Deliverable 1.1 Starting Regulatory Framework (SRF)

Compendium and Summary of relevant codes/regulations/ contracts and practices, both existing and short-term expected, in Med-TSO systems

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"Mediterranean Project"

Task 1 "Common Set of Rules for a Mediterranean Power System and Transmission Grid Code"

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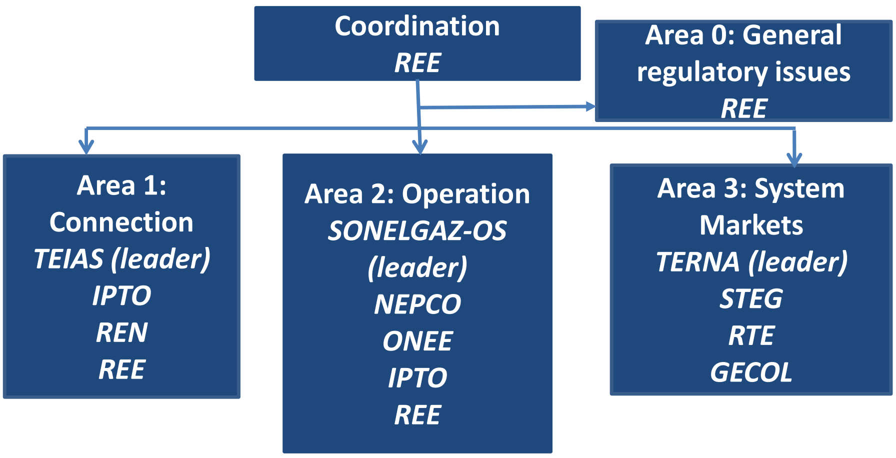
0. Executive summary

The present report constitutes the final deliverable of Subtask 1.1 of the Mediterranean Project. As detailed in Chapter 1, the overall objective of this Subtask has been to collect, analyse and summarise the current regulatory framework (understood here as rules –mainly technical- concerning the TSOs functions and obligations) for the Mediterranenan region in the following thematic fields:

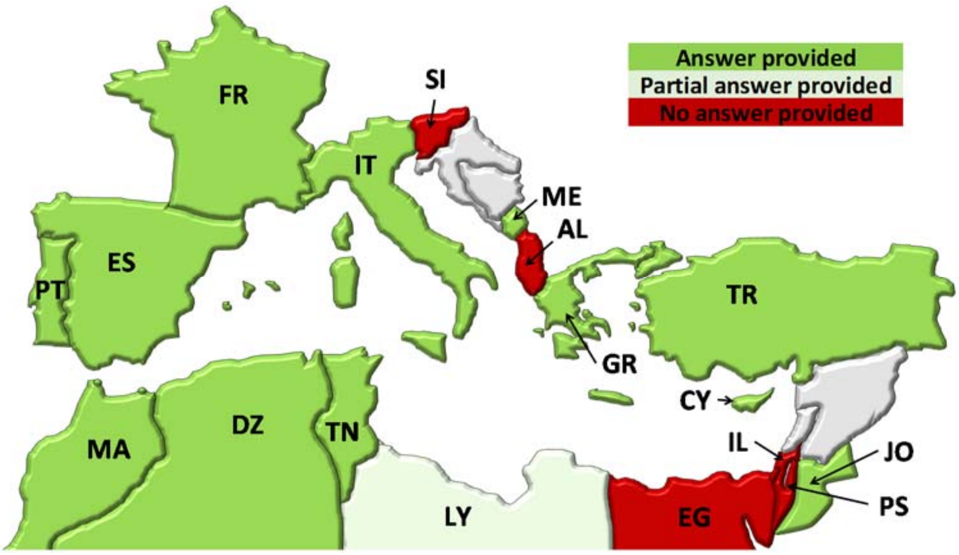
- Connection of users (generation, distribution and consumption units) to the grid.
- Operation of the interconnected systems.
- Markets; particularly those associated to the system services management.

Main figures of the power systems within the Region are introduced in Chapter 2. Besides, this includes relevant references in regulatory harmonization. The most relevant may be the European Network Codes (or Guidelines), currently approved (or under development), which are (or will be) directly binding in all EU countries, with no further need for transposing within national regulation when approved and published in the Official Journal of the European Union. Other initiatives in the region to be highlighted are COMELEC (*Comité Maghrébin de l'Electricité*), IESOE (*Electricity Interconnection in South-Western Europe*) or the eight countries (EIJLLPST) interconnection project, as well as some other projects (Maghreb Internal Market Project, Paving the Way, Medgrid). However, the scope of the current document has not been covered in the mentioned references with the required detail.

The work has been performed by MedTSO Technical Committee 2 (TC2), maximizing the internal participation of TSOs members of the association. The methodology used for obtaining the current regulatory status (detailed in Chapter 3) has been based on surveys about the regulatory framework in each power system. In order to analyze the results received from TSOs, specific task forces were created between TC2 members maximizing TSOs involvement according to the following structure:



The current situation in 13 power systems around the Mediteranean region has been collected and is included in this report. The preliminary analysis has been performed thanks to the direct participation of national TSO experts in meetings and dedicated workshops.



Prior to the above mentioned thematic fields, some general issues have been analysed concerning structure and roles of the different actors –particularly TSOs- when rules are to be approved and implemented. The analysis of this general issues shows an uneven degree of harmonisation; for instance, while the distribution of competences within the rules implementation chain (between Ministry, NRA and TSO) may be considered rather similar in all MedTSO countries, this is not the case for other major primary aspects which could be considered as high level regulation (e.g., unbundling levels are more heterogeneous and harmonisation is not foreseen in the near future in most non-European countries).

The level of regulatory harmonization of each technical issue from the different areas (connection, operation and system markets) has been analysed in detail and is presented in Chapter 4.

The main conclusions of the analysis carried out in three different areas referred above are presented in Chapter 6, and summarised next:

- Issues related to real time operation of interconnected systems have a higher degree of harmonization, especially technical requirements. However, the analysis of other issues such as reserves management and load frequency control shows that many differences appear between different power systems.
- Issues related to connection to the grid are subject to a more heterogenous spectrum. While some aspects such as the development of demand side response services or the control requirements between TSO and non-transmission facilities are highly harmonized; others still need an effort to be made in order to be more equal and homogenous in the future.
- Concerning system market issues, the structure of the market around the region is based on two reference models: a market based, typically European systems adhering to the ENTSO-E perimeter; and a non-market based, typically North African and Middle East systems. Regarding the analysis of the rules and methodology for capacity calculation and allocation, it is also quite different around the region. General principles (like the N-1 criteria) are quite similar but specific details in each power system are significantly different and need to be heavily harmonized.

Although as a primary conclusion we may highlight that full harmonization is not yet achieved in any issue and all those analysed need to be further harmonized in some degree, in order to give a general view of the level of harmonization a simplified classification is summarised in the next Table (which for the mentioned reasons must be understood as relative; i.e., high harmonisation is not total).

	HIGH	MEDIUM	LOW
CONNECTION	Control reqs. DSR services	Connection procedure Frequency reqs. Voltage reqs. Short circuit reqs. Power quality Restoration capabilities Compliance	Reactive power reqs.
OPERATION	System states Technical reqs. Outage coordination Dispatch priority	Information Exchange Contingency Analysis Dynamic stability Studies Management exchange programs System defense and restoration Training and certification	Load frequency control Reserves management HVDC operation
SYSTEM MARKETS		Monitoring and settlement	Legal issues Capacity calculation Capacity allocation Dispatching and balancing

In Chapter 5, an advance with some initial considerations regarding the rules implementation format is presented, anticipating that an important analysis and discussion will be needed in order to decide on the right combination of internal and external regulation to be applied to the technical issues (grid codes, contracts/agreements between TSOs or between TSOs and agents, etc.).

Once the analysis of the present situation has been carried out, Chapter 7 introduces the next steps, which will be focused on prioritizing issues to be commonly regulated and the decision on which rules format need to be adopted for each purpose. With this analysis completed, a proposal of a potential common regulatory framework in the Mediteranean region (including a draft roadmap for adoption and compliance) will be elaborated according to Subtask 1.2 of the Mediterranean Project.

1. Scope of the document and background

The overall objective of this document on Starting Regulatory Framework (SRF) is to present an overview and overall analysis of the electric sector regulatory framework in the MedTSO[1] countries of the Mediterranean region (see point 3 for more details). In particular, the present document is devoted to those rules related to TSOs responsibilities and functions, which are associated to the following fields:

- Connection of users (generation, distribution and consumption units) to the grid.
- Operation of the interconnected systems.
- Markets; particularly those associated to the system services management.

In this regard, the term "Starting" should be understood referring not only to the current regulation, but also to the expected regulatory developments in the near future for the Mediterranean power systems.

This objective (SRF) is framed within a more general purpose of advancing towards harmonisation of rules for the coordinated operation and development of interconnected systems in those aspects more related with the TSOs activities.

There are a number of drivers behind the convenience of extension of interconnected systems: on one hand there are benefits related to the enhanced security of supply and reliability provided by interconnections, and on the other hand there are benefits in terms of economic efficiency, from the extension of the commercial possibilities for the market agents to the advance in the standardisation for stakeholders (agent, equipment builders, …). The key point in this harmonisation process is to identify the set of rules which should be shared among the subjects in the different power systems, so that we capture the beneficial effects of the extended interconnection, while preserving the above-mentioned drivers of security and economic efficiency.

Due to this general purpose, MedTSO has included within its currently ongoing **MedTSO´s Action Plan 2015-2017** the Task of elaborating a **Common Set of Rules for a Mediterranean Power System**, which has also been incorporated within the **Mediterranean Project**[2] as Task 1, whose final objective is to develop a common draft set of basic network codes or rules applicable to the power systems of MedTSO member countries. This Task is being developed by MedTSO Technical Committee on Regulation and Institutions (TC2) with the support and contribution of all its members. The present document constitutes the deliverable D1.1, as a result of Subtask 1.1 within Task 1 of the Mediterranean Project, which is structured as follows:

[1] MedTSO is an Association of Mediterranean TSOs, established in Rome in 2012 with 15 founding members, having recently reached 18 TSOs members from 18 different countries.

[2] The Mediterranean Project integrates the main activities of the MedTSO´s Action Plan 2015-2017, and it is partially supported by European Commission (EC), having been signed between EC and MedTSO in December 2014 and officially started in February 2015.

- Activity 1.1. Compilation of relevant regulatory framework
  - Deliverable 1.1 Starting Regulatory Framework.

- Activity 1.2. Elaboration of common target regulatory framework.
  - Deliverable 1.2.1. Proposal of Common Target Regulatory Framework.
  - Deliverable 1.2.2. Proposal of tentative roadmap.

- Activity 1.3. Elaboration of draft set of Mediterranean network rules.
  - Deliverable 1.3. Models of rules and contracts.

2. Mediterranean region

The Mediterranean region includes power systems from 3 different continents (Africa, Asia and Europe) and, considering seaside countries and those relevant in electric international interconnections existing or foreseen, is composed of more than 20 countries (from Portugal to Jordan, from Morocco to Turkey).

Figure 1 shows the countries which may be included in the Mediterranean region, emphasizing the largest majority of these countries (18) which have currently their TSOs as MedTSO members.

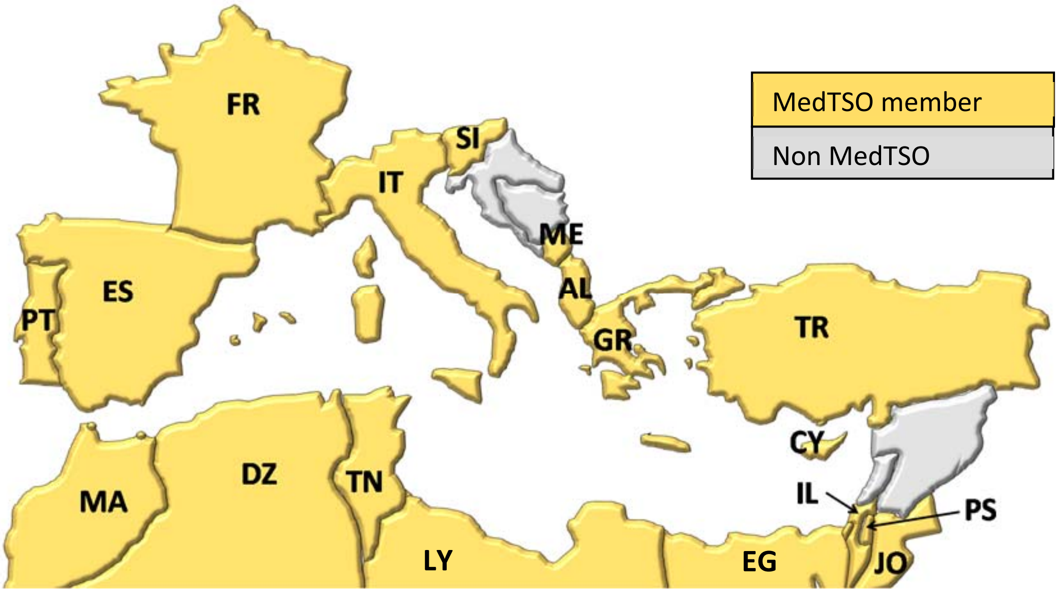


Figure 1. Mediterranean region and MedTSO members

The Table 1 shows the main figures of the electric systems within the Mediterranean region corresponding to 2015, in terms of annual energy demand and installed generation capacity.

Country Name	Country Code	Energy Demand [TWh in 2015]	Installed capacity [GW end of 2015]	Peak load [GW in 2015]
Albania	AL	(2014) 7,8	(2014) 1,8	(2014) 1,5
Algeria	DZ	(2014) 60,5	(2014) 16	(2014) 10,9
Bosnia & Herzegovina	*BA*	*(2014) 12,2*	*(2014) 4*	*(2014) 2,1*
Croatia	*HR*	*(2013) 17,7*	*(2013) 4,3*	*(2013) 2,8*
Cyprus	CY	4,54	1,7	1,0
Egypt	EG	(2013) 140	(2013) 27	(2013) 27
France	FR	(2014) 465	(2014) 129	(2014) 82,5
Greece	GR	51,5	18	9,8
Israel	IL	(2014) 50	(2014) 13	(2014) 12
Italy	IT	315	122	59,35
Jordan	JO	18,5	4,1	3,3
Lebanon	*LB*	*(2014) 13*	*(2014) 2,5*	*(2014) 2,45*
Libya	LY	(2013) 28	(2013) 8	(2013) 6
Malta	*MT*	*(2014) 2*	*(2014) 0,6*	*(2014) 0,44*
Morocco	MA	34	8,1	5,8
Montenegro	ME	(2014) 3,3	(2014) 0,9	(2014) 0,6
Palestine	PS	(2014) 1,3	(2014) 0,06	(2010) 0,76
Portugal	PT	49	18,79	8,62
Slovenia	SL	(2014) 12,5	(2014) 3,6	(2014) 2
Spain	ES	263	103	40,3
Syria	*SY*	*(2012) 30*	*(2012) 9*	*(2010) 7,8*
Tunisia	TN	18,25	5,22	3,6
Turkey	TR	(2014) 255	(2014) 69,5	(2014) 40
Total MedTSO systems		**1.777,19**	**549,77**	**315,03**
Total Mediterranean region		**1.852,09**	**570,17**	**330,62**

Table 1. Main power features (round figures) of Mediterranean systems
(Source: TSOs information for MedTSO systems; publically available information for others)

Total electric energy demand in the Mediterranean region is around 1.850 TWh with more than 570 GW of installed generation capacity.

The Figure 2 shows the expected situation regarding electric interconnections between MedTSO countries and with the non-MedTSO countries in 2030 (links show interfaces between countries with existing interconnections or already planned interconnections).

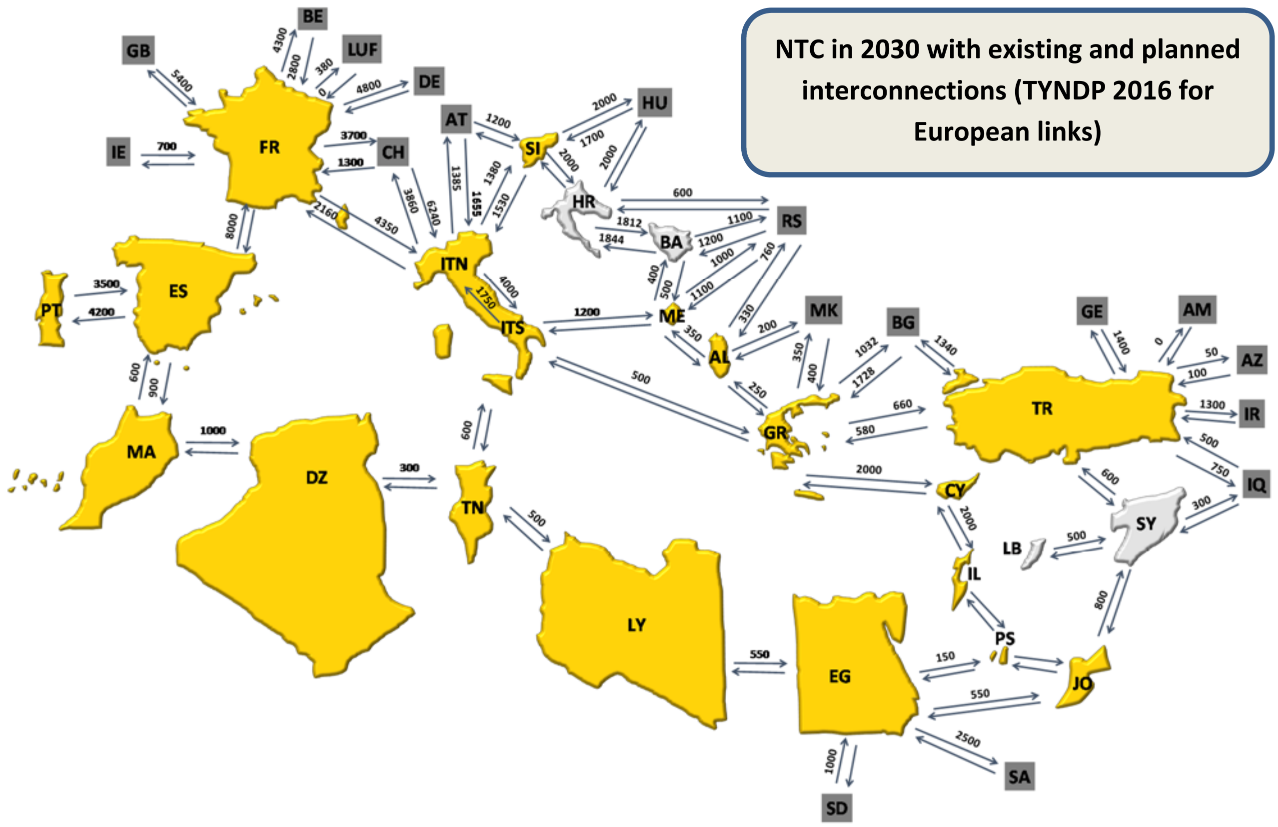


Figure 2. International links with existing and already planned interconnections in the Mediterranean Region in 2030 (NTC values in MW)

Regarding rules harmonisation, it is important to take into account the current situation of the different Mediterranean power systems, which is not homogeneous but it includes a wide variety of advances regarding the integration of national electric systems and markets.

For the realisation of the Mediterranean Project, and more particularly for the elaboration of this document, relevant references of cooperation between Mediterranean countries and system coordination must be considered.

European Union (EU) MedTSO members, which are also part of ENTSO-E, belong to an integrated area which is nowadays advancing towards a real internal energy market (besides, TEIAS has recently joined ENTSO-E as observer member).

Table 2 shows the TSOs within MedTSO operating power systems of EU countries (7 out of the 18 current TSOs belonging to MedTSO).

EU TSOs		Non EU TSOs	
TSO	***Country***	***TSO***	***Country***
CYPRUS TSO	Cyprus	CGES	Montenegro
ELES	Slovenia	EETC	Egypt
IPTO	Greece	GECOL	Libya
REE	Spain	IEC	Israel
REN	Portugal	NEPCO	Jordan
RTE	France	ONEE	Morocco
TERNA	Italy	OST	Albania
		PETL	Palestine
		SONELGAZ/OS/GRTE	Algeria
		STEG	Tunisia
		TEIAS	Turkey

Table 2. MedTSO members (as of February 2016)

Precisely, the European Union provides nowadays one of the main worldwide references in terms of international rules harmonisation process for the electricity sector: the European **"Network Codes"** (or **"Guidelines")**, which are (or will be once finally approved and published in the Official Journal of the European Union) directly binding in all countries, with no further need for transposing within national regulation. European Network Codes (NCs) are sets of rules which apply to one or more parts of the energy sector. The need for those rules was identified during the course of developing the "***Third Energy Package***". More specifically, *Regulation (EC) 714/2009 of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity* sets out the areas in which NCs should be developed and the process for elaboration up to their entry into force.

NCs are drafted by ENTSO-E, with guidance from the Agency for the Cooperation of Energy Regulators (ACER). The objective of such rules is to facilitate the harmonisation, integration and efficiency of the European electricity market. Each NC is an integral part of the drive towards completion of the internal energy market, and achieving the European Union's 20-20-20 energy objectives. NCs cover 3 key areas of the European electricity transmission sector: grid connection, system operation and market related aspects.

