UCTE

Annual Report 2003

union for the co-ordination of transmission of electricity

A visit to UCTE in 2003

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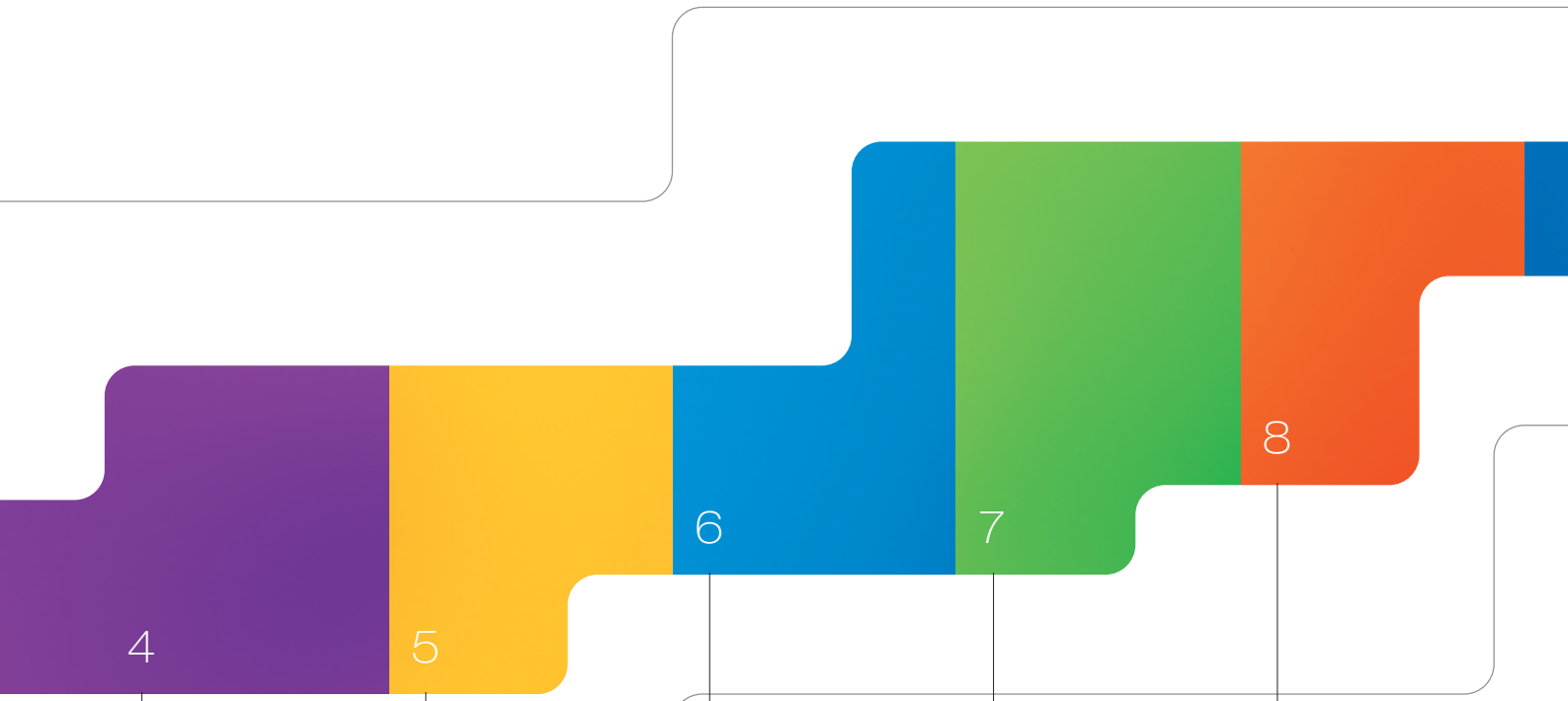

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SECURITY OF SUPPLY IN THE LIMELIGHT

» The Association had to cope with extraordinary

The electricity network has become a focal point of interest: After an exceptionally hot summer with electricity shortages in some European regions, and after blackouts in the USA and in Europe, the security of supply issue has come to largely dominate the discussion in terms of energy policy. Transmission system operators' functions and activities have never before been a matter of such considerable interest to politics and public. Basically, the point in question is to what extent transmission system operators are responsible for the security of supply within the scope of synchronous interconnection. As UCTE we have played an important part in this discussion, and we will continue to do so in future. After all, it is imperative to ensure that the two most important requirements for the security of supply, i. e.

1. adequate coverage of electricity demand,
2. high-performance network assets

are satisfied, and to be thus prepared to answer relevant questions and take part in the discussion.

This shows that the security of supply cannot be ensured by the network alone. It is rather based upon each of the aforementioned pillars. Each of them must make its contribution, function independently and be self-supporting.

However, due to its crucial importance, the network can provide relevant information to the market, just like UCTE has done for instance in its *Adequacy Forecast*.

Within the scope of the security of supply issue, the Association had to cope with extraordinary challenges during the past year. After the blackout in Italy in September 2003, the UCTE was faced with the extremely difficult task to analyze the reasons, and to provide information on how to prevent similar occurrences in future. All parties involved undertook great efforts to cope with this challenge; their timely and substantial analysis was highly appreciated, and large tribute was paid for this to the Association as a whole. The work on recommendations for the future has not been finalized yet. >>>

Martin Fuchs,
President of UCTE

challenges during the past year.«

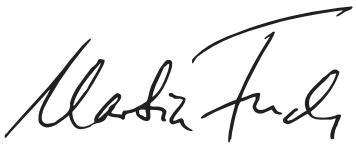
>>> All stakeholders also expected a great deal of the activities regarding the *Operation Handbook*. Especially the market-relevant elements of our regulation inventory are in the focus of interest. In this context, we have come to realize that it is indispensable to make the *Operation Handbook* legally binding, thus providing a central basis for the well-functioning co-operation of all transmission system operators in the UCTE.

In May 2003, the UCTE family enlarged by two new members: after years of preparations and after upgrading their systems to UCTE standards, Bulgarian and Romanian companies *NEK* and *Transelectrica* joint UCTE as full members.

This achievement consolidated the UCTE organisation and enabled progress in the discussion about the extension of synchronous interconnection has also made progress. The European Commission and in particular the Russian government having underlined their interest in such a co-operation, IPS/UPS and UCTE developed common ideas on the investigation of this enormous project. The discussion about the security of supply will continue to play an important role in planning of this project. We have always pointed out that we will never enter into experiments that may jeopardize network security.

The aforementioned examples of our fields of activity also outline future prospects. This makes us note that the UCTE has become an esteemed interlocutor in the discussion about essential framework conditions and development prospects in the electricity market. This entails obligations and new challenges which we will take up true to our maxim »quality first«.

Let me finally extend my thanks to the experienced experts from among the transmission system operators. Without their valuable work, UCTE would not have been able to accomplish its work in 2003 so successfully.



Martin Fuchs

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SYSTEM SECURITY IN THE LIGHT OF SYSTEM FAILURES IN 2003

Final Report of the Investigation Committee on the 28 September 2003 blackout in Italy

In the immediate aftermath of the 28 September 2003 blackout in Italy, Transmission System Operators' (TSO) executives of the five involved countries (Austria, France, Italy, Slovenia and Switzerland) met within the framework of UCTE and decided to set up an independent UCTE Investigation Committee that was given the mission to bring a transparent and complete explanation of the blackout to the national and European Authorities and to the general community.

It was agreed that all required data would be provided by the operators of the five countries to the Committee and that they should operate in full transparency. The Committee, with the full cooperation of these operators, comprised, apart from representatives of the involved countries, experts from Belgium, Germany, the Netherlands and Spain.

