations of network security**. TSOs exchange all useful information and data related to network topology, active and reactive flows, sums of country EXCHANGE PROGRAMS and to some extent the pattern of generation in compliance with the national legal framework in use for confidentiality only when the pattern is relevant for operation at boundary, etc and required for calculations of network security. These data will be used for the completion of real-time and forecast calculations for network security and then for congestion forecasts week and day ahead (P4-A1).

S3.2. **Day-Ahead Congestion Forecast**. With a view to completing the most accurate studies to relieve network congestions, TSOs exchange specific relevant provisional data (see also section F).

Procedures

P1. **Procedures for the N-1 CRITERION**. TSOs individually and jointly develop, maintain and implement procedures to comply with the N-1 CRITERION.

P2. **Types of analysis.** Two types of analysis are used for the verification of operational security by members:

- forecast analyses based upon network data and various hypotheses for electricity exchanges, generation pattern, incoming power flows and system topology;
- real-time analyses based upon network data supplied by a given TSO, together with data on those parts of ADJACENT SYSTEMS which will have a significant influence upon the system of the TSO concerned.

TSOs within the SYNCHRONOUS AREA complete forecast calculations for the synchronous network as a whole, using a simulation of N-1 criterion cases. The provision of a uniform set of data hypotheses for incoming power flows allows each TSO to complete individual calculations (forecast and real time) for the verification of the security of their own networks. This will involve the calculation of:

- the effects of power plant failures upon power flows, both in national networks and on TIE-LINES, taking account of the PRIMARY CONTROL power supplied by other networks;
- power flow transfers associated with the tripping of lines or other elements of national networks, taking account of the influence of other networks.

P3. **Online calculations for network security.** This method involves the representation of the actual condition of networks in the areas concerned, referred to as adjacent zones. To this end, measurements and the signalling of the status of switching devices on the circuits concerned will be elaborated and transmitted in order to allow effective observation of these circuits. Equivalent representation is deemed sufficient for remote zones. Adjacent zones will be limited to the first loop linking the system node points which are directly adjacent to frontier node points. The reduction of external networks will therefore be completed beyond the scope of adjacent zones. This method allows members to apply their algorithms for the real-time verification of network security to a cross-border model which takes account the actual situation at any given time.

Guidelines

G1. Inter-linked double bus bar operation. It is advisable to provide inter-linked double bus-bar operation in a transformer substation if the number of branches exceeds a given number. An operation with multiple electric nodes can be requested at some boundary substations for security reasons.

G2. Support from an ADJACENT SYSTEM. The N-1 CRITERION may be assured with the support of an ADJACENT SYSTEM, subject to the prior agreement of the latter. This assumes that scheduled outages for the performance of work affecting ADJACENT SYSTEMS have been agreed in advance by the TSOs concerned.

G3. Operational switching for periodical maintenance. In order to ensure the permanent manoeuvrability of TRANSMISSION circuit isolators and breakers at any time, TSOs organise periodical switching of such elements. This must be done without endangering the security of operation.

G4. Overload indicators. All TIE-LINES, and the important internal TRANSMISSION lines and large transformers are equipped with devices which enable overloads to be indicated and information to be transmitted to National Control Centres, in order to alert TSOs of a close risk of violating the N-1 CRITERION.

Measures

M1. Tripping of interconnecting lines. In order to allow the support by INTERCONNECTION to be provided as long as possible, deliberate tripping of TIE-LINES should be avoided, as long as interconnected operation remains possible, except when defined and agreed between neighbouring TSOs.

Bibliography :

[Review of UCPTE recommendations on interconnected operation– 31/07/1991 (§ Network security (42))]

[Network protection devices against faults, QR 1974/75]

[UCPTE 37: Operation of the UCPTE interconnected network in normal operation and during disruptions, AR 1985-1986 (§1, 2)]

[UCPTE 13 : Measures to prevent or limit major disruptions, AR 1962-1963 (§ 2, 3, et 5)]

[UCPTE 15 : Measures to maintain a stable frequency and precautions against falls in frequency, QR I-1965 (§ 2, 3)]

[UCPTE 16 : Measures to counteract major disruptions in interconnected network operation, QR IV-1966 (§ 3.2, 3.4, 4, 5(other references)) + Revision of 31/10/1990]

[UCPTE 42 : Measures to counteract major disruptions in interconnection and to re-establish normal operating conditions, HR I-1990 (§ 3.2, 3.4, 4)]

[UCPTE 37 : Operation of the UCPTE interconnected network in normal operation and during disruptions, AR 1985-1986 (§ 3)]

[Recommendation UCTE regarding plans of network restoration – 1/12/1999 (§ 2, 4, 5)]

[ETSO Web-site]

B. Voltage Control and Reactive Power Management

Introduction

VOLTAGE is a measured physical quantity, which fluctuates as a function of network load, generation programmes, POWER SYSTEM operator decisions and POWER SYSTEM contingencies (tripping of generators or TRANSMISSION components). The VOLTAGE levels are maintained by REACTIVE POWER generation assured by different facilities. Nevertheless, for network security reasons, and in accordance with operational VOLTAGE limits of equipment (insulation of network elements, functioning limits of automatic transformer tap changers), a control of VOLTAGE is locally needed to maintain the VOLTAGE deviations within pre-determined limits.

