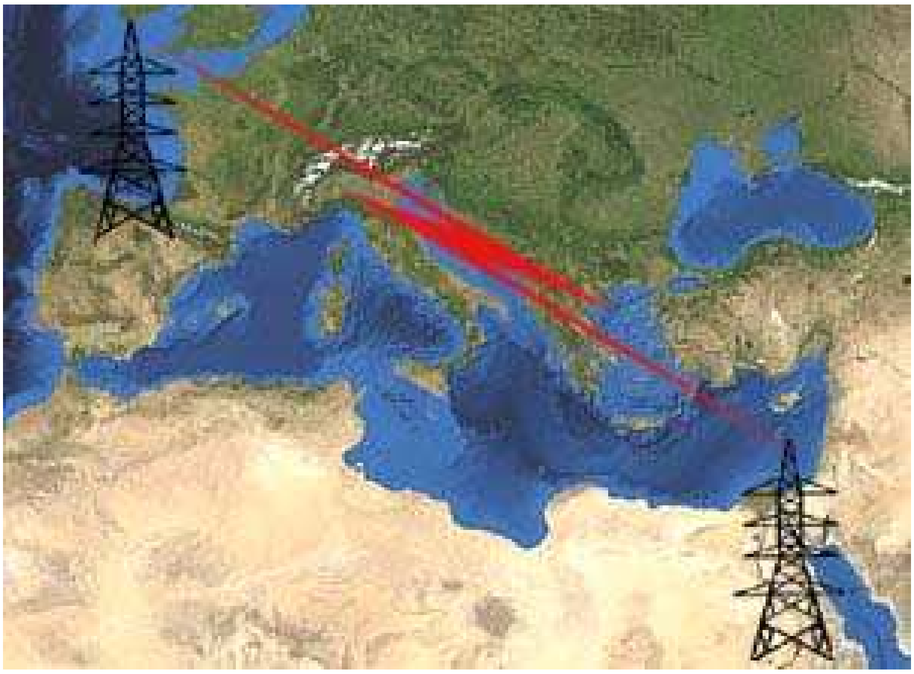
Adhoc Group on Electricity

Interconnection Rules and Practices For MedReg Countries



FINAL REPORT

November 2008

MEDREG is supported by the European Union

Interconnection Rules and Practices Survey For MedReg Countries

Executive Summary

Task forces have been formed to collect the required information for this report as follows:

- Spain is responsible for providing the principles of exchange energy between the European countries of the Mediterranean.
- Turkey is responsible for providing the contracts of exchange energy between the Balkan countries of the Mediterranean.
- Egypt and Jordan is responsible for providing the contracts of exchange energy of the neighboring Mashreq countries.
- Algeria is responsible for providing the contracts of exchange energy between the Arab Maghreb countries of the Mediterranean.

Two survey forms have been circulated among MedReg participants.
This report builds on the respondents feedback.

Chapter 1 Introduction

Based upon the MEDREG WORKPLAN 2007 , an Ad hoc group on Electricity (ELE AG) has been established since January 1st, 2007. The functionality of the ELE AG has been specified per the "MEDREG WORKPLAN 2007", "MEDREG Doc 06-06", as:

- Explore the current regulatory status of the electricity sectors in participating countries
- Explore opportunities and difficulties of further market integration from a legal, technical and economic perspectives, focusing also on cross border exchange even in terms of transparent and non-discriminatory access and, possibly, cross border tariffs mechanisms.
- Explore the issue of new interconnection and cross border exchange in terms of infrastructures development, defining common regulatory provisions. In that respect, it will start from existing developments and studies, explore difficulties encountered by operators, and outline common steps including guidelines for regulation aimed at facilitating the development of new facilities."
- Starting from the assessment of the current status of electricity markets of sector regulation in the MEDREG countries and its expected evolution, the AG on electricity will identify the basic requirements of harmonization and improvement of regulation in the MEDREG countries that are needed in order to develop an integrated, competitive and functioning electricity market in the region.

Furthermore, the group outputs over the period 2007/2009 have been specified per the group TOR "Doc Med 03-07 GA" as:

- A report on the present and the future interconnections infrastructure needs from the technical, economic, and financial perspectives, to reach the final goal of the establishment of a regional integrated electricity market.
- Recommendation on the improvement and harmonization of the regulation of the sector that are required for the development of an integrated, functioning and competitive market in the region. The recommendations will cover subjects listed in the TOR and should possibly lead to a proposal concerning common rules/guidelines to be set out in the MEDREG countries.
- a study on the present rules and practices governing exchanges among member countries
- a report on the present and the future interconnections infrastructure needs from the technical, economic, and financial perspectives, to reach the final goal of the establishment of a regional integrated electricity market
- a report on the present rules and practices governing exchange of information among member countries

The Electricity Ad hoc group has issued a report entitled "Regulatory Status and Market Implementation", to capture the electricity market status in MedReg countries. The conclusion of this report is that all countries are working towards the establishment of free electricity markets at different paces determined by internal factors. However, the core question that is standing against that transform is the financial viability of the industry. All respondent countries are still working towards that goal. Cross border trade still has the potential to grow in all MedReg regions.

Similar to the "Regulatory Status and Market Implementation" report, a report to capture the present rules and practices governing exchanges among member countries is under development. This document is the final draft of that report. MedReg participants agreed to form task forces to collect the required information for this report as follows:

- Spain is responsible for providing the principles of exchange energy between the European countries of the Mediterranean.
- Turkey is responsible for providing the contracts of exchange energy between the Balkan countries of the Mediterranean.
- Egypt and Jordan is responsible for providing the contracts of exchange energy of the seven countries.
- Algeria is responsible for providing the contracts of exchange energy between the Arab Maghreb countries of the Mediterranean.

Two survey forms have been circulated among MedReg participants. The first survey form questioned the present and future infrastructure facilities. The second survey investigated the practices that govern cross border exchange in MedReg regions. The draft report is organized in four chapters including this introductory chapter. Chapter 2 describes the interconnections facilities and operation among member countries. Chapter 3 presents the present rules and practices that govern exchange among member countries. Chapter 4 is conclusions and recommendations.

Chapter 2

Interconnection Infrastructure between MedReg Countries

The Euro-Mediterranean electric power systems of today comprise a variety of different supply systems: regional, national and supranational. Some of these systems are forming in reality a single, densely meshed system. Other systems are weakly interconnected by one or more long AC lines. Some others have to be operated as isolated systems due to geographical borders.

In a short to long-term horizon, all electrical systems located around the Mediterranean Sea will be interconnected as a result of bilateral agreements, thus forming one unique synchronous system, in the shape of a RING. This will connect - in a clockwise pattern - Western Europe to Eastern Europe, Turkey, Eastern Mediterranean countries and finally, through Egypt, south-western Mediterranean countries and again Europe (Spain).

The steps towards the complete interconnection
The envisaged steps to arrive to the closure of the Ring are as follows:

Open ring configuration
The electric power system of Libya - operated as a separate isolated system up to a few years ago - was synchronously connected to Egypt in 1998 and should be connected to Tunisia (one single circuit and one double circuit 220kV line have been already installed). When this connection is closed, the two blocks "Morocco- Algeria- Tunisia" and "Libya to Syria" will constitute one long (more than 5000 km) synchronous system, connected to the European UCTE system via Spain.

Closed ring configuration

The closure of the "Mediterranean ring" on the Eastern side will occur when the Syrian system is connected to the Turkish one, which then itself also synchronously interconnected to UCTE through Greece and Bulgaria.

The MEDREG sees the MEDRING as composed of four blocks. Those blocks are:

UCTE Block, Annex 1
UCTE - the "Union for the Co-ordination of Transmission of Electricity" - seeks at guaranteeing the security of the network to provide a reliable market base. The formation of the present UCTE system results from a series of successive interconnections of national systems. This has been realised through a step by step process, where the procedures, tests and studies were standardised, and where the new connecting countries adopted the UCTE standards.
Presently, the following requests for enlargement of the UCTE towards the establishment of the MEDRING are investigated:

- The interconnection of Turkey.
- The interconnection Tunisia - Libya that would bring the UCTE frequency up to Syria and Lebanon. Nowadays, the UCTE synchronous area comprises Morocco (linked by the AC cable with Spain), Algeria and Tunisia. The interconnection of Turkey with the UCTE grid via Greece and Bulgaria is also a pre-requisite for the feasibility of the prospective Mediterranean Synchronous Ring. However, given UCTE’s technical requirements, the synchronisation of Turkey’s power system with its Eastern and

South-Eastern neighbours cannot be realised in the short-term. Further details about the interconnection facilities are in Annex 5.

The Turkish block, Annex 2

The Turkish block includes the system of Turkey, without the isolated part of the Turkish system in the Thrace region (supplied by Bulgaria) but with the isolated part of Azerbaijan (Nahcievan) (supplied by Turkey).

According to the UCTE procedure for a planned extension of the synchronous zone, a Project Group was set up to manage the interconnection of the Turkish power system with UCTE. This Project Group is responsible for the preparatory phase and the trial parallel operation including the necessary system tests as well. The Project Group will be finished when the Turkish power system fulfils all requirements for a reliable and secure parallel operation with UCTE.