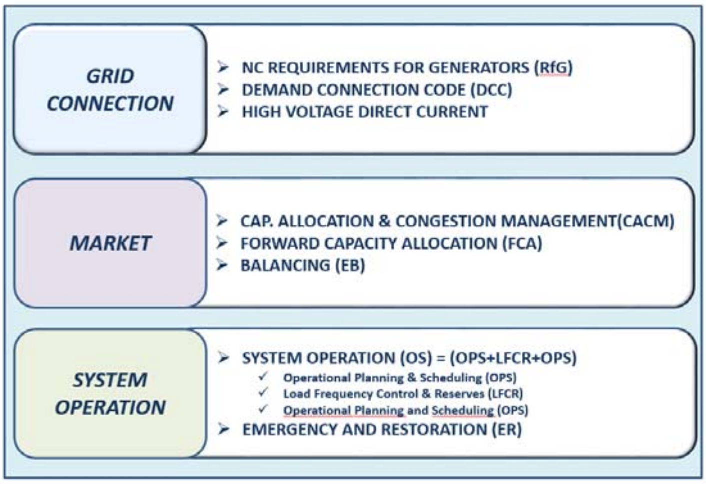


Figure 3. European Network Codes

Another interesting reference is COMELEC which stands for *Comité Maghrébin de l'Electricité* and is a non-profit organization concerned with addressing questions that have to do with generation, transmission and distribution of electricity in the Maghreb region. The five members of COMELEC are ONEE, SONELGAZ, STEG, GECOL and SOMELEC which respectively represent the five Maghreb Countries, namely Morocco, Algeria, Tunisia, Libya and Mauritania. COMELEC was created back in 1974 but remained inactive for a period of 13 years. In 1989, following the creation of the Union of Arab Maghreb, COMELEC benefitted from the newly established political frame that now ties Maghreb Countries one another and has started to ensure its coordination role between Maghreb Countries in electricity related issues. On an international level, the Maghreb Organization works with counterparts such as EURELECTRIC, the African Union and the Arab Union. In addition, COMELEC is a member of MEDELEC which is the non-profit organization whose members are Mediterranean electricity companies. Working with MEDELEC, COMELEC contributed to "system" which is the study of the expansion of Mediterranean Countries' electricity networks.

COMELEC is involved in considering questions that are relevant in the electricity sector and then coordinating actions for the sake of addressing them. Some of these questions are:

- Interconnections and interconnection reinforcements;
- Coordination in terms of power generation expansion plans;
- Coordination in terms of trainings;
- Exchange of technical, economic and financial information;
- Harmonizing the policies of COMELEC members towards international organizations;
- Carrying out electrical studies;
- Achieving a higher integration of electricity industries.

Another relevant reference, as a forum of discussion and exchange of experiences in power systems coordination, is IESOE (Electricity Interconnection in South-Western Europe[3]). It is a regional association of the TSOs from France (RTE), Portugal (REN), Spain (REE) and COMELEC countries (ONEE from Morocco, SONELGAZ from Algeria and STEG from Tunisia). The aim of this organisation is to analyse the performance of the electrical interconnection grid of these countries and to draft initiatives to improve their operation. No particular relevant action could be considered in the rules harmonisation.

For the Eastern region the main reference to be considered is the eight countries (EIJLLPST interconnection project, which stands for Egypt, Israel, Jordan, Libya, Lebanon, Palestine, Syria and Turkey) which aims at enhancing the transaction and wheeling of power among their networks in order to utilize the existing interconnection capacities and to enhance the economic justification to reinforce the existing interconnection facilities. The National Electric power company of Jordan

[3] http://www.iesoe.eu/iesoe/

(NEPCO) has been nominated by the other parties as the coordinating body which appointed Engineer Amani Al-Azzam as Secretary General of the EIJLLPST.

The project yields great economical and technical benefits for interconnected countries, reducing investments in constructing new power stations, exchanging energy among the networks in normal and emergency cases which improves their economics; exchanging knowledge and more experience in power system planning, operation. Nowadays there are 2 committees: operation and planning.

At present Jordan, Egypt, Libya, Syria and Lebanon are electrically interconnected through the following links:

- Egypt – Libya since 1997 in 220 kV level.
- Egypt – Jordan since 1998 in 400 kV level.
- Jordan – Syria since 2001 in 400 kV level.
- Syria – Lebanon since 2009 in 400 kV level (not synchronized).
- Syria – Jordan is opened since 2012 due to the circumstances in Syria.

In addition:

- Iraq – Syria, still not operated due to the circumstances in the area.
- Syria – Turkey. All the works related to 400 kV interconnection transmission line between the two countries is completed since 2003.
- Planned projects: Jordan – West Bank and Egypt – Gaza.

Agreements have already been signed between the interconnected countries, as follows:

- The General Trading Agreement in 1993.
- The General Interconnection Agreement in 1996.
- Based on the above mentioned agreements, bilateral interconnection agreements were signed between two adjacent interconnected countries.
- Contracts for energy exchange on short-term basis were signed by Jordan-Egypt, Jordan-Syria, Egypt-Syria, Egypt-Libya, and Egypt-Lebanon.

Finally, it is worthwhile to mention an internal reference carried out within MedTSO. In 2013 MedTSO started operational activities with the production of the Master Plan of the Mediterranean Interconnections (result of the EU funded project "***Paving the Way for the Mediterranean Solar Plan***") which Task 1 on Harmonized Regulation presented an insight on the regulatory situation in each country.

3. Methodology for identifying the regulatory framework

MedTSO members to the TC2 have been working during 2015 in the collection and assessment of the required information needed to come up with the "Starting Regulatory Framework (SRF)" in the Mediterranean region.

The methodology used for the drafting of the present work has been through a cooperative approach between all MedTSO members, by means of physical meetings and, where necessary, through phone conferences. These meeting and the discussions around multitude of regulatory and technical aspects have contributed extensively to the drafting of the document by allowing participants the sharing of experiences and best practices.

The main tool used has been to the collection of documentation regarding the regulatory framework in all MedTSO countries. With this information, an analysis has been made to identify common requirements, methodologies and guidelines. On the basis of the referred information, a proposal for issues that could have a common regulatory treatment has been developed. In following steps this proposal should be prioritized, taking into account the great existing differences in the region. In addition, a decision must be taken as regards the type of regulatory instrument should be proposed for each of the identified issues.

Issues to be Regulated	Internal TSO-Stakeholders TSO-TSO		External National ⇨ Regional	
	Agreements	Contracts	National	Regional
Technical issues (connection & operation)				
Market issues				

Decision on which type of rule/format should be proposed for every issue

Figure 4. Template between technical issues and type of regulation

For this purpose a classification of the different types of regulations has been adopted:

- Internal regulation for agreements or contracts adopted between TSOs or with other stakeholders that do not need an external approval (i.e. the regulator)
- External regulation for Grid Codes or other type of regulation approved by other entities rather than the TSO. This regulation could be national or regional when it applies to more than one country.

Within this cooperative approach, a dedicated Task Force named Task Force on Questionnaires (TFQ) and which members were designed between TC2 members, was created in order to take the leadership on this task and design a set of questionnaires to be completed by each TSO in the Mediterranean region.

TFQ was divided in 3 technical areas (connection to the grid, operation and system markets). In addition general regulatory issues were also included in the survey. Each area has had a TSO leader and a dedicated team composed of other members, which have been responsible for the analysis.

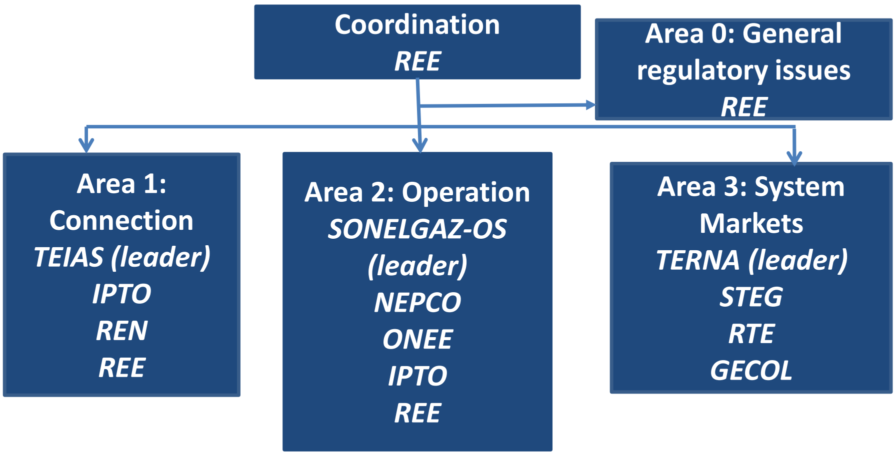


Figure 5. Task Force on Questionnaires (TFQ) structure

To start with the work TFQ proposed a "List of issues with a potential common regulatory framework" that was approved by all TC2 members and that has been the basis for the elaboration of the questionnaires. Once the list was defined, TFQ prepared one questionnaire for each area. These questionnaires were sent as a survey to all MedTSO members in order to have a picture of the Starting Regulatory Framework of the potential issues to be commonly regulated around the Mediterranean region.

Information on 12 countries (Morocco, Portugal, Spain, Algeria, France, Italy, Tunisia, Montenegro, Greece, Turkey, Cyprus and Jordan) has been collected. In addition Libya has provided some information for the connection area, but due to the circumstances in the country the grid code is not yet ready; while Palestine TSO informed that was not able to provide an answer due to the short experience.

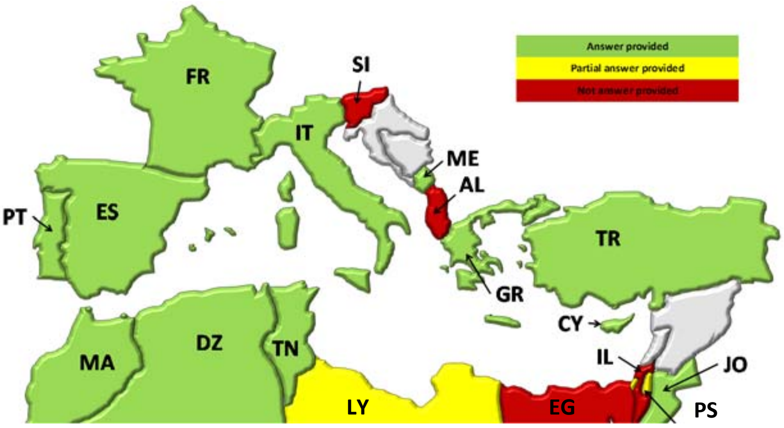


Figure 6. Questionnaire collection status

In the following chapters the analysis of the questionnaires is presented and in fact the picture of what is the ***Starting Regulatory Framework*** in the Mediterranean region is shown.

STARTING REGULATORY FRAMWORK (KEY AREAS)		
Connection area	***Operation area***	***System markets***
• Connection procedure. • Frequency requirements. • Voltage requirements. • Reactive power requirements. • Short circuit requirements. • Protection requirements. • Control requirements. • Power quality. • Demand disconnection schemes. • System restoration capabilities. • Demand side response services. • HVDC requirements. • Compliance and monitoring.	• System states. • Technical requirements. • Information exchange. • Contingency analysis. • Dynamic stability. • Management of international exchange programs. • HVDC technologies. • Outage coordination. • Load frequency control. • Reserve management. • Defence plan. • Restoration plan. • Training. • Dispatch priority.	• Legal issues. • Capacity calculation. • Capacity allocation. • Dispatching and balancing. • Settlement and metering.

Figure 7. List of issues identified to be analysed

4. Current situation

This chapter includes an analysis on the current situation of the Starting Regulatory Framework in the 12 MedTSO countries that have responded to the survey.

4.1 General regulatory issues

Some regulatory aspects are identified as relevant to better understand the regulatory framework in the different MedTSO member countries. In particular, the following aspects have been assessed through the ad- hoc questionnaires that have been circulated to and answered by almost all MedTSO members.

Competence for the approval of technical rules or codes.

Concerning the responsible national authority for the development and/or approval of technical rules[4], the overall picture is quite homogeneous, showing that in most MedTSO countries the TSOs are responsible for developing the technical rules.

As regards the approval of such rules, in the case of some countries it is to the NRA (National Regulatory Authority) to approve the technical rules or codes (Algeria, Cyprus, Greece, Jordan, Montenegro and Turkey) whereas in other countries this task corresponds to the competent Ministries (France, Italy, Portugal, Spain and Tunis). However in four of the latter countries, Ministries have to consult the NRA before approving the rules (France, Italy, Portugal and Spain).

Competence of dispute settlement.

Concerning the responsible authority for the settlement of disputes among stakeholders[5], in most of the Med-TSO countries consulted, this competence lies on the NRA. Only in 2 Med-TSO countries this tasks corresponds to the Ministry responsible of Energy (Morocco and Tunisia). In the particular case of Spain, this competence may lie on the corresponding regional authority, depending on the voltage level.

[4] In this case, it has been assessed whether the responsible authorities are the corresponding Ministries for Energy, the National Regulatory Authority (NRA), the TSO or any other national body.
[5] Eg. Conflict of third parties´ access of to the network.

		DZ	CY	FR	GR	IT	JO	ME	MA	PT	ES	TN	TR	TOTAL
A. Responsible body for the development and/or approval of technical rules	Ministry responsible for Energy			A		A				A	A	A		-
	National Regulatory Authority or Agency (NRA)	A	A	O	A	A	A	A		O	O		A	-
	TSO	D	D	D	D	D	D	D	A	D	D	D	D	-
	Other		O									O		-
B. Responsible authority for the settlement of disputes among stakeholders? (eg. Conflict of access to the network, ...)	Ministry responsible for Energy								X			X		2
	National Regulatory Authority or Agency (NRA)	X (**)	X	X	X	X	X	X		X	X (***)		X	10
	TSO	X (*)												1
	Other													0

(*) At technical phase; (**) If no agreement is reached at technical phase;
(***) Or regional authority, depending on voltage level.

A Approval
D Development
O Opinion/ Consultation

Figure 8. Distribution of competences

Possibility of appeal.

Additionally, some other aspects that have also been considered of interest in the different countries are related to the possibility of stakeholders to appeal certain decisions from National regulatory authorities (NRAs) before a higher instance. This possibility provides additional certainty to stakeholders by providing them for the possibility to have the decisions of such NRAs revised or reassessed at a higher instance. In this particular regard, it must be said that this possibility exists in all the consulted countries, without exception.

Stakeholder's involvement

Stakeholder involvement in the regulatory process serves as a vehicle through which stakeholders become deeply involved in regulatory policy-making, by, for example, engaging in a "*deliberative process that aims toward the achievement of a rational consensus over the regulatory decision*."[6]

Concerning the stakeholder's involvement in the process of elaboration of technical rules or regulations, all TSOs have confirmed such participation in their national regulatory process. In this regard, it is also important to have active NRAs that guarantee a neutral and transparent consultation process enhancing the traceability of the regulation and its inclusiveness[7].

[6] Coglianese, "The Internet and Citizen Participation in Rulemaking," p. 39.
[7] By allowing the participation of stakeholders and third parties in the regulatory process by way of *ad-hoc* public consultations.

Market opening to third parties

Having an open market provides for additional competition therefore allowing the final consumers to reap the benefits of lower energy prices.

Regarding the degree of openness of the national “markets” to third parties activities (TSOs, DSOs or generators or supplier), only 3 Med-TSO countries (Algeria, Montenegro and Tunis) allow new entrants in all activities. In some other countries, this market access restriction is only applicable to transmission activities (Cyprus[8], Italy, Greece, Jordan, Morocco[9], Spain, Portugal[10] Turkey and France).

Unbundling

Under normal market conditions, unbundling is considered as an essential aspect for an efficient market opening and functioning. According to the EU electricity Directive[11], *“[without effective separation of networks from activities of generation and supply (effective unbundling), there is an inherent risk of discrimination not only in the operation of the network but also in the incentives for vertically inte-grated undertakings to invest adequately in their networks.”*

In the case of Med-TSO countries, almost all of them require the unbundling of activities in a similar way as does the EU legal framework. On the other hand, only three countries (Morocco, Jordan and Tunisia) do not foresee this unbundling regime for their companies.

The following table shows the results of the previous analysis:

	DZ	CY	FR	GR	IT	JO	ME	MA	PT	ES	TN	TR	TOTAL
c) Possibility to appeal NRA´s decisions at a higher instance	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	12
													0
d) Stakeholders involvement in elaboration of technical rules/regulations	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	12
													0
e) New entrants allowed (T/D/S)	YES	YES (**)	YES (**)	YES (**)	YES (**)	YES (**)	YES	YES (**)	YES (***)	YES (**)	YES	YES (**)	12
													0
f) Unbundling of regulated/non regulated activities required	YES	YES	YES	YES	YES		N/A		YES	YES		YES	8
						NO	N/A	NO			NO		3

(*) Except for Transmission and Distribution activities
(**) Except for Transmission.
(***) Except for transmission activity which is allocated by law to REN as sole TSO. REN holds a concession renewed on June the 15th for 50 years more.

YES (green) / NO (pink)

Figure 9. Applicabilty of regulation

[8] Cyprus is an non interconnected system with market access allowed to producers and suppliers.
[9] Currently in Morocco, Power Generation Market opening to third parties is limited to long term PPA in addition to recently allowed private sector renewable energy projects that are based on an Authorization System.

[10] The Portuguese TSO, single TSO by law, holds a concession which has recently been extended to 50 years more.
[11] Directive 2009/72/EC of the European Parliament and of the Council, of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC, whereas (9).

Interconnections

In order to make international interconnections feasible and viable there are some basic issues that, according to most of Med-TSO members, require a coordinated regulatory framework. Some of these basic issues are:

a) The concerned national networks;

b) The provision of transmission services on the link;

c) The operation of the link, including the allocation and management of transmission capacity.

As regards the referred international interconnections, most of Med-TSO members consider that the subjects that, according to their national regulation, have to be involved are[12]:

a) Operators of the concerned national networks;

b) The operators of the domestic markets (regardless of the model used);

c) The operators of the link; and

d) The users of the link.

		DZ	CY	FR	GR	IT	JO	ME	MA	PT	ES	TN	TR	TOTAL
G. In order to make feasible and viable an international interconnection, do you think that other basic issues, apart from the mentioned ones, require a coordinated regulation?	Concerned national networks	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	✓	✓	11
	Provision of transmission services on the link	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	✓	✓	11
	Operation of the link, including the allocation and management of transmission capacity	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	✓	✓	11
H. On the basis of your national regulation, do you think that other Subjects have to be involved? (*)	Operators of the concerned national networks	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	✓	✓	11
	Operators of domestic markets (regardless of the model used)	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	✓	Not necessary	10
	Operators of the link	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	✓	✓	11
	Users of the link	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	✓	Not necessary	10

(*) CYPRUS TSO includes National Regulators in subjects that should have a role

Figure 10. Actors involved in development of international interconnections

[12] The Turkish TSO considers that the operators of the domestic market and the users of the link are not necessary. Cyrpus TSO considers that national regulators should also have a role.

4.2 Connection of users to the grid

In this section an overview of the existing or short-term expected rules in the Mediterranean region is presented regarding the connection of users (generation, consumption and distributions) to the transmission grid.

4.2.1 Connection procedure

In this chapter a set of questions on how is the connection procedure managed in each power system have been analysed.

A. Which studies are performed for access and connection?
In most countries similar studies are performed when analysing viability for access and connection of non-transmission facilities to the grid (in general load flow calculation, short circuit, physical feasibility and transient stability).

Country	Load Flow	Short Circuit	Physical feasibility	Transient stability
DZ	X	X	X	X
CY	X		X	X
FR	X	X	X	X
GR	X	X	X	X*
IT	X		X	
LY	X	X	X	X
JO	X	X	X	X
ME	X		X	
MA	X	X	X	X
PT	X	X	X	X
ES	X	X	X	X
TN	X	X	X	X
TR	X	X	X	X

Figure 11. Studies performed for access and connection

*In Greece transient stability simulations (switching overvoltages) are performed depending on the type of generation/load, the type of connection, the installed capacity and the connection point.

B. Which horizons are used for access capacity calculation?

Regarding time horizons in all countries (8 out of the 12 that have responded) the long term horizon is studied. In many cases mid-term and short term horizons are also analysed.

Country	Long term (7 years or more)	Mid-term (between 3 and 7 years)	Short term (3 years or less)
DZ	X (15 years)		
CY	X (10 years)		
FR	X (10 and 20 years)	X (5 years)	X (1 year)
GR	X (10 years)		X (3 years)
IT*	X (10 years)		
LY	X	X	X
JO	X (10 years)	X (5 years)	X (2 years)
ME	X (10 years)		
MA**	X (10 years)	X (5 to 7 years)	X
PT	X (10 years)	X (5 years)	
ES	X (10 years)	X (5 years)	
TN	X (10 years)	X (5 years)	X (1 to 3 years)
TR	X (10 years)	X (5 years)	X (1 year)

Figure 12. Horizons used for access capacity calcualtion

*In Italy, current scenario and current connection demands are considered. Eventual interventions are realise according to planning horizon.

**In Morocco mid-term horizon is used essentially when studying the connection of planed power plants; and short-term studies are essentially performed for the purpose of connecting a customer that has significant power needs. Long-term horizon applies only for generation.

In addition some countries (Algeria, Portugal, Spain, Tunisia and Turkey) have included that the analysis performed is with the last approved planning grid and in some cases the existing or current grid (Italy and Spain).

C. Which criteria is used for access capacity calculation?

In all countries N-1 criteria is used. In addition in Algeria, Greece, Jordan, Portugal and Tunisia N criteria is also considered; while in Greece, Morocco, Portugal, Spain and Turkey N-2 (with the explanations given in the footnotes).

Country	N-1	N-2
DZ	X	
CY	X	
FR	X	
GR	X	X*
IT	X	
LY	X	X**
JO	X	
ME	X	
MA	X	X***
PT	X	X****
ES	X	X*****
TN	X	
TR	X	X

Figure 13. Criteria used for access capacity calcualtion

*In Greece N-2 criteria only for 400kV double-circuit lines on common tower.