VOLTAGE conditions in a high-VOLTAGE grid are directly related to the REACTIVE POWER balance at the system nodes. Depending on their operational state, all generators, LOADS and system components (lines, transformers) are either REACTIVE POWER consumers or producers. The network by itself produces or absorbs REACTIVE POWER depending on the load level through the line and their surge impedance loading sometimes called the "natural power". To compensate for an excessive CONSUMPTION of REACTIVE POWER, TSOs have to make sure that efficient producers feed sufficient reactive power into the networks in addition to the one produced by other devices installed in the networks or in consumers installations.

Unlike ACTIVE POWER, REACTIVE POWER cannot be transmitted over long distances, since the TRANSMISSION of REACTIVE POWER leads to an additional demand for REACTIVE POWER in the system components, thereby causing VOLTAGE drops. In order to obtain an acceptable VOLTAGE level, REACTIVE POWER generation and CONSUMPTION have to be situated as close to each other as possible to avoid excessive REACTIVE POWER TRANSMISSION. This REACTIVE POWER can nevertheless be produced in their CONTROL AREA or in the vicinity to those of neighbouring TSOs. In this last case, specific bilateral agreements should be made to transfer REACTIVE POWER through TIE-LINES.

VOLTAGE control is thus primarily a regional problem, which may involve several TSOs in an INTERCONNECTED SYSTEM.

The operating VOLTAGE reference values are : 380 kV or 400 kV and 220kV or 225 kV. These nominal VOLTAGE values 380kV or 400kV and 220kV or 225kV are slightly different depending on country equipment design ; 750 kV is an accepted operating VOLTAGE reference level, too. They do not introduce significant differences on the synchronously interconnected system operation.

Requirements

R1. Providing reactive resources.

R1.1. REACTIVE POWER resources. Each TSO arranges for providing reactive resources for its requirements and to maintain its control VOLTAGE capability.

R1.2. Information. Each TSO shall have information of the main REACTIVE POWER resources available for use in the TRANSMISSION network of its own CONTROL AREA.

R1.3. Location. Reactive resources are dispersed and located, whenever possible, close to loads in order to avoid REACTIVE POWER transport and to be applied effectively during normal conditions and when CONTINGENCY occurs.

R1.4. REACTIVE POWER Generation/absorption resources. A sufficient number of generators and/or capacitors and/or inductors connected to 380kV/400 kV and 220 kV/225 kV contribute to REACTIVE POWER generation or absorption. All main power plants connected to 380kV/400 kV and 220 kV/225 kV are able to contribute to REACTIVE POWER. Other sources at lower voltage levels can also be used where relevant for operation.

R2. Continuous VOLTAGE control. For operation security reasons and respect of mutual commitments for operational conditions, a continuous VOLTAGE control is needed and co-ordinated by each TSO in order to maintain VOLTAGE variations within pre-determined limits in their CONTROL AREAS.

R3. REACTIVE POWER demand and reserve.

R3.1. Each TSO shall be able to cover its REACTIVE POWER demand of the own transmission system.

R3.2. In order to establish a proper value of the REACTIVE POWER reserve within CONTROL AREAS, TRANSMISSION network nodes are operated at VOLTAGE levels with a sufficient margin as to the VOLTAGE critical point. In this respect, it is advisable to provide a proper REACTIVE POWER reserve.

R4. Monitoring and controlling VOLTAGE and Mvar flows.

R4.1. On TIE-LINES. REACTIVE POWER flows on TIE-LINES are maintained at a minimum level and if possible not beyond the natural demand of the TIE-LINE in order to limit VOLTAGE drops and to allocate the TOTAL TRANSFER CAPACITY mainly to ACTIVE POWER.
In order to ensure a safe operation of the SYNCHRONOUS AREA, the VOLTAGE levels at boundaries need to be optimised with regard to the specific nodes of TIE-LINES – at the points of exchange with neighbouring CONTROL AREAS. The pre-set VOLTAGE levels need to be compatible with and not to be far from the corresponding VOLTAGE value at the other side of the border.

R4.2. VOLTAGE and REACTIVE POWER control devices. Devices used to control TRANSMISSION VOLTAGE and REACTIVE POWER flows are available on decision or under the lead of the TSO.

R4.3. Within boundaries. Policies and procedures for VOLTAGE control are developed and implemented within boundaries in a subsidiary way by TSOs.

R5. Operating reactive resources. In case of a high system load, the system operator shall make sure that, in case of a loss of generation, VOLTAGE control facilities are able to deliver sufficient REACTIVE POWER to maintain the VOLTAGE within the required range. The same applies to the converse situation, where the system load is low and REACTIVE POWER needs to be absorbed.

R6. General loss of VOLTAGE. In case of a general loss of VOLTAGE, control centres, operating centres, and the substation personnel shall be in a position to allow the reconstitution of the network.

R7. Availability and performance of devices used for VOLTAGE control shall be taken into account for operational planning under real-time conditions.

Standards

S1. Providing reactive resources: Each TSO operates its capacitive and inductive reactive resources and reserves to maintain the system and TIE-LINES within established limits and to protect VOLTAGE levels under CONTINGENCY conditions.

S1.1. At the beginning of peak-LOAD periods, the operators shall make sure that a sufficient level of REACTIVE POWER is available and the VOLTAGE level is close to upper values.

S2. Lack of single CONTINGENCY coverage. The TRANSMISSION lines' loads and VOLTAGE/reactive levels are such that a single CONTINGENCY of a REACTIVE POWER device could not threaten the RELIABILITY of the INTERCONNECTION.

S3. Preventing a VOLTAGE collapse. The TSO takes corrective action, including LOAD reduction, LOAD SHEDDING, necessary to prevent a VOLTAGE COLLAPSE when reactive resources are insufficient.