The possible synchronisation of Turkish and Syrian Power Systems has been investigated in the framework of the Mediterranean Ring study. Further details about the interconnection facilities are in Annex 5.

SEMB, Annex 3

In the south-eastern part of the Mediterranean, a synchronous block - from Libya to Syria and Lebanon has been created in recent years. This will be part of the EIJLST interconnection project aimed at interconnecting most electricity systems of the Mashreq. The project includes Turkey, Iraq and Lebanon in addition to Jordan, Egypt and Syria. At present, the synchronous area covers Libya, Egypt, Jordan, Syria and Lebanon. Both Iraq and Palestine are expected to be part of this area.

The SEMB will become candidate for synchronous interconnection with the SWMB and UCTE when the Tunisia-Libya interconnection is closed. Further details about the interconnection facilities are in Annex 5.

SWMB, Annex 4

In the south-western part of the Mediterranean, there were pre-existing interconnections between Morocco, Algeria and Tunisia. These three countries have been interconnected and operated in a synchronous mode for a long time and this block has a total installed capacity of about 13,5 GW. The connection of the Maghrebian network to that European as well as the increase in networks which constitute it tends to the evolution of the interconnections towards the installation of connections in 400 kV; this evolution is currently in hand. Further details about the interconnection facilities are in Annex 5.

SEMB-SWMB Interconnection

Still, the investigations on further interconnection of Tunisia with Libya (already forming a synchronous block with Egypt, Jordan, Lebanon and Syria) are under way. Special attention is given to inter-area oscillations, their damping (by installation and setting of Power System Stabilizers in certain units), and to defense plans, assuring that a disturbance does not propagate throughout the system.

Future Tunisia-Italy Interconnection Project

The project foresees the realization of a new generation capacity of 1,200 MW by an independent power producer (IPP) to be selected via an open procedure organised by the Tunisian government with the support of Terna (Italian TSO) and Steg (Tunisian TSO).

The selected IPP will sign a power purchase agreement with STEG for a total power of 400 MW and will be assigned 800 MW of transport capacity on the new interconnection to be realised between Italy and Tunisia.

The IPP will then be able to sell 800 MW to the Italian electricity market while feeding 400 MW in the Tunisian grid.

The fuel to be used by the new power plant will be chosen directly by the proposers in the open procedure (tendering process).

The realisation and the operation of the interconnection will be under the responsibility of a newco to be established by Terna and Steg.

Nominal voltage ±400÷500 kV DC

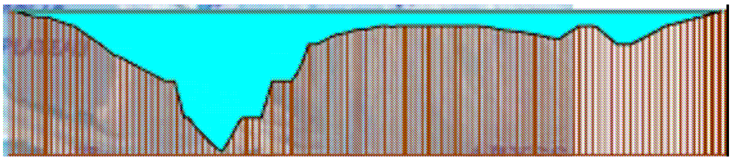
Nominal current 1250/1000 A

Total capacity 2 x 500 MW

Bi-directional power flow

Total length of the cable:

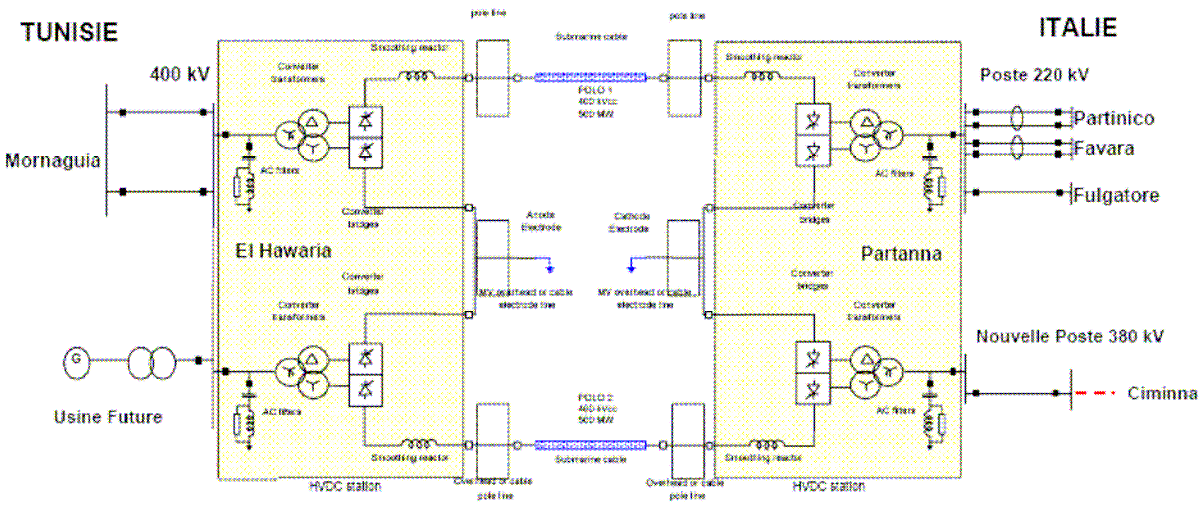
Lenght of the on-shore cable (Italian side) 32.5 km approx



total length of the sub-marine cable: 192 km

maximum depth: 750 mt

The new interconnection is expected to be realised as a “merchant interconnection” with 80% of the new total capacity to be destined to the IPP for a pre-defined duration period and 20% to other traders.



Mediterranean Interconnections Role in Renewables Promotion

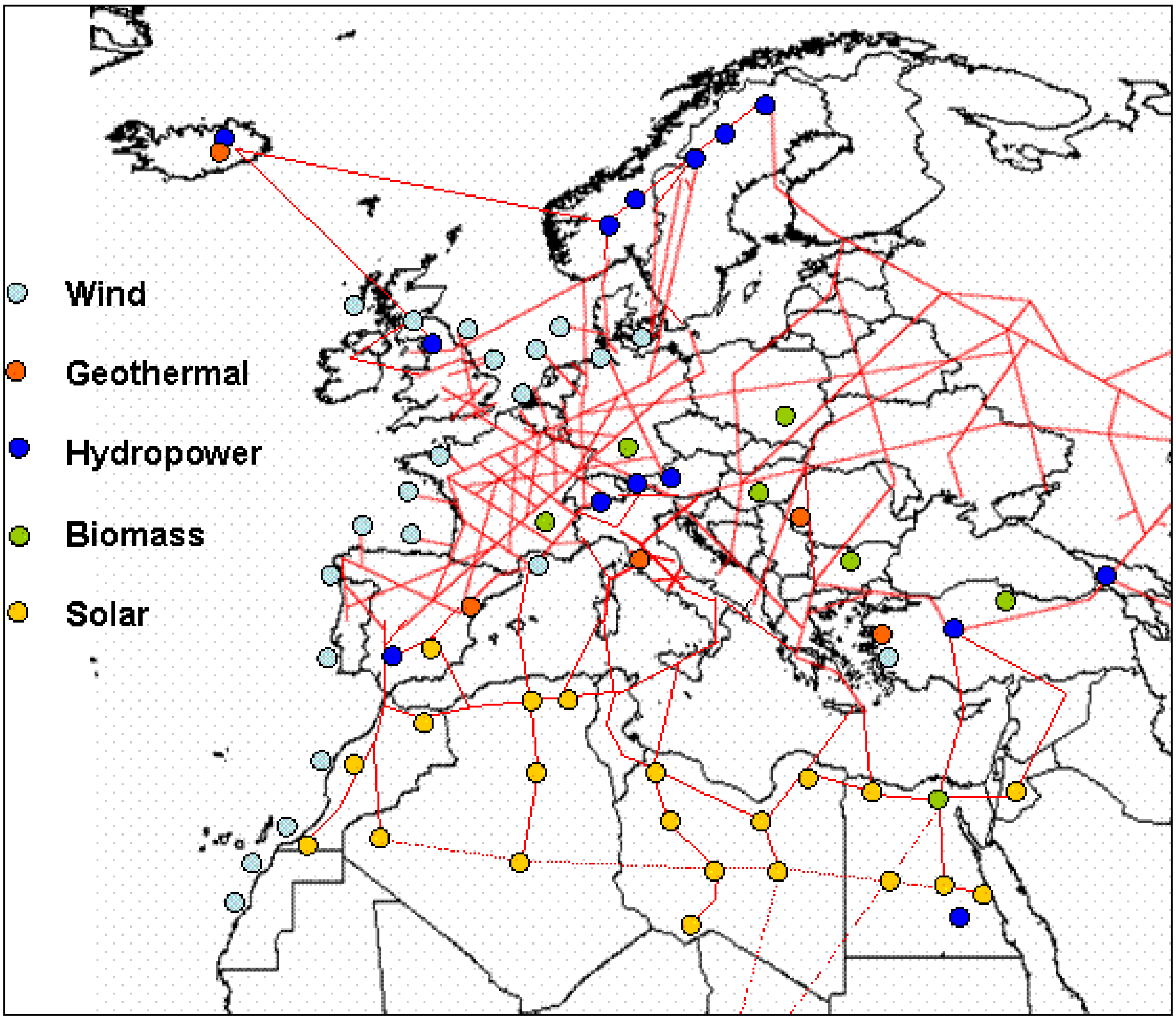
A recent study concluded that “a well balanced mix of renewable energy sources backed by fossil fuels can provide sustainable, competitive and secure electricity for Europe. For the total region, a scenario starts with a reported share of 20 % renewable electricity in the year 2000 and reaches 80 % in 2050. An efficient backup infrastructure will be necessary to complement the renewable electricity mix, providing firm capacity on demand by quickly reacting, natural gas fired peaking plants, and by an efficient grid infrastructure to distribute renewable electricity from the best centres of production to the main centres of demand”1.