**In Lybia N-2 criteria only for outage of double circuits on the same tower.

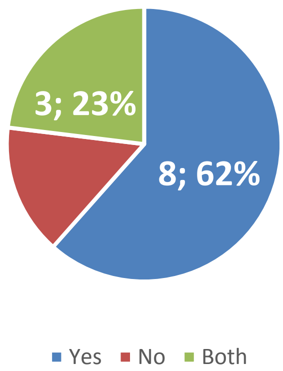
***In Morocco N-2 criteria is some severe cases, especially for huge power plants.

****In Portugal N-2 criteria only for 2-circuit lines longer than 35 km (sharing the same towers) and all 2-circuit lines which create possible supply risk at main cities of Portugal.

*****In Spain N-2 criteria only for 2-circuit lines longer than 30 km (sharing the same towers).

D. Are TSOs connection studies paid by the applicants?

In 8 countries out of 13 (62%, including Lybia) TSO connection studies are paid by the applicants, in 2 cases (Jordan and Spain) are not paid by users and in 3 cases (Greece, Portugal and Turkey) both possibilities are considered.



Country	Answer
DZ	Yes
CY	Yes
FR	Yes
GR	Both*
IT	Yes
LY	Yes
JO	No
ME	Yes
MA	Yes
PT	Both**
ES	No***
TN	Yes
TR	Both

Figure 14. Connection studies paid by applicants

* In Greece, connection studies should be paid by the applicant according to national legislation. Nevertheless this provision is not energised by IPTO for preliminary studies for access to the system. In case special studies are required in the connection phase, they are paid by the user, according to tariffs set by IPTO.

**In Portugal, two types of studies are possible to analyse. On the one hand the capacity calculation is performed by the Network Operator and its costs are indirectly considered in the tariffs; on the other hand connection studies and specific technical projects to power plants are paid by the owner.

***In Spain a methodology for cost recovery through applicants' payments is in progress and expected in the near future.

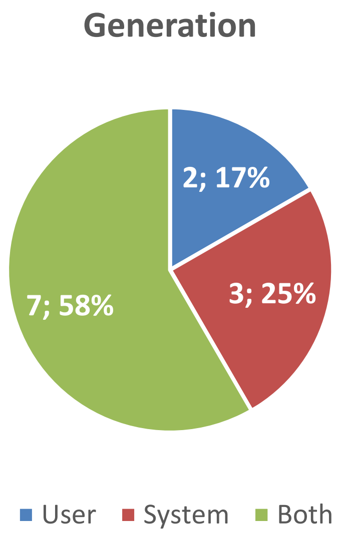
E. Who pays for the transmission assets needed for the connection of non-transmission facilities? (user, system or both)

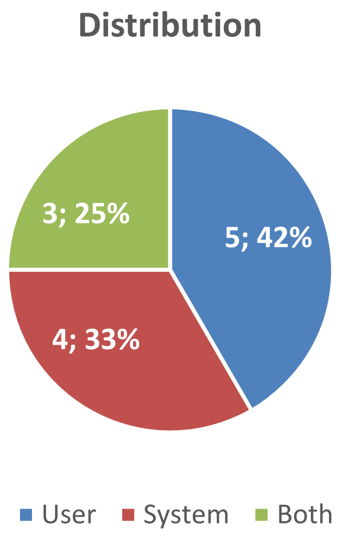
A great variety of responses is shown in the following table regarding who pays the transmission assets needed for the connection of non-transmission facilities.

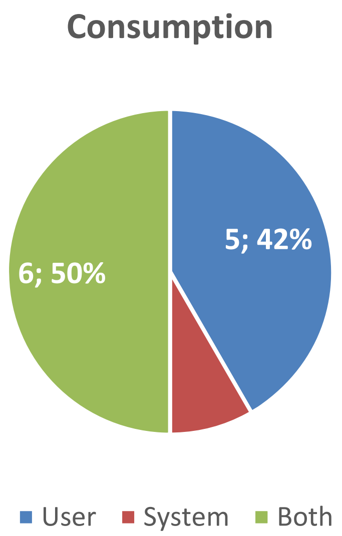
	Generation	Distribution	Consumption
DZ	TSO*	User	Both*
CY	User		
FR	Both (user pays investment in the connection point and system pays grid reinforcement needed)		
GR	Both (user pays investment in the connection point and system pays grid reinforcement needed)		
IT	Both (user and system)	System	Both (user and system)**
LY	Both	Both	User
JO	Both (user and system)	System	User
ME	System (under revision)***		
MA	System****	User	User
PT	User	Both (user and system)	User
ES	Both (user pays investment in the connection point and system pays grid reinforcement needed)	System	User
TN	Both (user pays investment in the connection point and system pays grid reinforcement needed)	User	Both
TR	System	User	Both

Figure 15. Payer of the transmission assets needed for the connection of non-transmission facilities

*In Algeria in case of generation facilities the TSO for the length ≤ 50 km and the user for the difference > 50km (in distribution grid the limit is established in 5 km). In case of consumption 90% is paid by the user and 10% by the system.
**In Italy in case of consumption facilities the cost is shared 50% between user and system.
***In Montenegro the methodology is under revision.
****In Morocco pays the system except for RES, in which pays the user.


Generation
2; 17%
3; 25%
7; 58%
User
System
Both


Distribution
3; 25%
5; 42%
4; 33%
User
System
Both


Consumption
5; 42%
6; 50%
User
System
Both

F. Are there any limiting magnitudes required to connect to the transmission grid? This thresholds are general for the power system of specific for each case? Power / distance or both thresholds?

10 out of 12 countries have general magnitudes regarding requirements to connect to the transmission grid. In the other 2 countries (Montenegro and Morocco) specific magnitudes are required case by case.

	General / Specific	Power / Distance / Both	
DZ	General	Power	10 MW for generation
CY	General	Both	20 MW for generation 20 MVA for demand
FR	General	Power*	For generation: 250 MW in 400 KV; 50 MW in 220 kV; 12 MW in 63 or 90 kV For demand: 400 MW in 220 kV; 100 MW in 63 or 90 kV
GR	General	Power	8MW
IT	General	Power	10 MW
JO	General	Power	5 MW for generation 25 MVA for demand
ME	Specific		
MA	****		
PT	General*	Power	50 MVA for Generation (typical value) 10MVA for demand, but need DSO agreement
ES	General	Both**	For generation: 250 MW in 400 KV; 100 MW in 220 kV (75 MW in Balearic Islands); in Balearic island also: 25 MW in 132 kV and 15 MW in 66 kV For demand: 125 MW in 400 kV; 50 MW in 220 kV (40 MW in Balearic Islands); in Balearic island also: 15 MW in 132 kV and 10 MW in 66 kV
TN	General***	Power	See footnote
TR	General	Power	50 MW

Figure 16. Limiting magnitudes required to connect to the transmission grid

*In France and for demand units distance is also considered and threshold is calculated as minimum between 400 MW (and 100 MW in lower voltages) and 10.000/d (or 1.000/d) being

d the distance between connection point and nearest transformer connected to a higher level.
**In Spain and in case of new substations, distance limits are considered (depending if urban or rural area).
***In Tunisia general thresholds are only considered for RES (solar photovoltaic = 5MW; solar thermal = 10MW; wind energy= 30MW; biomass =15MW).
****In Morocco there is no limit. A case by case methodology applies.

G. Which design criteria is used for new substation transmission facilities needed for connection?

In almost all countries, except Algeria, Italy and Montenegro, a criteria is used when designing type of new substation to be built for the connection of non-transmission facilities. In the majority of the countries either one and a half breaker or double bus bar with coupling is needed.

Country	Simple bus bar	Double bus bar with coupling	Double bus bar with transfer bus	One and a half breaker	Not specified
DZ					X
CY*	X	X			
FR					X
GR**	X	X			
IT					X
LY					X
JO***	X	X		X	
ME					X
MA	X	X		X	
PT****			X	X	
ES		X		X	
TN	X	X		X	
TR*****		X	X	X	

Figure 17. Design criteria used for new substation transmission facilities needed for connection

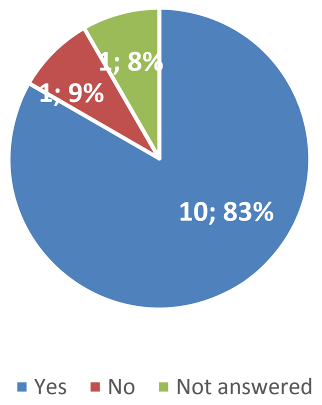
*In Cyprus simple bus bar for rural substations and double bus bar for major substations.
**In Greece the typical design implemented for all voltage levels is double bus bar with coupling with the exception of RES and large consumer's substations at 150kV, which are designed with single bus bar.
***In Jordan, normally double bus bar for 132 kV and one and half circuit breaker for 400kV double circuit lines.

****In Portugal depends on the voltage level. For 400kV: beaker and a half; for 220kV: breaker and a half or double bus bar (single breaker) with transfer bus; for 150kV: double bus bar (single breaker) with transfer bus.

*****In Turkey the 400 kV and 154 kV portions of the 400/154 kV substations are designed in the order of two main bus bars and one transfer bus bar, with transfer feeder and coupling feeder. However, they may be designed with transfer-coupling feeder with single breaker if necessary. If the substation is gas-insulated, the 400 kV and 154kV side will be designed with two main bus bars and coupling feeder.

H. Is there any obligation for users to send simulation models to network operators?

In 10 countries (83%) users need to send simulation models to the network operators, while in 1 (8,5%), namely Greece there is no obligation.



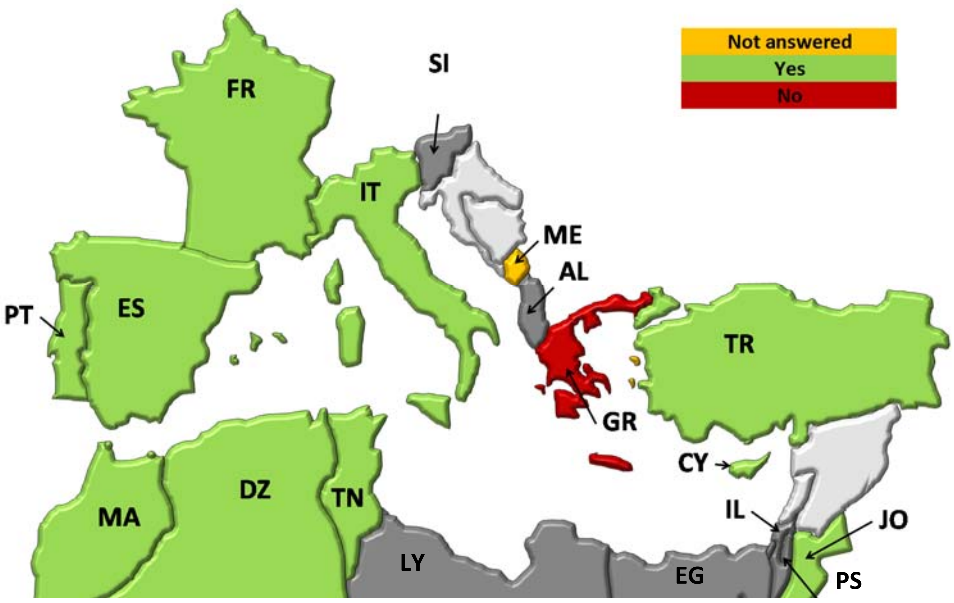


Figure 18. Simulation models required

I. Is there capacity connection priority?
In 8 countries, except Algeria, Lybia, Montenegro, Morocco and Turkey) a priority criteria for renewables is used. Anyway in all countries the FIFO (First In First Out) methodology applies.

Country	Answer
DZ	No
CY	Yes, for Renewables
FR	Yes, for Renewables
GR	Yes, for Renewables
IT	Yes, for Renewables
LY	No
JO	Yes, for Renewables
ME	No
MA	No
PT	Yes, for Renewables*
ES	Yes, for Renewables
TN	Yes, for Renewables
TR	No

Figure 19. Capacity connection priority

*In Portugal, different criteria is considered but in principle renewable may have priority.

J. Is there any binding relationship between planning and connection authorization?
In 7 out of 12 countries new non-transmission facilities connected to the transmission grid need to be already included in the approved planning process to obtain the connection authorization while in Algeria and Morocco this relationship is not needed.

Country	Answer
DZ	No
CY	Yes
FR	Not specified
GR	Yes*
IT	Not specified
JO	Yes
ME	Not answered
MA	No
PT	Yes
ES	Yes
TN	Yes
TR	Yes

Figure 20. Binding relationship between planning and connection

*In Greece, following the application of the user, IPTO issues a connection offer, after performing a preliminary connection study in order to specify the technically and economically optimal solution for the connection of the user to the system.

4.2.2 Frequency requirements

In this chapter a set of questions concerning the frequency requirements in each power system have been analysed. The questions concern the requirements requested by the users when they are connecting to the system and focus on three major aspects, namely the frequency/time range limits for users to withstand without damage, rate of change of frequency withstand capability and the application of limited frequency sensitive mode.

The frequency/time range limits for users to withstand without damage, which apply in the 12 countries that have responded to the survey are illustrated in the following diagram. In all countries in the frequency range from 49,5Hz to 50,5Hz operation is performed without time limitation. In frequency ranges lower than 47Hz, operation is limited to less than 1min in all countries, with the exception of Turkey and Montenegro, where it applies only for 10 minutes, and Morocco with no time limitation.

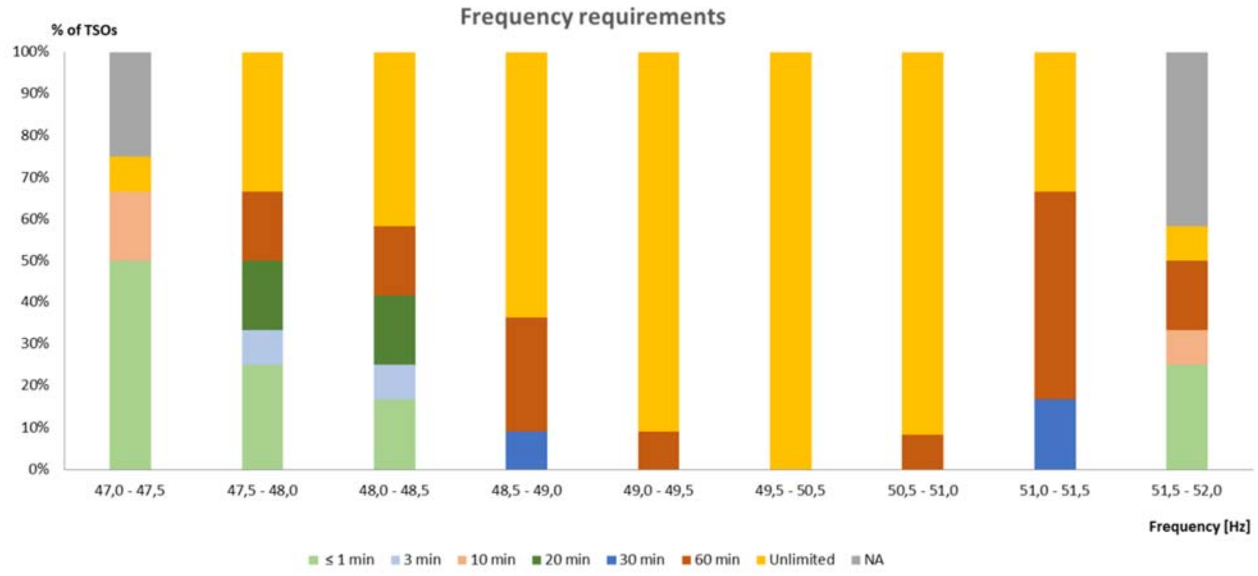


Figure 21. Frequency ranges

Concerning the rate of change of frequency withstand capability (where applicable), in all countries that have provided information, this rate ranges from 1 to 2 Hz/sec, with the exception of France and Jordan, where such rate is not specified and Montenegro where it is expressed in terms of minimum allowed frequency deviation for quasi-steady and dynamic states. The following map provides an overview of the rate of change of frequency withstand capability.

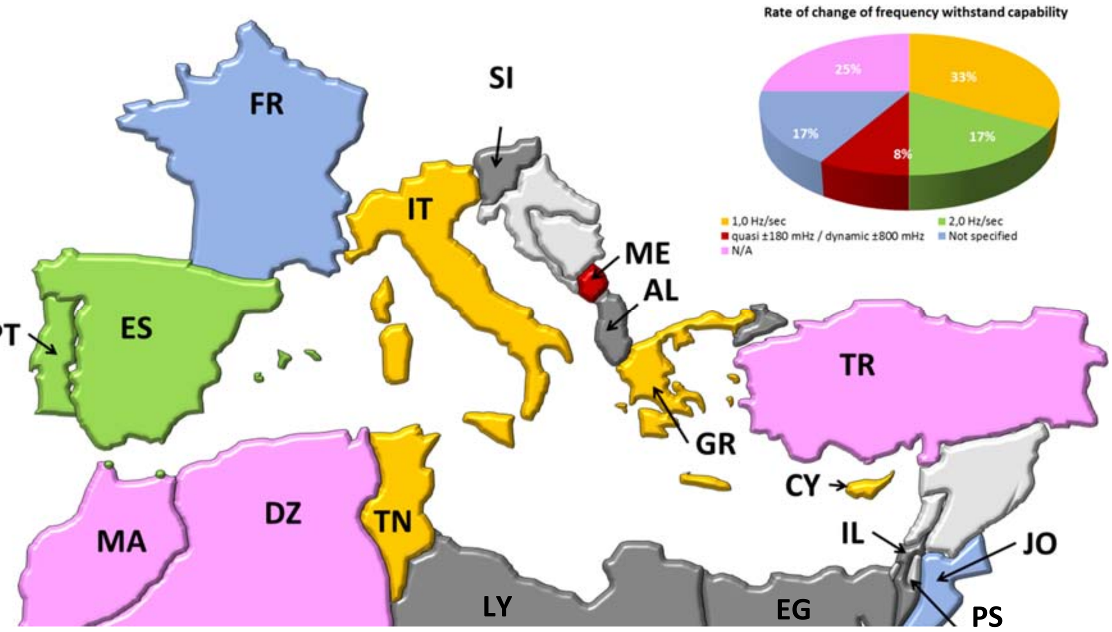
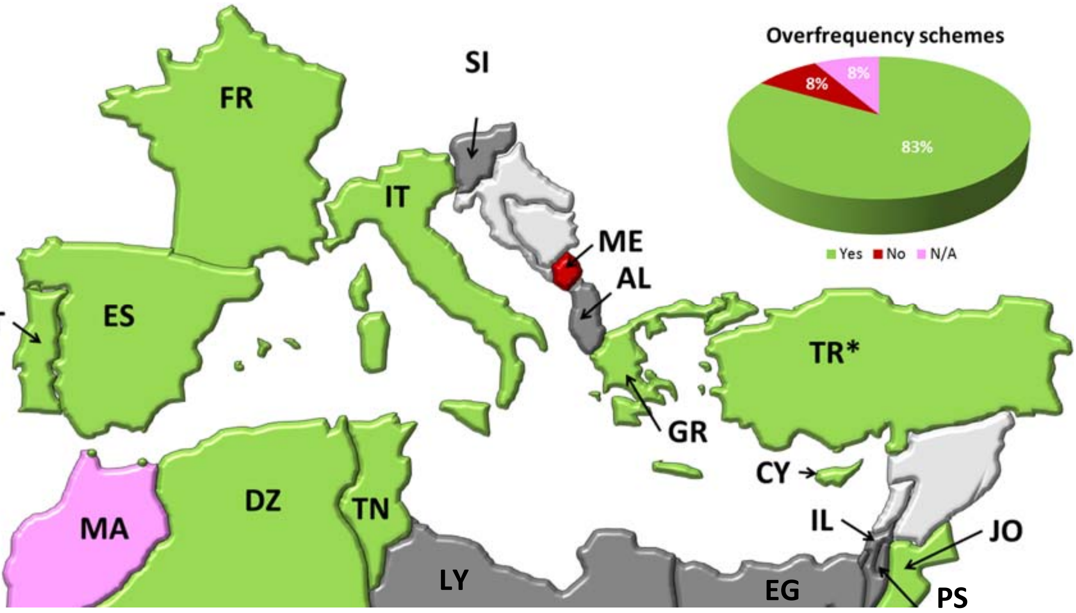


Figure 22. Rate of change of frequency withstand capability

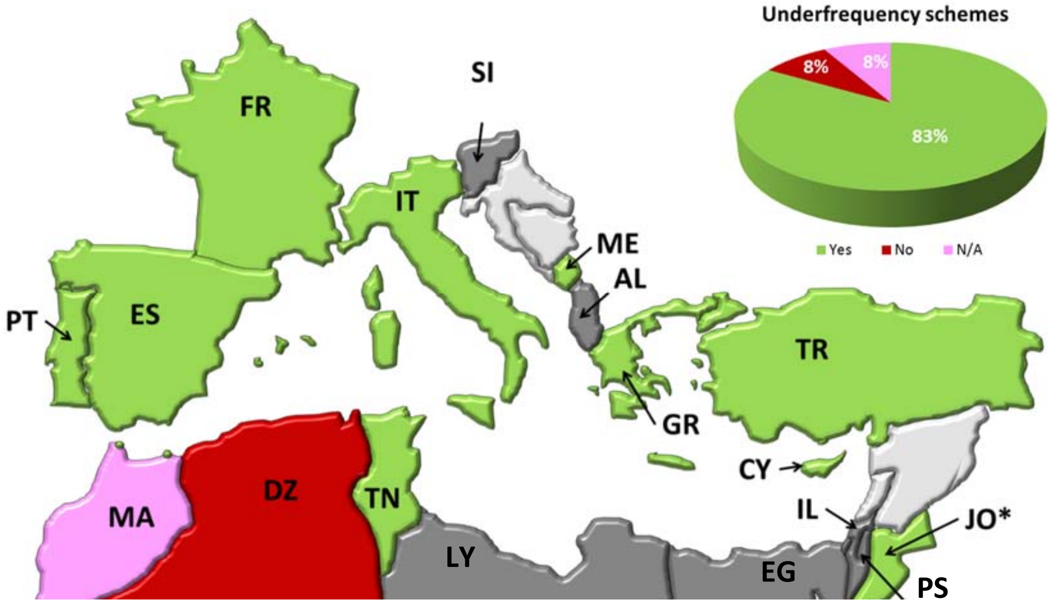
Concerning the application of limited frequency sensitive mode (where applicable), with the exception of Montenegro (and Turkey for RES), in all countries that have provided information, there are requirements for overfrequency schemes for all generation units above certain MW threshold defined by each TSO. In general, such requirements are harmonised (or there is provision for future regulation) in all European countries including Turkey, while similar provisions exist in the Maghreb countries, where the service is applicable. The following map provides an overview of the situation concerning the existence of overfrequency mode regulation.