S4. Joint action at boundaries between TSOs. The VOLTAGE range for boundary substations has to be jointly agreed and designed to suit particular situations.

Neighbouring TSOs shall jointly seek to optimize the implementation of voltage control facilities. If existing installations are not sufficient, the requisite compensation facilities are installed. Effective management of the voltage level needs co-ordination and contributions of neighboring TSOs involved.

S4.1. Pre-set values at boundaries. VOLTAGE levels are kept as close as possible to pre-set values agreed between neighbouring TSOs.

S4.2. REACTIVE POWER flows on TIE-LINES. Any VOLTAGE values at boundaries are agreed and controlled bilaterally between neighbouring TSOs depending on the VOLTAGE level agreed at the boundary substations or on specific situations (potential case of REACTIVE POWER purchase from another CONTROL AREA). Depending on operational conditions which could jeopardise the INTERCONNECTED SYSTEM operation, adjacent TSOs can agree on the amount of REACTIVE POWER that may be exchanged during normal operation or when CONTINGENCY occurs.

S4.3. Bilateral policies. Bilateral policies are set up between neighbouring TSOs to manage VOLTAGE levels at boundaries in case of disturbances.

S4.4. Data to be exchanged. At boundaries, TSOs exchange data on VOLTAGE values and profile and REACTIVE POWER data at boundary substations and TIE-LINES for the network security analysis and for real-time operation.

S5. Use of VOLTAGE reduction and load shedding close to borders

S5.1. The TSO operates appropriate settings of the VOLTAGE levels on the transformers to reduce loads.

S5.2. When a TSO uses VOLTAGE reduction (3% or 5% in some countries) or LOAD SHEDDING, it shall inform its neighbouring TSOs involved when using such dispositions.

Guidelines

G1. Range of VOLTAGE values in normal conditions. For ultra-high VOLTAGE networks, the ranges of observed VOLTAGE values in normal condition are respectively close to 380 kV – 420 kV for 380kV/400 kV level and 200 kV – 240 kV for 220kV/225 kV level. Values below 365 kV and 200 kV or above 420 kV and 250 kV can be reached in some circumstances for a short duration. 750 kV is also an existing voltage level the use of which is very limited. For high VOLTAGE networks, these ranges are maintained at around 10% of nominal VOLTAGE values.

G2. Policies and procedures for boundary substations and installations are developed with neighbouring TSOs.

G3. VOLTAGE control (adjustment of REACTIVE POWER generation). In order to ensure safe operation of the SYNCHRONOUS AREA, the VOLTAGE levels need to be optimised with regard to the specific nodes of the TIE-LINES at the points of exchange with neighbouring CONTROL AREAS.

G4. VOLTAGE control facilities. Different kinds of facilities to maintain the VOLTAGE levels are allowed: REACTIVE POWER production by generators, synchronous compensators, fixed capacitor banks, inductors, fixed reactors, SVCs (Static Var Compensators), generators coupling transformer taps, transformer tap controllers etc.

G5. Switching TRANSMISSION elements. A manual opening/disconnection of transmission lines is used to maintain the VOLTAGE level in normal operating conditions during off-peak periods with low load flows.

G6. TSOs support for voltage level at borders. Adjacent TSOs can agree on mutual voltage support.

G7. Remote control of on-load tap changers. In networks including transformers equipped with on-load tap changers, the security of operation may be endangered by these devices in case of serious VOLTAGE drops due to the high LOAD and the a REACTIVE POWER deficit. The resulting increase in REACTIVE POWER demand may cause a VOLTAGE collapse. Therefore, it is recommended to use remote control devices to stop the action of on-load tap changers.

G8. **Emergency strategy.** If due to an unforeseen event, the network functioning point approaches a critical VOLTAGE level, an adequate emergency strategy shall be agreed by the TSOs at the boundary.

Procedures

P1. **Primary VOLTAGE control** is implemented and is active in operation by the VOLTAGE regulators of generating units, which initiate a rapid variation in the excitation of generators when they detect a variation in VOLTAGE across the generator terminals. Other controllable devices, such as SVCs (Static Var Compensators) may also be involved in primary VOLTAGE control.

P2. **Secondary VOLTAGE control** co-ordinates the action of VOLTAGE and REACTIVE POWER control devices within a given zone of the network in order to maintain the required VOLTAGE level at a ”key node point” in the system.

P3. **Tertiary VOLTAGE control** involves a process of optimisation, using calculations based upon real-time measurements, in order to adjust the settings of devices which influence the distribution of REACTIVE POWER (generating set controllers, transformer load controllers and compensating devices, such as inductances and capacitors).

P4. **Implementation of secondary and tertiary VOLTAGE control.** Each TSO implements secondary and/or tertiary VOLTAGE control in a subsidiary way.

Measures

M1. **VOLTAGE reduction**. TSOs reduce the VOLTAGE at customer levels to reduce LOAD (3% or 5%) as preventive measure.

M2. (**Automatic load) shedding.** LOAD SHEDDING is initiated at the time when the VOLTAGE has decreased at an abnormal level.

M3. **Contribution of power plants to the safeguard measures and to BLACK START.** Power plants are able to accommodate variations in VOLTAGE (and frequency) outside of the normal range of operation as long as this is technically feasible before automatic disconnection from the network. Power plants are able to operate under impaired (frequency and VOLTAGE) conditions with reduced performances for a limited period of time accordingly. A number of generating units are equipped for start-up with no external VOLTAGE supply (BLACK START CAPABILITY). These plants should be suitably distributed throughout the network. It is recommended to locate these plants on sites comprising several generating units.