However, the transfer capacities of the conventional AC grid are rather limited, and even considering that the MENA countries would empower their regional electricity grid to Central European standards and would create additional interconnections all around the Mediterranean Sea, the transfer would still be limited to about 3.5 % of the European electricity demand. Over a distance of 3000 km, about 45 % of the generated solar electricity would be lost by such a transfer.

[1] German Aerospace Center, Trans-Mediterranean Interconnection for Concentrating Solar Power”, 2006

HVDC technology is becoming increasingly important for the stabilisation of large electricity grids, especially if more and more fluctuating resources are incorporated. HVDC over long distances contributes considerably to increase the compensational effects between distant and local energy sources and allows to compensate blackouts of large power stations through distant backup capacity. It can be expected that in the long term, a HVDC backbone will be established to support the conventional European electricity grid and increase the redundancy and stability of the future power supply system.

Only 10 % of the generated electricity will be lost by HVDC transmission from MENA to Europe over 3000 km distance. In 2050, twenty power lines with 5000 MW capacity each could provide about 15 % of the European electricity demand by solar imports, motivated by their low cost of around 5 €-cent/kWh (not accounting for further cost reduction by carbon credits) and their high flexibility for base-, intermediate- and peak load operation.



Vision of an EUMENA backbone grid using HVDC power transmission technology as "Electricity Highways" to complement the conventional AC electricity grid.

Bottlenecks and Constraints

Based upon the individual regions reports and individual country surveys in Annexes 1-5, it can be drawn that the Mid Ring is facing primarily two bottlenecks. The first one is in the SEMB due to the weak connections. Efforts are already underway to devise the best solution for this problem. It is worth mentioning that the strongest interconnected systems have always started as weak ones. However an overall interconnection Master Plan for the whole Mediterranean region may unify the vision of the Mediterranean countries in that respect. One challenging aspect of the reinforcements is furnishing the required investments whether governmental, inter-governmental or private.

The other point of concern is the Turkish block, which has always been at cross roads for many goods and trades. The energization of the Turkish interconnections whether with Europe or its other many neighbours will constitute a huge step towards the establishment the Med Ring as the physical medium for the Mediterranean electricity market.

Furthermore, drawing from the report entitled, "Regulatory Status and Market Implementation", still the non-consistent approach to internal market regulation is a hurdle towards the free trade in electricity. Consequently, it is only natural to perceive harmonized internal market regulation as the first step towards the establishment of a regional market.

Indeed, the interconnection projects in the Mediterranean World (implemented or planned), cover a huge geographical area from east to west and from north to south. In such a system, power flow patterns will change from time to time. Consequently, it will include power flow conditions which have to be monitored and carefully controlled in both normal and emergency states.

In addition, World Blackout Reports identified, among other things, failures in the system that monitors the electric grid and the operators' lack of situational awareness, which was in turn the result of inadequate reliability tools and backup capabilities. These reports also provided the following recommendations for avoiding future blackouts:

- establishing requirements for collecting and reporting of data needed for post-blackout analyses;
- expanding research programs on reliability related tools and technologies;
- evaluating and adopting better real-time tools for operators and reliability coordinators
- improving the quality of system modeling data and data exchange practices;

From the abovementioned a need appears to establish a **Reliability Council** in the Mediterranean region. The Mediterranean Electric Reliability Council is to look at two aspects of bulk power system reliability: system adequacy and system security.

Chapter 3

Cross Border Trade

Guidelines Survey

This chapter investigates the rules for cross-border exchange in electricity. The conditions for access to the network for cross-border exchanges in electricity as set by the regulation (EC) No.1228/2003 are considered the state of art in preparing this document.

The chapter is composed of three sections:

i. The first section investigates the transit energy compensation among different TSOs.

ii. The second section discusses the access network charges.

iii. The third section explores information provision on interconnection capacities.

iv. The fourth section describes the question management.

Table 1 shows the summary of the surveyed data.

Inter transmission system operator compensation mechanism:

Country / Topic	Algeria	Bosnia and Herzegovina	Croatia	Egypt	EU[2]	Jordan	Tunisia	Turkey
Are there common regional rules guidelines for cross-border exchanges?	✓	✓	✓	✓	✓	✗	✓	✗
Does the transmission system operator receive compensation for costs incurred due to energy transit?	✗	✓	✓	✓	✓	✓	**N/A**	**N/A**
Which entity pays the aforementioned compensation?	N/A	Parties of the Agreement on the ITC Mechanism (national TSOs) who causes the energy transit by the net export or import of the electricity on the hourly basis.	ITC agreement 2008-2009 is adopted.	The Egyptian Electricity Holding Company (EETC).	Generally speaking, contributions are socialized through the ITC mechanism. The wheeling charges collection mechanism is described in art. 3.1 to 3.3 of EC Regulation n° 1228/2003: Transmission system operators shall receive compensation for costs incurred as a result of hosting cross-border flows of electricity on their networks**.** The compensation referred to in paragraph 1 shall be paid by the operators of national transmission systems from which cross-border flows originate and the systems where those flows end Compensation payments shall be	buyer	N/A	**N/A**

[2] From Spain On behalf of the European block.
e-mail attached

Topic	Algeria	Bosnia and Herzegovina	Croatia	Egypt	EU[2]	Jordan	Tunisia	Turkey
					made on a regular basis with regard to a given period of time in the past. Ex-post adjustments of compensation paid shall be made where necessary to reflect costs actually incurred."			
How often compensation payments are made?	**N/A**	Monthly	Monthly	Monthly	Monthly	Monthly	N/A	**N/A**
Which entity decides on the amounts of compensation payable?	**N/A**	regional organization	regional organizatio n ITC	System Operator	Transmission System Operator The compensation methodology is defined directly by the TSOs with the formal approval of the relevant National regulators.	Transmission System Operator	N/A	**N/A**
On what basis is the magnitude of cross – border flows designated?	**N/A**	Measured Physical Flows	Measured Physical Flows	Measured Physical Flows	Measured Physical Flows	Measured Physical Flows	Defense Plan	**N/A**
What are the factors considered in assessing the costs of having cross								Transmission tariffs approved by the energy regulator and published in both internet addresses of energy regulator and TSO are applied for cross border trade.
·. Losses	**N/A**	✓	✓	✓	✓	✓	N/A	✓

Topic	Algeria	Bosnia and Herzegovina	Croatia	Egypt	EU[2]	Jordan	Tunisia	Turkey
i. Investment in new infrastructure	**N/A**	✗	✓	✓	✗	✗	N/A	✓
ii. Cost of existing infrastructure	**N/A**	✓	✓	✓	✓	✗	N/A	✓
iii. Stranded costs	**N/A**	✗	✗	✓	✗	✗	N/A	✗

Charges for access to networks:

Topic \ Country	Algeria	Bosnia and Herzegovina	Croatia	Egypt	EU[3]	Jordan	Tunisia	Turkey
Do the network access charges provide locational signals?	✗	✗	✗	✗	✗	✗	N/A	✓
Which party bears the network access charges?	N/A	Customers and exporters.	Network users (deep cost of connection)	N/A	Network access charges are shared in a different way in each country, for example: France: 97.5% by consumers / 2.5% by producers Spain: 100% by consumers / 0% by producers Italy: approx. 96% by consumers / 4% by producers	buyer	N/A	Generation and consumption sides of the market
Which party pays more than the others?	N/A	N/A (Uniform network access charge)	Network users (deep cost of connection)	N/A	See above	N/A	N/A	Approximately equally shared
Are payments & receipts resulting from the energy transmitted on the national network considered in setting the charges for network access?	N/A	✓	✗	N/A	✓	✓	N/A	✗

[3] From Spain On behalf of the European block.
e-mail attached

Country / Topic	Algeria	Bosnia and Herzegovina	Croatia	Egypt	EU[3]	Jordan	Tunisia	Turkey
Do the countries of origin and destination of electricity affect network access changes?	N/A	✗	✗	✗	✗	✗	N/A	✗

Provision of information on interconnection capacities:

Country / Topic	Algeria	Bosnia and Herzegovina	Croatia	Egypt	EU[4]	ordan	Tunisia	Turkey
Are there any mechanisms for co-ordination of information exchange in place?	✓	✗	✓	✓	✓	✓	✗	✓
Are rules for safety, operational and planning standards available for public?	✓	✓	✓	✗	✓	✓	✗	✓
Do the published standards include:								
x. General scheme for the calculation of the total transfer capacity	✗	✓	✗	✓	✓	✓	N/A	✗
:. General scheme for the calculation of transmission reliability margin.	✗	✗	✗	✓	✗	✓	N/A	✗
Does the Transmission System Operator publish estimates of the available transfer capacity for each day?	✗	✓	✗	✓	✓	✓	N/A	✗

[4] From Spain On behalf of the European block.
e-mail attached

General principles of congestion managements:

Country / Topic	Algeria	Bosnia and Herzegovina	Croatia	Egypt	EU[5]	ordan	Tunisia	Turkey
Do the congestion management procedures adopted involve selection mechanism between the contracts of individual market participants?	✗	✗	✓	✗	✗	✗	N/A	✗
Do curtailed market participants who have been allocated capacity receive any compensation?	✗	✗	✗	✗	✓	✗	N/A	✗
Is the maximum capacity of the interconnection and/or the transmission networks affecting cross border flows made available to market participants?	✗	✓	✓	✓	✓	✓	N/A	✓
How much time ahead of relevant operational period do market participants need to inform the Transmission System Operator of its intent to use its allocated capacity?	For the moment there is no market. The three countries mutually go help according to capacities' of the lines and production available.	1day	1day	N/A	1day	1day	N/A	Other Following the issuance of the related license by the energy regulator, the market participant applies to TSo and realizes the electricity trade.