* In Turkey, overfrequency schemes not provided by RES

Figure 23. Overfrequency schemes

In all countries that have provided information (where applicable), with the exception of Algeria (and Jordan for RES), there are requirements for underfrequency schemes for all generation units above certain MW threshold defined by each TSO. Such requirements are harmonised (or there is provision for future regulation) in all European countries including Turkey, while similar requirements exist in Tunisia which is the only Maghreb country where the service is provided. The following map provides an overview of the situation concerning the existence of underfrequency mode regulation.



* In Jordan, underfrequency schemes not provided by RES

Figure 23. Underfrequency schemes

4.2.3 Voltage requirements

In this chapter a set of questions on what are the voltage requirements in each power system have been analysed.

A. What are the voltage/time range limits for users to withstand without damage?

The voltage/time range limits for users to withstand without damage, which apply in the 12 countries that have responded to the survey are illustrated in the following diagrams. Different responses are shown in the two diagrams. However, is possible to conclude that for all countries the operation voltage range from 0,95 pu to 1.05 pu is performed without time limitation for voltage level between 300 kV to 400 kV. For voltage level between 110 kV to 300 kV, the operation voltage range from 0,90 pu to 1,10 pu is performed without any time limitation[13]. In voltage ranges lower or upper than these values, some countries defined limitation times, like 5 minutes, 30 minutes, 60 minutes, 90 minutes or others, as possible to see in the diagrams.

[13] Except for Morocco transmission grid, that in this country the operation voltage range with unlimited time is only between 0,90pu to 1,087pu.

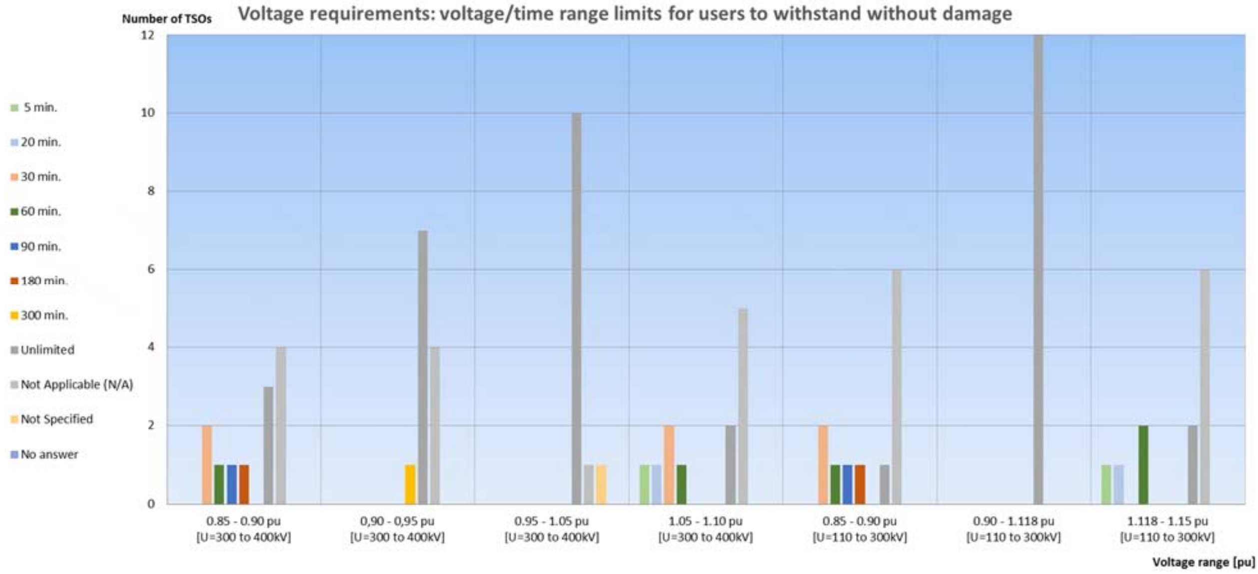


Figure 24. Voltage/time ranges

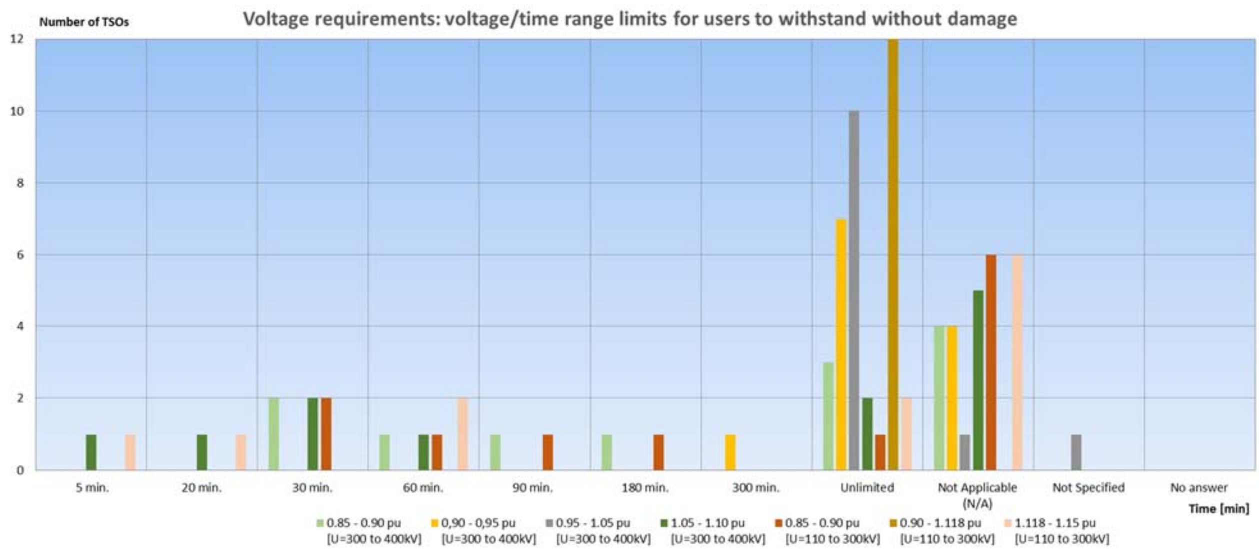


Figure 25. Time/voltage ranges

B. What technologies have to comply with fault ride through capability requirements?

The fault ride through capability requirements for transmission grid users, which apply in the 12 countries that have responded to the survey, are illustrated in the following table, diagrams and maps. Different responses have been received. However, the most of the countries have defined fault ride through (FRT) profiles curves for different technologies, like wind, solar or Synchronous generation. Some of the countries don't have specific FRT profiles curves for all of generation technologies. In the European countries, NC RfG[14] will be applied in the near future, so new FRT profiles curves will be clearly defined briefly for all technologies.

[14] NC RfG – network code on requirements for grid connection of generators

Country	FRTC requirements (Yes or No)			
	Wind	Solar	Other RES	Synchronous generation
DZ	Not required	Not required	Not required	Not required
CY	Yes	Yes	Yes	Yes
FR	Yes	Yes	Yes	Yes
GR	Yes	Yes	Yes	Yes
IT	Yes	Yes	Yes	Yes
JO	Yes	Yes	Not required	Not required
ME	Yes	Yes	Yes	Yes
MA	Yes	Yes	Not required	Not required
PT	Currently: Yes Future: Yes, according NC RfG)	Currently: Not clearly Future: Yes, according NC RfG)	Currently: Not clearly Future: Yes, according NC RfG)	Currently: Yes Future: Yes, according NC RfG)
ES	Currently: Yes Future: Yes, according NC RfG	Currently: Yes, above 2 MW Future: Yes, according NC RfG	Currently: Not Applicable (N/A) Future: Yes, according NC RfG	Currently: No Future: Yes, according NC RfG
TN	Yes	Yes	Yes	Yes
TR	Yes	Not required	Not required	Not required

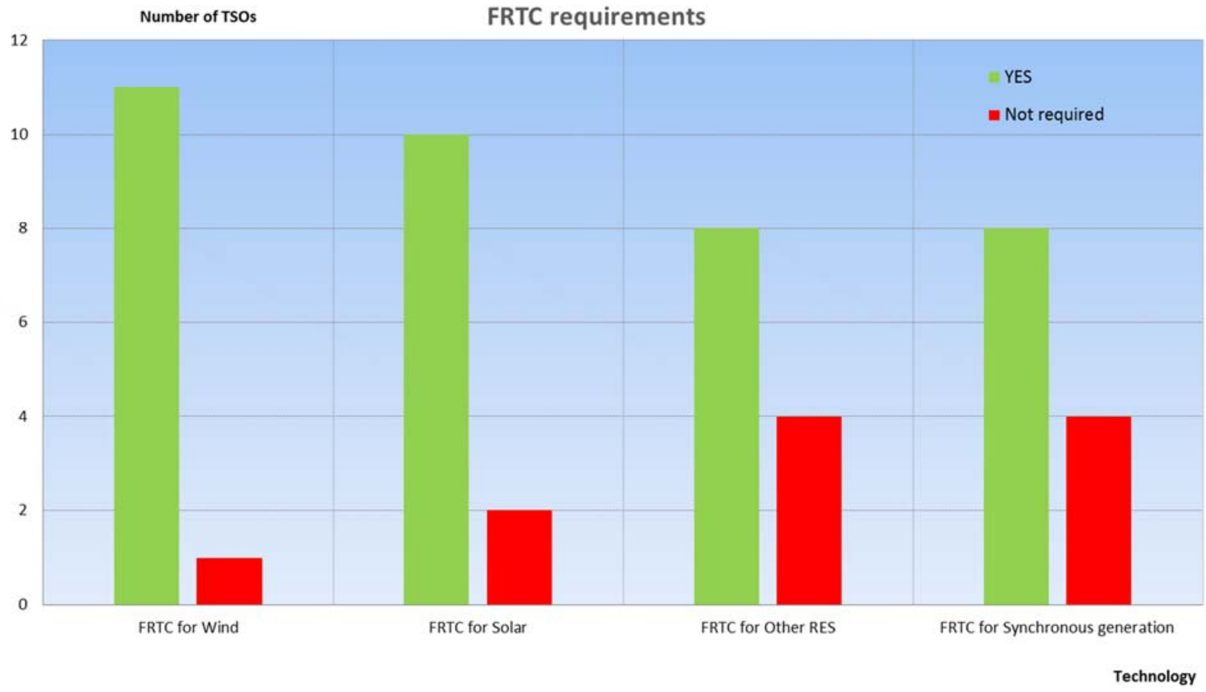
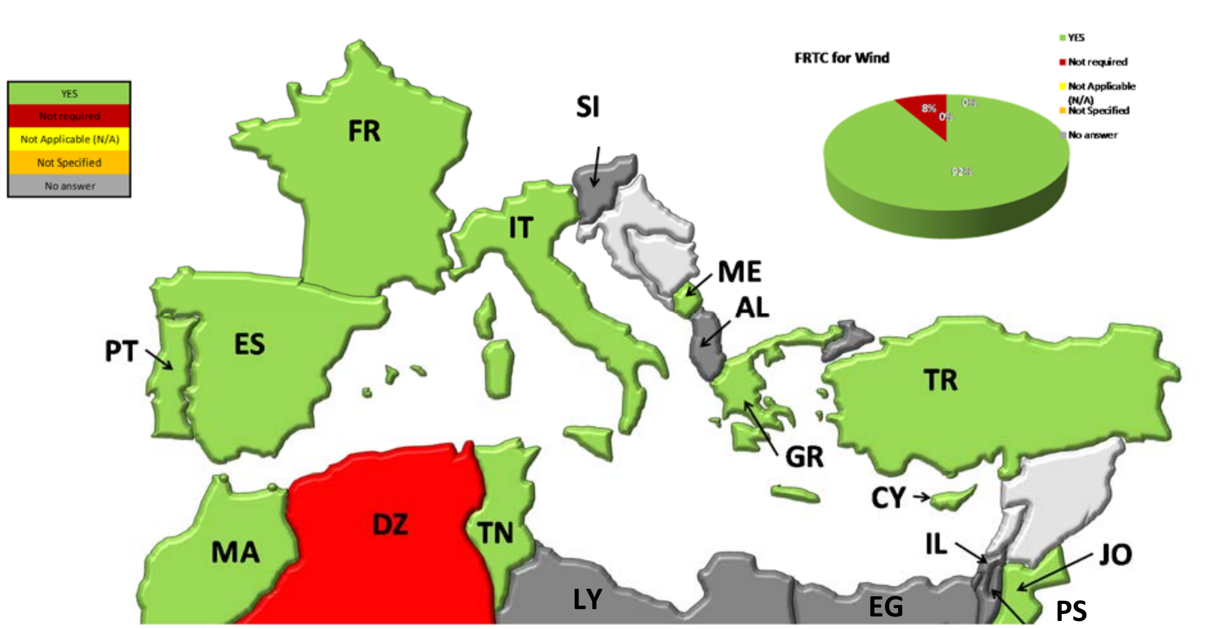
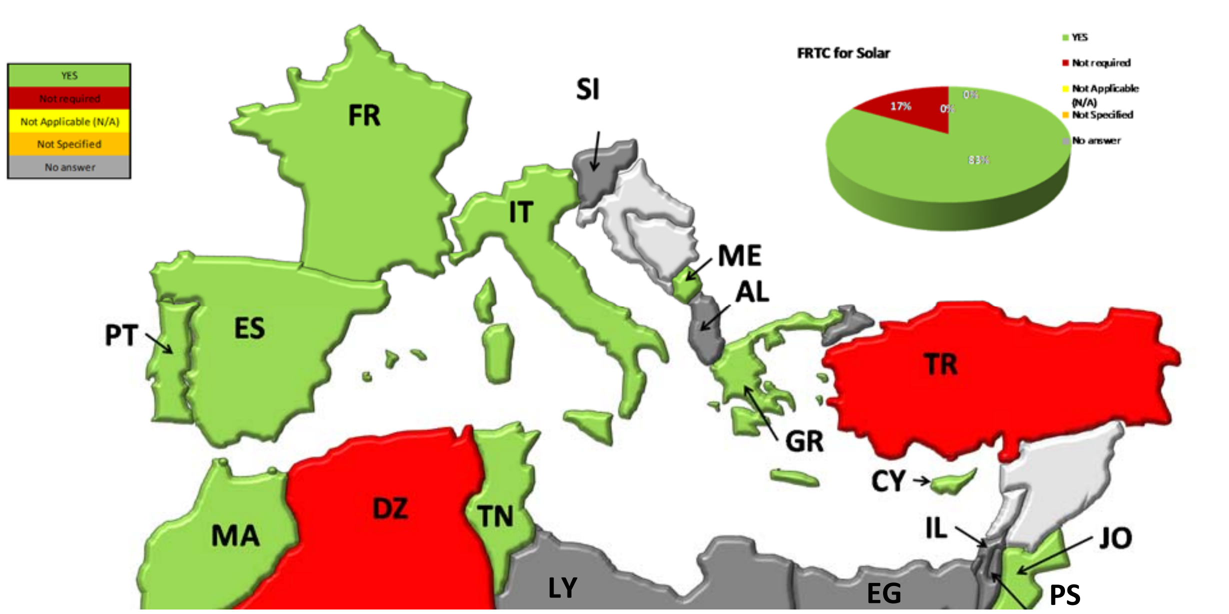


Figure 26. Fault ride through capability requirement

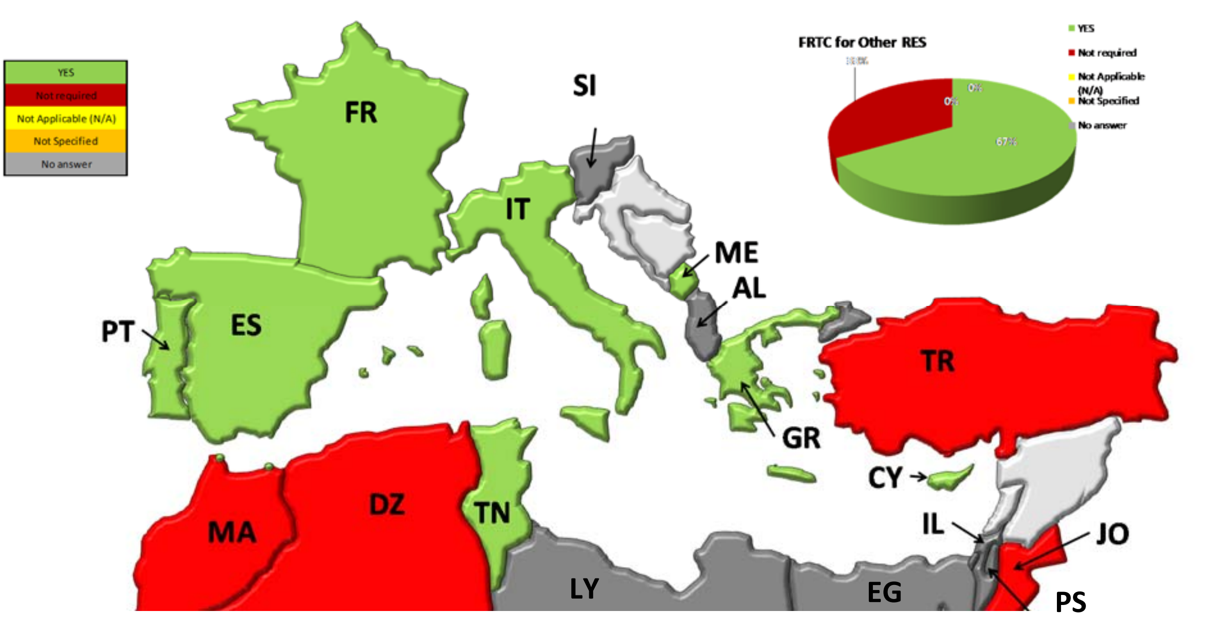
FRTC requirements for Wind



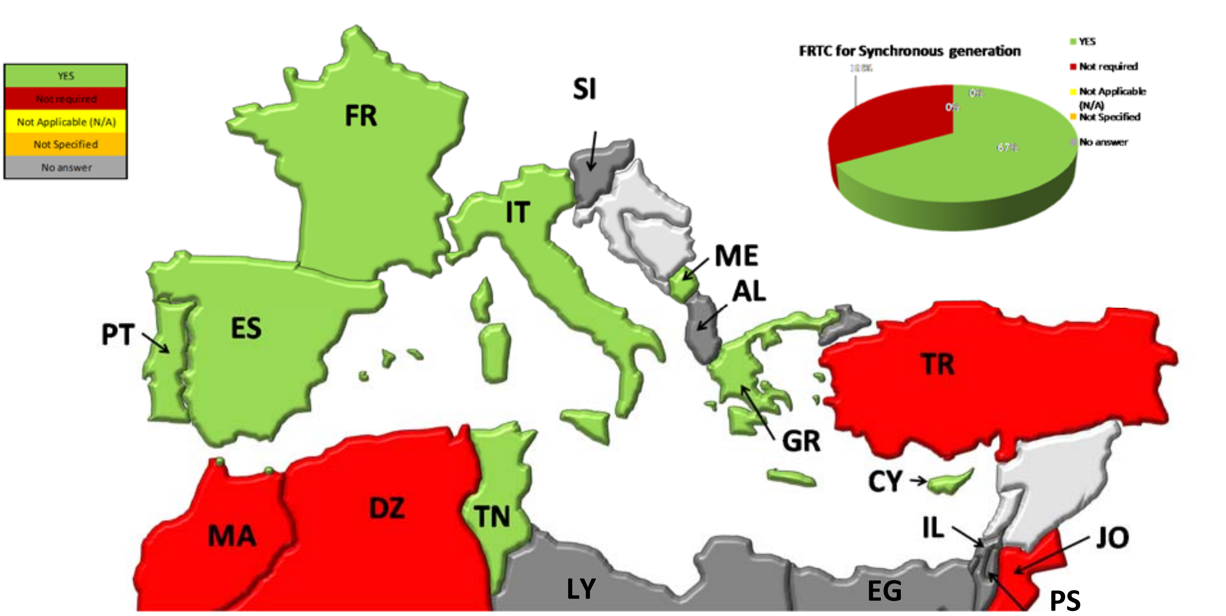
FRTC requirements for Solar



FRTC requirements for other RES



FRTC requirements for Synchronous generation



In the next diagrams are presented as example, different FRT profile curves considered in to Med-TSO countries for the wind technology:

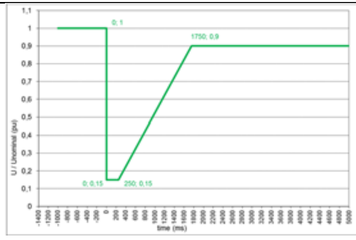
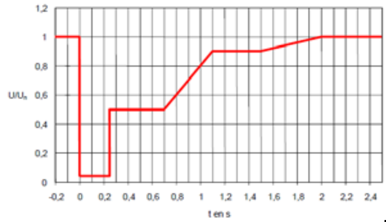
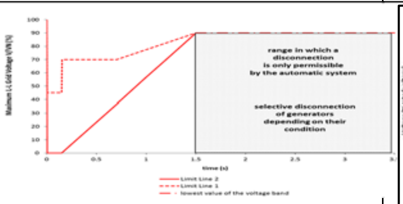
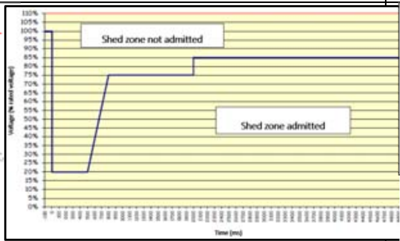
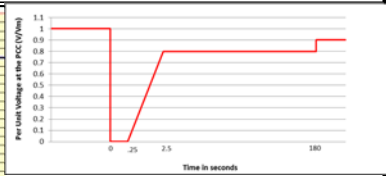
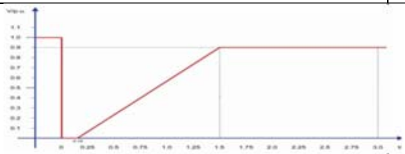
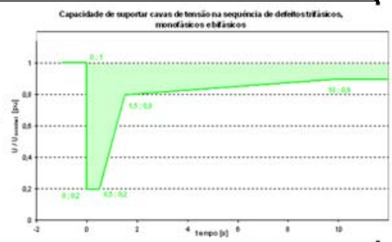
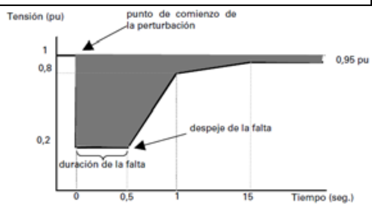
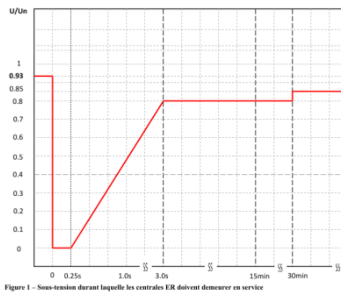
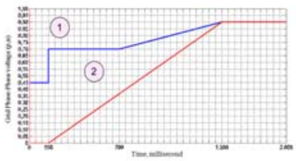
FRT profile curves considered for the wind technology in Med-TSO region		
DZ	***CY***	***FR***
Not Required		
GR	***IT***	***JO***
		
ME	***MA***	***PT***
		
ES	***TN***	***TR***
		

Figure 27. Detail of FRTC curves considered in MedTSO countries

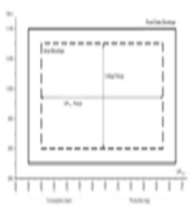
4.2.4 Reactive power requirements

In 6 out of 12 TSOs (Algeria, Cyprus, Montenegro, Morocco, Tunisia and Turkey), the limits of reactive power requirement are differentiated per technology, while there is no difference in the other 6 (France, Greece, Italy, Jordan, Portugal and Spain). Details on each country are shown in the following tables.