Bibliography :

[UCPTE 9 : Voltage stability and reactive power flow in the European interconnected network QR I-1959, III-1961, III-1962, I-1964, IV 1967]

[UCPTE 38 : Summary of the study « Behaviour in hazardous situations – maintaining the voltage and stability », QR III-1986 »]

[UCPTE 43 : Reactive power and voltage control in the UCPTE system, AR 1990 (§ 6)]

C. Network Faults Clearing and Short-Circuit Currents

Introduction

The network is subject to short circuits between cables or with earth mainly due to critical atmospheric conditions (thunderstorms, heavy fog in polluted areas) which can cause numerous short-circuits. Perturbations can also be caused by other external sources: to some extent for example by blows of excavators in underground cables or by the starting of fishing canes with overhead lines, by planes flying close to the ground, etc.

Short-circuit protective devices for all items of equipment (generators, transformers, bus-bars, TRANSMISSION lines) promptly and effectively disconnect any occurring fault with selectivity. Such equipment is backed-up. Its functioning does not result in premature tripping with overloads or loss of synchronism. An effective mutually compatible adjustment of all individual protective devices is very important. Speed and selectivity when disconnecting lines are facilitated by the use of signal links between both ends of the lines.

The setting and function of the protective equipment are checked regularly. The best way of doing this is by including it in the maintenance schedule.

If there are any changes in operating conditions, the settings of protective devices are immediately adjusted to suit to the new conditions. The protective equipment is also readjusted by remote control via the network management where possible.

Criteria

C1. **Network fault clearing**. Whatever the type of power network fault, it is due to be eliminated. That means to disconnect the network element concerned (generators, transformers, bus-bars, TRANSMISSION lines) as quickly as possible and within a specified clearing time, with selectivity and reliability, in order to prevent impairing or jeopardising the rest of the networks, mainly because of safety concerns: Damages to network elements when the fault duration is too long and risk of losing synchronism of power networks.
This criterion is applicable to faults located in the interconnecting elements with distribution and generation systems.

Requirements

R1. **Efficiency of protection devices**. The protective devices for generators, transformers, bus-bars and lines eliminate all faults selectively and reliably and with the requisite speed.

R2. **Requisite speed of devices.** The requisite speed of protective devices is designed to satisfy STABILITY requirements or to keep equipment within its construction limits.

R3. **Protection system design.**

R3.1. **Redundant Protection devices**. The ultra-high VOLTAGE network protection devices are of a redundant design and equipped with a main and a back-up clearing system (possibly with two protections of the same hierarchical level).

R3.2. **Proper operation.** Protection systems should normally not operate for minor system disturbances, recoverable system power swings or transient overloads.

R3.3. **Selectivity.** The only affected network element has to be automatically disconnected.

R3.4. **High speed equipment.** High speed relays, high speed circuit breakers, and automatic reclosing are used where appropriate.

R3.5. **Phase reclosing devices.** All major lines, and in particular TIE-LINES, are operated with single-phase rapid reclosing devices and, normally, with three-phase slow reclosing devices. Automatic three-phase reclosing systems are commonly used at the ends of the circuits at suitable locations of interconnecting lines. Manual reclosing is done by means of synchronising equipment.

R3.6. Automatic reclosing. Automatic reclosing during out-of-step conditions is prevented with appropriate internal protection functions. TSOs should avoid undesired tripping during out-of-step conditions. If tripping occurs, specific out-of-step detection for reclosure blocking is not provided as a standard.

R3.7. Reviewing applications (equipment, installation). Protection system applications, settings, and co-ordination are reviewed periodically and in case of major changes in generating resources, TRANSMISSION, load or operating conditions.

R3.8. Protection scheme co-ordination. Protection scheme co-ordination is guaranteed with generation and distribution systems and between separately owned transmission systems.

R4. **Synchronising equipment for switching supervision** has to be installed in all major substations, in particular in those involving cross-border or CONTROL AREAS interconnecting lines.

R5. **Facilities' short-circuit capability.** The facilities and devices connected to networks are designed to operate up to given current limits. Therefore, the POWER SYSTEM is to be operated within construction limits. Technical requirements upon generator connection are defined in order to guarantee that short-circuit currents stay below the established limits. Sound operation requires that, at any node on the POWER SYSTEM, short-circuit currents do not exceed the breaking CAPACITY of devices installed on that node.

R6. **Efficiency of short-circuit protection.** The protection devices are adequately sized for TRANSMISSION equipment, and in particular for frontier substations, to prevent major damage and loss of operating facilities for an unreasonable length of time.

R7. **TSO Calculation.** Each TSO has to calculate where appropriate the short-circuit currents at each node of its system.

Standards

S1. **Co-ordination between TSOs at the boundary.** Protection systems for cross-border lines are co-ordinated between TSOs. Each TSO shall inform in advance neighbouring TSOs of setting and changes in operating conditions of protective relays and systems and exchange information on the evaluation of protection system functioning.

S2. **Basic reliability requirement regarding single contingencies.** All TSOs plan and operate their system so that network faults clearing does not lead to cascading outages or to more severe CONTINGENCIES according to the N-1 CRITERION.

S2.1. Single contingencies elimination. Any short-circuit current is correctly eliminated and does not impair any TRANSMISSION element.