[5] From Spain On behalf of the European block.
e-mail attached

Country / Topic	Algeria	Bosnia and Herzegovina	Croatia	Egypt	EU[5]	ordan	Tunisia	Turkey
The revenues resulting from the allocation of interconnection is used for:								
xi. Guaranteeing the actual availability of the allocating capacity	N/A	N/A	✓	✓	✓	✓	N/A	✓
i. Network investments maintaining or increasing interconnection capacities	N/A	✓	✓	✓	✓	✗	N/A	✓
ii. As an income to be taken into account by regulatory authorities when approving the methodology of calculating network tariffs.	N/A	✓	✓	✓	✓	✗	N/A	✓
iii. Any other purpose	N/A	N/A		✗	✗	✗	N/A	✓

Discussion

Transit energy compensation among different TSOs

The survey has shown that though the UCTE and SWMB already have common regional rules for the cross border trade, still the rest of the Mediterranean ring requires the adoption of such rules and regulations. Furthermore, the survey has shown that practices differ among the different MedReg blocks.

Network access charges

All the respondents agreed that the country of origin or sink of the transit power flow does not affect network access chareges. Moreover, none included locational signals in the network access charges. However, still further harmonization required regarding payment arrangements. Furthermore, a crisp and unified methodology for network access charge is still lacking.

Information provision on interconnection capacities.

The survey showed that the mainstream of member MedReg countries had adopted varying methods of communication among different TSO. However, further effort in harmonizing the present practices so that all TSOs speak one Language is still needed.

Congestion management.

The survey showed that the mainstream of member MedReg countries agree on the general principles of congestion management. However, still a minor effort is needed to bring all the practices in line together.

Chapter 4

Conclusions and Recommendations

The report has presented the results of the two surveys circulated among MedReg participants pertaining the present interconnection infrastructure and the present cross-border governing rules and procedures. It is firmly concluded that the first step towards the establishment of a regional electricity market is the harmonization of internal market rules. Still, reinforcements for the interconnections as the physical medium of the market are in progress in different parts. Closing the ring around the Mediterrranean is awaiting removing the hurdles faced between the SEMB and SWMB interconnection and the Turkish connections. Furthermore, a panmediterranean guidlines for cross border trade still need to be put in place.

Therefore, it is recommended to establish a master plan and an entity responsible for the follow up of the required efforts for the fulfillement of this plan.

Moreover, it is recommended to establish a **Reliability Council** in the Mediterranean region. The Mediterranean Electric Reliability Council is to look at two aspects of bulk power system reliability: system adequacy and system security. A system must have enough capacity to supply power to its customers (adequacy), and it must be able to continue supplying power to its customers if some unforeseen event disturbs the system (security).

Annex 1

West South Mediterranean Countries.

ENERGY EXCHANGES WITH THE NEIGHBOURING COUNTRIES

The interconnection between the Algerian and Moroccan Power Systems is composed by the lines 220 kV Ghazaouet (Algeria) - Oujda (Morocco) and Tlemcen (Algeria) - Oujda (Morocco) commissioned June 15, 1988 and on January 16, 1992.

The interconnection between the Algerian and Tunisian Power Systems is composed by the lines: El Aouinet (Algeria) - Tajerouine (Tunisia) in 220 kV, Djebel Onk (Algeria) - Metaloui (Tunisia) in 150 KV, El Aouinet (Algeria) - Tajerouine (Tunisia) and El Kala (Algeria) - Fernana (Tunisia) in 90kV. These lines were commissioned respectively, on October 29, 1980, on April 3, 1984, on June 16, 1953 and in June 1955.

In normal operation, the exchanges of power on the interconnections are made with a tolerance of ± 10 MW during 10 minutes; the maximum energy deviation should not exceed 5MWh/h.

However, if needed, each company can ask its partner to make available power for an agreed duration.

In order to interconnect the Maghrebian and European networks and to cope with the expansion of the national grids, it was necessary to develop 400 kV grid. The lines under construction are: Hassi Ameur (Algeria) - Bourdim (Morocco) 1 and 2 El Hadjar (Algeria) - Jendouba (Tunisia).

The studies have been carried out to interconnect the Algerian and Italy Power Systems (two stages of 500 each) and Spain (2X1000 MW) in order to export to Europe done.

The Maghrebian network is a control block synchronised to the European network (UCTE). by two connections in 400 KV aero-submarine between the substations: Pinar Del Rey (Spain) and Meloussa (Morocco).

<u>MANAGEMENT OF THE EXCHANGES ON THE INTERCONNECTIONS</u>

In normal operation, exchanges could be scheduled or not scheduled (deviations). ompensations for the deviations are scheduled bilaterally according to contracts or conventions' established between the various partners (Algeria-Morocco and Algeria-Tunisia).

In scheduled mode, the exchange is limited to 100 MW between Algeria and Morocco and to 100 MW between Algeria and Tunisia.

These exchanges are defined in contracts negotiated for a duration up to three months or confirmed by messages between the systems operators in case of assistance needed by one party facing unexpected conditions. The compensation for the unscheduled deviations is done after establishment of weekly assessment or on request for assistance.

Amounts of energy to be compensated are mutually agreed and compensation will be scheduled during similar periods (full hours, peak hours and off-peak hours) during which the deviations were recorded.

DEFENCE PLAN:

Automatic Frequency Load Shedding Two thresholds of load shedding known as “of solidarity “:

1) First threshold with 49 Hz 0,2 s In Algeria 240 MW, in Morocco 160 MW and in Tunisia 80 MW;

- automatic disconnection in case of loss of synchronism
- automatic disconnection in case of overloading,

2) Second threshold with 48,5 Hz 0,2 s In Algeria 120 MW, in Morocco 80 MW and in Tunisia 40 MW.

Tie-lines opening policy

Three types of protections are installed on the tie-lines:

In order to limit the operation of overloading protections of the lines of interconnection Algeria – Morocco, following the loss of production equal or higher than a given value load will be automatically shed at the substations located at the border (Tlemcen and Ghazaouet).

- automatic disconnection in case of frequency drop : 48,2 Hz; 0,2 s for the interconnection Algeria - Morocco and 48,2 Hz; 0,2 s for the interconnection Algeria - Tunisia.

RESERVES

Primary control

In accordance with the recommendations of the UCTE, each partner must maintain for the primary adjustment a reserve of adjustment from at least 2,5% of the power developed in its network.

Nota UCTE rule in Continental Europe: Starting from undisturbed operation, the FREQUENCY DEVIATION following the simultanaeous loss of the two largest units (reference incident) must be offset by PRIMARY CONTROL alone, without the need for LOAD-SHEDDING

Secondary control

The Maghrebian network being a block (Algeria, Morocco and Tunisia) synchronised to the European network, the secondary reserve available by the three partners (Algeria, Morocco and Tunisia) shall compensate the loss of the largest unit running on the Maghrebian network.

This reserve is distributed proportionally with the maximum demand of each country: Algeria: 40% Morocco: 40% Tunisia: 20%.

Largest unit being Djerf Lesfar (Morocco) with a capacity of 320 MW, distribution of secondary by country is as follow: Algeria: 120 MW, Morocco: 120 MW, Tunisia: 80 MW.

The introduction of groups whose installed capacity higher than Djerf Lesfar (ex: a combined cycle of SK Skikda (Algeria) 412 MW) the revision of the sizing of secondary reserve is required.

Disturbances on the Maghrebian network:

Disturbances affecting one of the Maghrebian power systems (loss of generation) will modify the scheduled flow between Morocco and Spain. The Maghrebian network not having a centralised secondary control to mitigate these disturbances, each Maghrebian country shall participate in bringing back the exchange between Morocco and Spain to the agreed schedule within 15 minutes.

FACTORS FAVORABLE A a WALK MAGHREBIAN OF ELECTRICITY

Already active Co-operation between countries in the area

- Existence of an adequate framework for the technical coordination of the power systems
- Common interests and problems in the power sector
- Increase of the capacities of interconnections
- Projects under development study
- Reduction in the local risks of unavailability of energy (lack of capacity)

- Economy of scale through the size of the groups of production
- Possibilities of realization of common power stations
- Use of the primary resources of energy available in renewable area Natural gas and energies.