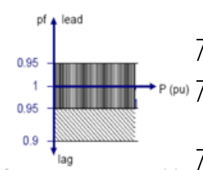
	Difference per technology	No Difference per technology
DZ	x	
CY	x	
FR		x
GR		x
IT		x
JO		x
ME	x	
MA	x	
PT		x*
ES		x*
TN	x	
TR	x	

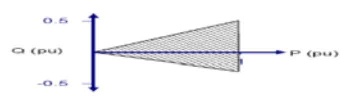
Figure 28. Reactive power requirements differentiated per technology

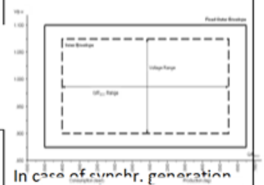
*In Portugal and Spain, difference per synchronous generators and power park modules are expected. In Spain also between conventional and RES generation.

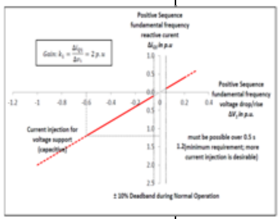
	Algeria				Cyprus				France			
Power Plant Unit	Normal operating conditions (power factor)		During faults (power factor)		Normal operating conditions (power factor)		During faults (power factor)		Normal operating conditions (power factor)		During faults (power factor)	
	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)
Nuclear	NA	NA	NA	NA	N/A	N/A	N/A	N/A	For French law today, the maximum range of Q raccordement /Pmax = between -0.35 and +0.32. 0,3 Pmaximum is an average value. 		Not specified	
Combined Cycle	0,9	0,3 nominal active power	NA	NA	0,93	0,8	N/A	N/A				
Hydro	0,85	0,3 nominal active power	NA	NA	N/A	N/A	N/A	N/A				
Gas Turbine	0,85	0,3 nominal active power	NA	NA	0,93	0,8	N/A	N/A				
Steam turbine (gas, coal or fuel)	0,85	0,3 nominal active power	NA	NA	0,93	0,8	N/A	N/A				
Wind	NA	NA	NA	NA	0,835	0,835	to absorb reactive current during voltage rise	to inject reactive current during voltage dip				
Solar	NA	NA	NA	NA	0,835	0,835						
Cogeneration	NA	NA	NA	NA	0,93	0,8						
Demand with onsite generation	NA	NA	NA	NA	N/A	N/A	N/A	N/A	Tbd by each TSO but not wider than 0.9 of max import capability	Tbd by each TSO but not wider than 0.9 of max export capability		
Demand without onsite generation	NA	NA	NA	NA	N/A	N/A	N/A	N/A	Tbd by each TSO but not wider than 0.9 to 1 p.f. of max import capability			

Power Plant Unit	Greece: Normal operating conditions (power factor)		Greece: During faults (power factor)		Italy: Normal operating conditions (power factor)		Italy: During faults (power factor)		Jordan: Normal operating conditions (power factor)		Jordan: During faults (power factor)	
	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)
Nuclear	Not applicable in the Greek System				At international level: Tbd by each TSO (in coordination with distribution companies at distribution level) within the following limits: - Maximum range of Q/Pmax: 0.95. - Maximum range of steady-state voltage level in PU: 0.225. In case of synchr. generation units				0.85 lag - 0.95 lead			
Combined Cycle			N/A	N/A								
Hydro			/A	N/A								
Gas Turbine			/A	N/A								
Steam turbine (gas, coal or fuel)			/A	N/A								
Wind												
Solar	Not specified yet (expected in the near future)											
Cogeneration												
Demand with onsite generation	Psystem ≥ 70%Pmax 0.96 PFaverage ranges from 0.96 to 1.0 absorbing >0.98 injecting				The same requirements of generation facility	The same requirements of generation facility			Net Demand should comply with>= 0.88 Power Factor (Consumption)			
Demand without onsite generation	Psystem < 70%Pmax 0.96 PFaverage ranges from 0.91 to 1.0 absorbing >0.97 injecting				TbD by TSO case by case				Demand should comply with>= 0.88 Power Factor (Consumption)		reactive current injection as in the figure	

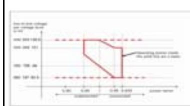


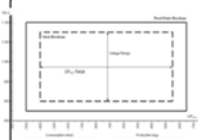


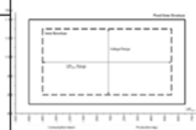




Power Plant Unit	Montenegro: Normal operating conditions (power factor)		Montenegro: During faults (power factor)		Morocco: Normal operating conditions (power factor)		Morocco: During faults (power factor)		Portugal: **Normal operating conditions (power factor)**		Portugal: **During faults (power factor)**	
	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)	Absorbing (leading)	Injecting (lagging)	**Absorbing (leading)**	**Injecting (lagging)**	**Absorbing (leading)**	**Injecting (lagging)**
Nuclear	n.a.	n.a.							Tbd by each TSO (in coordination with distribution companies at distribution level) within the following limits: In case of synchr. generation units - Maximum range of Q/Pmax: 0.95. - Maximum range of steady-state voltage level in PU: 0.225. In case of Power Park Modules - Maximum range of Q/Pmax: 0.75. - Maximum range of steady-state voltage level in PU: 0.225.		Not specified. Expected in Portugal: Should not absorb reactive power.	
Combined Cycle	n.a.	n.a.			40%Pn	60%Pn						
Hydro	0,95	0,9										
Gas Turbine	n.a.	n.a.										
Steam turbine (gas, coal or fuel)	0,9	0,85										
Wind	n.a.	n.a.			30%Pn	40%Pn						
Solar	n.a.	n.a.										
Cogeneration	n.a.	n.a.										
Demand with onsite generation									Tbd by each TSO but not wider than 0.9 of max import capability	Tbd by each TSO but not wider than 0.9 of max export capability		
Demand without onsite generation									Tbd by each TSO but not wider than 0.9 to 1 p.f. of max import capability			







<table>
<tr><th></th><th colspan="4">Spain</th><th colspan="4">Tunisia</th><th colspan="4">Turkey</th></tr>
<tr><th rowspan="2">Power Plant Unit</th><th colspan="2">Normal operating conditions (power factor)</th><th colspan="2">During faults (power factor)</th><th colspan="2">Normal operating conditions (power factor)</th><th colspan="2">During faults (power factor)</th><th colspan="2">Normal operating conditions (power factor)</th><th colspan="2">During faults (power factor)</th></tr>
<tr><th>Absorbing (leading)</th><th>Injecting (lagging)</th><th>Absorbing (leading)</th><th>Injecting (lagging)</th><th>Absorbing (leading)</th><th>Injecting (lagging)</th><th>Absorbing (leading)</th><th>Injecting (lagging)</th><th>Absorbing (leading)</th><th>Injecting (lagging)</th><th>Absorbing (leading)</th><th>Injecting (lagging)</th></tr>
<tr><td>Nuclear</td><td colspan="2" rowspan="8">For conventional generation (above 30 MW) +/- 0,989 PF within the full operatig range of active power.

For RES generation and cogeneration (above 5 MW) +/- 0,98 PF.

In the future RfG requirements for synchrnous generation units and power park modules</td><td colspan="2" rowspan="8">Not specified</td><td colspan="2">NA</td><td colspan="2">NA</td><td>0,95</td><td>0,9</td><td>NA</td><td>NA</td></tr>
<tr><td>Combined Cycle</td><td rowspan="4">0,95</td><td rowspan="4">0,85</td><td rowspan="4">0,95</td><td rowspan="4">0,85</td><td>0,95</td><td>0,85</td><td>NA</td><td>NA</td></tr>
<tr><td>Hydro</td><td>0,95</td><td>0,85</td><td>NA</td><td>NA</td></tr>
<tr><td>Gas Turbine</td><td>0,95</td><td>0,85</td><td>NA</td><td>NA</td></tr>
<tr><td>Steam turbine (gas, coal or fuel)</td><td>0,95</td><td>0,85</td><td>NA</td><td>NA</td></tr>
<tr><td>Wind</td><td colspan="4">see diagrams</td><td>Defined in figure</td><td>Defined in figure</td><td>%100 Nominal current</td><td>%100 Nominal current</td></tr>
<tr><td>Solar</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>Cogeneration</td><td>0,8</td><td>0,9</td><td>0,8</td><td>0,9</td><td>0,95</td><td>0,85</td><td>NA</td><td>NA</td></tr>
<tr><td>Demand with onsite generation</td><td>0,95

In the future DCC requirements</td><td>Generation limits

In the future DCC requirements</td><td>NA</td><td>NA</td><td>0,8</td><td>0,9</td><td>0,8</td><td>0,9</td><td>0,95</td><td>0,85</td><td>NA</td><td>NA</td></tr>
<tr><td>Demand without onsite generation</td><td>0,95

In the future DCC requirement</td><td>NA

In the future DCC requirement</td><td>NA</td><td>NA</td><td colspan="2">0,9</td><td colspan="2">0,8</td><td>0,95</td><td>0,85</td><td>NA</td><td>NA</td></tr>
</table>

Figure 29. Reactive power requirements

4.2.5 Short circuit requirements

A. Short circuit current limits for switching equipment.

TSOs use different short circuit current limits for switch equipment’s ranging from 16 kA to 63 kA (depending on the voltage level). Anyway, in general:

- For voltages above 380 kV the limit varies from 40 to 63 kA.
- For voltages between 200 and 380 kV the limit varies from 31,5 to 40 kA (and up to 50 kA in Portugal).
- For voltages below 200 kV the limit varies from 16 to 31,5 kA (and up to 40 or 50 kA in Portugal).

	U > 380 kV (kA)	380 kV > U > 200 kV (kA)	U < 200 kV (kA)
DZ	40	31,5	31,5
CY	NA	40 - 31,5	NA
FR	63 - 40	40 - 31,5	31,5 - 20
GR	40	NA	31
IT	63 – 50	50 – 31,5	40 - 20
LY	50 - 40	50 - 40	31,5
JO	50 - 40	40 - 31,5	31,5 - 25
ME	40	31,5	31,5
MA	40	40	31,5
PT	50 - 40	50 - 40	50 - 40 -31,5
ES	50	40	31,5
TN	63-40	40 - 31,5	31,5 - 25
TR	63	NA	31,5 - 16

Figure 30. Short circuit current limits for switching equipment

B. Short circuit ratio limits

75% (8 out of 12 countries) have responded either “Not specified” or “Not applicable (N/A)” for short circuit ratio limits. In the other 4 the situation is as follows:

- In Montenegro and Tunisia short circuit ratio limits are specified by connection agreement.
- Cyprus adopted IEC 60034-1 edition 12.0 as standard.
- In Turkey, short-circuit ratio of the unit may not be smaller than 0.5 for the thermal and combined cycle gas turbine units; 0.75 for the hydroelectric units with an installed power of 10 MW or below, and 1.0 for the hydroelectric units with an installed power above 10 MW.

	Specified	Not Specified	N/A
DZ			x
CY	x		
FR		x	
GR		x	
IT			x
JO			x
ME	x		
MA			x
PT			x
ES		x	
TN	x		
TR	x		

Figure 31. Short circuit ratio limits

4.2.6 Protection schemes

A. Protection criteria for non-transmission facilities connected to the transmission grid is general or is particular for each case?

In 8 out of 12 countries a general criteria is applied regarding protection schemes to be used for non-transmission facilities connected to the transmission grid. In the other 4 (Cyprus, France Italy and Montenegro) a particular criteria is applied in each case.

Country	Answer
DZ	General
CY	Particular
FR	Particular
GR	General
IT	Particular
JO	General
ME	Particular
MA	General
PT	General
ES	General
TN	General
TR	General

Figure 32. Protection schemes

B. Which aspects are included in the protection schemes for non-transmission facilities connected to the transmission grid?

In the following table the aspects considered in the protection schemes for non-transmission facilities connected to the transmission grid are shown. In general the following aspects are always included:

- Short circuit, mainly internal but also external.
- Over and under frequency.
- Over and under voltage.
- Demand circuit protection.
- Unit transformer protection.

Country	External short-circuit	Internal short-circuit	Over frequency	Under frequency	Over voltage	Under voltage	Demand circuit protection	Unit transformer protection	Backup schemes
DZ	X	X		X		X			
CY	X	X	X	X	X	X	X	X	X
FR*	X	X	X	X	X	X	X	X	X
GR*	X	X	X	X	X	X	X	X	X
IT**	X	X	X	X	X	X	X	X	X
JO	X	X	X	X	X	X	X	X	X
ME	X	X	X	X	X	X	X	X	X
MA	X	X						X	
PT	X	X	X	X	X	X	X	X	X
ES***	X	X	X	X	X	X	X	X	X
TN	X	X	X	X	X	X	X	X	X
TR	X	X	X	X	X	X	X	X	X

Figure 33. Aspects included in protection schemes

*In France and Greece, protection schemes may cover all aspects mentioned in the questions and additionally stator and rotor overload, asymmetric load, over and under excitation, inter-area oscillations, inrush current, and sub synchronous resonance.

**In Italy may cover all the aspects mentioned, depending on the needs.

***In Spain, is also considered the coordination with the transmission system protection scheme.

C. Isolation levels in the transmission grid follow international standards or have specific regulation?

In 9 out of 12 countries, the international standards (IEC 60071 on isolation coordination) are in use while Cyprus, France and Turkey have national regulation and/or specifications regarding this issue.

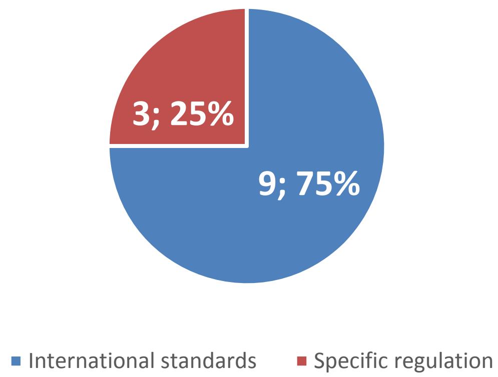


Figure 34. Isolation levels in the transmission grid

D. Which redundancy is required for telecommunication and protection schemes?

In all power systems a double telecommunication and double protection scheme (2P+2C) is required, except Italy which only requires double protection.

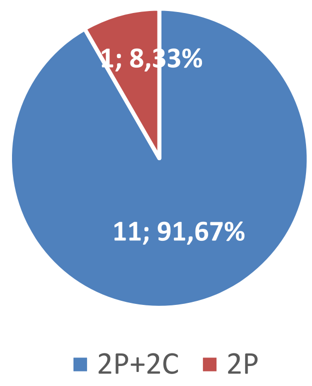


Figure 35. Redoundancy required in protections schemes

E. Which main functions are required inside the multifunctional relays installed in the transmission grid?

In general all power systems require similar functions, especially distance protection and differential protection which are included in all countries that have answered this question (all except Turkey). Overcurrent function is also widely used (in Cyprus, Greece, Jordan, Montenegro, Portugal, Tunisia and Turkey).

Country	Internal Regulation*	Distance	Differential	Overcurrent	Other
DZ	x	x	x		
CY	x	x	x	x	
FR	x				
GR	x	x	x	x	x
IT	x	x	x		
JO	x	x	x	x	x
ME	x	x	x	x	
MA	x	x	x		
PT	x	x	x	x	x
ES	x	x	x		
TN	x	x	x	x	x
TR	x	x	x	x	x

Figure 36. Main functions in protection schemes

*In all cases this issue is not specified in external regulation, but specified in internal regulation from TSOs.

4.2.7 Control requirements

A. Which global architecture and schemes are required for controllability and observability of non-transmission facilities connected to the transmission grid?

In this question the state of art regarding different possibilities of communication between non-transmission facilities and the TSO control centre is presented. In general 2 answers have been provided:

- Only direct communication between user and TSO control centre.
- Through intermediate control centres, differing between mandatory and optional.

All TSOs include a direct communication user-TSO as the global scheme used in their respective power systems, except Spain in which in some cases is mandatory through intermediate control centres.

Country	Answer
DZ	Direct communication between user - TSO
CY	Direct communication between user – TSO
FR	Direct communication between user – TSO
GR	Direct communication between user – TSO
IT	Direct communication between user – TSO
JO	Direct communication between user – TSO
ME	Direct communication between user – TSO
MA	Direct communication between user – TSO
PT	Direct communication between user - TSO*
ES	Direct communication or mandatory through intermediate control centers**
TN	Direct communication between user – TSO
TR	Direct communication between user – TSO

Figure 37. Global control scheme

*In Portugal the architecture requires redundant backbone communication infrastructure ended by redundant communication front-end on the TSO control centre side and by a Remote Terminal Unit (RTU) on the facility side, which must be provided with redundant Ethernet ports.

**In Spain, for renewables above 5 MW communication through generation control centres is mandatory. For renewables between 1 and 5 MW, communication could be also through distribution control centres. On the other hand, conventional units have direct communication user-TSO.

B. Which non-transmission facilities are required to be observable by TSO control systems (real time monitoring at TSO control centre)? (Specify limit in power or voltage).

In all power systems a limit is included in the regulation. In most cases a power limit is included while in Montenegro only a voltage limit is included (facilities connected to the transmission grid). Jordan, Algeria and Tunisia have either a power limit or a voltage limit.

Country	Power / Voltage / Both	Numeric limit
DZ	Both	> 10 MW (or > 60 kV)
CY	Power	> 1 MW
FR	Power	> 5 MW
GR	Power	> 10 MW
IT	Power	> 10 MW
JO	Both	> 5 MW (or > 33 kV)
ME	Voltage	≥ 220 kV
MA	Both	> 5 MW (or > 60 kV)
PT	Power	> 10 MW*
ES	Power	> 1 MW*
TN	Both	> 5 MW (or > 90KV)
TR	Power***	> 10 MW

Figure 38. Observability requirement for non-transmission facilities

*In Portugal, wind power plants have special agreements (independently of installed power).
**In Spain, power limit also applies to aggregation of generation units.
***In Turkey, all generation units directly connected to the transmission grid (400 and 154 kV) are also observable.

Regarding numeric limits, power limit is between 1 MW (in Spain and Cyprus) and 10 MW (in Algeria, Greece, Italy and Portugal).

C. Which magnitudes must be provided from non-transmission facilities to TSO control centre in real time?

In all power systems voltage and power (both active and reactive) are sent from non-transmission facilities in real time. In non-European countries (and Greece) also the current is provided.

Country	I	V	P	Q	Other
DZ	x	x	x	x	
CY		x	x	x	
FR		x	x	x	x*
GR	x	x	x	x	
IT		x	x	x	
JO	x	x	x	x	
ME		x	x	x	x**
MA	x	x	x	x	
PT		x	x	x	x***
ES		x	x	x	x****
TN	x	x	x	x	x*****
TR			x	x	x******

Figure 39. Magnitudes sent in real time

*In France other magnitudes are also provided: switchgear position, contribution to voltage/frequency control (on/off signal), and signal when the limits of the PQ diagram are reached, in case of fault, information on the location of the fault seen by the user's protection system.