After giving the factual description of the sequence of events (chapter 1), the report brings the technical analysis of the main phases in the blackout: the disconnection of Italy, the dynamics of the isolated Italian system during the two and a half minutes of its island operation before the blackout, the restoration of the Italian system and the behavior of the UCTE system after the sudden split of the synchronous area, causing the loss of its exports to the Italian control area (chapters 2 and 4). The Committee's findings on the root causes of the incident are listed and discussed in chapter 3. Chapter 5 deals with the short-term measures taken after the blackout and the report concludes with chapter 6, which lists and comments recommendations and conclusions. <<<

1) Context

It must be emphasised that the original function of the interconnected systems is to form a backbone for the security of supply. To this aim the system has been developed in the past 50 years with a view to assure mutual assistance between national subsystems. This includes common use of reserve capacities and, to some extent, optimising the use of energy resources by allowing exchanges between these systems. Today's market development with its high level of cross-border exchanges was out of the scope of the original system design. It has led the TSOs to operate the system closer and closer to its limits as allowed by the security criteria, which in essence have remained unchanged over this period of time.

Nevertheless, in the last few years, the transmission system operators have steadily improved the capability of the existing infrastructure. Cross border exchanges have been increased by employing several measures, i. e. computerised control and data acquisition, phase-shifting transformers, coordination mechanisms and electronic data exchange between operators.

The blackout must be seen in this general context. <<<

2) Sequence of events and analysis

The sequence of events was triggered by a trip of the Swiss 380 kV line Mettlen – Lavorgo (also called the »Lukmanier« line) at 03:01 caused by tree flashover. Several attempts to automatically re-close the line were unsuccessful. A manual attempt at 03:08 also failed.

Meanwhile, other lines had taken over the load of the tripped line, as is always the case in similar situations. Due to its proximity, the other Swiss 380 kV line Sils – Soazza (also called the »San Bernardino« line) was overloaded. This overload was acceptable in such emergency circumstances, according to operational standards, only for a short period. The allowable time period for this overload was approximately 15 minutes, according to calculations by the experts.

At 03:11, a phone conversation took place between the Swiss coordination centre of ETRANS in Laufenburg and the GRTN control centre in Rome; the Italian transmission system operator. The purpose of the call was to request from GRTN countermeasures within the Italian system, in order to help relieve the overloads in Switzerland and return the system to a secure state. In essence, the request was to reduce Italian imports by 300 MW, because Italy imported at this time up to 300 MW more than the agreed schedule, which amounted to 6,400 MW on the northern border.

The reduction of the Italian import by about 300 MW was, in effect 10 minutes after the phone call at 03:21 and returned Italy close to the agreed schedule.

This import reduction, together with some internal countermeasures taken within the Swiss system, was insufficient to relieve the overloads. At 03:25, the line Sils – Soazza also tripped after a tree flashover. This flashover was probably caused by the sag in the line, due to overheating of the conductors.

Having lost two important lines, the then created overloads on the remaining lines in the area became intolerable. By an almost simultaneous and automatic trip of the remaining interconnectors towards Italy, the Italian system was isolated from the European network about 12 seconds after the loss of the line Sils – Soazza. During these 12 seconds of very high overloads, instability phenomena had started in the affected area of the system. The result was an unsatisfactory low voltage level in northern Italy and consequently, the trip of several generation plants in Italy.

After separation from the European network, the fast frequency drop in Italy was temporarily stopped at approximately 49 Hz, by the primary frequency control and the automatic shedding of the pumped storage power plants and part of the load. Subsequently, additional generating units tripped for various reasons: turbine tripping, underfrequency relay operation, high temperature of exhaust gases, loss of excitation, etc. Despite additional load shedding, the frequency continued to decrease and the system collapsed 2 minutes and 30 seconds after the separation of the country, when the frequency reached the threshold of 47.5 Hz.

The analysis of the UCTE system outside Italy after the splitting of the network shows that the primary frequency control performed well, limiting the positive frequency deviation. The early trip of some generation units by overfrequency has been observed. These units were either large centralised plants or smaller decentralised units embedded in the distribution system. Some generation units switched their control mode from load frequency or load control to frequency control. Generally speaking for the UCTE area, there were differences between the control areas in the way the frequency/power control reacted. The event was also observed in the second UCTE synchronous zone, due to the tripping of the HVDC link Greece – Italy.

In Italy, the restoration process started immediately after the blackout. Nearly all of the northern part of Italy was energised before 08:00, the central part around 12:00 and the remaining parts of mainland Italy at 17:00. Sicily was fully energised at 21:40. Although some difficulties were encountered, the restoration process was successfully performed. <<<

3) Security and reliability standards – security of the system

The operation of the European interconnected electricity system is subject to security and reliability standards set within the framework of the UCTE cooperation. A main principle underlying these standards is that the system must be operated in such a way that any single incident, for example the loss of a line, should not jeopardize the security of the interconnected operation. This is called the N-1 rule, implying two steps:

– First, by applying corrective measures following an incident, it must be ensured that the stable operation of the interconnected network is not jeopardized;

– Second, as soon as possible after ensuring stable operation, complementary measures must be taken if necessary to return the system to the N-1 security state;

It implies that countermeasures must be identified and prepared at each moment and for each single incident, enabling the system to be brought back to a secure state when an incident occurs.

The Committee examined the state of the system just before the occurrence of the first event and the countermeasures that had been identified and prepared to tackle the loss of the Mettlen–Lavorgo line. The Committee's finding in this respect is that the system was complying with the N-1 rule at this time, ETRANS taking into account countermeasures available outside Switzerland.

In this specific case, the appropriate countermeasure for the loss of the line was the shutting down of the pumps in the pump storage plants located close to the connection points of the Swiss tie-lines to Italy and therefore have a high influence on their loading. The pumping load in Italy amounted to about 3,500 MW.

Shutting down the pumps in mutual support, when requested under emergency conditions by ETRANS, is operational practice, although there is no official procedure or special agreement between ETRANS and GRTN on this course of action.

After a double incident that occurred with the same two Swiss lines in September 2000, a trilateral procedure was established between France, Switzerland and Italy. This procedure involved the mutual transmission of information by fax in case of an emergency on the critical lines between the 3 countries. However, the ETRANS operator did not execute it before the blackout happened, since no fax was sent and no phone call was made to RTE within this time window.

Concerning the security state of the Italian system, it was assessed that the countermeasures were available for facing the loss of the interconnections on the Northern borders, by combined measures such as primary reserve, load shedding and stopping of pumping storage plants. <<<

4) Main reasons for the blackout

1. *Unsuccessful re-closing of the Lukmanier (Mettlen – Lavorgo) line because of a phase angle difference that was too high*

   Due to the high loads on the remaining lines, an automatic device, aiming at protecting the equipment, blocked according to its design settings, the possibility of restoring the line back into service.

2. *Lacking a sense of urgency regarding the San Bernardino (Sils – Soazza) line overload and call for inadequate countermeasures in Italy*

   The operators were unaware of the fact that the overload on Sils–Soazza was only allowable for about 15 minutes. A single phone call by ETRANS took place 10 minutes after the trip of the first line. ETRANS asked for the imports to be decreased by 300 MW. This measure was completed by GRTN within 10 more minutes. Despite the joint effort with the Swiss internal countermeasures, it was insufficient to relieve the overloads.

3. *Angle instability and voltage collapse in Italy*

   As explained in the sequence of events, this was one of the main reasons why the Italian system collapsed after its separation from the UCTE system. It was not the original cause of the event.

4. *Right-of-way maintenance practices*

   Tree cutting, to maintain safe clearances regarding flashover, is subject to national regulation. Therefore, the Committee did not examine these practices.

   The Swiss Federal Inspectorate for Heavy Current Installations conducted an investigation into the line maintenance practices before the incident. Their findings are that the line inspections and line maintenance practices of the two affected transmission system operators ATEL Netz AG and EGL Grid AG were both in full compliance with the Swiss regulation in this area.

