POLICY 5

EMERGENCY PROCEDURES

P5 – Policy 5: Emergency Operations [E]

Chapters

A. System Operation in insecure conditions

B. System Restoration after collapse

Introduction

In an extremely complex and highly meshed system, disturbances may be propagated over a vast area within a very short period of time. Whatever precautions, the short-term occurrence of insecure operating conditions can take place at any time due to a cascade of contingencies. Experience has shown that even a simple incident can degenerate very rapidly into a large-scale breakdown. Transmission System Operators (TSOs) will therefore need to apply any measures required to ensure that the consequences of any type of incident will be contained within the frontiers of their respective area of operation as far as possible. However, since electrical phenomena know no frontiers, consultation and co-ordinated actions between neighbouring systems will be required for the establishment of effective measures.

Therefore, it is necessary in the "Emergency Operations" to anticipate any critical situation within a very few hours or a few minutes before the real time operation, preventing system cascading and limiting its consequences. Accordingly TSOs will provide specific alarm and information on how to deal with a partial or total shutdown of the transmission system, and to ensure that the necessary procedures and facilities are in place to support rapid restoration of the collapsed parts and to restore supply to customers. A partial or total shutdown represents one of the most serious failures likely to occur on the interconnected transmission system, having a major effect on both users of the transmission system and on customers. Due to the significance of such incident and the urgency in restoring supply to all customers, it is imperative that all TSOs maintain a high level of communication, of system awareness and of dispatching operators training with respect to power system integrity.

Due to the fact that TSOs cannot ensure the security of operation irrespective of the conditions of operation of power plants and distribution networks, TSOs call for a regular coordination at the level of generation and distribution and for a sufficient performance of equipment connected to their networks with robustness to face disturbances and to help to prevent any large disturbance or to facilitate restoration of the system after the collapse. The operational standards to be established at national level in addition to those of the Operational Handbook of UCTE are mainly related, on the one hand, to the behaviour of generation units with house-load operation capability and black start capabilities and, on the other hand, to the operation of distribution networks, including load-shedding.

History of changes

v.1.0 final policy, approved by the UCTE Steering Committee on 03.05.2006

Current status

This document summarises current UCTE rules and recommendations relating to emergency and system restoration issues in a new structure, with additional items describing today's common practice.

This policy replaces previous UCTE ground rules and recommendations regarding emergency and system restoration issues. This version of the document (version 1.0, level E, dated 03.05.2006) has "final policy" status.

A. System Operation in insecure conditions

Introduction

The security of operation is defined as the capability to assure a normal functioning of the power system, to limit the duration and number of disturbances, to prevent any large disturbance, and to limit the consequences of a large collapse when it occurs. Disturbed operation exists when the system is close to security limits or when the risk is considered to be high. The appreciation of whether the situation is normal or insecure is left to the TSOs.

When the means for margins (case of lack of generation) and predefined remedial actions may not be sufficient for secure operation of the system (e.g. after failure of a network element, an occurrence of new disturbance within the N-1 recovery period or a multiple contingency) the system is considered to be in a insecure conditions: N-1 security, limits of voltage, of current, of frequency and balance reserves can be violated consequently.

Criteria

C1. Affected TSO. TSOs in whose system the disturbance takes effect.

C2. Causes of insecure operation. Serious uncertainties about returning to normal operation are caused by:

- **C2.1.** Flows on network elements and tie-lines beyond security limits (overload situation, e.g. due to unforeseen flows)
- **C2.2.** Lack of (short-term) primary, secondary or other reserve power (reduced generation, e.g. caused by outages of units or by lack of cooling water or by restricted transmission capacities)
- **C2.3.** Lack of reactive power leading to a critical voltage level (low or high).
- **C2.4.** Lack of observability and controllability (e.g. loss of SCADA system, malfunction of load-frequency-control, loss of control system)
- **C2.5.** Indications of instabilities such as voltage drop, frequency drop, undamped power swings or increase of phase angles.

Requirements

R1. Inter-TSO co-ordination.

- **R1.1. Inter-TSO actions.** National regulations for emergency have to be complemented by bilateral/multilateral agreements and procedures between neighbouring TSOs.
- **R1.2. Exchange of information.** The bilateral/multilateral procedures shall allow rapid information exchange about systems' conditions next to the borders: topology, weak points in the network and the potential risks of operation.
- **R1.3. Inter-TSO alarm on system states.** The bilateral/multilateral procedures to inform neighbouring TSOs about the different system states shall be set up among neighbouring TSOs. The details of the common procedures are left to subsidiarity. Neighbouring TSOs shall exchange information on their system state including risk of operation to alarm each other when operational conditions are critical. Rules and procedures for alarming must be part of training for operators.
- **R1.4. Cross-border actions.** Cross-border actions have to be evaluated, agreed and prepared on a bilateral or multilateral basis, where necessary. These

actions start upon receipt of an alarm notification. They should be agreed by means of inter-TSO agreements (see A-P2).