**In Montenegro, the topology status.

***In Portugal, upstream and downstream quotas and powered flow is also provided by hydro power plants.

****In Spain switch connectivity and set points are also provided by non-transmission facilities.

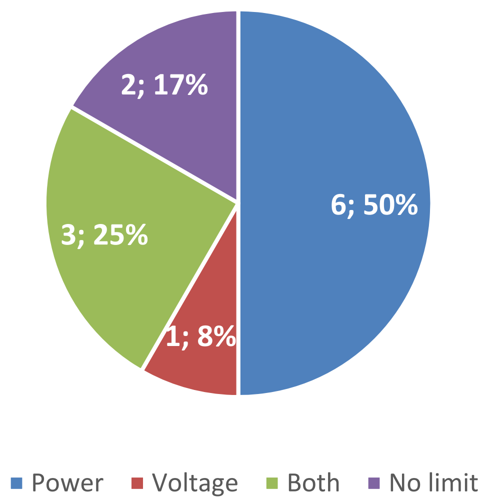
*****In Tunisia, the topology status.

******In Turkey, for non-transmission facilities, the total consumption value shall be also required. In addition and if required, information related to the connection points and other information to be requested by TEIAS shall also be collected.

D. Which non-transmission facilities are required to be controllable by TSO control systems? Specify limit in power or voltage.

Regarding this aspect, a great heterogeneity is shown:

- 6 countries (Cyprus, France, Italy, Montenegro, Spain and Turkey) have a power limit.
- 1 country (Jordan) has a voltage limit.
- 3 countries (Algeria, Morocco and Tunisia) have both limits (power and voltage).
- 2 countries (Greece and Portugal) do not have a numeric limit.



Country	Power / Voltage / Both	Numeric limit
DZ	Both	> 10 MW or > 60 kV
CY	Power	> 8 MW
FR	Power	> 120 MW
GR	No limit*	
IT	Power	> 10 MW
JO	Voltage	> 33 kV
ME	Power	≥10 MW
MA	Both	> 5 MW or > 60 kV
PT	No limit**	
ES	Power	> 5 MW***
TN	Both	> 5 MW or > 90KV
TR	Power	≥10 MW renewable energy

Figure 40. Controlability requirement for non-transmission facilities

*In Greece, the facilities controlled by TSO control centre are all registered conventional production units (hydro and thermal), Tap changers of HV transformers and reactances.

**In Portugal, two types of facilities can be controlled by TSO control centre: the conventional power plants (hydro and thermal) that are accepted into secondary power system regulation market (in this case power plants have to regulate power according with set points provided by TSO); and the wind power plants in order to limit injection power to balance production and load, or resolve grid congestion situations.

***In Spain, power limit also applies to aggregation of generation units.

E. Which of the following characteristics are required for the communication system?

In general similar characteristics are required by regulation for the communication systems, basically:

- A dedicated channel is required in France, Greece, Italy, Morocco, Portugal, Spain and Turkey (7 out of 12).
- A double communication channel is required in Algeria, France, Greece, Italy, Morocco, Portugal, Spain, Tunisia and Turkey (9 out of 12).
- Optic fiber is required in Algeria, Cyprus, France, Greece, Jordan, Portugal, Tunisia and Turkey (8 out of 12).
- IEC standard protocol is requires in all power systems except in Jordan and Montenegro.

Country	Dedicated channel	Double communication channel	Optic fiber	IEC standard protocol
DZ		x	x	x
CY			x	x
FR	x	x	x	x
GR	x	x	x	x
IT	x	x		x
JO			x	
ME	*Not answered*			
MA	x	x		x
PT	x	X	x	x
ES	x	x		x
TN		x	x	x
TR	x	x	x	x

Figure 41. Communication system characteristics

4.2.8 Power quality

In this chapter a set of questions on what are the Power Quality regulations and requirements in each power system have been analysed.

A. Which normative standards are used as reference for power quality regulation in the transmission grid?

All the 13 countries have responded to the survey (including Lybia) and have established normative standards for power quality. The survey response is illustrated in the following table, diagram and map. The most of the countries consider the IEC 61000 normative and others consider the EN50160 normative. In the particular case of Algeria is considered the rules and normative presented in the National Network Code.

Country	Normative standards for Power Quality?		Designation
	Yes	No	
DZ	Yes		National Network Code
CY	Yes		EN 50160
FR	Yes		IEC61000
GR	Yes		IEC 61000-3-6 (harmonics) IEC 61000-3-7 (variations of voltage) EN 50160
IT	Yes		EN50160 and IEC61000
LY	Yes		IEC 61000
JO	Yes		IEC 61000
ME	Yes		IEC 61000
MA	Yes		IEC 6100-3-7 IEC 61000-3-6 IEC1000-2-2
PT	Yes		Portuguese legislation and EN 50160
ES	Yes		EN 50160, IEC 61000.
TN	Yes		IEC 61000
TR	Yes		IEC 61000

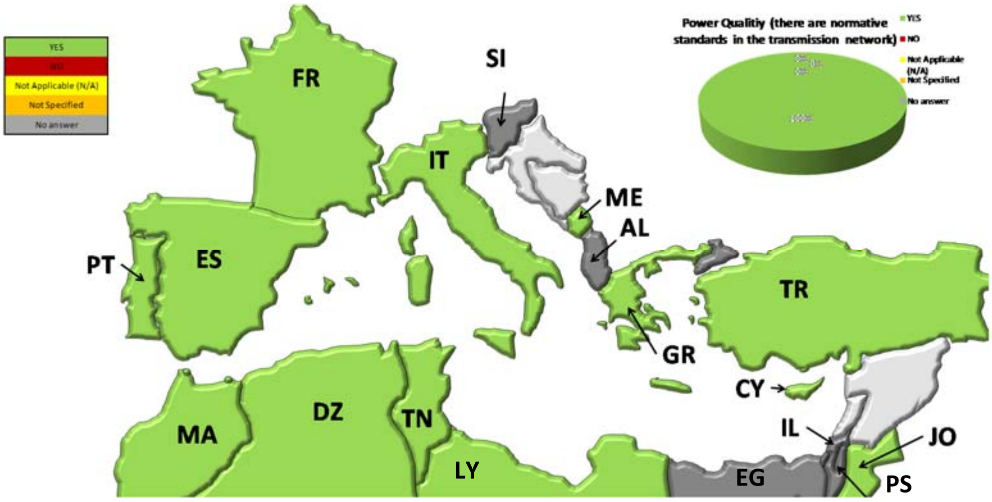


Figure 42. Normative standards used for power quality

B. What is the limit total number of voltages dips per node in your system?

Among the 13 countries (including Lybia) that have responded to the survey, 12 have not established any voltage dips limit number in there system (per node or per voltage level). The survey response is illustrated in the following table, diagram and map.

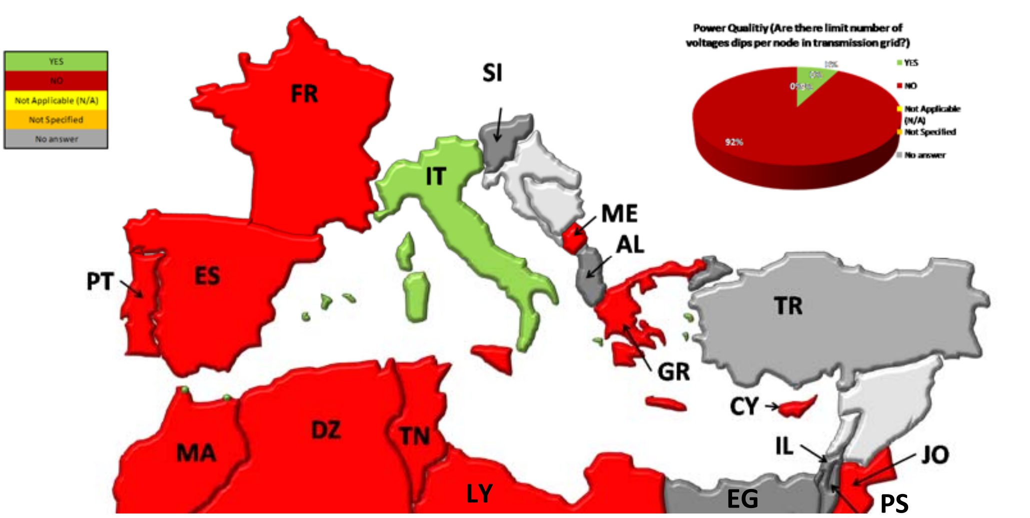


Figure 43. Limit number of voltage dips per transmission node

As can be seen in the above table only the TSO of Italy has established limit number of voltage dips per node/voltage level. In the below table are presented these limits for the year 2015.

The reference values shown are related to the voltage levels (i.e. or for all nodes of each voltage level).

These limits are not imposed by any normative but are expected values on the basis of specific measurement campaigns.

U (kV)	Voltage dips with residual voltage under 90%		Voltage dips with residual voltage under 70%	
	Monophase	Multiphase	Monophase	Multiphase
380	200	50	5	3
220	200	100	10	6
120-132-150	400	250	15	9

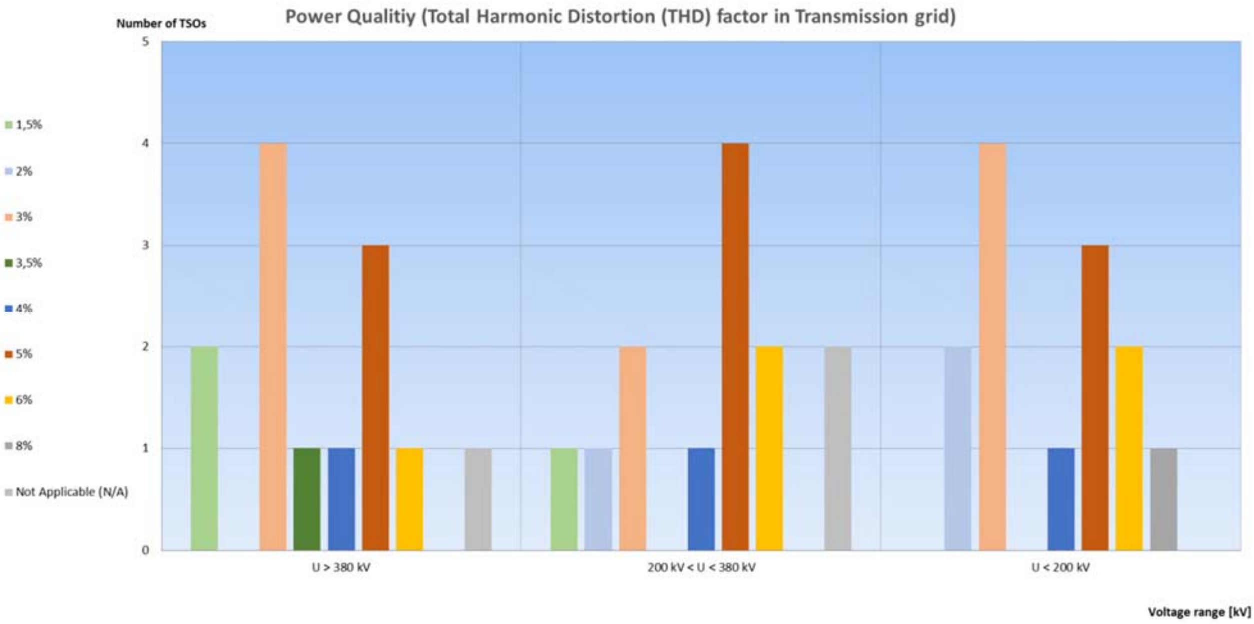
Figure 44. Reference levels in Italy (voltage dips per voltage level)

C. Which is the Total Harmonic Distortion (THD) factor in your system?

All of the 13 countries (including Lybia) have responded to the survey and have established different THDs per voltage range. The THD values are between 1.5% and 8%. The THD equal 3% and 5% are the most common. The survey response is illustrated in the following table and two diagrams.

Country	U > 380 kV	200 kV < U < 380 kV	U < 200 kV
DZ	5%	5%	5%
CY	Not Applicable (N/A)	Not Applicable (N/A)	2%
FR	6%	6%	6%
GR	3%	Not Applicable (N/A)	3%
IT	3%	6%	6%
JO	1,5%	2%	2%
LY	5%	5%	5%
ME	1,5%	1,5%	3%
MA	3%	3%	3%
PT	4%	4%	4%
ES	3%	3%	3%
TN	5%	5%	5%
TR	3,5%	5%	8%

Figure 45. Total Harmonic Distortion factor in each system



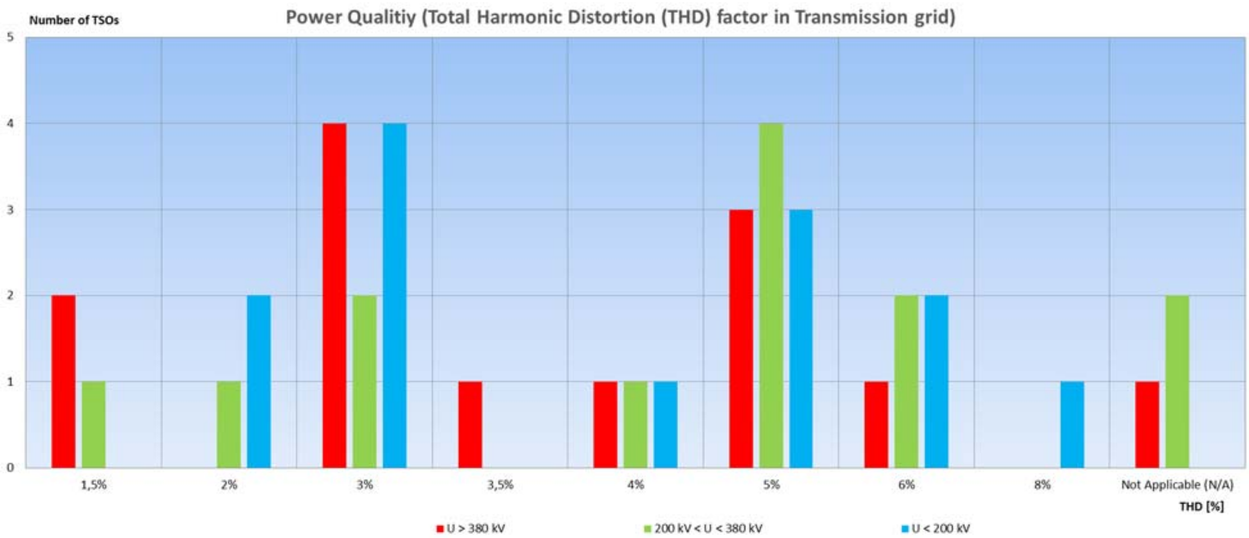


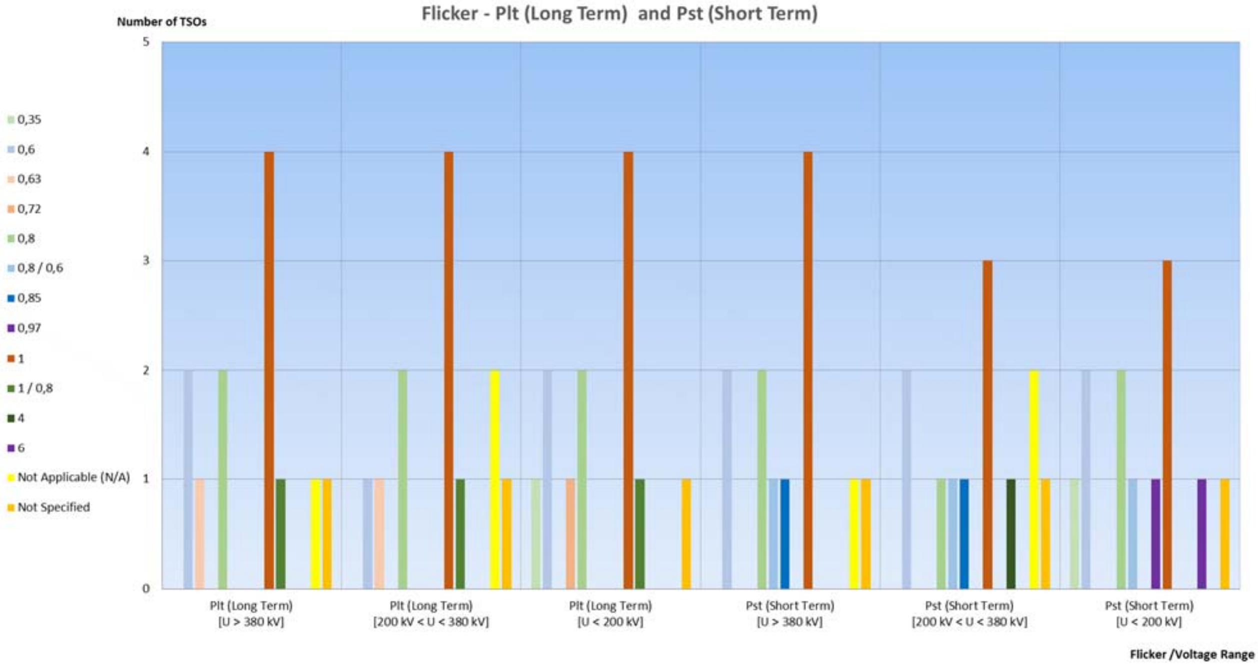
Figure 46. Analysys of the total Harmonic Distortion factor in each system

D. Which are the flicker limit values in your system?

All of the 12 countries have responded to the survey and have established different Flicker limits per voltage range. The flicker limit values are between 0,35 and 6 (for Plt and Pst). The flicker limit equal 1 is the most common. The survey response is illustrated in the following table and two diagrams.

Country	Plt (Long Term)			Pst (Short Term)		
	Plt (Long Term) [U > 380 kV]	Plt (Long Term) [200 kV < U < 380 kV]	Plt (Long Term) [U < 200 kV]	Pst (Short Term) [U > 380 kV]	Pst (Short Term) [200 kV < U < 380 kV]	Pst (Short Term) [U < 200 kV]
DZ	1	1	1	1	1	1
CY	Not Applicable (N/A)	Not Applicable (N/A)	0,35	Not Applicable (N/A)	Not Applicable (N/A)	0,35
FR	1	1	1	---	---	---
GR	0,6	Not Applicable (N/A)	0,6	0,8	NA	0,8
IT	Not specified	Not specified	Not specified	1	4	6
JO	0,8	0,8	0,8	0,6	0,6	0,6
ME	0,8	0,8	0,8	0,6	0,6	0,6
MA	0,6	0,6	0,6	0,8	0,8	0,8
PT	1	1	1	1	1	1
ES	1 / 0,8	1 / 0,8	1 / 0,8	0,8 / 0,6	0,8 / 0,6	0,8 / 0,6
TN	1	1	1	1	1	1
TR		0,63	0,63 (V>154) and 0,72 (35 kV < V ≤ 154 kV)	0,85	0,85	0,85 (V>154) and 0,97 (35 kV < V ≤ 154 kV)

Figure 47. Flicker limit values in each system



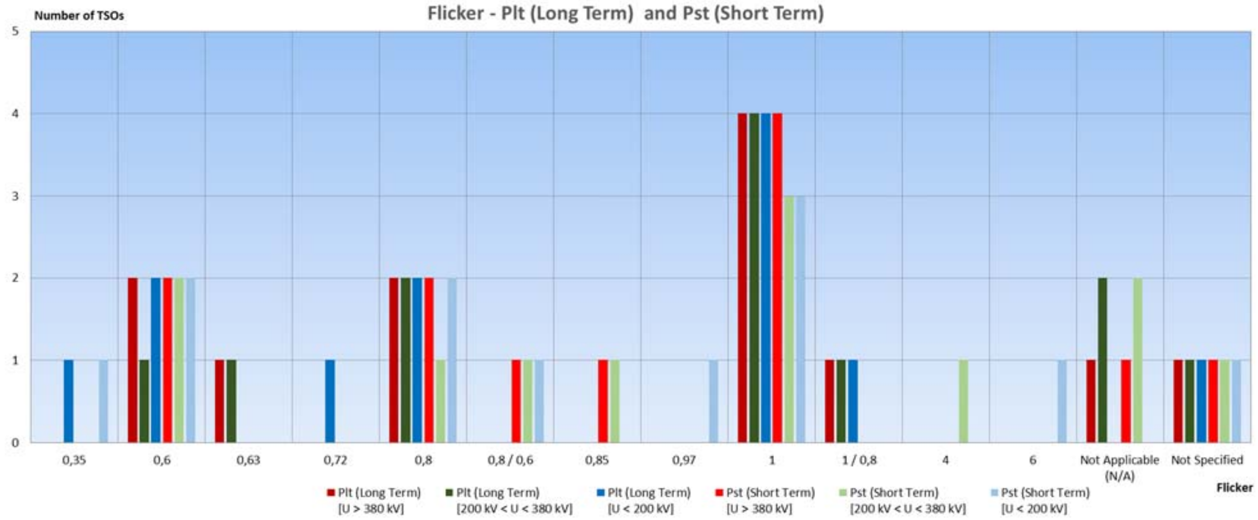


Figure 48. Analysis of the flicker limit values in each system

E. Which are the reference levels for voltage unbalances in your system?

Among the 12 countries that have responded to the survey, all of them have established different Voltage Unbalance limit levels. Some of them consider different unbalance limits per voltage range. The unbalance limit values are between 1% and 5%. The most common value is 2%. The survey responses are illustrated in the following table and in two diagrams.

Country	Voltage Unbalance limit levels in Transmission grid
DZ	1%
CY	5%
FR	2%
GR	2%
IT	2%
JO	1% to 2% 1)
ME	2%
MA	1%
PT	2%
ES	1% to 2% 2)
TN	1% to 2% 3)
TR	1% to 2% 4)

Figure 49. Voltage unbalance limits

1) Under Normal Operation, the maximum negative phase sequence component of the phase voltage of the Power System should remain below 1%. Under planned outage conditions, infrequent short duration peaks with a maximum value of 2% are permitted for phase unbalance.