   Nevertheless, this Swiss Authority decided to review the procedures for maintenance practices and documentation of the conducted inspections. With regard to the increased load flow on specific lines, the assumptions for sag calculation are also subject to evaluation by the authorities. <<<

5) Short-term measures taken after the blackout

In the aftermath of the incident, measures were taken in all the involved countries.

The Net Transfer Capacity (NTC) towards Italy has been significantly reduced during off-peak hours and slightly during day hours. This was based on more conservative assumptions and taking into account a larger set of contingencies.

A Memorandum of Understanding was signed between ETRANS and GRTN to improve the management of the interconnection. The work between ETRANS and GRTN started immediately and major parts of it are already completed. Similar action has been agreed with the other neighbouring countries.

At ETRANS, one operator was on shift during the blackout. The Swiss representative declared ETRANS being in the process of recruiting additional operators in order to have two operators in shift by mid-2004.

The phase angle calculation has been incorporated in the ETRANS contingency analysis. Additional real-time exchange of information between ETRANS and GRTN is being implemented. This real-time exchange covers the areas with mutual influence between Switzerland and Italy and is part of the respective state estimator perimeters. More particularly, the representation of the status of the Sils – Soazza and the Mettlen – Lavorgo lines will be improved.

Cross-training of Swiss and Italian dispatchers has been organised.

Some measurement and protection equipment has been adapted or upgraded: special protection schemes to initiate load shedding and installation of Phase Measurement Units (PMU).

The Investigation Committee welcomes these measures and encourages ETRANS and GRTN to expedite their further implementation. <<<

6) Recommendations and Conclusions

Features of the blackout

In view of the recommendations for further work, the following features of the blackout are mentioned:

– Up until the time of the first incident (the loss of the Lukmanier line), the system was in a state compliant with the security criteria: the total level of import towards Italy did not exceed the level that was jointly accepted and its control deviation was within the Transmission Reliability Margin (TRM).

– The blackout was not caused by some extraordinary »out of criteria« event such as a severe storm, a cyber-attack, simultaneous lightning strikes on several lines, etc…

– The blackout was triggered by causes in Switzerland. The initial stages in the sequence of events were out of reach for action by the Italian operators.

– After the first contingency, although the foreseen countermeasures for returning the system to a secure state were available from a purely technical point of view, human, technical and organisational factors prevented the system from returning to a secure state. These factors are related to known principles and available tools of the TSO business. They do not reveal fundamental deficiencies in the existing rule setting of the UCTE system.

– The behaviour of the UCTE system outside Italy after disconnection did not reveal critical malfunctions on a global level.

– The restoration process of the Italian system was performed successfully. However, its duration might have been reduced should more units have successfully switched to house load operation or have performed black-start capability. >>>

>>> *Ongoing action within UCTE*

The UCTE Working Group on Operations & Security and its subgroups are elaborating an Operation Handbook that collates and updates the recommendations and rules set up since the creation of UC(P)TE in 1951. The Investigation Committee proposes a set of recommendations arising from the analysis of the events. They do not involve a fundamental change of direction in this ongoing work, but rather draw special attention to some aspects of particular interest as highlighted by the investigation of the blackout.

The recommendations in this respect are:

R1: For interconnections between UCTE control blocks, confirm, set up or update where necessary the emergency procedures between the involved TSOs. They should be made mandatory and integrated in the joint operator training programs. Their performance should be evaluated at regular intervals.

R2: UCTE is reviewing its rules and introducing the Operation Handbook: the policies 3 and 5 on security assessment should specifically take care of the following issues:

- harmonise criteria for compliance with the N-1 principle;
- determine criteria for the time delay to return the system to N-1 secure state after a contingency;
- include issues such as phase angle and voltage stability into the standard short term contingency analysis;
- define clear guidelines for sharing of tasks to be performed, taking into account the perimeter of each control centre.

R3: Intensify the ongoing work on Day-Ahead Congestion Forecast (DACF) in UCTE, regarding the following aspects: increase the frequency of DACF calculations, increase the number of areas involved and provide quality indicators for the involved data and computation results in order to assess the performance of the tool.

R4: Extend the existing real time data exchange among neighbouring TSOs. Data should be consistent to run the state estimators in a reliable way on a wider topology basis.

R5: To determine on a UCTE level a set of minimum requirements for generation equipment, defence plans and restoration plans, as a basis for harmonization to be implemented throughout the respective national grid codes and regulations.

R6: Further work on a UCTE level is needed to agree the implementation of appropriate load-frequency control strategies should an accidental split of the synchronous area occur.

R7: As a support tool for dynamic analysis and monitoring of the UCTE system, accelerate the ongoing Wide Area Measurement System (WAMS) installation program.

Recommendations on a national level

In the unbundled business framework, special attention must be paid to national regulations or grid codes governing the technical and operational requirements of the generation-transmission-distribution supply chain. The UCTE Operation Handbook (OH) and the underlying Multilateral Agreement (MLA) between TSOs under preparation, provide basic harmonisation criteria for these regulations.

R8: National Grid Codes (or equivalent regulation) should enforce a set of minimum requirements, to be harmonised on UCTE level, with respect to the specification of generation units regarding their robustness in case of frequency and voltage disturbances.

R9: National regulations should, insofar as they are not yet implemented, provide for:

- binding defence plans with frequency coordination between load shedding, if any, and generator trip settings;
- binding restoration plans with units sufficient capable of switching to house-load operation and black-start capability. Due consideration should be given to joint simulation, training and evaluation of these plans with all involved parties.

R10: Tree trimming practices should be evaluated and the operational results should be audited with respect to the line sag in maximum rated overload condition.

R11: The blocking of On Load Tap Changers (OLTC) of transformers in case of severe voltage drop should be accepted practice.I

Interface with the regulatory framework

Since the first electricity Directive of 1996, the countries of the European Union have been forerunners of a transmission system model with independent TSOs. The new Directive of 2003 has added, among others, legal unbundling and the necessity of effective TSO decision-making rights with respect to the network assets, their operation, maintenance and development.

The blackout and subsequent investigation has cast no doubt on this model in principle. On the contrary, the lack of a grid operator's empowerment and independence could be identified as a potential security risk.

A basic recommendation to be made in this respect is the fact that in a liberalised market, the interconnected countries, as far as it is not yet the case, should adopt this TSO model in order to prevent incompatibilities with possible consequences on the system operation and network security.

Concerning this broadly accepted principle of TSO empowerment to control the flows on the system, it involves several tasks for which the TSOs must be in charge in a transparent and non-discriminatory way, on the one hand vis-à-vis market participants and on the other hand vis-à-vis neighbouring TSOs. These tasks include the assessment of transmission capacity, the redispatch of generation or the activation of reserves when security is at stake, as last resort measure the management of defence plans, etc.

A clearly identified risk regarding system security is the possible lack of adequacy between generation and load, either on a general or a regional level. Although it is out of UCTE scope to give further recommendations on the actual type of market rules and incentives regarding adequacy, the necessity was clearly identified. On a general level, adequacy implies also the harmonisation on several issues such as taxation, building permission and environmental constraints. Distortions regarding these elements lead to non-balanced developments, putting strains on the system and thus generating security risks.

Finally, maintaining the same level of reliability, in a system with steadily increasing loads and dramatic changes in the location and structure of the generation mix, needs significant investments in transmission. The regulated structure of the TSO business in most of the UCTE countries gives an appropriate framework for these investments, provided that it yields a fair and stable return on investment. <<<

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UCTE OPERATION HANDBOOK AND ITS ENFORCEABILITY

Close co-operation of member companies is required to make the best possible use of benefits offered by interconnected operation. For this reason, the UCTE has developed a number of technical and organisational rules and recommendations in the past that constitute a common reference for smooth operation of the power system.