R1.5. Communication. A list of contact persons to be contacted at any time with phone numbers, fax numbers and e-mail addresses shall be provided by all TSOs and regularly up-dated. All critical information about real-time operation shall be sent to these TSOs counterparts. The provided lists have to be verified at regular intervals. Direct telephone lines shall be installed between neighbouring TSOs.

R2. Emergency procedures. Each TSO shall implement successive organisational and preventive measures in the limit of its available means to cope with the most serious phenomena such as cascading overloads, voltage collapse, serious frequency drops, loss of synchronism.

R3. TSOs' human resources for operation. Each TSO has to ensure that sufficient resources of personnel are available in control rooms and for operation in normal and disturbed situations.

R4. Dispatching Operators' training. Training concerning congestions, disturbances, remedial actions and network restoration has to be performed on a regular basis.

R5. Security requirements.

R5.1. Security analysis. Security analysis (based on DACF or real-time state estimations in control rooms) must be performed regularly, including, if appropriate, real-time calculations.

R5.2. Functional back-up of control room. A back-up function of the dispatching control room to back any damage to the main installations shall be assured and periodically tested for operation.

R5.3. SCADA system requirements. SCADA systems have to provide a complete overview for the power system and relevant parts of surrounding areas. The system must be of redundant design with a back-up system in a remote location.

R6. Real-time data of power system. Each TSO has to make available real-time data of relevant parts of the systems to other neighbouring TSOs.

R7. Exchange of information of settings of automatics. Neighbouring TSOs have to exchange information about the type and agree on the settings of the devices for automatic tripping of tie-lines.

Standards

S1. Information by affected TSO. The affected TSO has to inform other neighbouring TSOs about the state of its system and associated risks in order to achieve appropriate common actions. The affected TSO can request help from neighbours.

S2. Timely and appropriate actions.

S2.1. In case a TSO identifies a contingency endangering the security of the interconnected operation, this TSO adopts urgently all internal measures for autonomous congestion relieving. If the security violation is still ongoing, the TSO proceeds to arrange, if possible and in co-operation with the neighbouring TSOs, coordinated congestion management measures to relieve the detected security violation. The remedial actions can cause limitations and restrictions upon normal market conditions (including power exchanges reduction).

S2.2. In case the remedial actions are expected to have an impact on neighbouring systems, the TSOs concerned shall be notified prior to action, if possible.

S2.3. Each TSO shall develop with neighbouring TSOs the requisite procedures and/or agreements to prepare in advance the most appropriate set of cross-border remedial actions available. These procedures take into consideration the possible changes of topology (bus-bar configuration, tap changers of phase shifters), the possibilities of cross-border redispatching and emergency reserves of generation abroad.

S3. Maintaining the interconnection of systems.

S3.1. TSOs shall make any effort to remain connected to the synchronous area. In case a TSO considers that its system can be endangered, under special operational conditions, if it remains interconnected, it may implement remedial action necessary to protect its own system.

S3.2. Role of neighbouring TSOs in preventing any spreading of collapse. In case the TSO is in trouble and is not anymore capable to face the critical situation which could have a tendency to collapse at very short notice, the neighbouring TSOs shall render maximal assistance to support the affected TSO and, with respect to the security of their systems, to limit the propagation of disturbance, in accordance with agreed common procedures and agreements. TSOs have to co-ordinate actions with the affected TSO.

S3.3. Tie-lines opening policy. Opening a tie-line has to be assessed and agreed upon in advance in a transparent way; automatic opening may be performed when given events occur and if certain thresholds are exceeded (e.g. overload damage of the equipment); this should contribute to the speed up of a restoration sequence. TSOs have to agree on points of manual and automatic disconnection in case of frequency drop, overloading, loss of synchronism. Urgent opening can be carried out in emergency situations in case of physical danger to human beings or installations without prior information to neighbouring TSOs involved. To keep the interconnection in operation as long as possible is of utmost importance, but shall be consistent with the operating constraints. Therefore any manual emergency opening of tie-lines shall be, by preference, announced in advance or justified ex-post with neighbouring TSOs.