2) Expected values in O.P.12.2 proposal --> 1% for unbalances of less than 10 minutes / 2% for more than 10 minutes.

3) 1% for U > 90kV; 2% for U < 90 kV.

4) During the measurement period of power quality to the voltage positive components at the network main frequency may not exceed 1% at the voltage level of 400 kV or 1.5% at the voltage level of 154 kV or 2% at the voltage levels below 154kV. With the approval of TEIAS, this ratio may increase to 1.4% at the voltage level of 400 kV or 2% at the voltage level of 154 kV at the points where the single-phase or two-phase loads are fed.

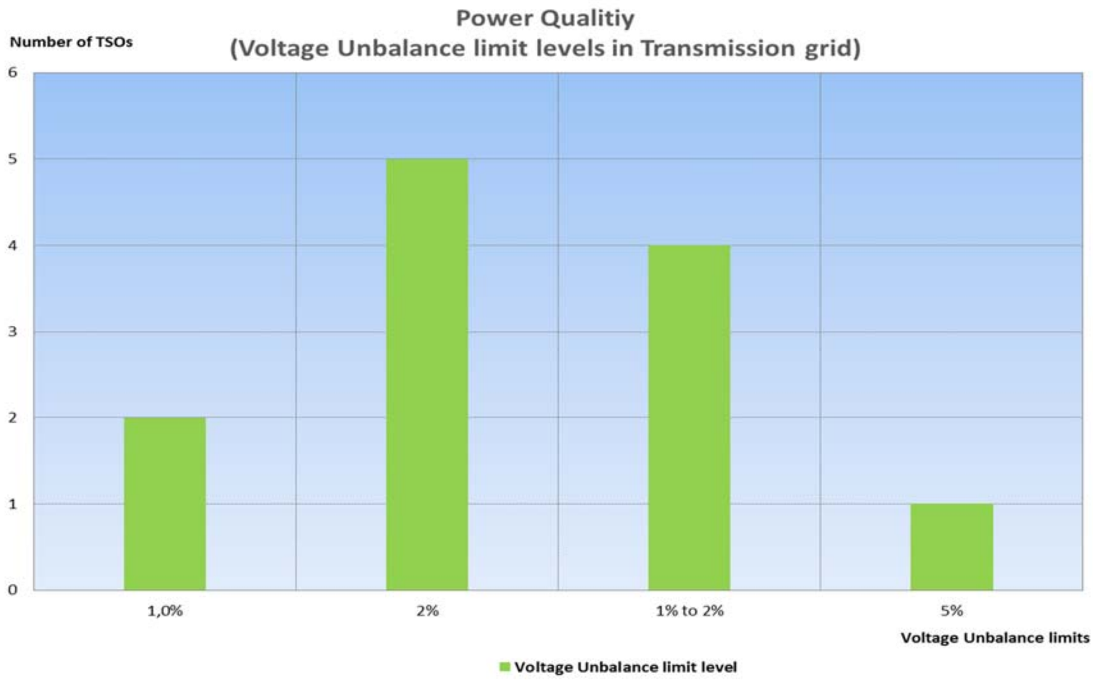


Figure 49. Analysis of the voltage unbalances in each system

F. Which are the reference levels for transient overvoltage in your system?

Among the 13 countries (including Lybia) that have responded to the survey, 10 have recognized different transient overvoltage limit in their system. Some countries consider transient overvoltage limits per voltage range/voltage level. The most common value is 110%. The survey responses are illustrated in the following table and in two diagrams.

Country	Limit level of transient overvoltage
DZ	Not Applicable (N/A)
CY	Not Applicable (N/A)
FR	105% - 109% 1)
GR	105% - 400kV 113% - 150kV
IT	107% - 114% 2)
LY	110%
JO	120%
ME	110% - 400kV 115% -220kV 115% - 110kV
MA	105% - 400kV 108.7% - 225kV 110% -60kV
PT	110%
ES	120% - 50 ms 115% - 1 sec
TN	110%
TR	Not Applicable (N/A)

1) 105% - 400kV, 109% - 225kV, 108% - 90kV and 63kV;

2) 107% - 400kV, 107% - 230kV, 113% - 150kV, 114%;

Figure 50. Transient overvoltage limits

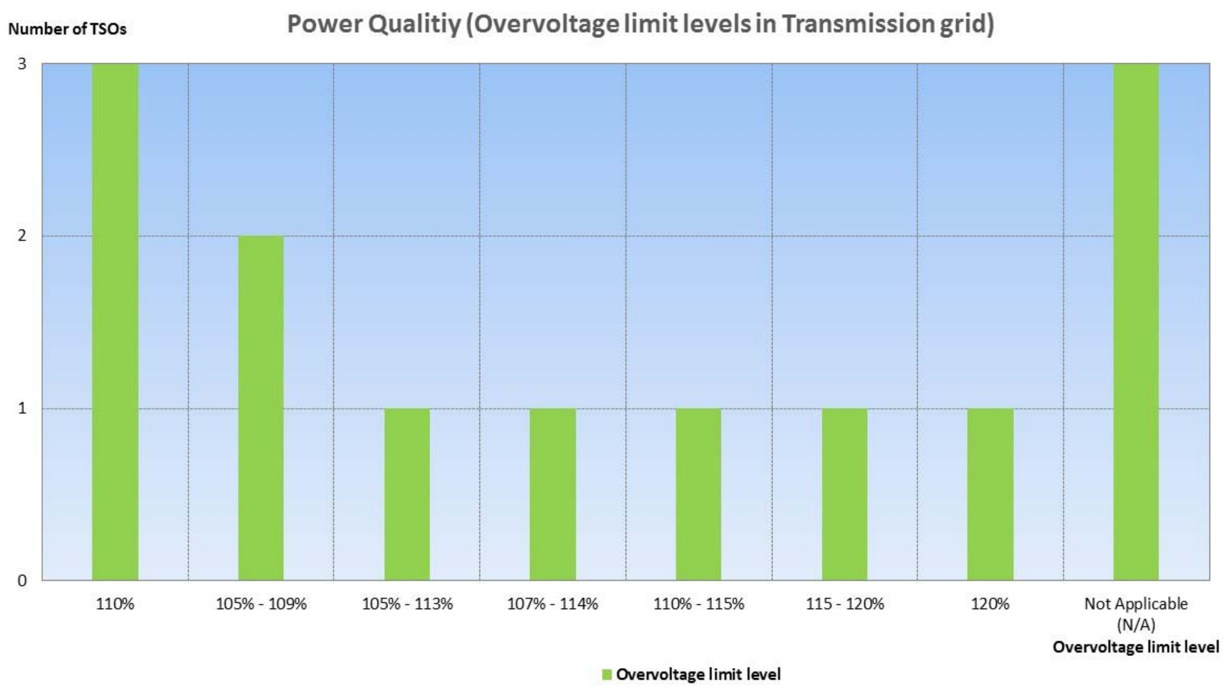


Figure 51. Analysis of the transient overvoltage in each system

4.2.9 Demand disconnection schemes

In this chapter a brief description on the demand disconnection schemes in use in this system is shown.

6 out of 12 TSOs have both low frequency and low voltage demand disconnection schemes while 7 TSOs (including Lybia) have only low frequency demand disconnection scheme. In general the low frequency demand disconnection scheme consists on an automatic low frequency disconnection program (load shedding, including pump storage units) in different steps in order to prevent a further frequency drop and the collapse of the system. In general automatic demand reconnection is not allowed.

	Both	Only LF
DZ*	x	
CY		x
FR	x	
GR	x	
IT	x	
LY		x
JO		x
ME		x
MA	x	
PT		x
ES**		x
TN	x	
TR***		x

Figure 52. Demand disconnection schemes

*In Algeria, the low frequency scheme has 4 levels: 49,3 Hz; 49.0 Hz; 48.5 Hz and 48.0 Hz (disconnection 10% for each level); while the low voltage scheme for 60kV has 2 levels: 54 kV and 52 kV (disconnection of 20% for each level) and for 220kV: 190kV and 192 kV is an exception for a part of the grid.

**In Spain:

- 49,5 Hz: 50% of energy storage.
- 49,3 Hz: 50% of energy storage remaining.
- 49,0 Hz: 15% demand disconnection of the total load.
- 48,7 Hz: 15% demand disconnection of the total load.
- 48,4 Hz: 10% demand disconnection of the total load.
- 48,0 Hz: 10% demand disconnection of the total load.

***In Turkey, demand is automatically disconnected by means of low frequency relays in the event of a fall in frequency to the frequency levels determined as 49.0, 48.8, 48.6, 48.4 Hz. If the system frequency drops to 49.0 Hz, 10% to 20% of demand is automatically and forcedly disconnected. Amount of demand to be disconnected at each frequency level following 49.0 Hz is determined by the System Operator considering the technical requirements of the system users. TEIAS performs rotations without any discrimination between equal parties every 4 months for demand to be automatically disconnected by the low frequency relays.

4.2.10 System restoration capabilities

In this chapter an analysis of the system restoration capabilities in each national power system is shown.

A. Technologies need to have Black Start Capability

In Greece and Jordan all generators except RES have to have Black Start Capability. In Morocco and Turkey, Gas Turbines and Hydro PPs have Black Start capability. In Algeria, Cyprus and Tunisia Gas Turbines are the only generators with Black Start Capability. France, Italy, Portugal and Spain do not have any specific regulation for Black Start Capabilities.

	Gas Turbines	All generators (Except RES)	Hydro	Not specified
DZ	X*			
CY	x			
FR				x
GR	x	x	x	
IT				x
LY	X**			
JO		x		
ME			x	
MA	x		x	x
PT				x
ES				x
TN	x			
TR	x		x	

Figure 53. Technologies with black start capability

*In Algeria, also combined cycles.
**In Lybia, diesel generators in some strategic power plants.

B. Technologies need to have Island Operation Capability

In Greece, Italy, Montenegro and Tunisia, all generators have Island mode capabilities. In Turkey, Gas Turbines and Hydro PPs have Island mode capabilities. In Morocco and Portugal only Gas Turbines have to have Island mode capabilities. Cyprus, France and Spain do not have any specific regulation for Island mode capabilities.

	Gas Turbines	All generators (Except RES)	Hydro	Not specified	Other
DZ	x				
CY				x	
FR	x	x	x		
GR	x	x	x		
IT		x			
LY	x				
JO					X*
ME		x			
MA	x				
PT	x				
ES				x	
TN		x			
TR	x		x		

Figure 54. Technologies with island operation capability

*In Jordan, PV & Wind Plants connected to 33 kV and higher in terms of LVRT capability. Other Generation are not required by regulation to work in island operation.

C. Other System Restoration Capabilities. 7 out of 12 TSOs restore their network through interconnections in case of Black-out.

	Yes (through interconnections)	No
DZ	x	
CY		x
FR		x
GR	x	
IT		x
JO		x
ME		x
MA	x	
PT	x	
ES	x	
TN	x	
TR	x	

Figure 55. Other system restoration capabilities

4.2.11 Demand Side Response services

In this chapter the use of demand side response (DSR) services in each power system has been analysed. The provision of DSR services is included being optional in 10 of the 13 countries that have responded to the survey, with the exception of Cyprus, Lybia and Jordan where there is no regulation developed in this aspect yet. The following map provides an overview of the situation concerning the provision of DSR services.

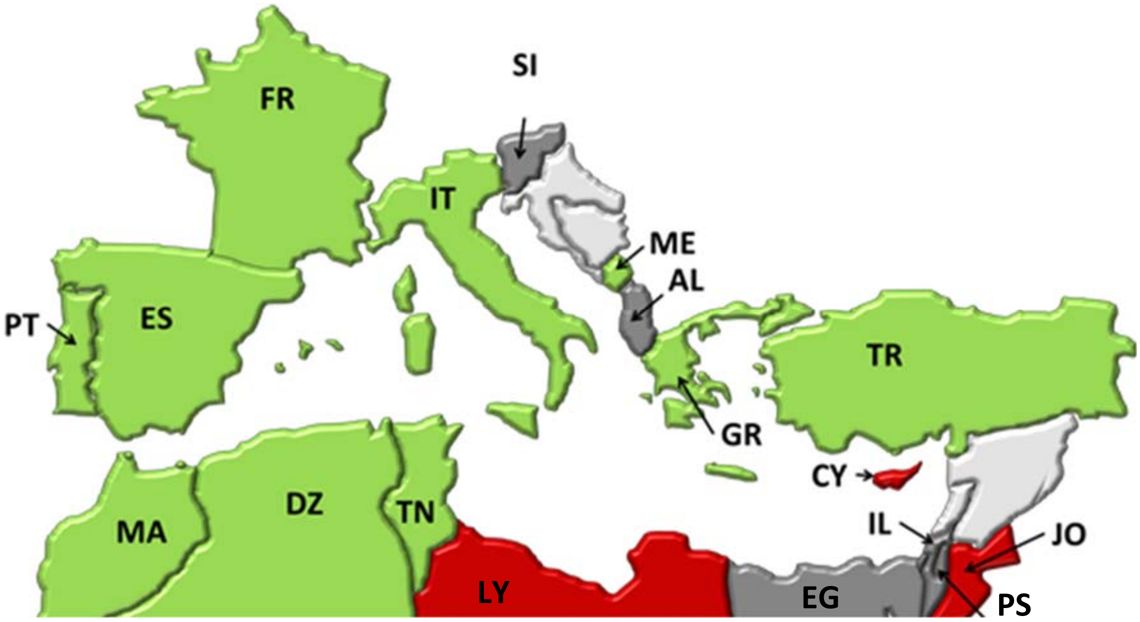


Figure 56. Demand side response services use

4.2.12 HVDC requirements

In this chapter the existence of specific HVDC requirements or criteria in each power system has been analysed.

HVDC technology exists in 9 of the 13 countries that have responded to the survey, with the exception of Jordan, Lybia, Morocco and Cyprus. In all countries where HVDC technology applies, no special regulation for HVDC has been established yet with the exception of France and Italy that have already developed national HVDC regulation in this aspect. European Network Codes on HVDC were recently approved in comitology by the European Commission and are expected to apply in all European countries. The following map provides an overview of the situation concerning the existence of specific HVDC regulation.

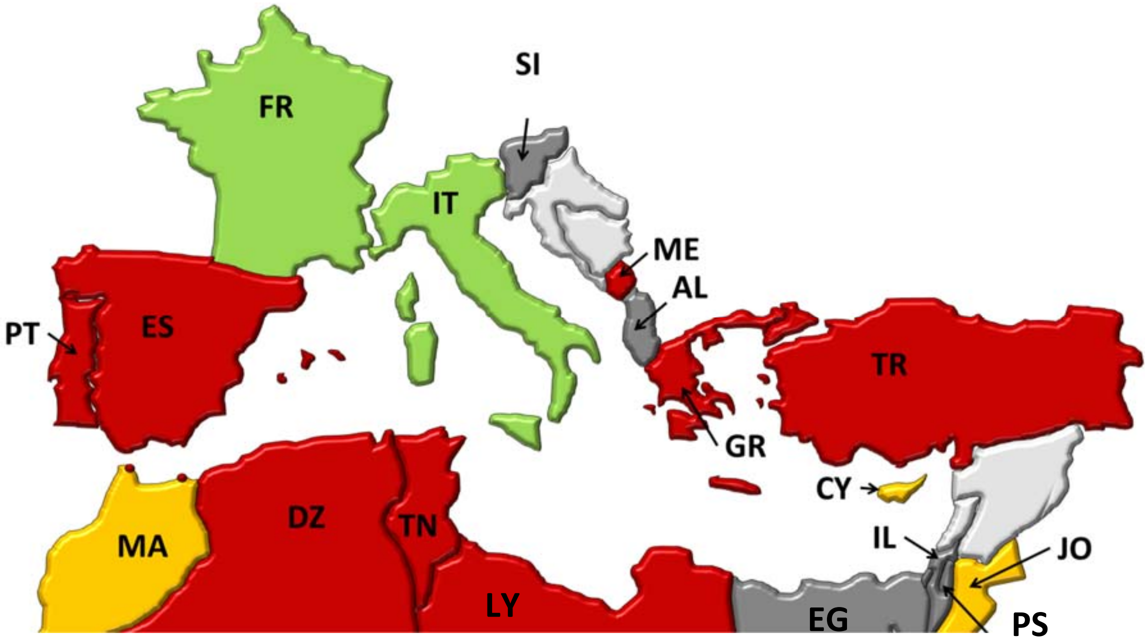


Figure 57. HVDC specific requirements

4.2.13 Compliance

In this chapter the compliance scheme used in each system is presented. Three main answers have been provided regarding which compliance schemes for monitoring the technical requirements non-transmission facilities have to comply with.

In all the countries that have answered (except Jordan) TSOs are entitled to perform tests and simulations in order to verify the compliance. In 5 of these countries (Cyprus, France, Greece, Italy and Spain) third party entities have the responsibility of certifying compliance. In Cyprus and Portugal a user declaration could also be used depending on the specific case.

Country	TSO tests and simulations	3rd party certification entity	User declaration
DZ	X		
CY	X	X	X
FR	X	X	
GR	X	X	
IT	X	X	
JO		X*	
ME	X	X	
MA	X		
PT	X		X
ES	X**	X	
TN	X		
TR	X		

Figure 58. Compliance schemes

*In Jordan, tests are done by an independent engineer hired for this purpose, but with the presence of the TSO and according to the relevant agreements.

**In Spain, REE is partly entitled to monitor the technical requirements compliance for generators connection. Only FRT requirement is monitored by means of a validation procedure approved by a national committee. Summarizing a lot the process, certification entities have to be accredited by the national accreditation entity (ENAC) and are entitled to carry out compliance tests for FRT and afterwards, the generation facility owner would have to provide the Ministry with the compliance certificate.

4.3 Operation of the interconnected systems

In this section an overview of the existing or short-term expected rules in the Mediterranean region is presented regarding the operation of the interconnected systems including the coordinated operation between neighbouring TSOs and the coordinated dispatch of the users facilities involved, with a specific chapter for the operation of HVDC links.

4.3.1 System states

A. Classification of system states

Regarding system states classification in almost all countries 5 different possibilities are considered, as follows:

- Normal state: operation of the concerned TSO’s control area is and will remain within operational security limits even after occurrence of a contingency.
- Alert state: at least one of a list of conditions is satisfied.
- Emergency state: operational security limits are violated in N state or frequency deviations outside larger thresholds. Activation of defense plan measures.
- Blackout state: loss of more than 50% of demand in the affected TSO’s control area or total absence of voltage for at least 3 minutes in the affected TSO’s control area.
- Restoration state: when a TSO, being in the emergency or blackout state, has started to activate measures of its restoration plan.

In Jordan, an additional state (System Stress) is also considered; while in Turkey the previous classification is not defined in regulation. But regarding the frequency of the system there is a definition of system states as "normal" (49,8 Hz ≤ f ≤50,2 Hz), "acceptable" (49,5 Hz ≤ f < 49,8 Hz and 50,2 Hz < f ≤ 50,5 Hz), "critical" (47,5Hz ≤ f < 49,5Hz and 50,5Hz < f ≤ 52,5Hz) and "unstable" (f < 47,5 Hz and 52,5 Hz < f).

DZ, CY, FR, GR, IT, ME, MA, PT, ES, TN	Normal Alert Emergency Blackout Restoration
JO	Normal Alert Emergency Restoration Partial Blackout System Stress
TR	Normal Acceptable Critical Unstable

Figure 59. System states classification

B. Parameters monitored in real time

In general, in all countries the parameters monitored in real time are similar and the following list could be considered as common:

a) active and reactive power flows;
b) busbar voltages;
c) frequency and frequency restoration control error of its LFC area;
d) active and reactive power reserves;
e) generation and load.

4.3.2 Technical requirements

In this chapter the current situation regarding technical requirements in real time operation of the potential interconnected systems is presented.

A. Frequency ranges

The references to the different system states is similar in each frequency range as can be observed in the following figure.

	47,0 Hz < f < 47,5 Hz	47,5 Hz < f < 48,5 Hz	48,5 Hz < f < 49,0 Hz	49,0 Hz < f < 51,0 Hz	51,0 Hz < f < 51,5 Hz	51,5 Hz < f < 52,0 Hz
DZ	Emergency/ Blackout	Emergency	Emergency	Normal/Alert	Emergency	Emergency
CY	Emergency/ Blackout	Alert/Emergency/Blackout	Alert/Emergency	Normal/Alert/Emergency	Alert/Emergency	Alert/Emergency
FR	Emergency/ Blackout	Emergency	Emergency	Normal/Alert/Emergency	Emergency	Emergency
GR	Emergency/ Blackout	Emergency	Emergency (48,5 Hz < f < 49,5 Hz)	Normal/Alert/Emergency (49,5 Hz < f < 50,5 Hz)	Emergency (50,5 Hz < f < 51,5 Hz)	Emergency
IT	Emergency/ Blackout	Emergency	Emergency	Normal/Alert (49,9 Hz<f<50,1 Hz)	Emergency	Emergency/Blackout
JO	NA	Fault conditions	System Stress (48,5Hz < f < 49,95 Hz)	Normal (49,95Hz < f < 50,05 Hz)	System Stress (50,05 Hz < f < 51,25 Hz)	Fault conditions (51,25 Hz < f < 51,5 Hz)
ME	Not answered					
MA	Emergency/ Blackout	Emergency	Emergency	Normal/Alert/Emergency	Emergency	Emergency
PT	Emergency/ Blackout	Emergency	Emergency	Normal/Alert/Emergency	Emergency	Emergency
ES	Emergency/ Blackout	Emergency	Emergency	Normal/Alert/Emergency	Emergency	Emergency
TR	Unstable	Acceptable	Normal/ Acceptable	Normal/Acceptable	Acceptable/ Critical	Critical/Unstable
TN	Emergency/ Blackout	Emergency	Normal/Alert	Normal/Alert	Normal/Alert	Emergency

Figure 60. System states in each frequency range

B. Voltage ranges (for unlimited operation).

In general we can consider voltage ranges quite similar in all countries, especially the maximum values for each voltage level. In the following table minimum and maximum values in normal conditions in each power system are shown.