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

Target audience for the Operation Handbook

The »UCTE Operation Handbook« shall support consultation and provide assistance to different parties in issues of system operation, such as:

– Transmission System Operators (TSOs)/Grid Operators, Co-ordination Centres. Every TSO in the UCTE interconnected network (synchronous areas) has declared to follow the technical standards and procedures that are comprised in this »UCTE Operation Handbook« (main focus of the handbook). This operation handbook therefore serves as the reference (»legislation«) for the grid operation by the TSOs and guarantees the UCTE's quality and reliability standards.

– Generation Companies (GENCOs). Every party operating a generating unit in the UCTE interconnected network (synchronous areas) makes use of the transmission network and may have to deliver products for the provision of system services that are indispensable for secure and stable grid operation. This operation handbook sets standards for the essential requirements and capabilities regarding generation that contribute to the operation of the grid by the TSOs.

– Other associations, traders, customers, politicians and decision makers. Operation of an interconnected transmission system is bound to physical principles and technical constraints, that differ significantly from other well-known technical or financial systems. This operation handbook explains these differences and characteristics in a transparent manner to the public for a better understanding. It can also serve as a general reference document. <<<

Main characteristics of the Operation Handbook

The following main characteristics of the »UCTE Operation Handbook« serve as a guideline for the development and set-up of the handbook:

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

– Liability: Following the Articles of Association of the UCTE, as they have been signed by all members, the standards and recommendations of the Operation Handbook were developed as binding for all members (including associated members) of the UCTE and their operation of the grid.

– Unambiguousness: All standards and recommendations of the Operation Handbook are written to be straightforward and unmistakable for the processes of secure operation of the UCTE SYNCHRONOUS AREA(S). All terms used in the handbook are defined only once.

– Relevance to the present: Standards and recommendations included in the Operation Handbook are continually adapted to the changed technical and legislative environment. A version »history« clearly shows the status of each part of the handbook.

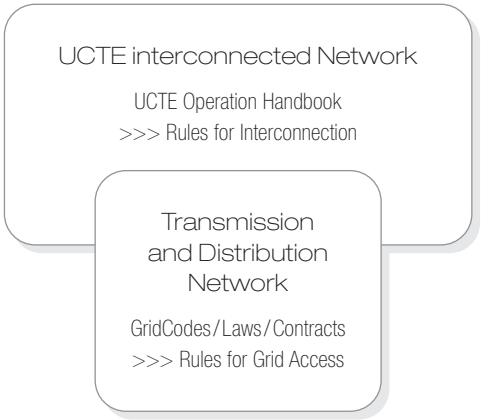
– Minor Redundancy: The Operation Handbook is written to have only the minimum of redundancy that is required. For this purpose, references to other chapters within the handbook are used instead.

– Modularity: Each chapter, policy, rule and guideline of the Operation Handbook can be seen as a separate document that may be revised independently of the other parts. All chapters use a similar layout and internal structure. <<<

Main scope of the Operation Handbook

The main objective of the »UCTE Operation Handbook« as a comprehensive collection of all relevant technical standards and recommendations is to provide support to the technical operation of the UCTE interconnected grid (synchronous areas), including operation policies for generation control, performance monitoring and reporting, reserves, security criteria and special operational measures. The basic subject of the Operation Handbook is to ensure the interoperability among all TSOs connected to the synchronous areas.

Standards for network access of customers, network tariffs, accounting, the commercial part of unintentional deviations, billing procedures and market rules as well as other standards that may be set by national GridCodes, laws or contracts are not within the scope of this Operation Handbook (see next figure). <<<



The basis of the consultation process to be implemented by UCTE

Legislative framework for making standards enforceable

The conclusion of a multilateral agreement between TSOs should be completed by a framework of standards ensuring coherence and harmonization towards network users, as far as the reliability aspects of international interconnection are concerned.

Therefore, the institutional European organisms could acknowledge the UCTE standards (or, more general reliability principles applicable to the 4 European synchronous areas within the Union) in an apposite act (regulations, directives or simple recommendations). This solution could have the advantage of providing binding force to the UCTE rules within the EU States, but, on the other hand, this would apply only to EU member states. For non-EU member states whose electricity systems are synchronously coupled with one of the 4 synchronous areas, it might be advisable that the national grid codes provide for adherence to the minimum set of »reliability building blocks« which are necessary for international interconnection. Already today, several national grid codes have adopted such a position.

In the case of a European Directive or Regulation, it would be essential that TSOs' responsibilities and liabilities be clearly defined, including the liabilities between TSOs of different member states and third countries adhering to the code. <<<

Conclusions of the Regulatory Forum held in Rome on 18 October 2002

»The Forum stressed that a comprehensive set of common security and reliability standards, to be observed by TSOs and network users, is necessary in order to ensure the efficient and secure functioning of the interconnected system and appropriate quality of electricity supply. UCTE presented proposals on how to further develop common security and reliability standards, which were welcomed by the Forum. UCTE was invited to continue its work, and continue to develop progressively more binding rules. This work would now be brought forward through regular meetings to be held at technical level between UCTE, CEER, NORDEL, other relevant regional TSO organisations and the Commission. Where appropriate, all relevant parties, including system users, will be invited to participate in these meetings. UCTE will present the further progress achieved during the next meeting of the Forum.«

Consultation is a key element of the development process of the Operation Handbook since it will contribute to identify issues and proposals of common interest with stakeholders, seeking ways to improve the quality of the document. The UCTE endeavours to ensure that all interested parties operating in the electricity sector express their views in this process.

In 2003, a series of meetings with key individual stakeholders took place in Brussels, where UCTE presented in detail the transformation of UCTE rules into enforceable reliability standards, and the fundamentals of the Operation Handbook. The parties were encouraged to actively participate in consultations. The consultation process is planned to start at the beginning of 2004, a new web-based technical tool »Consultation Process« will be launched at the address

http://www.ucte.org/ohb/consult_process.asp

UCTE encourages interested shareholders to participate actively in consulting the Operation Handbook. Participating in the process will require prior registration, and participants will be electronically kept informed about crucial events in the consultation process. <<<

PROGRESS MADE IN THE RECONNECTION OF THE TWO UCTE ZONES

Resynchronisation of the two UCTE zones that were split in 1991 as a result of the war events in former Yugoslavia has been a matter of priority to the UCTE for many years. However, it was not before the beginning of this decade that the proper preparation of the process could be started due to the development of positive political and economic relations between the countries involved, and due to the global importance of the reconnection that was recognised by large international communities including EU bodies, international financial institutions, and countries at the interface themselves.

Without reconnection, the creation of the South East European Regional Electricity Market envisaged by the Athens Memorandum would be put at risk.

The UCTE Executive Team for Reconnection coordinates all actions aiming at the integration of the whole UCTE area. During the year 2003, ET met important organizational prerequisites:

- the minimum grid configuration was defined
- the design of control blocks and sharing of responsibilities were outlined
- all back-up technical facilities (data links) were specified
- civil works of the grid restoration of key infrastructure were monitored by regularly updated inventory reports

The preparation of key documents – Resynchronization Program and Agreement on Operational Coordination – were well advanced at the end of 2003.

Without reconstruction of the infrastructure, it would not have been possible to carry out the resynchronisation. Major restoration of the damaged Ernestinovo substation in Croatia, managed by HEP and financed by the Croatian government, was completed in 2003, together with the construction of a new 400/110 kV substation in Zerjavinec. Following intensive negotiations with the authorities in Bosnia-Herzegovina, the World Bank gave its no-objection-letter at the end of 2003 for financing the crucial projects – the restoration of the Mostar substation and the »Adriatic line« Mostar – Gacko and of the line Ugljevik – Tuzla – Sarajevo – Mostar. Following successful negotiations of JPCC with contracting companies, all investments are likely to be completed in mid-2004. <<<

DEVELOPMENT OF THE UCTE SYNCHRONOUS AREA

During the last fifty years, UCTE has contributed to build one of the largest synchronous interconnected power systems in the world, supplying hundreds of millions of customers in a safe and reliable way. However, 2003 has seen some power outages around the world and in particular in the UCTE system which had dramatic consequences. This confirms that the main focus of UCTE is, must be and will remain the security and adequacy of the interconnected system.