S4. Limiting the risk and propagation of the disturbance. Common emergency procedures have to be created and agreed by neighbouring TSOs. For the most probable disturbed situations, remedial actions to bring the system back to the security limits have to be jointly co-ordinated, prepared, agreed and trained both at inter-TSO and at national level.

S5. Management of low frequency. In order to prevent a collapse of the whole interconnected system, load shedding has to be started automatically (see ⏩P1-A-C2.4). These load sheds intend to maintain a sufficient amount of generation before the generation units have reached their thresholds of tripping.

S6. Management of high frequency. In case the system frequency is higher than 50.2 Hz, TSOs shall take actions to reduce the frequency through starting pumped-storage power plants or decreasing the level of generation of active power proportionally to the K factor of the grid.

Procedures

P1. A system disturbance report is submitted if one or more of the following events has occurred:

P1.1. Uncontrolled loss of 3000 MW or more of firm system loads

P1.2. Load shedding of 3000 MW or more implemented under emergency operational policy

P1.3. Actual or suspected physical attacks that could have an impact on the electric power system reliability which target components of any security systems

P1.4. Actual or suspected cyber or communications attacks or disturbances that could have an impact on the electric power system's reliability

P1.5. Loss of electric service to several 100.000 customers for 1 hour or more

P1.6. Loss of a significant portion of the system

P1.7. Complete operational failure (blackout) of the electric transmission and/or distribution system

P1.8. The loss of interconnecting tie lines that significantly affects the integrity of the interconnected system

P1.9. System separation or system islanding

P1.10. Loss of generation exceeding 3000 MW

P2. **Emergency procedures among TSOs.** Bilateral or multilateral procedures between TSOs shall be implemented to improve information exchange and co-ordination in the management of critical or incidental circumstances. Such procedures can imply the following elements:

P2.1. A directory per country identifying each operational actor and pointing out the fields of intervention (operational planning team, real-time team, etc.). These lists with telephone and fax numbers, and mail addresses allows operators a quick communication. Each TSO keeps its directory up-to-date, and distributes such a document at regular intervals (once or twice a year) or after significant changes.

P2.2. A common operational diagram should display a simplified state of the network mainly next to boundaries: topology of each station (number of electrical nodes at least), generation (type, location and maximum output). Any critical alteration of the network (loss of an element) should be reported on this diagram, updated in real time and forwarded to neighbouring TSOs involved. The knowledge of neighbouring operational situations facilitates a better understanding of each partner's potential difficulties so that the affected TSO can be supported through remedial actions available abroad.

P2.3. Alarm system between TSOs to warn about different system states.

P2.4. A set of real-time data on physical exchanges at the borders to ease the visualisation of physical flows (active and reactive power) next to and at borders of each control area or of countries in order to anticipate the identification of potential network constraints.

P2.5. A standard information (e.g. by fax or e-mail) about constraints located close to borders; the procedures should describe the type of information to be exchanged and the preferred methods to solve the constraints (topology change, generation redirection).

P2.6. Remedial actions. Evaluation and agreement on implementation of the following possible inter-TSO and national actions:

P2.6.1. Topology changes.

P2.6.2. Use of phase shifting transformers.

P2.6.3. Contracted generation re-dispatch within the TSO's own control area.

P2.6.4. Generation re-dispatch involving neighbouring control areas.

P2.6.5. Requesting maximum or minimum values of generation for active and reactive power (P and Q).

P2.6.6. Changes of voltage at distribution level.

P2.6.7. Cancellation of maintenance, grid elements returning operational.

P2.6.8. Blocking of OLTC (On Load Tap Changers of transformers).

P2.6.9. Manual load shedding of interruptible customers.

P2.6.10. Shedding of storage pumps.

P2.6.11. Switching on additional capacitors or shunt reactors.

P2.6.12. Activation of power reserves abroad.

P2.6.13. Activation of emergency power reserves.

P2.6.14. Preventive or curative manual or automatic load shedding.

P2.6.15. Deliberate tripping of tie-lines.

P2.6.16. Generator shedding.

Guidelines

G1. Analysis of system states. Two levels of seriousness are under consideration in disturbed operation for inter-TSO alarm. A third level is related to Blackout, when some parts of the system are out of voltage.

