

Synchronous integration of the transmission systems of wider continental Europe, including the Baltic, Russia and FSU states, with Western Europe has long been an aspiration. An on-going feasibility study will shed light on how realistic it is to achieve this dream.

Connecting east and west

Early in 2002 the Electric Power Council of Commonwealth of Independent States (EPC CIS) requested a synchronous interconnection between the CIS countries - Azerbaijan, Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Uzbekistan and Ukraine - and the electricity transmission systems of the Union for the Co-ordination of Transmission of Electricity (UCTE), the association of transmission system operators in continental Western Europe. After the completion of a pre-feasibility study, dealing with steady state load-flow analysis, UCTE directing bodies decided to launch an extended feasibility study on a synchronous interconnection between the CIS countries, but which also included the Baltic States of Latvia, Lithuania, and Estonia - collectively the IPS/UPS system - with UCTE. Figure 1 gives an overview on the area under investigation.

Presently there is no existing electricity system in the world spanning more than ten time zones with different load characteristics and various generation structures and which would also serve more than 700 million people in two continents.

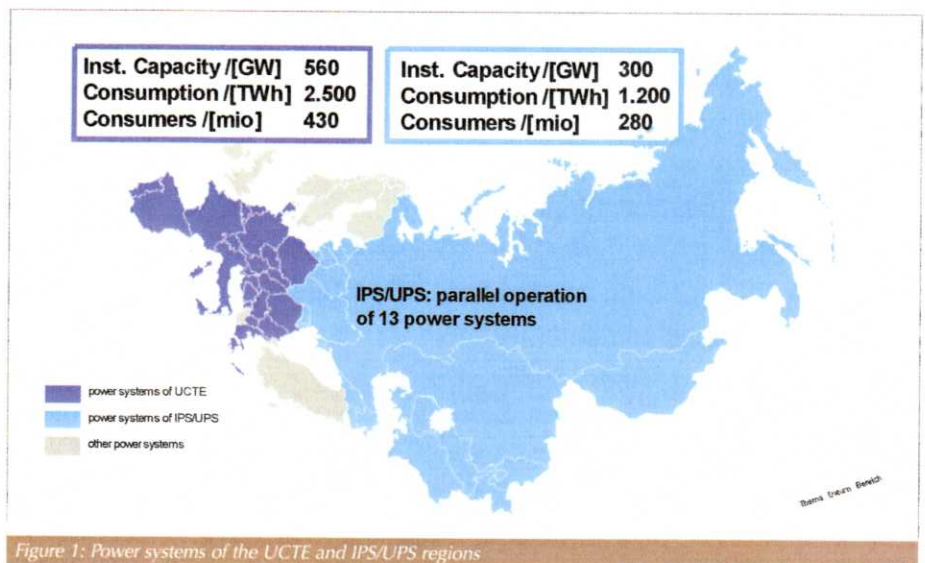


Figure 1: Power systems of the UCTE and IPS/UPS regions

principles, which all individual Transmission System Operators (TSOs) were committed to. These involve adherence to a common set of standards for the operation of the interconnection and its development and support for the principles of the common electricity market. Using these principles, relatively small power systems connect to UCTE in a step by step procedure by adopting all

large power systems, with different rules and standards for each of them as shown in the right hand side of Figure 2.

The two synchronous areas have been operated independently with different operation procedures and rules for some considerable length of time. Therefore, the feasibility of the synchronous interconnection has to be not only defined in terms of compatibility of technical performance, but also of organization and management in order to ensure a secure and reliable interconnection. A mandatory set of technical requirements needs to be defined in order to avoid any negative influence of one system on the other although the technical standards and internal rules of each system will, as far as possible, remain unchanged provided they do not have any negative impact on system security.

However, a precondition for any extension of the synchronous area beyond the borders of UCTE is to keep the reliability of the system at the current high level and the necessary measures and rules must be defined within a binding contract. Based on adequate solutions for these issues, legally binding commitments will need to be prepared and agreed upon with all involved operators, such as inter-area cooperation agreement with TSOs, legal rules covering system reserves for example, and specific contracts such as those with

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The feasibility study, which is due to be completed by the end of 2008, is designed to answer three major questions:

- Is a synchronous interconnection of IPS/UPS and UCTE possible?
- What measures have to be taken in both systems?
- What are the associated costs?

Scope of work

The scope of work covers all technical, operational and legal aspects related to an East-West synchronous interconnection, a major challenge that will be met jointly by experts from UCTE and IPS/UPS.

Until now all power system extensions of the UCTE grid were based on two

standards for operating and reliability. Moreover, the fulfilment of these preconditions is tested within a trial operation period, illustrated by the left hand side of Figure 2.

The last extension of the UCTE network took place on 1 November, 2004, when the disconnection of the power systems of the South-East of Europe resulting from the war in former Yugoslavia was overcome after thirteen years and Bulgaria and Romania were also interconnected synchronously.

However, the UCTE-IPS/UPS interconnection to be investigated is quite different from all former system interconnections. It is the electrical interconnection of two

generators concerning power system stability.

Technical options

When looking at the possible technical ways of interconnecting the IPS/UPS transmission system with UCTE, several scenarios seem to be possible:

- Full synchronous interconnection of both systems;
- Asynchronous interconnection by means of DC back-to-back stations at the end of existing interconnection AC lines or DC upgrading of these lines - an asynchronous interconnection has been in operation between IPS/UPS and NORDEL - a regional group of Nordic TSOs covering Denmark, Finland, Iceland, Norway and Sweden - for more than 20 years;
- Partial interconnection with radial operation of generation or passive islands without any specific DC equipment, and;
- Hybrid interconnection, mixing any of the above scenarios.