S3. **Preventive and corrective actions (repair, maintenance).** If a protective relay or equipment failure reduces system RELIABILITY, the responsible personnel is notified, and corrective action is undertaken as soon as possible. Preventive action is taken to guarantee the required reliability indices of protective systems (including circuit breakers, auxiliary power supplies, communication and current and voltage and measuring transformers).

S4. **Short-circuit calculations** are systematically carried out for studying and planning TRANSMISSION networks taking account of the contributions of adjacent systems to short-circuit power.

S4.1. Required data. The data needed for experts of different countries jointly operating the synchronously interconnected POWER SYSTEM shall be made available. These data are used by everyone to calculate ex-ante short-circuit currents at each node of its own network, once data contributions of neighbouring countries have been provided.

S4.2. Periodicity of a complete calculation. In order to provide a basis for assessment by each TSO of the contribution of ADJACENT SYSTEMS in the calculation of short-circuit currents, the UCTE uses its network model to carry out a calculation for the entire synchronously interconnected system every five years, and to get a consistent set of data.

S5. Bus-bar operation at boundary sub-stations. Neighbouring TSOs inform each other about specific operation of sub-stations with separated bus-bars.

Guidelines

G1. Bus-bar protection system. The bus-bar protection system is based on a longitudinal differential or differential protection The recommended response-time limit is lower than 30 ms.

G2. Fault locators. Fault locators are provided to ensure rapid fault location. Such devices are installed where they are relevant for operation. They help to save time in locating the origin of faults on affected lines in order to return as soon as possible to normal operation.

G3. Fault current limiters. In order to limit the short-circuit currents within the interconnected networks, fault current limiters can be used by TSOs.

Procedures

P1. Method to limit short-circuit currents.

P1.1. Network opening. In order to limit the short-circuit currents within the interconnected networks, some network loop opening can be achieved at different VOLTAGE levels in putting lines out of operation, with the risk of creating partial networks connected only through a limited number of lines. In case of bus-bar maintenance, manual opening of lines can be achieved for short-circuit current limitations. Choices are done depending on operating conditions.

P1.2. Separated bus-bars operation. TSOs operate sub-stations with different nodes (separated bus-bars) depending on the level of short-circuit currents.

Bibliography :

[UCPTE 12 : Short circuit reclosure AR 1961-1962 (table 1 & 2)]

[UCPTE 23 : Reserve protection, AR 1970-1971 (§ philosophy, particular measures…)]

[UCPTE 25 : Operational measures for limiting short circuit currents in the operation of interconnected network, AR 1972-1973 (§ 3)]

[UCPTE 28 : Behaviour of electrical protection in the interconnection network, AR 1979-1980]

[UCPTE 41 Short circuit current at UCPTE frontier nodes, 17th January 1990, AR 1989]

[UCPTE : Review of UCPTE recommendations on interconnected operation– 31/07/1991 (§ Network security (42))]

[Network protection devices against faults, QR 1974/75]

D. Stability

Introduction

This sub-policy deals with STABILITY issues from the point of view of preserving the synchronous operation of generators, i.e. VOLTAGE STABILITY is not addressed here even if it can be related to the former one.

POWER SYSTEM STABILITY consists in the ability of the system to withstand changes in the grid (for example: changes in VOLTAGE, load, frequency) and to survive transition to a normal or at least acceptable operating condition. In absolutely steady conditions, all generating units run synchronously. In case of a change or a large disturbance, some machines can immediately start swinging with respect to each other. This instability phenomenon can lead the POWER SYSTEM to a loss of synchronism and, consequently, can cause tripping of generating units, which jeopardizes the electric energy delivery to customers. Therefore, TSOs carry out computer simulations to check if instability problem will not endanger the secure operation of the system They determine themselves the frequency for the implementation of such simulations. To be able to perform computer simulations and operation, it is essential to get data from producers, although it is increasingly difficult to obtain these data in a liberalized environment.

Criteria

C1. Preservation of synchronous operation under normal conditions and after loss of an element. Each TSO is responsible for maintaining synchronous operation with other TSOs.

C2. Operation security. All TSOs operate their networks in such a way that a loss of STABILITY should not occur or spread to adjacent TSOs after loss of a system element.

Requirements

R1. Loss of element. The loss of any element, according to chapter A, due to any type of failure, eliminated pursuant to chapter C, must not lead to a loss of STABILITY of the connected generators or to operating constraints in adjacent areas, and does not cause the intervention of the line protection devices.

R2. Stability calculation. Each TSO is able to verify operational STABILITY with selected failures in the POWER SYSTEM. Calculation of STABILITY is carried out for planning of the TRANSMISSION system or prior to a substantial change in the TSO's network.

R3. Damping of network oscillations. Network oscillatory phenomena have to be either of sufficiently low amplitude, or need to be damped to a sufficient extent so that they will not impair or jeopardise system operation. Oscillations must not last inadequate period of time nor cause induced swinging of other remote generators which are not directly involved in the origin of this network oscillation.

Standards

S1. Application of the stability policy. Each TSO shall apply the STABILITY policy to its own network on its own responsibility. Adjacent TSOs jointly apply the STABILITY policy with due account to affected TIE-LINES and border parts of networks.

S2. **Co-ordinated analyses.** In case of STABILITY problems affecting several TSOs, co-ordinated analyses are required at UCTE level when appropriate to check the small signal stability of the whole power system. Each TSO shall take part in STABILITY studies if STABILITY problems concern its CONTROL AREA.

Guidelines

G1. **Studies.** Each TSO has to implement software models suitable for carrying out STABILITY calculations. Furthermore, each TSO shall make available all data necessary for these calculations, especially data about generators, and exchange all information and data required for the completion of real-time and forecast calculations for network STABILITY with other TSOs.