G1.1. In an **ALERT**, the power system is stable and all operational reserves (for transmission and generation balance) have to be mobilised. It is not clear if (or in which time frame) it will be possible to fully return to security limits (it depends on the gravity of the alert and the possible risk of cascading events). The system is viable and operated within the acceptable operating constraints; however, in this case the system parameters are very close (still within or just beyond) to the security limits. The system operators have serious uncertainties to return to a normal state due to existing network or load/generation margin constraints, and the situation is potentially dangerous.

G1.2. In an **EMERGENCY** system state the system is not stable and its "natural" evolution (phenomena such as tripping in cascade, frequency drop, loss of synchronism, power cuts, islanding may occur) tends to bring it to an insecure and uncontrollable situation. Global security of the whole interconnected power system is endangered. Exceptional actions such as load shedding may be necessary to limit the spreading of the dangerous phenomena and prevent the collapse of part or of the whole power system. In this state, the system goes rapidly towards highly endangering conditions of operation with system parameters out of the limits fixed for operational security (see Policy 3 "Operational Security").

G2. **Cross-border emergency help.** TSOs can import emergency power in accordance with existing agreements. A curtailment of cross-border exchanges is implemented according to the agreements with TSOs involved.

G3. **Load shedding to manage load**. A TSO can apply a preventive load shedding in some parts of its power systems in order to limit the risk of tripping cascading.

G4. **Analysis of contingencies.** Analysis of any contingency of the power system including undamped power swings and oscillation instability should be carried out systematically by TSOs to identify the causes of incidents, incurred risks and potential consequences, and to tackle any improvement of operational rules.

G5. **Preliminary set of emergency actions.** A preliminary set of emergency actions should be defined to accelerate their implementation. These actions are started by predefined orders sent through special communication channels by the control centre operators to the relevant parties. These emergency actions can include:

G5.1. The offer-demand balance (changing the generation programs of power plants, connection of fast start-up generating units, rapid increase of load of generating units (by activating all reserve capacity),

G5.2. The rapid (manual or by remote control) load shedding of customers,

G5.3. The voltage levels (preliminary alert to low voltage, reactive over-excitation of generators, blockage in load of transformers' tap changers, where possible and/or reduction of the voltage controller set-point values).

G6. **Secondary set of emergency actions.** A secondary set of curative actions shall be automatically implemented in addition to manual actions if the operational conditions continue to be exceeded with a spreading risk of disturbance. These automatic dispositions can include:

G6.1. The automatic load shedding of consumption due to the large drop of frequency, from and below 49 Hz with disconnection of 10% up to 20% in steps of consumption for any progressive stages e.g. of 0.3–0.5 Hz frequency drop,

G6.2. The automatic disconnection of sections of installations and possibly of areas having lost synchronism,

G6.3. Co-ordination of generation tripping in case of high frequency.

G7. **Loss of synchronism.** In case of a loss of synchronism between generating units, the latter should be islanded upon their own auxiliaries or some parts of the network should be separated. Such islanding is implemented to accelerate the restoration of the network after a collapse.

G8. **Security analysis.** Complementary methods (static and dynamic stability calculations, Wide Area Measurement Systems) are recommended.

G9. **Other joint operational measures,** TSOs should perform regularly, if possible once a year:

G9.1. A bilateral review of joint restoration plan principles.

G9.2. A bilateral check in protection systems.

G10. **Leadership for operation in case of cross-border collapse.** A leadership for operation in case of cross-border collapse can be based on bilateral or multilateral procedures depending on the appreciation and on the complex evolution of the power system. It contributes to set-up the most convenient urgent remedial actions, for which the affected TSO contributes for co-ordination .

G11. Common investigation of incidents. After any significant incident, TSOs should carry out common investigations to analyse the reasons of incidents and to improve the existing rules, if relevant.

G12. Dispatching operators training. Exchange of training methods and cross-visits of control centre personnel to help to identify critical situations, as well as joint training programs for dispatchers are recommended.

G13. System disturbance report. A system disturbance report should be sent within 24 hours by the affected TSO to the UCTE Bureau and be made available on the UCTE extranet after a critical event has occurred (see P1).

G14. Performance of generation units. In case of major voltage and/or frequency fluctuations, the power stations or units shall remain connected to the system as long as possible; i.e. only in case of network failure, units shall be disconnected from the network and tripped on their auxiliary supplies (house-load operation).

Each TSO shall provide minimum requirements for generation units (also for dispersed generation) to remain operational, especially:

G14.1. within certain ranges of voltage

G14.2. within certain ranges of frequency

G14.3. during disturbances such as nearby short circuits

G14.4. during a pre-defined time only on house-load operation

G15. Back-up supply sources. In the transmission installations (transformer substations, switching substations, dispatching centres) the supply of the main auxiliaries should be guaranteed for a sufficient time scale with internal independent power supply sources to enable remote control, telecommunication and computer installations to be operable also in case of failure of the surrounding power systems.