This applies particularly to the issues of the extension of the UCTE synchronous zone. The maxim of UCTE in these matters, as it has been in the process of creation of the present system, is to investigate all possible consequences of an extension on the system. UCTE has always pursued its efforts to develop the synchronous area while observing objective criteria and procedures in order to maintain the whole system on the present high level of reliability and stability.

Bulgaria and Romania

Since May 2003, Bulgaria and Romania have been full UCTE members, connected to the second UCTE zone. This achievement is the result of a long process started in 1997. The technical committee UCTE/ Bulgaria-Romania was set up to supervise the studies and field tests necessary to check the behaviour of the two systems. In addition to the studies and tests, the two countries had to invest in their electric system, including power plants, in order to upgrade it so as to meet the UCTE criteria on frequency control and damping of oscillations between generators.

Turkey

The potential connection of Turkey to the UCTE system through lines between Turkey and Bulgaria and a future line between Turkey and Greece is following the same process with the same maxim observed by UCTE. In 2003, the Terms of Reference of the feasibility study have been finalized and a solution for funding of the study has been found between UCTE, the European Commission and the Turkish Ministry of Energy and natural Resources.

The study will be performed by a consortium of UCTE members led by RWE Transportnetz Strom for the stability study and by HTSO for the load-flow study. The preparation of the contract was well advanced at the end of 2003. The study will last 15 months, starting in 2004. In addition to the study, UCTE is reviewing its catalogue of measures in order to define the necessary provisions on field tests to check the behaviour of the Turkish electric system. Once again, the whole process is to guarantee that the connection of this new large system will not jeopardize the reliability and stability of the overall UCTE system.

UPS/IPS

In the context of the EU Russia dialogue on energy, UCTE has received a request from RAO UES acting on behalf of the Electric Power Council of the Commonwealth of Independent States and on behalf of the Baltic States, to study the possible synchronous interconnection with the UCTE system. Following its maxim in terms of the reliability and stability of the UCTE system, and taking into account the fact that the two systems are of comparable size and have developed independently of one another regarding the technical standards, UCTE has decided to proceed in two steps and carry out two different studies:

– a load-flow study on the UCTE side

– a feasibility study modelling the whole system

The results of the load-flow study were obtained at the beginning of 2003. According to the defined scenarios the study shows that:

– the UCTE system is already operated at its limits

– the flows from East to West will have to cross already congested borders

– the exchanges will have to be significantly lower than the physical capacity of the existing lines between the two systems.

For the second step, UCTE and the Electric Power Council of the Commonwealth of Independent States (CIS EPC) decided to set up a common project organization under the responsibility of UCTE. UCTE finalized the Terms of reference of the study; funding of the study will be guaranteed by the European Commission under the TEN guidelines, and by the Eastern partners of UCTE through experts who will contribute to the study. This feasibility study could start in the second half of 2004 and will last three years. The long duration of the study is attributable to the complexity of the problem as this connection will not follow the usual UCTE process, and also in view of the possible consequences it may have on both systems. Since EPC-CIS is the intergovernmental body, a new body named KOTK – the counterpart of UCTE – was established in the framework of EPC-CIS to carry out functions of the organizational structure in IPS/UPS.

This challenge is the biggest ever faced by UCTE since its creation. This is why UCTE and RAO UESR have decided to pay the utmost attention to this project.

Tunisia-Libya

The closure of the 220 kV lines between Tunisia and Libya may lead to the connection of the five following countries: Libya, Egypt, Jordan, Lebanon and Syria (LEJSL), to the already synchronously connected countries Morocco, Algeria and Tunisia.

Although the total installed capacity of these eight countries represents roughly 40,000 MW only (approximately one third of the French capacity) UCTE pays great attention to the possible impact of this connection on the UCTE system. The main issue is related to potential inter-area oscillations between the generators of the two systems.

Taking account of the studies already implemented, UCTE decided to proceed to a series of measurements that will help UCTE to take a decision. These measurements, first on the LEJSL system alone, are under preparation and could start in 2004. After a two months' campaign, UCTE will decide whether a second three days' measurement campaign with the link closed can be envisaged. The in-depth analysis of the results will help to define the final UCTE position on this issue.

As regards these three projects, UCTE follows the same maxim motivated by the imperative to keep reliability and stability of the whole system at the high quality level known. As the last developments of the UCTE system have shown, this attitude is beneficial to all grid users both on the UCTE side and on the applicants' side. <<<

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SYSTEM ADEQUACY OF THE UCTE SYSTEM »TESTED« DURING THE SUMMER 2003

The dramatic events of the year 2003 have highlighted the relevance of the work performed by the UCTE »System Adequacy« Sub-Group providing early warning signals regarding system reliability. The statistical experts of UCTE have also started some new investigations aiming at fine-tuning their indices and criteria to even better analyze and evaluate system adequacy in the future.

Even if a blackout such as the one experienced in Italy which actually happened around 3:00 in the morning, a time where load is usually quite moderate, cannot be anticipated through that kind of report, UCTE had already warned that the general balance situation is getting tighter in some regions. The »UCTE system adequacy forecast 2003–2005« stressed the low level of remaining capacity and a nearly constantly tight situation for instance in the Italian system. This worrying situation was also mentioned in the UCTE press release of 30.01.2003, Italy being one of the countries where the level of 5% of remaining capacity was not met.

The forecast report issued last year pointed out the increasing risk concerning the Italian system in the following terms:

»When considering the remaining capacity as a percentage of the generating capacity, the Italian peninsula will evolve from a critical situation in 2003 to a more critical one in 2004–2005«.

Methodological improvements have been realized in 2003 in order to provide a more complete and comprehensive information and to respond to the growing awareness of the importance of the power system reliability issues.

Since 2002, the retrospective System Adequacy reports have included in one single paper a generation adequacy assessment and an overview of the situation and main changes in the UCTE transmission grids. >>>

Main trends of the year 2002

Generation Adequacy

In general, electricity supply remained at a high level of reliability in 2002.

This is attributable to the moderate increase in consumption (+0.6 %/+12 TWh) resulting from the global economic situation and from more favorable meteorological conditions compared to the previous year, while the generating capacity increased by 1.7 %.

The UCTE remaining capacity reached its minimum, though sufficient levels in January and in June (9.7 % and 9.0 % of the generating capacity, respectively), periods where the prices on the European Power Exchanges reached their highest values. That highlights the likely link existing between the UCTE remaining capacity index and the prices observed on the European Power Exchanges.

Commissioning of new power plants has significantly improved the power balance in Spain, where a difficult situation was observed last year, and in Greece, whose potential difficulties were highlighted in the System Adequacy Forecast report.

Production of hydroelectric plants showed a very significant decrease of 59 TWh (i. e. –18 %), essentially due to the exceptionally dry hydro conditions in continental Europe at the beginning of 2002.

The internal exchanges inside UCTE were stable as compared to the previous year (at around 260 TWh), that represents 12 % of the consumption.

Transmission System Adequacy

The interconnected UCTE network seems to be more and more loaded, especially the cross-border lines.

The physical flows due to commercial transactions between parties located in different countries (»the internal electricity market«) create some permanent or occasional congestions. Difficult situations resulting from unexpected loop flows were observed in Belgium, Italy, Switzerland and Austria.

New lines were commissioned with a direct impact on the constraints affecting the interconnections or on the transmission capacity and congestion management. The main improvements concern the interconnections between France and Germany, France and Spain, Germany and the Netherlands, Spain and Portugal.

Some countries were affected by severe storms and rainy periods, which caused damages and loss of load in Belgium, the Netherlands, Greece, Austria and the Czech Republic. <<<

System Adequacy Forecast 2004 – 2010

Generation adequacy assessment

The reliability of the UCTE System as a whole is likely to remain at an acceptable level over the 2004 – 2006 period, due to both the expected new generating capacity and some developments of national and international transmission grids.