G2. **Circuit breaking devices.** TSOs can provide automatic devices at appropriate junctions (international or within the internal networks), which in the case of frequency drop, overloading or loss of synchronism break the circuit at predetermined points in the network. If points of disconnection are provided, they should be selected where appropriate so that in each of the isolated network sections a good balance between generation and CONSUMPTION is attained so that each network section can continue to operate under acceptable frequency and STABILITY conditions.

G3. **Power swing detectors.** Power swing detectors provide a power swing blocking function to prevent false tripping by distance measuring elements during power swing. These relays should be installed in the 380 - 400 kV network.

G4. **POWER SYSTEM stabilisers**. Parts of the excitation control system are used for damping network oscillations in the POWER SYSTEM. In the limits of the national transmission rules and requirements, each TSO shall ensure as far as possible that newly built power station units connected to the TRANSMISSION grid with large nominal power are equipped with power system stabilisers which are able to damp inter-area oscillations**.**

G5. **Power unit fast valving.** Fast valving consists in a fast reduction of the mechanical power supplied to the electrical machine by the turbine in order to enhance the system STABILITY. Large thermal generating units connected to the TRANSMISSION network should be able to perform fast valving.

G6. **Emergency automatics.** If it is not possible to ensure the system STABILITY with common devices, also in view of events of low probability but with serious impact on POWER SYSTEM operation, appropriate emergency automatics should be introduced. Emergency automatics can be used to prevent loss of STABILITY of a generator group in unfavourable conditions.

G7. **Setting of excitation controllers.** The TSO shall ensure that AVR (Automatic VOLTAGE Regulators,) and POWER SYSTEM stabilisers settings on units within its CONTROL AREA meet its requirements. Special care is taken of the co-ordination of network protection devices.

G8. **Power units operation during network failures.** TSOs supervise in accordance with their national regulations that power units meet the requirements of resistance against network failures when their STABILITY is threatened. In case of threatened STABILITY, which has been found by calculations, POWER SYSTEMS can be equipped with relevant protections (leading to power plant tripping). In case of loss of synchronism, power units are equipped with respective protections to trip under predetermined conditions.

Measures

M1. **Assurance of stability.** If operational experience or computational results show that there is a risk of STABILITY loss according to the N-1 CRITERION fault or another failure with a high probability of occurrence, the TSO shall solve this problem in order to bring its network in line with the requirements of this chapter. Measures can include setting of excitation control systems and power system stabilizers, installation of special automatics or protection and coordinated studies and action with adjacent TSOs.

M2. **Reducing the risk of instability.** TSOs can operate the networks close to the upper value of each voltage range before reaching the peak of load, and reduce the fault clearing time in order to reduce the risk of instability.

Bibliography :

[UCPTE 9 : Voltage stability and reactive power flow in the European interconnected network QR I-1959, III-1961, III-1962, I-1964, IV 1967]

[UCPTE 38 : Summary of the study « Behaviour in hazardous situations – maintaining the voltage and stability », QR III-1986 »]

E. Outage Scheduling

Introduction

The European electric POWER SYSTEM, initially interconnected for RELIABILITY reasons, then used also for commercial purposes through well-defined exchange contracts (mostly long-term contracts), is now the scene for a more complex European market.

Potential restrictions of electricity exchanges are mostly due to limits OF THE TOTAL TRANSFER CAPACITY. TRANSMISSION congestion occurs when the TRANSMISSION system cannot be operated securely in the light of a requested pattern of generation, DEMAND and TRANSMISSION. As an absolute minimum, procedures relieve congestion before physical or SECURITY LIMITS are reached.

This is particularly true given the meshed nature of the European network.

For the purpose of national and international connection, the TSOs of the interconnected network are responsible for ensuring that operational security in accordance with the N-1 CRITERION, network STABILITY and short-circuit current will be maintained within the system as a whole, taking account of existing TIE-LINES and scheduled outages.

TSOs mutually determine the most suitable dates for scheduled outages to carry out maintenance work on transport installations such as the main interconnecting lines, other relevant installations close to the borders or installations with a substantial impact on internal lines. These scheduled outages enable TSOs to carry out maintenance work on their installations at regular intervals with a view to ensuring reliability. Unavailability of one TIE-LINE may have immediate consequences on NTC. Outage scheduling is carried out to be able to calculate and publish ATC..

As a result of companies' unbundling, it is increasingly difficult to TSOs to obtain from producers well in advance information about planning of scheduled outages of their main production installations located close to the borders which have a direct impact on the level of load on tie-lines. Any delay in the knowledge of power plant outages can impede TSOs to publish the summer NTC and the winter NTC in due time (six months ahead).

Provided that the aforementioned delays do not occur, TSOs are able to determine on a yearly basis the planning of scheduled outages of transport facilities by the end of the previous year or at the beginning of the forthcoming year, at the latest.

Criteria

C1. Planned outages of power plants. The outage of a power plant must not jeopardise the security of operation of the INTERCONNECTED NETWORK. Particular attention has to be paid to large-capacity power plants (more than 300 MW) and those in the vicinity of borders between different TSOs.

C2. Planned outages of TRANSMISSION lines. The outage of a TRANSMISSION line must not jeopardise the security of operation of the INTERCONNECTED NETWORK. Particular attention has to be paid to TRANSMISSION lines crossing borders or in the vicinity of borders between different TSOs.

Requirements

R1. Exchange of information about planned outages at the border.