B. System restoration after collapse

Introduction

A set of actions, the “re-setting of the network”, is implemented after a large-scale collapse when the network can be constituted with islanded areas or with an area in voltage collapse. Re-setting of the network consists of a very complex series of coordinated actions, studied and prepared in advance. In this situation, each control centre will check the quality of islanding of power plants making sure that their auxiliaries continue to be supplied externally by the network or are due to be urgently recovered, in order to allow more rapid resumption of generation by these plants as soon as network conditions allow them to do so. If not, dispositions will be taken to send a source of voltage towards these power stations thanks to “black start capabilities” of certain units. The action of re-feeding auxiliaries of generating units with network voltage can be prepared through a scenario that has proven to be robust. The control centres will then gradually be able to reconstitute safe areas to be re-connected.

Criteria

C1. **Blackout.** Blackout means that significant parts of the electrical grid are out of voltage, with total or partial disruption of consumption supply.

Requirements

R1. **Role of TSOs.**

R1.1. **Design and implementation of measures.** Each TSO is in charge of a consistent design and a correct implementation of measures which are in its own responsibility aiming at system restoration, ex-ante documented by periodical tests.

R1.2. **TSO internal remedial actions and neighbouring assistance.** Restoration has to be carried out by the affected TSO with its own available means and procedures for implementing remedial actions. Interconnection is used in a coordinated way with neighbouring TSOs that can provide support through active and reactive power.

R2. **Coordination and communication for grid interoperability and co-operation with generators in critical circumstances.**

R2.1. **Preparation of actions.** Neighbouring TSOs have to prepare and agree in advance the common actions to be taken in case of system restoration.

R2.2. **Coordination.** TSOs have to co-ordinate the restoration action especially in case when a blackout affects neighbouring grids.

R2.3. **Information exchange.** TSOs have to exchange information to identify isolated areas and networks out of voltage.

R2.4. **System requirements to re-energize.** Each TSO has to develop proper re-energization procedures allowing the progressive restoration of normal operating conditions of the system in the shortest possible timeframe.

R2.5. **Black start capabilities.** Within each control area a sufficient number of power plants able to start up from shutdown and to energize a part of the system, without an external electric power supply has to be foreseen.

R2.6. House load operation of units. Within each control area a sufficient number of power plants able to continue to supply their in-house loads after disconnection from the grid has to be foreseen.

R2.7. Priority to re-energize. After a blackout, the loads which, if unavailable, could compromise the continuation of the successive switching sequences (thermal power plants separated from the network but not secured, remote control centres, telecommunication centres, etc.) should be supplied in the first place.

R2.8. Reliability of control systems. TSOs have to assure, during the restoration, full functionality and reliability of:

R2.8.1. SCADA system,

R2.8.2. Remote control system,

R2.8.3. Communication system for dispatching centers,

R3. Dispatching operators training. Operators have to be trained to simulate different operational scenarios in emergency situations and to correctly implement emergency procedures. These are the most important conditions for carrying out a successful restoration plan.

Standards

S1. Inter-TSO communication. The affected TSO communicate the blackout state to other neighbouring TSOs.

S2. Knowledge of the power system state after a blackout. TSOs have to know as quick as possible the state of any component of their power system after a blackout: power plants in correct house-load operation and ready to re-energize, power plants having difficulty in supplying their house load, and thus in urgent need for an external source of voltage, black start capabilities and the state of the network.

S3. Secure operation by the affected TSO. During the restoration phase, an affected TSO has to manage flows and voltage on interconnection lines within agreed limits and co-ordinate actions with neighbouring TSOs.

S4. Tie-lines' load limits. In case the restoration is started with the help of neighbouring networks (which remained energized), involved TSOs shall make available all necessary resources and avoid congesting their involved border grid in order to make proper network margins available to supply the affected TSO.

Procedures

P1. Procedures to re-energize. For setting up re-energization procedures, the following aspects should be taken into account:

P1.1. Saving the integrity of the network elements and, more generally, of the whole power system;

P1.2. Restoring generating units able to re-energize the system;

P1.3. Supplying priority sites.

P2. Generating units and load supply. In the process of re-energizing the network, the thermal power plants previously supplying their in-house load should gradually increase their production, and proper block loads should be progressively connected.