For Tunisia and Morocco, country which imports primary energy, the reinforcement of the interconnections is an additional alternative for the diversification of their sources of energy, The reinforced interconnections help to manage with more effectiveness the risk of start-up of the power stations within the deadlines and ensures a better safety the Maghrebian network .The lacks and surpluses of electric capacities in the various countries will give opportunity for short-term and medium term exchange between systems. The development of the 400kV interconnections between the Maghrebian countries will improve the reliability of the interconnected system. However, to guarantee an adequate transfer of power, it is necessary to define and abide to rules for the operation (Plans of defence) and coordination between the system operators of the Maghrebian countries.

Annex 2

East south Mediterranean countries.

South & East Mediterranean Electrical Interconnection

4.1 Background

The South-east Mediterranean block is composed of Egypt, Jordan, Lebanon, Libya, and Syria. The existing interconnection between these countries is summarized in Table 1.

Interconnection	Commissioning Date	Operating Voltage	Type
Egypt-Libya	1998	220 kV	OHTL Double Circuit
Egypt-Jordan	1998	400 kV	Submarine Cable
Jordan-Syria	2001	400 kV	OHTL Double Circuit
Syria-Lebanon	Expected 2008	400 kV	OHTL Single Circuit
Syria-Turkey	Upon UCTE approval	400 kV	OHTL Double Circuit
Iraq-Turkey	Yet to be started		

At present the power exchange between the member countries is based upon annual contracts among participants. Those contracts may include electric power wheeling over the network of an intermediate country.

At present power exchange contracts exist between Egypt-Jordan, Egypt-Libya, and Egypt-Syria via Jordan.

In general, the contracts in the South-eastern Mediterranean block define a maximum contracted capacity. The contract defines a capacity charge dependent on the season of the year. Energy charge is time-dependent. It generally takes the form of:

T1: Day Period (09.00 : 18.00)
T2: Peak Period (18.00 : 22.00)
T3: Off Peak Period (22.00 : 09.00)

T1= A1 * FC (HFO) + B1 * FC (LFO) + OM
T2= A2 * FC (HFO) + B2 * FC (LFO) + OM
T3= A3 * FC (HFO) + OM

Where:
A1, A2, A3: Heat Rate for steam units * % Part.
B1, B2 : Heat Rate for gas units * % Part.
FC : Fuel Cost.

An annual energy exchange schedule is agreed upon annually. However, the final schedule is communicated 24 hours ahead of the operation.

Inadvertent energy is settled weekly between neighbouring countries. A program to recapture the inadvertent energy is prepared and executed weekly among neighbouring countries.

The present practice is that the buyer bears the wheeling charge. The seller shoulders the losses in transit networks. Losses are bartered, i.e., the sending side adds the expected losses to the programmed energy transacted.

Figure 1 – shows the South East of the Mediterranean Coast SEMB current interconnection. Further basic information about existing network is in Appendix D.

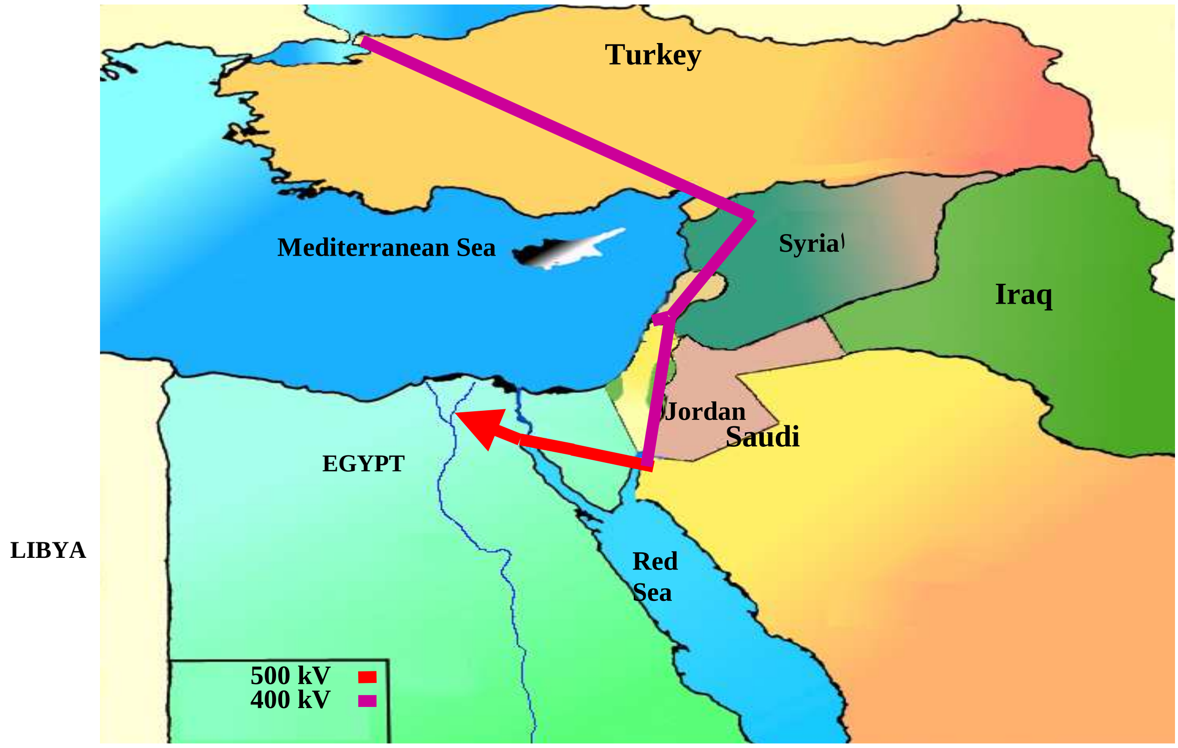


Figure 1: South East of the Mediterranean Coast SEMB interconnection

Taba transformer 500/400 is on Egypt

The other block which is called SWMB (South- Western Mediterranean Block) includes three countries (Morocco, Algeria & Tunisia). All three countries are synchronously interconnected with total installed capacity of about I5 GW against peak load of about 10 GW. This block is synchronously connected to Spain & UCTE 1 block via 400 KV submarine cable across the Straight of Gibraltar. It represents a good example of cooperation between neighboring countries. The first electrical connection between the two countries –Spain and Morocco- is a 400-kV submarine cable link 28 km (17.5 miles) long laid at a depth of 615 m (2000 ft). It was commissioned in 1997. Commercial operation of the interconnection began in May 1998, supplying energy market agents on the basis of bilateral short-term energy contracts, afterwards and by the beginning of 2007 this capacity is doubled (700 MW instead of 350 MW) after operating the second cable laid between Spain and Morocco.

Figure -2 shows the South West of the Mediterranean Coast SWMB interconnection.

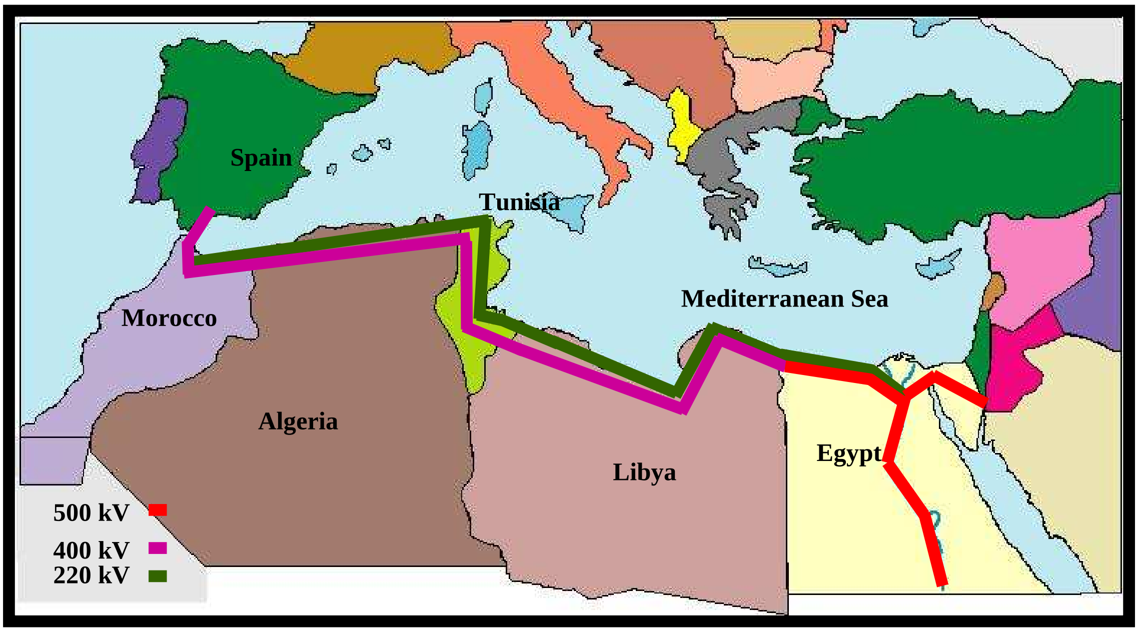


Figure 2: South West of the Mediterranean Coast SWMB

4.2 Connection of SEMB to SWMB and UCTE

The closure of SEMB , SWMB and UCTE is foreseen for the coming years, when the closing of the existing lines between Libya & Tunisia is going to be completed after finalizing the operational tests of this link started since about two years in parallel with the 380 KV line reinforcements recommended in the Maghrab Countries.