R1.1. Planned outages of power plants. Each TSO has to collect information on scheduled outages of power plants and transmit them to the neighbouring TSOs for what is relevant.

R1.2. Planned outages of TRANSMISSION lines. Each TSO has to provide information in advance on the planned OUTAGES of TRANSMISSION lines in its system and co-ordinate its planning with the neighbouring TSOs.

Standards

S1. **Forecast analyses.** The provision of a uniform set of data of the TRANSMISSION networks and hypotheses for scheduled power exchange allows each TSO to carry out individual calculations (medium-term and short-term forecast) for the simulation of

- the effects of power plant OUTAGES upon power flows, both in national networks and on INTERCONNECTIONS;
- flux transfers associated with the outage of lines or other elements of national networks, taking account of the influence of other networks.

S2. **Co-ordination of scheduled outages planning.**

S2.1. **Medium-term planning.** At least once a year, at the end of the preceding year (but not later than at the very beginning of the forthcoming year), the TSOs of neighbouring regions will meet to agree a joint schedule of outages on international lines for which they are responsible. This schedule will take account of overhaul programs for major generating facilities in the vicinity of frontiers, together with the unavailability of lines in these areas.

S2.2. **Short-term planning.** If necessary, this schedule has to be reviewed in the course of the year and any amendments will be notified to each TSO in the region concerned.

S3. **Confirmation of planned outages.** Each TSO will confirm on a weekly basis (and daily when relevant in case of changes) the outages of important power plants (where necessary) and TRANSMISSION lines to neighbouring TSOs involved. The set of these system elements that may affect interconnection, has to be previously agreed among the TSOs involved.

Procedures

P1. **Division in regions.** For the purpose of outage co-ordination, the SYNCHRONOUS AREA may be divided into a number of large regions.

Bibliography :

[see also: ETSO paper: Co-ordinated Auctioning; a market based method for TRANSMISSION capacity allocation in meshed networks, final report April 2001]

[see also: ETSO paper: Definition of Transfer Capacities in liberalized electricity markets, final report April 2001]

re-establish normal operating conditions, HR I-1990]

[see: UCPTE-Recommendation: Co-ordination of work on lines of importance in the interconnected network, AR 1980-1981]

F. Information Exchanges between TSOs for Operation

Introduction

Co-ordination and information exchange mechanisms are put in place by TRANSMISSION system operators to ensure the security of the networks in normal and contingency conditions and in the context of congestion management.

TSOs are continuously in contact for reasons of security of power network operation, for planning and related data (e.g. NTC) needed by the network users. The monitoring of load flows and the control of power balance for the whole system are carried out in regional and interregional load dispatching centres. Data transfer and data processing systems ensure that these centres are continuously supplied with up-to the minute information on the operating condition of the power stations and of the switching status in the TRANSMISSION network, as well as on the condition of transformer and compensation equipment. Moreover, the current values of active and REACTIVE POWER and the VOLTAGE on TRANSMISSION lines and transformers are continuously known. SCADA systems allow to display such requested information to operators of these dispatching centres whatever the operating conditions of installations. Back-up systems are always operated in reserve. With respect to telecommunication equipment, the transfer of important information to the dispatching centres and between them is still continuously guaranteed with a sufficient number of routes with back-up. These routes are not only used for providing information about any event occurring on networks but also for giving remote orders for switching directives. The supply in electricity of such dispatching centres is guaranteed.

TSOs manage continuously available communications even during a loss of communication facilities and set-up suitable procedures between each other. These contacts are mainly managed through telecom channels with private or confidential links. TSOs keep data available for possible exchange of information on system planning, system representation for studies and real-time operation, and for cross-border exchanges.

This sub-policy provides a survey of technical aspects of facilities and the main kind of information exchanged through telecom channels for the security of power system operation. It does not enter into details of common datasets to be exchanged in accordance with confidentiality issues.

Criteria

C1. **Responsibility.** TSOs are responsible for maintaining continuously available communication with their neighbouring TSOs.

C2. **System data availability.** Each TSO shall always have at its disposal reliable power system data for operational planning and real-time operation.

Requirements

R1. **Prevention of a loss of telecommunications.** TSOs are due to be continuously in an on-line liaison with each other whatever CONTINGENCY conditions of telecommunications may occur. Loss of telecommunications links or instrumentation and control links between control centres, operating centres and TRANSMISSION installations must not paralyze the operation of the interconnected network.

R2. **Reliable and secure telecommunications network.** Each TSO shall provide an adequate, reliable, secure, fast and highly available communications infrastructure to assure permanent exchange of information between TSOs.

R3. **Facilities redundancy.** Whenever possible, telecommunication facilities are redundant and diversely routed.

R4. **Back-up facilities.** In order to face any CONTINGENCY in telecommunication facilities and to ensure communication between operators during emergency conditions, any route will be backed-up by other ones. Backup voices/routes for telecommunication facilities including alternate telecommunications channels should be provided to assure co-ordinated control of operations during normal and CONTINGENCY/EMERGENCY SITUATIONS.

R5. **Effective procedures for operation communication**. Procedures for communication between TSOs have to be consistent, efficient and effective during normal and emergency conditions.

R6. **Co-ordination and information exchange mechanisms.** They are put in place by TSOs in order to ensure the security of the networks, also in the context of congestion management.

R7. **Case of general loss of VOLTAGE.** In case of general loss of VOLTAGE, telecommunication systems and remote control systems remain in operation to allow the reconstitution of the network to be completed.