According to the information available to the TSOs, a sensible decrease in remaining capacity is expected between 2008 and 2010. There is a potential deficit in generation unless additional firm investment decisions are taken soon. The CENTREL block seems to be the only one in a position to remain a structural exporter. But future environmental legislation could affect this position.

The UCTE main block, which represents a major part of the installed capacity and has been exporting until now towards the surrounding areas, will face until 2010 a decrease in the remaining capacity below the indicative adequacy margin. In 2010 this block could become a net importer in situations where the temperature drops 5 °C below normal.

The reliability of the Iberian and Italian blocks is expected to improve thanks to strong programs leading to the commissioning of many GW of new generating plants. The ability of these countries to effectively reach these goals has to be monitored in the next system adequacy forecasts.

Serbia and Montenegro, FYROM and Greece are in a weak position concerning generation adequacy; the reconnection of the second UCTE zone expected for mid-2004 will be of utmost importance for the reliability of this region. This reconnection will also play an important role for Romania and Bulgaria whose margins are decreasing all along the period.

It is also important to note the increasing role of renewable energy sources, mainly wind power, in the generation mix of the UCTE system. This development is liable to create some new problems concerning the availability of sufficient balancing power especially since important decommissioning of conventional thermal plants is expected during this decade and in the next. This important role of wind power is also liable to generate large short-term variations of flows across the international transmission system. It can also be observed that in the countries where the share of wind power is already high (Spain and Germany), significant development of the 400 kV transmission network is necessary.

Transmission system adequacy

The projects concerning the development of the international interconnections should help to improve the reliability of the surrounding blocks and of deficit areas.

Nevertheless, the number of projects is limited, which reflects the difficulties encountered by the TSOs to get these projects accepted by the public. <<<

>>> *The »System adequacy forecast 2004 – 2010« provided for the first time in the history of UCTE forecast data up to seven years ahead.*

It is a matter of fact that the longer the time horizon, the higher the uncertainties. Because the aim of such long-term forecasts is to highlight opportunities or show the necessity to invest in generation, UCTE decided to include only future generation capacities whose construction and commissioning are considered to be firm by the TSOs. On the other hand, the installed capacity can also be overestimated in those forecasts, since decisions concerning decommissioning of generating units are notified to TSOs at very short notice and are therefore not taken into account in UCTE forecasts.

Under these assumptions, the main conclusions of the exercise are that even if the security of supply should stay at an acceptable level for the short term, it cannot be excluded that unfavourable conditions such as a cold wave combined with plant outages above normal could lead to shortages in some parts of the system.

This kind of risk will increase in the medium term unless firm investment decisions are taken soon.

Of course the blackout in Italy was not a direct consequence of the low level of remaining capacity. Reliability of each power system is more complex and depends also on the operating rules followed by TSOs, market rules, weather conditions and many other factors. However, a tight situation concerning reserves in the system, usually combined with price differences between countries, encourages and stimulates market actors to rely more and more on energy imports from other power systems. This can lead to congestion on borders and erode reliability of the system. UCTE system adequacy forecasts can indicate negative trends in power systems and provide warning signals.

Some other important statistical publications of UCTE are the Monthly Statistics, which aim at giving rapidly a quick and complete overview of the UCTE system to market actors and authorities, and the Statistical Yearbook, published once a year with some consolidated values. The Yearbook is a unique source of information on UCTE transmission systems, production and consumption of electricity, loads, energy flows and other aspects of interconnected system operation.
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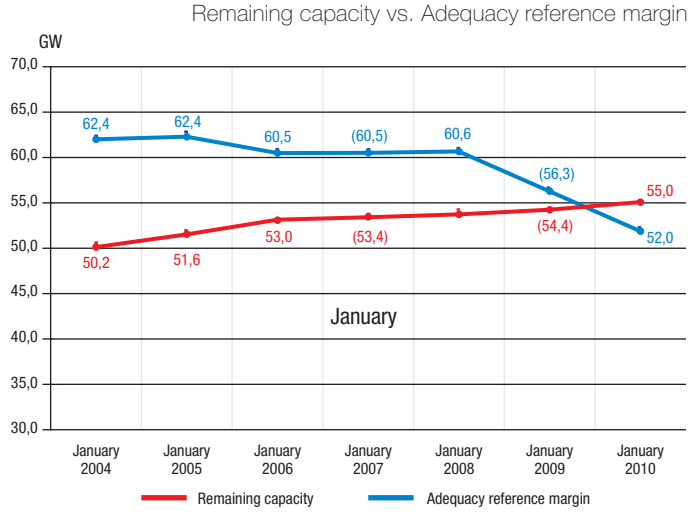

THE DACF (DAY-AHEAD CONGESTION FORECAST) PROCEDURE

A few decades ago, the main purpose of the interconnected UCTE-grid was an overall- and border-crossing-optimization of the operation of the grid in a technical as well as in an economical way and the mutual sharing of ancillary services (frequency and voltage control, active and reactive power reserves, network restoration, etc.). The system evolved with the background of integrated electricity companies, where the responsibility for production, trading, transmission and distribution rested with in the same company. In such an environment, it was relatively easy to manage the system and avoid congestion. With the ongoing liberalization, this prerequisite is no longer given. Especially traders want to have as less restrictions as possible. This makes it necessary for the TSOs to be able to forecast the load-flow situation at least for the following day and to identify possible congestion, based on the results of trading.

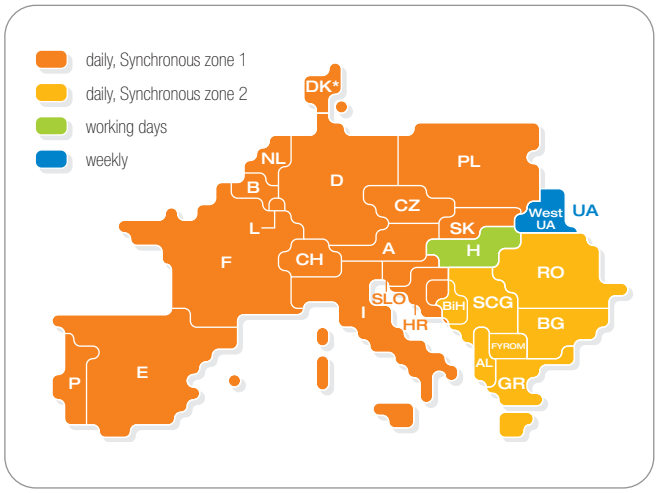

Fig. 1 : Participation in DACF procedure – end of 2003

The DACF method

To carry out load-flow forecasts and to identify possible congestion, which can also be located on tie-lines, it is necessary to exchange data with all other TSOs. It is also necessary to take account of the influence of neighboring networks onto the own network, even if the congestions are fully internal, especially for contingency analysis. The main objective is to have a modular method available. That means a method that works in the best possible manner and delivers satisfying results (e. g.: forecast error per element less than 5 % – 10 % of the maximum capacity of the corresponding element for more than 90 % of all elements).

The main principles of the method are :

– that each »control block« provides to all other »control blocks« a forecasted complete load-flow data set of its grid after closing of the markets,

– that the companies taking part in the forecast have to treat the data sets shipped to them by the other participants with utmost confidentiality, because they include sensitive production schedules, and

– that the principle of reciprocity is respected by the participants : a »control block« can get the data from other »control blocks« only if it agrees to provide data of the same quality for the same time to all the participating »control blocks«.