Syria – Turkey interconnection after closing the link between Libya & Tunisia would create a continuously interconnected system from the Turkish Block up to the UCTE Block. This closing is also subject to the UCTE approval.

4.3 Energy exchange in the Mediterranean region

Efforts for construction of new power plants in Northern Africa that is necessary to keep the reliability indexes and security margins in the Mediterranean can be mitigated by suitably exploiting the electrical interconnection among countries and reinforcing them to allow bigger power and energy exchange.

In the recent years, the SEMCs under-took to interconnect their power networks in order to further develop electricity exchanges.

In 2010, the SEMCs will build more than 38 GW of new natural gas power plants, which represents around 60% of the total capacity to be installed in these countries.

Annex 3

UTCE countries

Management of EU interconnections

1. Coordination of the electricity grid in continental Europe

UCTE, the association of transmission system operators in continental Europe in 24 countries, coordinates the operation and development of the electricity transmission grid and provides a reliable market platform to all participants of the Internal Electricity Market and beyond.

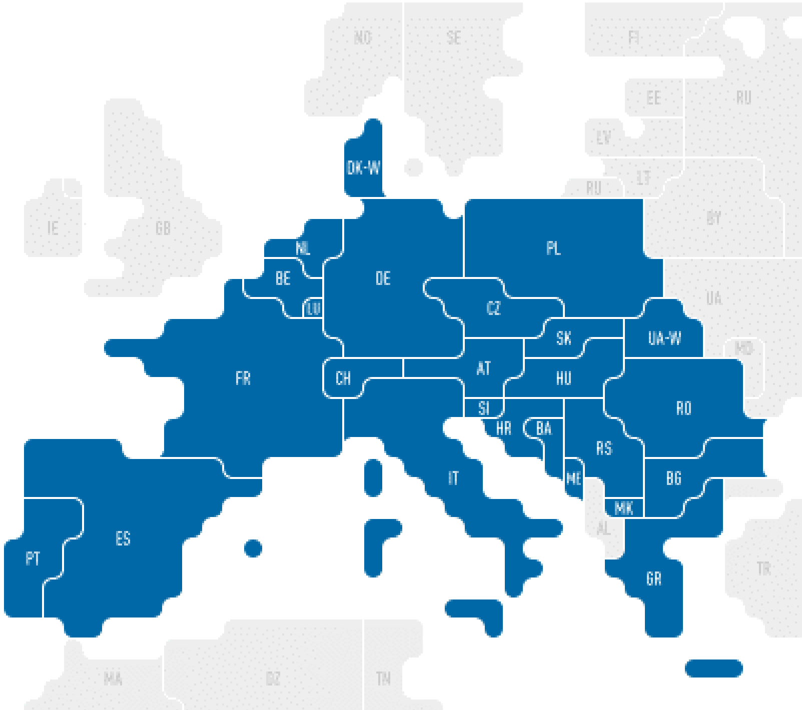


Fig 1. UCTE Member countries

UCTE stands for an efficient and secure operation of the interconnected electrical "power highways" and gives signals to markets when system adequacy declines. Over more than fifty years, UCTE has been issuing all technical standards indispensable for a co-ordination of the international operation of high voltage grids which are all working at one “heart beat”: the 50 Hz UCTE frequency related to the nominal balance between offer and demand. The UCTE network provides a safe electricity supply for 450 million people in one of the biggest electrical synchronous interconnections worldwide.

UCTE also monitors and supervises the development of the UCTE synchronous area. Presently, the following requests for enlargement of the UCTE area are investigated:

- The interconnection of Turkey.
- The interconnection Tunisia - Libya that would bring the UCTE frequency up to Syria and Lebanon. Nowadays, the UCTE synchronous area comprises Morocco (linked by the AC cable with Spain), Algeria and Tunisia. The investigations on further interconnection of Tunisia with Libya (already forming a synchronous block with Egypt, Jordan, Syria) are under way. Special attention is given to inter-area oscillations, their damping (by installation and setting of Power System Stabilizers in certain units), and to defense plans, assuring that a disturbance does not propagate throughout the system.
- And, most significantly, the assessment via a major feasibility study on the interconnection of the two largest systems (UCTE and IPS/UPS) - that would result in one electricity system spreading from Lisbon to Vladivostok.

UCTE has been monitoring for decades the adequacy (balance between generation and consumption to be steadily maintained) of the interconnected systems, giving investors and market players signals for construction of generation and transmission facilities.

Fig 2. View of the Interconnected Network of UCTE

The "UCTE Operation Handbook" is a follow-up manual to the set of rules and recommendations that have been continually developed during the decades of construction and extension of the power system since 1950, reflecting the changes which occurred in technical and political terms. This handbook is a comprehensive collection of all relevant technical standards and recommendations. It is made up from the following documents:

General part

ID	Title	Version/Date	Status
I	Introduction	v2.5/20.07.04	Final version
G	Glossary	v2.2/20.07.04	Final version

Policies

ID	Title	Version/Date	Status
P1	Load-Frequency Control and Performance	v2.2/20.07.04	Final version
P2	Scheduling and Accounting	v2.2/20.07.04	Final version
P3	Operational Security	v1.3/20.07.04	Final version
P4	Co-ordinated Operational Planning	v2.0/03.05.06	Final version
P5	Emergency Procedures	v1.0/03.05.06	Final version
P6	Communication Infrastructure	v0.9/03.05.06	Final version
P7	Data Exchanges	v0.4/03.05.06	Final version
P8	Operational Training	v0.5/06.09.07	Consultation Draft

Appendices

ID	Title	Version/Date	Status
A1	Load-Frequency Control and Performance	v1.9/20.07.04	Final version
A2	Scheduling and Accounting	v0.4/20.07.04	Final version
A4	Co-ordinated Operational Planning	v0.4/03.05.06	Final version

2. Cross-border trade through interconnections. Congestion management

The coordinated operation of the grid in Europe and the existence of interconnections among countries allow for cross-border trade of electricity among market agents. But it is a feature of the interconnected European electric power system that interconnections linking national transmission networks cannot accommodate all physical flows requested by market participants. Additionally, transmission lines within a country may be congested and not able to satisfy all the needs for transmitting electricity. Therefore, congestion management methods are applied when structural congestions exist.

According to the CM Guidelines[6] congestion management methods shall be market-based. Explicit and implicit auctions (for the interconnection capacity) are allowed for this purpose. Explicit auctions allocate just capacity (Physical Transmission Rights – PTRs) in different time-horizons while implicit auctions mean the allocation of capacity and energy at the same time. Furthermore, for intra-day trade continuous trading may be used. Explicit auctions are used at most of the European borders for long-term allocation of capacity and these are also used for short-term day-ahead allocation in continental Europe.

Moreover, it is also possible to use both methods – explicit and implicit - at the same interconnection, such as annual and monthly explicit auctions combined with day-ahead implicit auction.

In this moment there is a trend to implement day-ahead implicit auctions by means of market coupling (such as the Trilateral Coupling that comprises France, Belgium and the Netherlands) or market splitting arrangements (as it is the MIBEL or the Nordpool). In these arrangements, TSOs and PXs of different countries act in a coordinated way from the point of view of the operation of interconnections and the wholesale electricity market.

[6] Congestion Management Guidelines: Commission Decision 2006/770/EC of 9 November amending the Annex to Regulation (EC) No. 1228/2003.