P3. Prefixed switching sequences. Restoration procedures may envisage that pre-fixed switching sequences for restoration are carried out under certain conditions. This allows to save time and reduce errors in performing switching sequences as well as to face potential communication problems. Pre-fixed switching sequences may be used for preparing:

P3.1. Restoration paths;

P3.2. Suitable arrangements on the generation units;

P3.3. Block loads of appropriate size.

Guidelines

G1. Predetermined plans for separation of networks. In case of a large-scale collapse, pre-determined plans on the separation of networks, e.g. after a loss of synchronism, should be implemented with related protection devices.

G2. Restoration sequence. Each TSO should be able to restore its system internally. In case of a large disruption involving several TSOs, each TSO is entitled to give priority to restore its system prior to re-establish the interconnections. This does not exclude bilateral agreements for earlier mutual support including the issue of tie-lines.

G3. Guidelines for a restoration plan.

G3.1. Need for a restoration plan. The restoration plan should describe all the actions necessary to restore normal conditions of supply in a timely and reliable manner.

Thermal capacities of the links and controlling voltages should be maintained at an acceptable level during the process of restoration from energized parts of the grid.

During restoration, automatic equipment might be adopted to execute predetermined switching sequences.

G3.2. Base-cases for setting up a restoration plan. TSOs should define system scenarios in a restoration plan. To this end, a proper criterion is to select situations with highest probability of occurrence and with general validity. Restoration plans are based on the identification of proper re-energization paths. Re-energization paths connect black-start generating units to:

- the in-house loads of other generating units, important for size or location,
- to block loads (to mitigate over-voltage problems).

In particular, the re-energization path should be pre-set:

- to provide each network area with a restoration facility;
- to supply strategic load.

Redundant re-energization paths should be prepared for the most important facilities (nuclear power plants, large thermoelectric plants, etc).

G3.3. Restoration plan application. After a blackout, a quick system operation analysis should be possible for operators to arrive at a hypothesis about the contingency sequences that produced the blackout, identifying as a first step the presence of network elements in fault. As a result, it should be possible to establish the right order to start the proper re-energization paths.

G3.4. Re-energization paths. Re-energization paths should be established ex-ante for the progressive restoration of the interconnected network.

G3.5. Restoration path tests. The reliability of restoration paths should be periodically studied and practically tested by means of restoration tests, if possible. Tests should refer in particular to:

G3.5.1. Black-start capability;

G3.5.2. Load rejection efficiency (thermal plants);

G3.5.3. Times required for predisposing the restoration paths;

G3.5.4. Efficiency check of involved protection and automatic devices.

Success of the partial tests is a necessary condition to plan and carry out a complete restoration path check.

During restoration tests, attention has to be paid to all units involved in order to identify all factors that could obstruct a correct implementation of the procedures.

G3.6. Organization of restoration plans. With reference to the restoration plan, the system operator is responsible for:

G3.6.1. the coherent drawing up

G3.6.2. the coordination of test schedules

G3.6.3. the straightforward application

TSO shall provide and check technical requirements for interfaces with generators and distributors.

G4. Re-energizing a network backbone. TSOs should implement restoration procedures to re-create as soon as possible an energized network backbone, to which load and generation should be reconnected step by step.

G5. Tests to re-energize power plants. Regular tests should be organised to re-energize the main units in order that they contribute to reliable procedures for restoration. These tests help to verify that the scenarios for re-energizing such power plants (power plants used as a voltage source, lines and the associated topology) are convenient and applicable.

G6. Dispatching operators training. The use of an operators training simulator is recommended and indicated in order to verify the operators' ability in responding to emergencies and unusual scenarios which rarely occur in practise on the electric system. In this way, it is possible to verify the ability of operators to promptly and efficiently react to critical situations and to improve the application of emergency procedures.

Such training actions should be directed, in different and appropriate ways, to all operators involved in the application of the restoration plan, in particular TSOs' operating staff responsible for electric system control and operators responsible for operations in the production, transmission and distribution plants.

G7. Inter-TSO preparation of critical situations. TSOs should hold periodical meetings with other interested operational units in order to illustrate the application of the restoration plans and to study more accurately the problems concerned.

G8. TSO public communication. Due to the economic and social effects of a black-out, it is necessary to establish an internal and external communication plan. TSOs should communicate to the main stakeholders involved to inform them about the operational situation of the system. Further communication requirements should be granted by appropriate organizations, in order to avoid interference with the operational activities of the control centres.