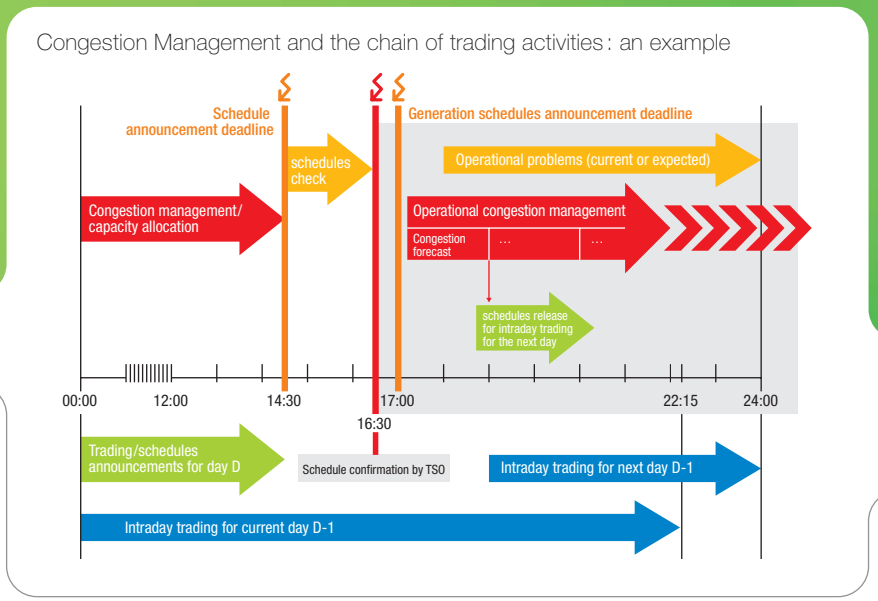

Fig. 2: Congestion Management and chain of trading activities

After all these data sets have been exchanged, each »control block« is able to construct a load-flow model that represents the most probable state of the forecast time. That model should preferably include all UCTE networks, but a »control block« could also disregard the data sets of »control blocks« whose influence on its network is deemed negligible. With this model each »control block« is then able to carry out a load flow-study and security analysis and to identify congestion. The goal of the security analysis is to conclude that there is a possibility that there will be a congestion on any element of the UCTE interconnected power system. Each »control block« has the responsibility to test its network for congestion.

It is important to carry out these calculations with the whole detailed network model in the area of interest.

Description of the Modular Short-Term Load Flow Forecast

The different steps of the modular short-term-load-flow-forecast are the following:

1. On the basis of reference data, each participating »control block« collects the forecast data for the commonly agreed time on a daily basis for several hours of the following day (production schedules from the 380-/220 kV-power plant operators, topology, etc.) and adjusts a suitable selected load-flow data set (e.g. snap shot of his system).
2. Each »control block« puts its complete load-flow data set in the UCTE-format on the Electronic Highway (EH) FTP-server where it is accessible to all other participating »control blocks«. Besides the participants' networks, it is intended that the control block programs, provided by the block coordinators *RWE Transportnetz Strom* and *ETRANS*, should also be accessible to all participants. With this information, the control program of the sum of all non-participating countries per control block can be calculated. Conventions are used for naming the exchanged files in order to enable an automatic merging procedure
3. Each participating »control block« takes the last available and convenient load-flow data set of the non-participating »control blocks« (update of known topology changes, etc.) and adjusts this load flow data sets analogously to step 1.
4. After having collected the complete load-flow data sets of all other participating »control blocks« and after adaptation of the load flow data sets of the non-participating »control blocks«, these data sets have to be merged by connecting the »X-nodes« and setting the X-node injections to zero.
5. Carry out a load flow calculation and a contingency analysis with the whole, detailed, and adjusted synchronously interconnected grid corresponding to step 4 and identify congestions.

And, finally, the partners exchange the results (the overloaded elements) with the participants in a defined format.

Conclusion

In such networks, the responsibility for operation of the network is incumbent upon different parties, therefore no one has the complete real time information about the overall network status (status of switch gears, tap positions, injections and loads) and the schedules for production, planned outages and topology changes. Therefore, the DACF method is necessary to predict the load-flow situation in a meshed, synchronously interconnected network. <<<

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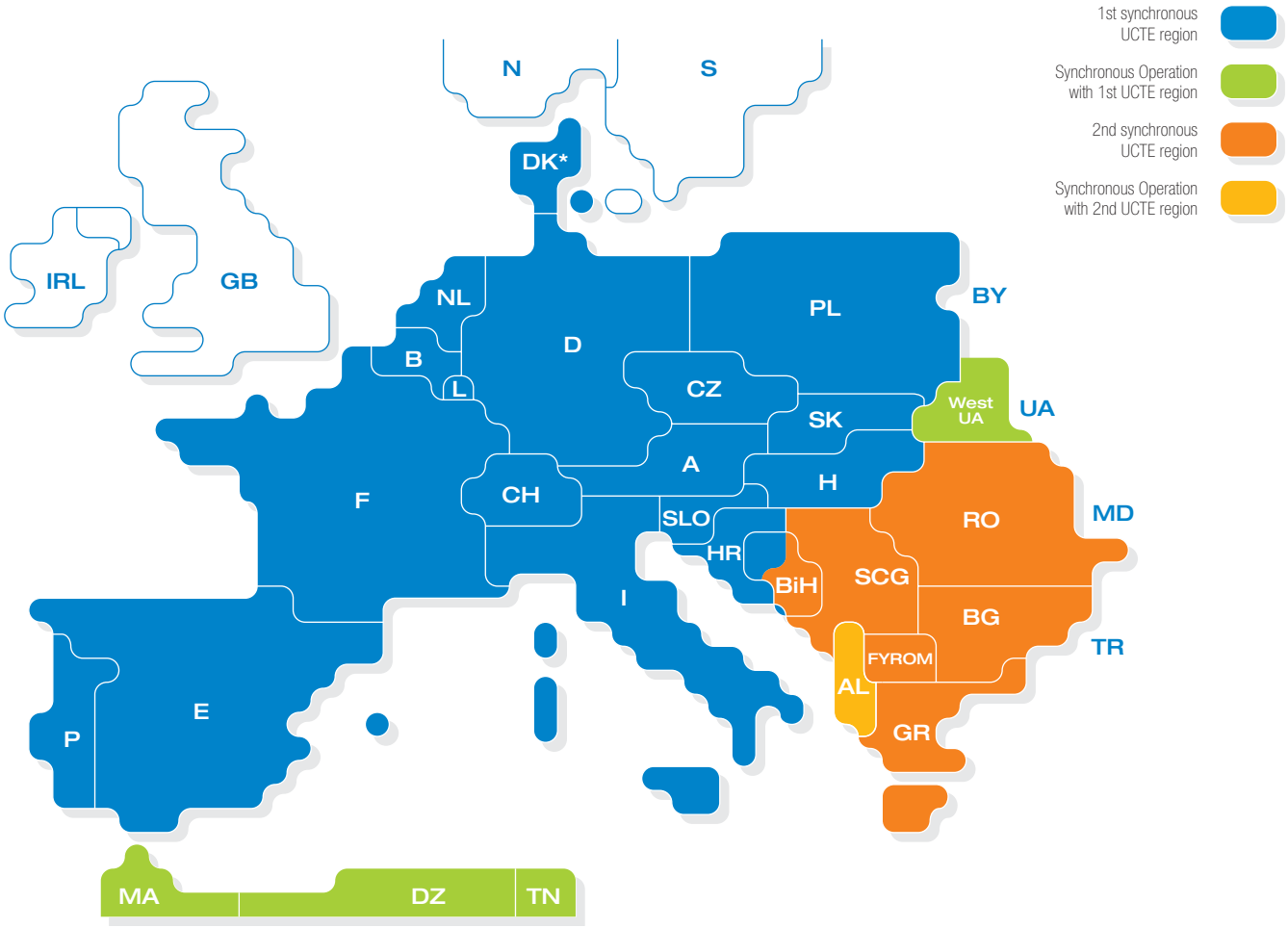
UCTE'S INTERNAL STRUCTURE

The European area covered by the UCTE



All member countries are represented in the Steering Committee, which is the executive body of the association.