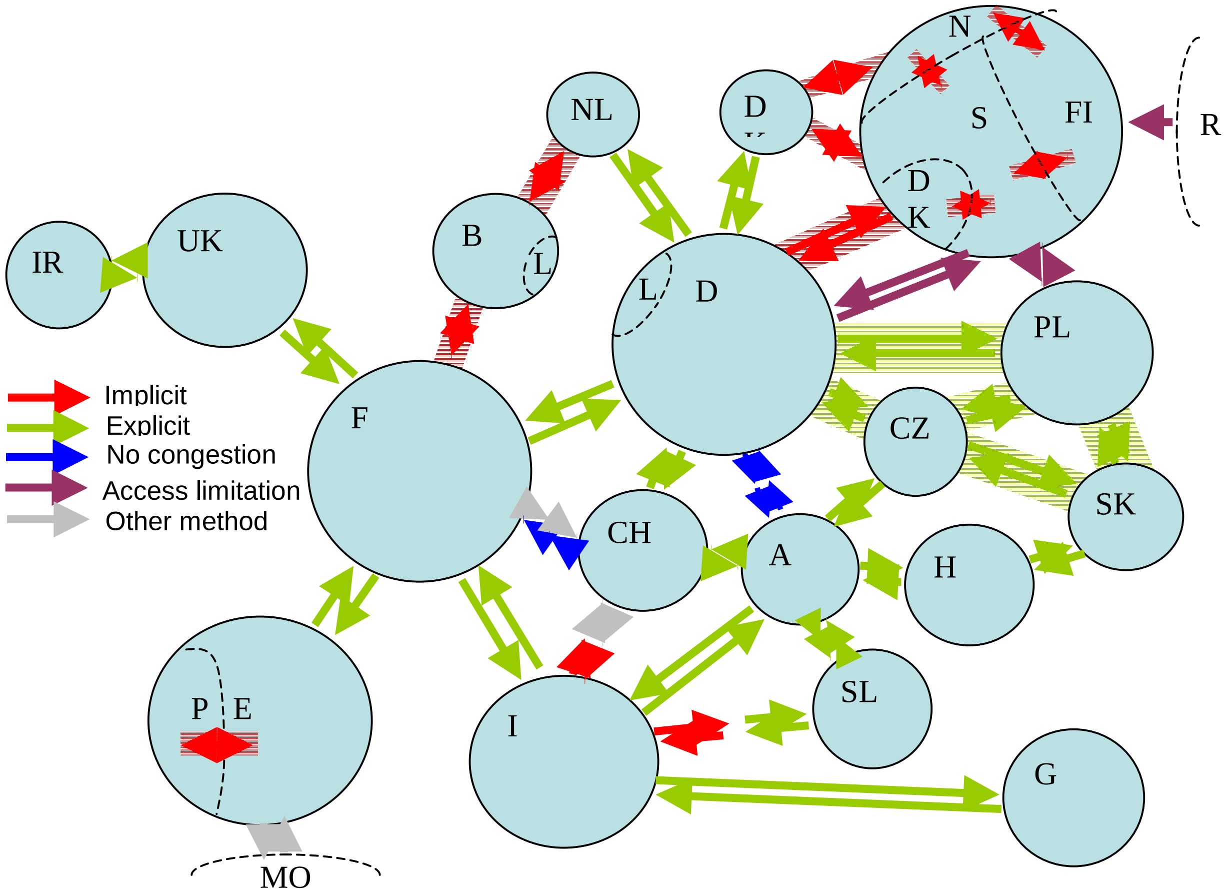


Fig 3. Day-ahead transmission capacity allocations across Europe (updated June 2007).[7]

3. Rules for electricity cross-border trade in Europe

The conditions for access to the network for electricity cross-border trade are set up by the Regulation 1228/2003/EC. This involves the establishment of a compensation scheme for cross border flows of electricity (ITC: inter-TSO compensation); the setting of harmonised principles on cross-border transmission charges; and the allocation of available capacities of interconnections between national transmission systems.

This Regulation aims to ensure non-discriminatory and cost-reflective network access conditions for cross border exchanges of electricity in order to contribute to customer choice in a well functioning internal market and to long-term security of supply.

[7] Source: Compliance with Electricity Regulation 1228/2003 - An ERGEG Monitoring Report Ref: E07-EFG-23-06. 18th July 2007

Charges for access to networks applied to producers and consumers shall be applied regardless of the countries of destination and origin, respectively, of the electricity, as specified in the underlying commercial arrangement.

In that way, it is possible for producers (and consumers) to sell (or buy) electricity in one country and to transport it to other country paying only one network access charge in the country where electricity is produced (or consumed) provided that enough capacity was acquired, implicitly or explicitly, in the interconnections to transmit the power. Afterwards, the ITC mechanism clears the compensation to other countries' TSOs.

Annex 4

Balkan countries

INTERCONNECTIONS OF TURKEY

Since synchronous parallel operation with UCTE power system is a priority for Turkey, Turkey has no plan to establish a synchronous parallel operation with its neighbours other than Bulgaria and Greece. Interconnection with Greece is planned to finish in 2008.

SYNCHRONOUS PARALLEL CONNECTIONS : Turkey has no synchronous parallel operation

at the moment. Synchronous Parallel Operation with UCTE system is planned to establish at the end of 2008.

NON SYNCHRONOUS PARALLEL CONNECTIONS :

Only one direction can be used at the same time. 3 methods are possible:

1. Unit Direction : Generation unit in Turkish power system is connected to neighbouring power system or Generation unit in neighbouring power system is connected to Turkish power system. TURKEY->NEIGHBOURING COUNTRY and NEIGHBOURING COUNTRY-> TURKEY directions are possible
2. Passive Island: Part of passive neighbouring power system is connected to Turkish power system. Only TURKEY->NEIGHBOURING COUNTRY direction is possible.
3. DC Connection: Establishing a DC back to back station Explicit auction are used on all Turkish borders for non-synchronous operation.

ARMENIA: Non Synchronous Operation. The line is disconnected. Until installation of 220/154 kV transformer at border Turkish substation, any exchange is not possible

AZERBAIJAN (Nahcievan): Non Synchronous Operation. Inter-governmental agreement exists for long term. Passive Island method is being used for TURKEY->AZERBAIJAN direction in 50 MW, 35-40 million kWh/month.
BULGARIA: Non Synchronous Operation. The lines are disconnected. Interconnection can be used until the synchronous parallel operation is realized. NTC for TURKEY->BULGARIA (unit direction method): 700 MW, NTC for BULGARIA->TURKEY (unit direction method): 550 MW. NTC values would change after connection to UCTE

GEORGIA: Non Synchronous Operation. The line is disconnected. There are new applications for using the interconnection.. NTC for TURKEY- GEORGIA (unit direction method) : 150 MW.

NTC for GEORGIA->TURKEY (unit direction method): 165 MW.

There is a new proposal to build a 400 kV DC back to back station which will be connected to Ahalsike S/S (Georgia) and Borcka S/S (Turkey).

IRAN: Non Synchronous Operation. Long Term Contract exists. Passive Island method is being used for IRAN->TURKEY direction.in 70 MW.

IRAQ: Non Synchronous Operation. Passive Island method is being used for TURKEY->IRAQ direction in 350 MW, 1.750. million kWh/year. Currently “First come first served” method is being used..

SYRIA: Non Synchronous Operation. The line is disconnected. There are new applications for using the interconnection. NTC for SYRIA- >TURKEY: 440 MW (unit direction method).

List of Respondents

Annex 5

Algeria
Croatia
Egypt
France
Greece
Italy
Jordan
Spain
Turkey

- ***The analysis of the surveyed data is under development***

Topic Country	What are the interconnected countries?	Line characteristics	What are the capacities Thermal?		What is the total transfer capacity (TTC) of the present interconnections?		What is the annual energy exchanged?		Year of commission	Phases for implementation
			Import (MW)	Export (MW)	Import (MW)	Export (MW)	Import (GWh)	Export (GWh)		
Egypt	Jordan	1. 400KV 2. Single Circuit 3. Sub marine Cable 4. -4 1. AC 13km	550	550	180	120	Year 2006 109 Year 2007 139	Year 2006 626 Year 2007 614	21/10/1998	--------------
	Libya	1. 220KV 2. Double circuit 3. Overhead 4. – 5. – 7. Ac 165Km	200	350	120	120	Year 2006 83.9 Year 2007 91.4	Year 2006 121.7 Year 2007 68.8	28/05/1998	--------------
	Syria	-----------------	------	------	------	------	------	------	---------------- -	-----------------
Jordan	Syria	1. 400kV 2. single circuit 3. Over head line	150	150	700 MVA	700 MVA	8 G.w.h	0	2001	
	Egypt	1. 400 kV 2. Submarine cable 4- core	250	250	550 MVA 500 MW	550 MVA 500 MW	199 G.w.h	0	1999	

Topic / Country	What are the interconnected countries?	Line characteristics	What are the capacities Thermal?		What is the total transfer capacity (TTC) of the present interconnections?		What is the annual energy exchanged?		Year of commission	Phases for implementation
			Import (MW)	Export (MW)	Import (MW)	Export (MW)	Import (GWh)	Export (GWh)		
Turkey	Bulgaria	1. AC 400 kV 2. 1) Babaeski (TR) - Maritsa East (III) (BG) 3. Single Line 4. Overhead 5. 2x954 MCM 6. 2x517 mm² 7. aluminum cable, steel reinforced 136km	0	0	1000 MW	1000 MW [8]	0	0	1975	3 phase
	Bulgaria	1. AC 400 kV 2. Hamitabat (TR) - Maritsa East (III) (BG) 3. Single Line 4. Overhead 5. 3x954 MCM 6. 3x547 mm² 7. aluminum cable, steel reinforced 150km	0	0	2000 MW	2000 MW [9]	0	0	2002	3 phase

[8] This capacity is Thermal Capacity of the interconnection lines and NTC (Net Transfer Capacity) between neighbouring countries. NTC are much lower than this capacity depending on the season of the exchange.