The option of an asynchronous interconnection is beyond the scope of the study, although this does not mean that such an interconnection is impossible.

Project organization

In order to pursue the feasibility study a number of bodies have been brought together or established, including:

- Project Representative Board (PRB), responsible for political communication and lobbying and which shall consist of representatives of the European Parliament, European Commission, UCTE, EPC CIS and the Baltics, TSOs and

IPS/UPS companies;

- Project Management Board (PMB), responsible for steering the project and deciding on further steps as well as approving working group progress and reports. This joint board consists of representatives from UCTE and IPS/UPS;
- Project Management comprising the project manager, an adviser and an assistant, steering the five working groups, these consist of experts from UCTE TSOs and IPS/UPS companies for joint activities.

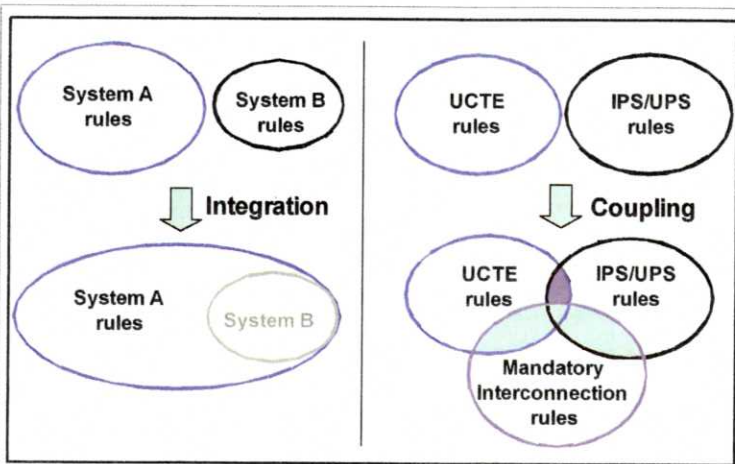


Figure 2: System integration vs. system coupling

On the basis of the findings of these groups, the total cost of the full synchronous interconnection will be evaluated and for each necessary measure, the associated costs will be assessed, with a distinction between operational and investment costs, and between IPS/UPS and UCTE.

Status of work

After the project kicked-off in April 2004 major activities have been carried out with respect to the preparation of the Terms of References (ToR), the set-up of the consortia in UCTE and IPS/UPS and an application for funding submitted to the European Commission. Moreover a web-site for the project was implemented, which comprises a public part and a password protected member-net in order to serve as a communication platform for the project members. Additionally the collaboration of the UCTE consortium with those IPS/UPS companies which are involved was fixed in a cooperation agreement.

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In addition five working groups have been established to study Steady State Analysis, System Dynamics, Power System Control, Network Operation/Organization and Legal Aspects.

The first project phase, illustrated in Figure 3 is aimed at acquiring the necessary data needed for the simulation models for investigating the study’s three principal questions.

The data collection for IPS/UPS is based on a questionnaire, developed by UCTE experts and agreed with IPS/UPS specialists. The necessary UCTE data and models have been collected individually from the TSOs and have been updated for the investigations.

The models for steady state and dynamic calculations will be verified for both individual power systems by comparison of simulated vs. measured values of the existing system. This procedure is well known and has been successfully applied by UCTE experts in former studies. Furthermore, a first common load flow model, which consists of IPS/UPS and UCTE study models, has also been successfully merged.

The forthcoming phases of the project are dedicated to the system simulation, analysis and identification of organizational and legal requirements for the development of the secure and reliable interconnected synchronous operation of both systems.

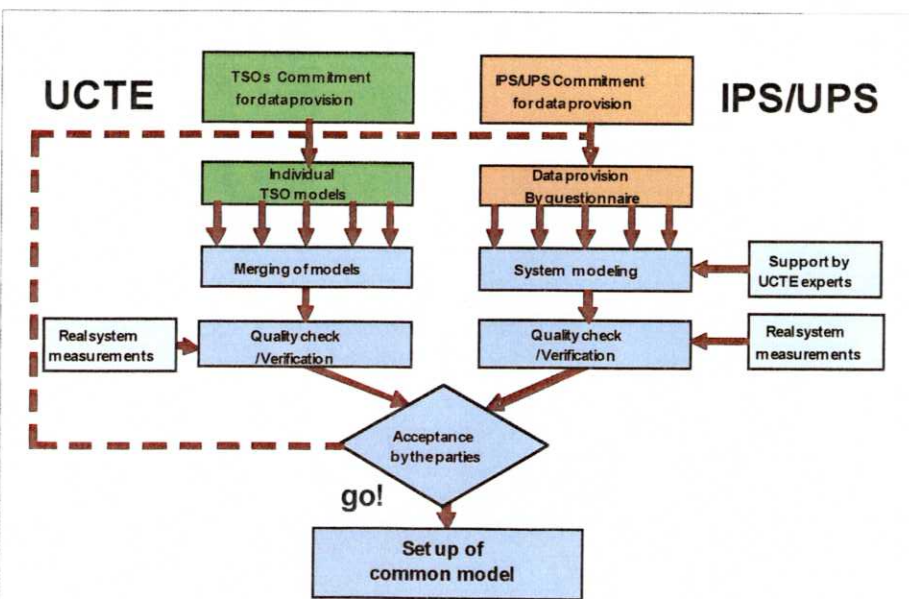


Figure 2: Principles of model building