*Associate member

Member companies in UCTE as of 1 January 2004

Austria	TIRAG	*Tiroler Regelzone AG*
	VERBUND APG	*Verbund – Austrian Power Grid*
	VKW UNG	*VKW-Übertragungsnetz-AG*
Belgium	Elia	*Elia System Operator SA/NV*
Bosnia-Herzegovina	JPCC	*Joint Power Coordination Center*
Bulgaria	NEK	*Natsionalna Elektricheska Kompania EAD*
Croatia	HEP	*Hrvatska elektroprivreda d. d.*
Czech Republic	CEPS	*CEPS, a. s.*
France	RTE	*Gestionnaire du Réseau de Transport d'Electricité*
FYROM	ESM	*Elektrostopastvo na Makedonija*
Germany	EnBW Transportnetz	*EnBW Transportnetz AG*
	E.ON Netz	*E.ON Netz GmbH*
	RWE	*RWE Transportnetz Strom AG*
	Transportnetz Strom	
	VE Transmission	*Vattenfall Europe Transmission GmbH*
Greece	HTSO/DESMIE	*Hellenic Transmission System Operator/Diachiristis Elinikou Sistimatos Metaforas Ilectrikis Energias*
Hungary	MAVIR Rt.	*Magyar Villamosenergia-ipari Rendszerirányító Rt.*
Italy	GRTN	*Gestore della Rete di Trasmissione Nazionale*
Luxembourg	CEGEDEL	*Compagnie Grand Ducale d'Electricité du Luxembourg*
The Netherlands	TENNET	*TenneT bv*
Poland	PSE	*Polskie Sieci Elektroenergetyczne SA*
Portugal	REN	*Rede Eléctrica Nacional, S.A.*
Romania	Transelectrica	*Transelectrica S. A.*
Serbia-Montenegro	EPCG	*Elektroprivreda Crne Gore*
	EPS	*Elektroprivreda Srbije*
Slovak Republic	SEPS	*Slovenská Elektrizačná prenosová sústava, a. s.*
Slovenia	ELES	*Elektro Slovenija*
Spain	REE	*Red Eléctrica de España S.A.*
Switzerland	ATEL	*Aare-Tessin Ltd. for Electricity*
	BKW UTN	*BKW Übertragungsnetz AG*
	EGL Grid	*EGL Grid AG*
	EOS	*Energie Ouest Suisse*
	ETRANS	*ETRANS AG*
	NOK	*Nordostschweizerische Kraftwerke AG*
Denmark	ELTRA*	*Eltra*

*Associate member

The Bureau, from left to right: Antonio Serrani (I), Vice-President, Martin Fuchs (D), President of UCTE, Marcel Bial, Secretary General and Gerard Maas (NL), Chairman of Steering Committee.

Bodies

The decision-making bodies of UCTE are the *Assembly* consisting of all 33 members of UCTE and one associated member, and the *Steering Committee* with one representative from each one of the 22 countries represented in the UCTE.

The *Bureau* representing the Association externally consists of the President, Martin Fuchs (D), the Vice-President of the Association, Antonio Serrani (I), the Chairman of the Steering Committee, Gerard Maas (NL), and the Secretary General, Marcel Bial.

Working Groups

In 2003, the Legal Experts Network was transformed into the Working Group Legal Issues (WGLI), due to the growing importance of legal aspects of the TSO business. Working group communication policy was reorganised into »Liaison Advisory Working Group« aiming at providing expertise to the Steering Committee.

The 5 Working Groups composed of experts from the member companies, focus their activities on operations and security, system development, communication and European issues, statistics and legal issues. They are installed and entrusted with specific missions by the Steering Committee to which they report according to the Articles of Association.

The Secretariat

The Secretariat is led by Marcel Bial, who has been elected for a 4-year term starting on 1st January 2002. The premises of the Secretariat are located in Brussels,

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Tel.: +32 2 741 69 40, Fax: +32 2 741 69 49,
http://www.ucte.org
E-Mail: info@ucte.org

The Secretariat is responsible for the assistance and the support to the bodies of the association. Furthermore, it is responsible for the UCTE web site, the information system, all kinds of publication and the implementation of all the statistical and communication measures decided by the Steering Committee.

National representatives in the Steering Committee as of 1 January 2004

A	*Heinz Kaupa*	H	*Antal Tombor*
B	*Hubert Lemmens*	HR	*Ivica Toljan*
BG	*Mitiu Christozov*	I	*Carlo Sabelli*
BiH	*Josip Jerkovic*	L	*Georges Bonifas*
CH	*Patrick Braun*	NL	*Gerard Maas*
CZ	*Jirí Feist*	P	*José Penedos*
D	*Wolfgang Neldner*	PL	*Jerzy Dudzik*
E	*Angel Landa*	RO	*Jean Constantinescu*
F	*Pierre Bornard*	SCG	*Vladimir Marjanovic*
FYROM	*Pande Lazarov*	SLO	*Vekoslav Korosec*
GR	*Adrianos Papathanassiou*	SK	*Alena Salamonova*

Organizational chart as from 1 January 2004

Bureau

– President:
Martin Fuchs (D)

– Vice-President:
Antonio Serrani (I)

– Chairman SC:
Gerard Maas (NL)

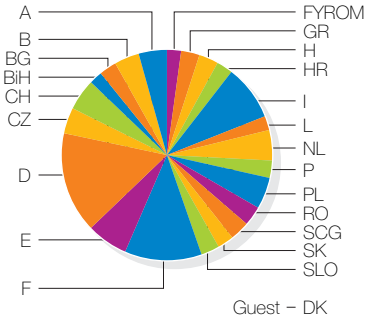
– Secretary General:
Marcel Bial

Assembly

33 TSOs from 22 countries

Chairman: Martin Fuchs (D)

Voting rights:



Steering Committee

1 representative per country

– Chairman:
Gerard Maas (NL)

Secretariat

– Secretary General:
Marcel Bial

Working Groups

Operations and Security
Convenor:
Klaus Kleinekorte (D)

System Development
Convenor:
Georges de Montravel (F)

Statistics
Convenor: Jacek Ratz (PL)

Liaison Advisory
Convenor: Carlo Crea (I)

Legal Issues
Convenor: Luigi De Francisci (I)

Subgroups

– *Network Models and Forecast Tools*

– *TSO Forum*

– *Electronic Highway*

– *East of CENTREL*

– *Mediterranean Ring*

– *Turkey*

– *Study Tool*

– *System Adequacy*

Technical Committees

Executive Team for North-South reconnection
Convenors: Ivica Toljan (HR)
Jirí Feist (CZ)

Ad-hoc WG Albania Issues
Convenor:
Georges Katsigiannakis (GR)

Network of Experts EMF
Convenor: Jean Senot (F)

Network of Experts Windpower
Convenor:
Juan Ma. Rodríguez-García (E)

*SYSTINT**
Convenor:
Georges de Montravel (F)

* joint Task Force UCTE/EURELECTRIC

Fom left to right:
Georges de Montravel (F), Marcel Bial, Jacek Ratz (PL), Carlo Crea (I), Martin Fuchs (D),
Luigi De Francisci (I), Antonio Serrani (I), Gerard Maas (NL), Klaus Kleinekorte (D), .

Used abbreviations

CEER	*Council of European Energy Regulators*
DACF	*Day Ahead Congestion Forecast*
CIS EPC	*Electric Power Council of of the Commonwealth of Independent States*
FTP	*File Transfer Protocol*
KOTK	*Commission on Operational and Technological Coordination for the Joint Operation of Power Systems of the CIS and Baltic States*
TSO	*Transmission System Operator*
UCTE	*Union for the Co-ordination of Transmission of Electricity*
UPS/IPS	*Unified Power System/Interconnected Power Systems (of CIS and Baltic countries)*

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