R8. **System data exchange.** TSOs are involved in system planning and study processes in order to make clear the operator's perspectives and TRANSMISSION limits; therefore, TSOs elaborate reliable data of system representation for their networks.

Standards

S1. **General provisions.** Information is provided either by voice, fax, e-mail or by other private or confidential routes.

S2. **Information exchange for power system computation.**

S2.1. TSOs inform each other about the main evolution of their POWER SYSTEM when planning or commissioning a new equipment.

S2.2. TSOs yearly provide to each other a provisional data-set including network, generation, load and exchange programmes for the preparation of a reference case, the so called "**UCTE base case**" which serve to calculate NTC. Two data-sets are provided: One for winter delivered in April/May, one for summer delivered in October/November. These NTC values are published six-months ahead (ETSO web): In December for summer NTC, in July for winter NTC.

S2.3. TSOs yearly provide to each other **data sets** for a full representation of their network in real-time conditions (the so-called "**snapshots**"). Two data-sets are provided: One file for the following winter delivered in July, one file for the following summer delivered in January. Other snapshots can be exchanged when relevant.

S2.4. **Day-Ahead Congestion Forecast.** With a view to completing the most accurate studies and to help appreciating congestions ex-ante, TSOs exchange specific relevant provisional data for the day-ahead congestion forecast.

S2.5. All these data-sets are merged into consistent files, which are used as reference files (UCTE "base case" and a whole snapshot) for further studies and calculations.

S3. **Cross-border transfer capacity**. With respect to borders where capacities are not auctioned, TSOs determine their cross-border transfer capacities six-months ahead, one month ahead, week and day ahead, when appropriate, and publish some of them on their Web-site at different time intervals.

S4. **Outages planning.** Each TSO confirms in advance the planned OUTAGES to other TSOs (see section E).

S5. **Exchange programmes.** The scheduled energy exchanges aggregated per time unit for each relevant specific CONTROL BLOCK are made available to all TSOs. (see P2-A).

S6. **Data on real-time conditions.** Each TSO determines with neighboring TSOs concerned the suitable set of real-time data to be exchanged on-line such as data at boundary sub-stations and at the agreed other stations such as topology, VOLTAGE, LOAD MW and MVAr on tie-lines and at boundary sub-stations.

S7. **Information on new installations to be commissioned.** Each TSO shall inform its neighbouring TSO about planning and commissioning of any new significant installation (power plant, substation) located near the border. This new installation can change the level of short-circuit power to be faced by TRANSMISSION equipment. Verifications or reinforcements of such equipment are carried out accordingly.

Guidelines

G1. **Electronic Highway – EH (exclusively for TSOs)**. Since opening of markets and unbundling of TSOs from other market actors, confidential channels for information exchange have been developed. In addition to the classic telecommunication channels mentioned above, a specific Electronic Highway between TSOs with encoded data [currently data interchanged over EH are not encoded (confidential)] is implemented for any energy information related to network operational security and, to some extent, to relevant market aggregated data:

G1.1. Each TSO will take measures to be connected to EH.

G1.2. A wide use of EH is assured by TSOs.

G1.3. TSOs are responsible for maintaining their channels of EH.

G2. **Data on operational planning.** Wherever necessary, TSOs shall exchange data on a bilateral basis or among one another for planning purposes and studies, concerning for example:

- The results of POWER SYSTEM studies pertinent to operation
- OUTAGE scheduling of TRANSMISSION elements at different time intervals: year ahead and more frequently when appropriate.
- Assumptions of generation patterns for power plants having a main influence on system operation, when appropriate at the boundary
- Aggregated cross-border exchange programmes between CONTROL AREAS and countries
- Cross-border transfer capacities (Net Transfer capacities - NTC, Available Transfer Capacities - ATC and TRANSMISSION reliability Margin – TRM) – (Cf. ETSO web-site)
- Changes in operating conditions and limits.

G3. **Campaign of measurements.** TSOs exchange data in the context of measurement campaigns in the light of security of operation (Cf. Policy 1 for frequency/power response of the system).

G4. **WAMS (Wide Inter-area Measurement System**). TSOs exchange data in case of measurements following phenomena of low-frequency oscillations between UCTE areas.

G5. **Data and procedures for emergency operation.** In order to withstand fast emergency operation, pre-requested procedures and data should be prepared and exchanged between TSOs to improve the knowledge of bordering networks and to limit transits trough INTERCONNECTIONS for security reasons or to face any major CONTINGENCY.

G6. **Language.** TSOs agree on the language used for any communication issue in operation. English is the official common language. All inter-TSO procedures will be written down in English or in another language agreed with neighbouring TSOs.

Bibliography :

[UCPTE 29 : Recommendations on a data transmission network between the control centres of the UCPTE, AR 1980-1981]

[UCPTE 30 : Co-ordination of work on lines of importance in the interconnected network, AR 1980-1981]

[UCPTE 32 : Recommendations relating to the method of « real time » data exchange between computers in control centres, AR 1982-1983 (§ 1, 5, 6)]

[UCPTE 36 : Co-operation in the UCPTE via the interconnected networks, AR 1985-1986 (§ 3, 4)]

[UCTE regarding a method for the co-ordinated exchange of operating experience within the UCTE system (MESU) – 1/12/1999 (§ 5 + annexes)]

[UCPTE 37 : Operation of the UCPTE interconnected network in normal operation and during disruptions, AR 1985-1986 (§ 1, 2)]

[UCPTE 39 : Generating and failure – simulation of effects on the load – flows in the UCPTE interconnected network, QR IV-1986]