[9] Capacity is limited by regional transmission system and 220/154 kV transformers capacity, for island mode operation

Topic / Country	What are the interconnected countries?	Line characteristics	What are the capacities Thermal?		What is the total transfer capacity (TTC) of the present interconnections?		What is the annual energy exchanged?		Year of commission	Phases for implementation
			Import (MW)	Export (MW)	Import (MW)	Export (MW)	Import (GWh)	Export (GWh)		
	Greece	1. AC 400 kV 2. Single Line 3. Overhead 4. 3x954 MCM 5. 3x547 mm² 6. aluminum cable, steel reinforced 7. 200km	180 MW (temporary)	180 MW (temporary)	180MW (temporary for island mode interconnection .2.00 MW 1(after	180MW (temporary for island mode interconnection .2.00 MW 1(after	90.000. (only two month	90.000. (only two month	2008	3 phase
	Georgia	1. AC 220 kV 2. Babaeski (TR -(Nea Santa (GR)(The line is under construction to be commissioned in 2008) 3. Single Line 4. Overhead 5. 954MCM 6. 517mm² 7. aluminum cable, steel reinforced 28km	75 MW	75 MW	300 MW	300 MW	150.000.	150.000.	1970	3 phase
	Armenia	1. AC 220 kV 2. Kars (TR)- Gumri (AM) 3. Single Line 4. Overhead 5. 2x954 MCM 6. 2X546 mm² 7. aluminum cable, steel reinforced 78.4 km	0	0	100 MW	100 MW	0	0		3 phase

Topic / Country	What are the interconnected countries?	Line characteristics	What are the capacities Thermal?		What is the total transfer capacity (TTC) of the present interconnections?		What is the annual energy exchanged?		Year of commission	Phases for implementation
			Import (MW)	Export (MW)	Import (MW)	Export (MW)	Import (GWh)	Export (GWh)		
	Iraq	1. AC 400 kV 2. PS3 (TR)- Zakho 3. Single Line 4. Overhead 5. 2x954 MCM 6. 2x547 mm² 7. aluminum cable, steel reinforced 16km		300 MW	350 MW	350 MW	1.750.000.	1.750.000.	1995	3 phase
	Nahcievan	1. AC 154 kV 2. Iğdır (TR)-Babek 3. Double circuit 4. Overhead 5. 477MCM 6. 281mm² 7. aluminum cable, steel reinforced 87.3km		50 MW	100 MW	100 MW	420.000.	420.000.	1992	3 phase
	Iran	1. AC 154 kV 2. D.Beyazıt (TR)-Bazargan (IR) 3. Single Line 4. Overhead 5. 954MCM 6. 547mm² 7. aluminum cable, steel reinforced 73km	0	0	100 MW	100 MW			1996	3 phase

Topic / Country	What are the interconnected countries?	Line characteristics	What are the capacities Thermal?		What is the total transfer capacity (TTC) of the present interconnections?		What is the annual energy exchanged?		Year of commission	Phases for implementation
			Import (MW)	Export (MW)	Import (MW)	Export (MW)	Import (GWh)	Export (GWh)		
	Iran	1. AC 400 kV 2. Başkale (TR)- Khoy (IR) 3. Single Line 4. Overhead 5. 3x954 MCM 6. 3x547 mm² 7. aluminum cable, steel reinforced 100km	70 MW		450 MW	450 MW	1000 MW	1000 MW	2003	3 phase
	Syria	1. AC 400 kV 2. Birecik (TR)- Aleppo (SR) 3. Single Line 4. Overhead 5. 2x954 MCM 6. 2x547 mm² 7. aluminum cable, steel reinforced 124km		440 MW	100 MW	100 MW	130	122	2003	3 phase
Algeria	Tunisia	1. 1x220, 1x150 2x90 2. 4xSL 3. O AC	100	100	100 MW	100 MW	125	152	1954 1980 1984	
	Morocco	1. 220 2. 2XSL 3. O 4. 411mm2 5. Al Acier (Steel) AC	100	100	600 MW	650 MW	12 GWh	3.530 GWh	1988 1992	

Topic / Country	What are the interconnected countries?	Line characteristics	What are the capacities Thermal?		What is the total transfer capacity (TTC) of the present interconnections?		What is the annual energy exchanged?		Year of commission	Phases for implementation
			Import (MW)	Export (MW)	Import (MW)	Export (MW)	Import (GWh)	Export (GWh)		
Spain	Morocco	400 kV	0 MW (min) and 600 MW (max)	0 MW (min) and 650 MW (max)	1.700 MW	1.700 MW	2.315 GWh	9.695 GWh		
	Portugal	400 kV / 220 kV / 132 kV / 66 kV / 15 kV	700 MW (min) and 1400 MW (max)	1400 MW (min) and 1600 MW (max)	133 MW	133 MW	0 GWh	260 GWh		
	Andorra	110 kV	133 MW	133 MW	1.400 MW	500 MW	6.425 GWh	1.328 GWh		
	France	400 kV / 220 kV / 132 kV / 110 kV	600 MW (min) and 1300 MW (max)	300 MW	2650 MW	1160 MW	15132	1154		
France	Spain	150, 225 and 400 kV			1160 MW	2350 MW				
	United Kingdom	270 kV dc			300 MW	1400 MW				
	Belgium	63, 225 and 400 kV ac			2000 MW	2000 MW				
	Germany	225 and 400 kV ac			1500 MW	3400 MW				
	Switzerland	63, 150, 225 and 400 kV ac			5300 MW	2200 MW				
	Italy	63, 150, 225 and 400 kV ac and 220 kV dc			500 MW	500 MW				
Italy	France	3x 380 kV lines 5x 220 kV lines AC lines only	---	---	220 MW	100 MW	1405	---		

Topic / Country	What are the interconnected countries?	Line characteristics	What are the capacities Thermal?		What is the total transfer capacity (TTC) of the present interconnections?		What is the annual energy exchanged?		Year of commission	Phases for implementation
			Import (MW)	Export (MW)	Import (MW)	Export (MW)	Import (GWh)	Export (GWh)		
	Switzerland	4x 380 kV lines 1x 220 kV line 1x 132 kV line AC lines only	600 MW	---	>1800 MW[10]	3200 MW				
	Slovenia	1x 380 kV line 1x 220 kV line AC lines only	----	----	500 MW	500 MW	170	1131		
	Austria	1 x 220 kV AC line	----	----	430 MW	180 MW	3233	295		
	Greece	1 x 400 kV DC line	----	----	4090 MW	1760 MW	28859	66		
Greece	Italy	1. kV 2. .Overhead + underwater cable 3. – 4. DC 5. o/h line:105 km on Greek territory , 45km in IT Cable: 160 km	----	-----	650 MW	600 MW	Year 2007 1128.7	Year 2007 173.5		
	Albania	1. kV 2. Single circuit 3. Overhead 4. 2conductors / phase 5. 2x483 mm2 6. ACSR 7. AC 49km	----	----	650 MW	600 MW	Year 2007 57	Year 2007 1773.2		

[10] In the Switzerland-France direction, there has never been any congestion. Consequently there is no calculation of capacity. If there were, this capacity would be greater than 1800 MW because such a flow has already been observed.

Topic / Country	What are the interconnected countries?	Line characteristics	What are the capacities Thermal?		What is the total transfer capacity (TTC) of the present interconnections?		What is the annual energy exchanged?		Year of commission	Phases for implementation
			Import (MW)	Export (MW)	Import (MW)	Export (MW)	Import (GWh)	Export (GWh)		
	Fyrom	1. 400 kV 2. Single circuit 3. overhead 4. 2 conductors / phase 5. 2x483 mm^2 6. ACSR 7. AC 8. 60.5 km / 17.5 km	----	----	650 MW	600 MW	Year 2007 900.5	Year 2007 110.5		
	Bulgaria	1. 400 kV 2. Single circuit 3. overhead 4. 2 conductors / phase 5. 2x483 mm^2 6. ACSR 7. AC 102 km	----	----	650 MW	600 MW	Year 2007 4293.4	Year 2007 0		
	Turkey	1. 400 kV 2. single circuit 3. overhead 4. 3 conductors / phase (B´B´B´) 5. 3x483 mm^2 6. ACSR 7. AC 74.5 km	----	----	----	----	Year 2007 88.7	Year 2007 2		
Croatia	Slovenia	400 kV, 220 kV	Auctions	Auctions	300 MW	300 MW	1011,4 GWh	-8098,6 GWh		
	Hungary	400 kV	Auctions	Auctions	225 MW	100 MW	6690,0 GWh	0,0 GWh		
	Serbia	400 kV	Auctions	Auctions	50 MW	50 MW	4129,7 GWh	-0,7 GWh		

Topic / Country	What are the interconnected countries?	Line characteristics	What are the capacities Thermal?		What is the total transfer capacity (TTC) of the present interconnections?		What is the annual energy exchanged?		Year of commission	Phases for implementation
			Import (MW)	Export (MW)	Import (MW)	Export (MW)	Import (GWh)	Export (GWh)		
	Bosnia and Herzegovina	400 kV, 220 kV	Auctions	Auctions	175 MW	175 MW	2761,5 GWh	-1382,4 GWh		

Total Transfer Capacity (TTC)

TOTAL TRANSFER CAPACITY is the maximum EXCHANGE PROGRAM between two ADJACENT CONTROL AREAS that is compatible with operational security standards applied in each system (e.g. GridCodes) if
future network conditions, generation and load patterns are perfectly known in advance.

Two mechanisms based on auctions are the cornerstones of the newly created electricity markets.

- First the so-called **implicit auctions** are called "implicit" in the sense that the available transmission capacities are directly taken into account in the selection process of energy bids and offers by the market operator. In other terms, it consists in dealing simultaneously with transmission capacities and energy. The resulting price of the congestion can be inferred from the energy prices and corresponds to the difference in the energy prices on either side of the congested path.
- In the so-called **explicit auctions**, transmission bids and energy bids are sequentially separated.

PX power exchange An organization established to facilitate the trading of and creation of a spot market for electricity. ...

Market coupling is a method for integrating electricity markets in different areas. With market coupling the daily cross-border transmission capacity between the various areas is not explicitly auctioned among the market parties, but is implicitly made available via energy transactions on the power exchanges on either side of the border (hence the term implicit auction).