NORMAL CONDITIONS					
400 kV	**Min**	**Max**	**220 kV**	**Min**	**Max**
DZ	380	420	DZ	204,6	235,4
CY	*	*	CY	198	242
FR	380	420	FR	200	245
GR	380	420	GR	**	**
IT	375	415	IT	209	231
JO	380	420	JO	**	**
ME	Not answered		ME	Not answered	
MA	380	435	MA	210	245
PT	380	420	PT	209	245
ES	390	420	ES	205	245
TR	340	420	TR	**	**
TN	380	420	TN	204,6	235,4

Figure 61. Voltage ranges in normal conditions

**400 kV not applicable in Cyprus system*
***220kV not applicable in the Greek, Turkish and Jordan system*

In 400 kV minimum values differ from 340 kV (in Turkey) to 390 kV (in Spain); being the most repeated value 380 kV. Regarding maximum value in general all countries consider 420 kV (415 kV in Italy and 435 kV in Morocco). In 220 kV minimum values differ from 198 kV (in Cyprus) to 210 kV (in Morocco). Regarding maximum value all countries consider values between 231 kV and 245 kV.

In addition voltage ranges increase in extraordinary conditions as shown in the next table (highlighted in purple).

EXTRAORDINARY CONDITIONS					
400 kV	**Min**	**Max**	**220 kV**	**Min**	**Max**
DZ	372	428	DZ	198	242
CY	*	*	CY	198	242
FR	380	420	FR	200	245
GR	350	420	GR	****	****
IT**	360	420	IT**	200	242
JO	360	440	JO	****	****
ME	Not answered		ME	Not answered	
MA	375	435	MA	205	245
PT***	372	420	PT***	205	245
ES***	380	420	ES***	205	245
TR	340	450	TR	****	****
TN	372	428	TN	198	242

Figure 62. Voltage ranges in extraordinary conditions

**400 kV not applicable in Cyprus system*
***In Italy, more extreme values for the restoration state (350-430 in 400 kV and 187-245 in 220 kV)*
**** In Portugal and Spain values are for N-1 conditions. Regulation includes more ample values for N-2 conditions (360-420 for 400 kV and 198-245 for 220 kV in Portugal; and 375-435 for 400 kV and 200-245 for 220 kV in Spain).*
*****220kV not applicable in the Greek, Turkish and Jordan system.*

C. Specific voltage ranges for international interconnections

Regarding international interconnections, in some countries (Algeria, Greece, Jordan, Montenegro, Turkey and Tunisia) specific voltage ranges apply.

NORMAL CONDITIONS			EXTRAORDINARY CONDITIONS		
	400 kV	220 kV	220 kV	400 kV	220 kV
DZ	± 2,5%	± 7%	DZ	± 5%	± 7%
GR	± 5%	*	GR	(-13%/+5%)	*
JO	± 5%	*	JO	± 15%	*
ME	± 5%	± 10%	ME	± 10%	± 15%
TR	(-15%/+5%)	*	TR	(-15%/+12,5%)	*
TN	± 5%	± 7%	TN	± 5%	± 7%

Figure 63. Specific voltage ranges for international interconnections

**220kV not applicable in the Greek, Jordan, and Turkish systems*

D. Which measures apply in your system for reactive management?

In general, the measures which apply in each country are similar including the switching of reactors and capacitors; power factor control by distribution companies; on load tap changers transformers; opening lines; HVDC.

E. Specific reactive power management for international interconnections?

Regarding international interconnections 2 main blocks of countries on how reactive power is managed can be considered:

- On the one side the European countries in which reactive power is managed in a coordinated manner. TSOs interconnected with AC interconnectors shall jointly define the voltage and/or reactive power flow limits on these interconnectors, in order to use the reactive power capabilities in the most efficient way and ensure adequate voltage control.
- On the other side Maghreb countries and Jordan where reactive power is managed autonomously, avoiding Mvar flow through the interconnections.

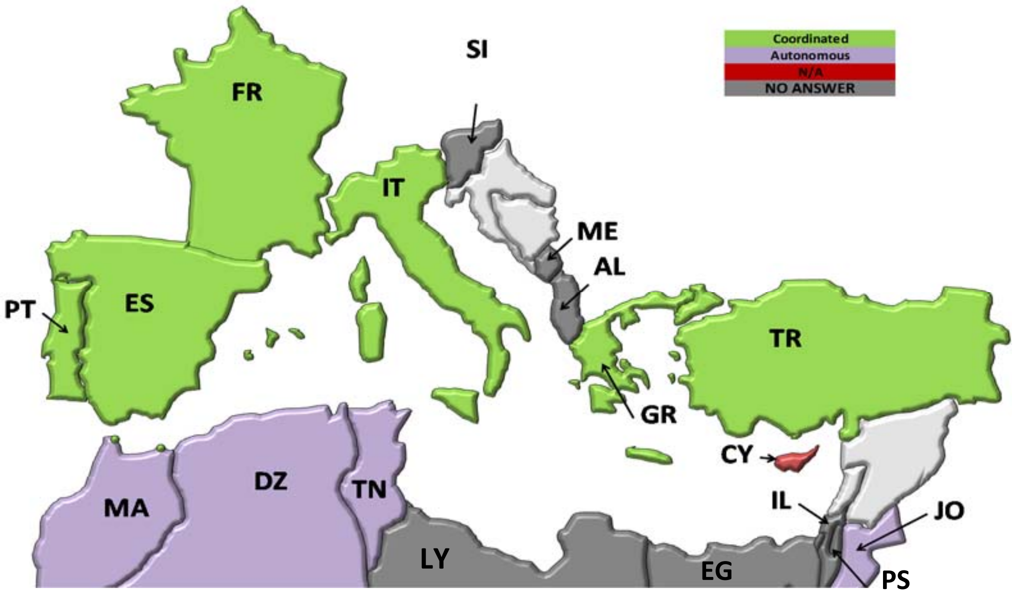


Figure 64. Reactive power management for inthernational interconnections

F. Limit criteria for short-circuit management

In general there is no specific short-circuit management in real time operation. In the following table short-circuit values for the switch equipment is shown.

	U > 380 kV (kA)	380 kV > U > 200 kV (kA)	U < 200 kV (kA)
DZ	40	31,5	31,5
CY			40 - 31,5
FR	63 - 40	40 - 31,5	31,5 - 20
GR	40	NA	31
IT	63	63 - 31,5	40 - 20
JO	50 - 40	40 - 31,5	31,5 - 25
ME	40	31,5	31,5
MA	40	40	31,5
PT*	50 - 40	50 - 40	50 - 40 -31,5
ES*	50	40	32,5
TN	63-40	40 - 31,5	31,5 - 25
TR	63	31,5	31,5 - 16

Figure 65. Short-circuit values for swith equipment

* In Spain and Portugal criteria is related to the specific short-circuit current of each substation.

G. System protection coordination criteria.

In general, the system protection coordinated criteria is agreed with neighboring TSOs through common protocols or bilateral agreements/contracts, not being the criteria previously specified in the regulation.

4.3.3 Information exchange

In this chapter the current situation regarding the information exchange between neighbouring TSOs is presented (for Cyprus this chapter in not applicable as there are no international interconnections in the Cyprus power system).

A. Issues included in the contingency list (internal and external contingencies)

In general, the contingency list includes both grid (single or double lines, bus bars, transformers) and generation facilities considered as influential (with impact in the neighboring system).

B. Joint remedial actions agreed between TSOs after a contingency in each operation time horizon

Joint remedial actions are agreed and coordinated between TSOs. The most common actions performed are topology actions, countertrading, coordinated re-dispatching, lines tripping and PST tap changing.

In general, only non-costly actions are considered to solve congestions linked to outage planning management.

C. Operational planning models in each operation time horizon

In general planning models are exchanged in yearly, monthly, weekly and daily time horizons. These models include load curve, generation program, maintenance plan for both transmission and generation assets.

D. Real time data

Regarding real time data exchange in general SCADA values of neighboring substations are exchanged in real time and observed by both TSOs.

In addition, European countries exchange with all the TSOs in the same synchronous areas general data such as frequency, aggregated generation, system state, set value of the FR controller or power exchange. Additional data from the observability area is also exchanged between European countries (substation topology, bus bar voltage, active and reactive power in lines and transformers, regulating positions of transformers or power restrictions within the observability area). Algeria and Tunisia do not exchange data between their SCADA systems.

E. Scheduled data

A heterogeneous situation is considered regarding the exchange of scheduled data, with 3 main blocks:

- European countries: In general the data exchanged is the scheduled on D-1 and the forecasted aggregate amount of injection and withdrawal, per primary energy source, at each node of the transmission system for different timeframes (forecast shall be realistic and accurate). In the near future, European countries will follow requirements included in European Network Code on System Operation.
- Maghreb countries: Voltage, power in the interconnections lines and topology data. In Morocco, additional data is exchanged with Spain according to the bilateral agreement between REE and ONEE.
- Jordan and Montenegro: only data used for day-ahead congestion management.

F. Structural data

Regarding structural data the following can be considered from the answers given by each TSO:

- Maghreb countries: network topology and parameters in peak load and off load situations (winter and summer).
- European countries: neighboring TSOs shall exchange at least the following structural information related to the observability area:
  (a) the regular topology of substations and other relevant data by voltage level;
  (b) technical data on transmission lines;
  (c) technical data on transformers connecting the DSOs, significant grid users which are demand facilities and generators’ block-transformers of significant grid users which are power generating facilities;
  (d) the maximum and minimum active and reactive power of significant grid users which are power generating modules;
  (e) technical data on phase-shifting transformers;
  (f) technical data on HVDC systems;
  (g) technical data on reactors, capacitors and static VAR compensators; and
  (h) operational security limits.
- Jordan: only maximum and minimum active and reactive power of generation units.

4.3.4 Contingency analysis.

A. Contingencies considered.

In all countries that have answered this questions the N-1 contingency is considered while the loss of the biggest generation plant is considered in all except Jordan; and partial N-2 except in Algeria, Jordan and Morocco.

	N-1	Partial N-2*	Loss of biggest generation plant
DZ	x		x
CY	x	x	x
FR	x	x	x
GR	x	x	x
IT	x	x	x
JO	x		
ME	Not answered		
MA	x		x
PT	x	x	x
ES	x	x	x
TR	x	x	x
TN	x	x	x

Figure 66. Contingencies considered

*Partial N-2 consists on the simultaneous tripping of two circuits on common carrier (in some cases like Greece and France only 400kV; in other cases like Spain and Portugal at least 35 common kilometers)

B. Operational security limits.

In all countries the security limit considered in N conditions is 100% (except in Montenegro where is limited to 90%), with the specific considerations included below.

DZ*	100%
CY	100%
FR	100%
GR	100%
IT**	100%
JO***	100%
ME	90%
MA****	100%
PT*****	100%
ES******	100%
TR	100%
TN*******	100%

Figure 67. Operational security limits

*In Algeria the limit can be 120% during 2 hours.

**In Italy, 120% is admissible for overhead lines if remedial actions are available in 20 minutes.

***In Jordan, in operation studies n-1 mainly, maybe extended to n-2 of the loss of a generating plant depending on the case. For transformers 132/33 setting 110%, for OHL 132 KV 120 % setting, and for OHL 400 KV thermal limit.

****In Morocco the limit can de 120% during 20 minutes (in N-1 conditions).

*****In Portugal the table below summarizes the thermal limits considered both under normal operation conditions and under N-1 or N-2 contingencies, according to current security operation practices in Portugal:

	N-1	N-2
Lines		
overloads temporary (t<15min.)	15%	15%
overloads temporary (15min.<t<2h)	0%	0%
Transformers		
overloads temporary (t<15min.)	20%(winter)	30%(winter)
	5%(summer)	10%(summer)
overloads temporary (15min.<t<2h)	20%(winter)	30%(winter)
	5%(summer)	10%(summer)

******In Spain, 100% operational limits is used in normal, alert and emergency states in all cases except on aerial lines (115% for a max. of 20 min) and transformers (up to 120% depending on contingency and season).

*******In Tunisia the limit can be 110% for a maximum of 20 minutes.

C. Periodicity of state estimations calculations

In 6 out of 12 countries, state estimations calculations are performed each 5 minutes. In some cases (France and Greece) the contingency analysis is regularly performed on a daily basis but in case of emergency or system risk it is possible to run it more times during the day.

DZ, CY, JO, PT, ES*, TN	5 minutes
FR, GR	Daily
IT**	1 minute
ME, MA	15 minutes
TR***	NA

Figure 68. Periodicity of state estimations calculations

*In Spain, the state estimation runs each 5 minutes and the contingency analysis each 10 minutes.

**In Italy, the state estimation runs every minute but N-1 security analysis and OPF runs every 5 minutes.

***In Turkey, SCADA/EMS system is under upgrade now. Currently online contingency analyses is not being performed but after finalization of the SCADA/EMS upgrade project this tool will be available. Currently off line contingency analyzes are performed by using the last hour system data.

4.3.5 Dynamic stability studies (performed day ahead or in real time)

In this chapter the elaboration of dynamic stability studies performed day ahead or in real time and the periodicity of their use in each power system have been analysed.

7 out of 12 countries that have provided information on this topic perform dynamic stability studies. From those, only Algeria perform them regularly on a day-ahead basis, while in the rest of the countries such studies are performed only occasionally, in specific situations identified as possible risk for the system or upon request. The following map provides an overview of the situation concerning the application of dynamic stability studies.

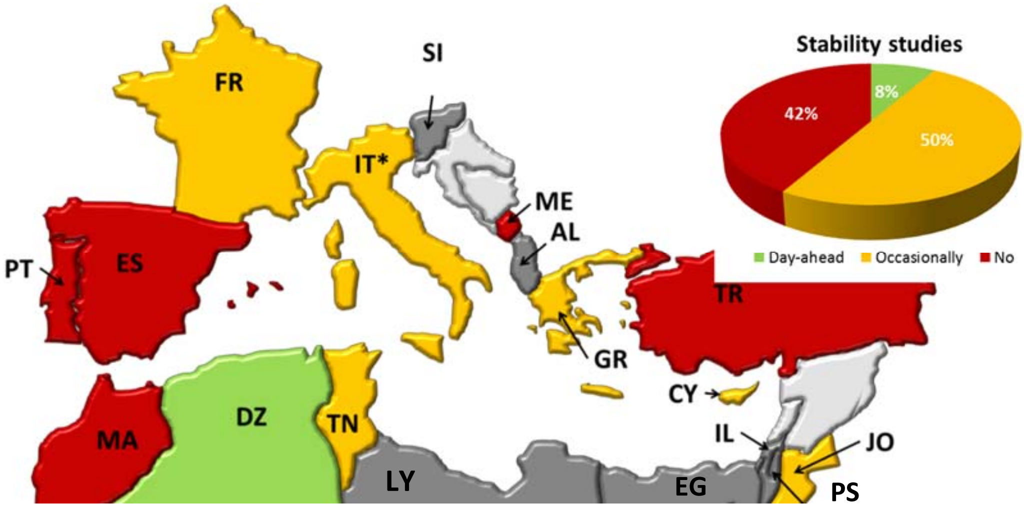


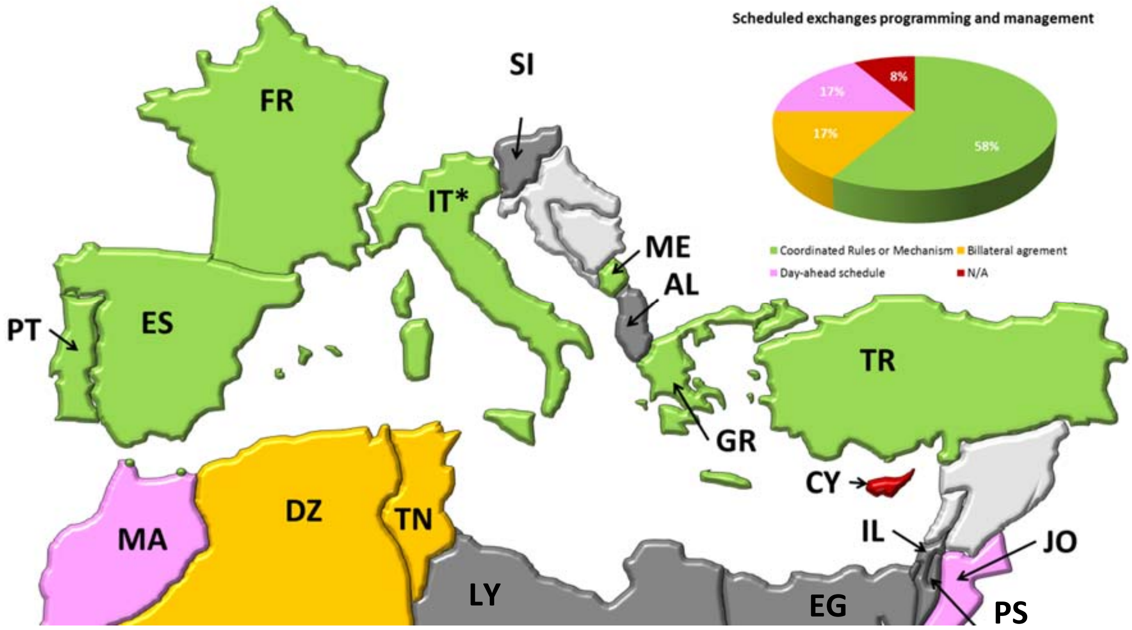
Figure 69. Dynamic stability studies in real time

*In Italy, real time dynamic security assessments are possible with DSA (Dynamic security assessment) tool.

4.3.6 Management of international exchange programs

In this chapter the principles of programming and management of scheduled international exchanges between TSOs have been analysed.

In all the European countries that have provided information on this topic (where applicable) including Turkey, programming and management of scheduled international exchanges is performed in accordance with coordinated rules and mechanisms (such as Operational Handbook and ENTSO-E standards). From the countries of the Maghreb area that have provided information, Algeria and Tunisia perform day ahead scheduling of international exchanges, while in Morocco and Jordan energy trading is performed according to bilateral contracts and mainly in cases of emergency. The following map provides an overview of the above described situation.



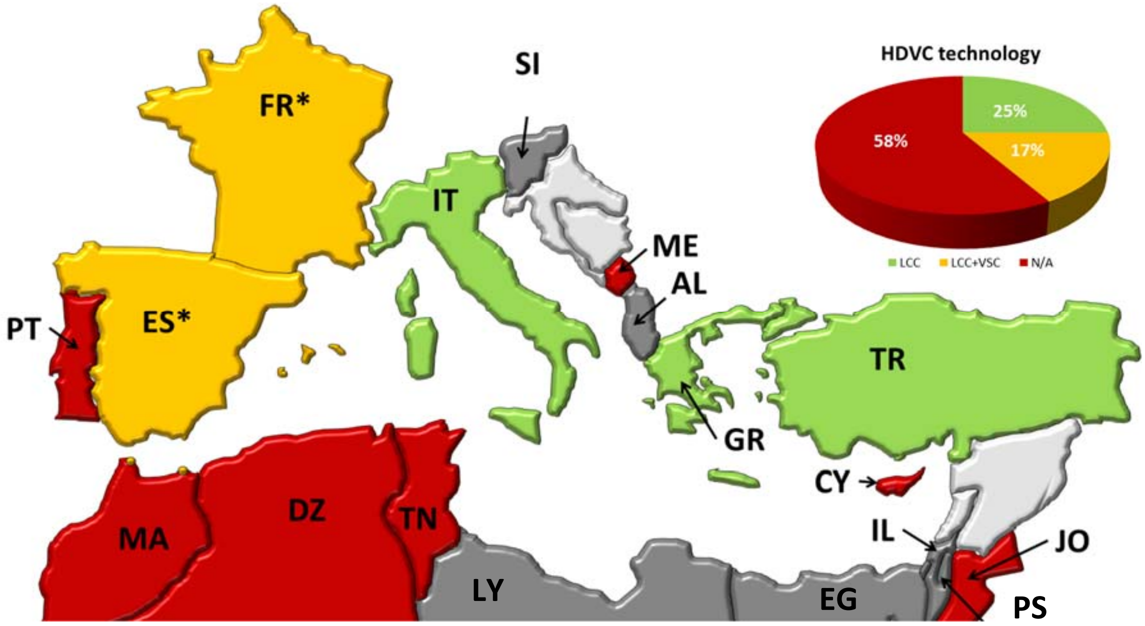
* In Italy, only in case of emergency

Figure 70. Management of international exchange programs

4.3.7 HVDC technology

In this chapter the experience of the TSOs from the operation of HVDC technologies has been further analysed, in combination with the parallel co-existence of the AC technology.

HVDC technology exists in all European countries including Turkey, with the exception of Portugal, Montenegro and Cyprus. Among them, only Spain and France have both LCC and VSC technologies installed, while in the rest of the countries only LCC technology exists. Only few TSOs report their experience from the operation of the HVDC interconnectors, in particular France from the operation of the LCC link with the UK, in which the need for management of inverse flows and voltage deviations has been identified and Greece form the operation of the LCC link with Italy, which in the past withstood major disturbances in the South East Europe without being affected. The experience from the operation of the VSC link between France and Spain and of the LCC link between Turkey and Georgia is rather short to provide currently any feedback. The HVDC interconnectors of France with the UK and Spain are in fact the only HVDC links in the Mediterranean Region, which operate in parallel with AC lines and until today no special operational problems or unexpected behaviour have been identified. The following map provides an overview of the above situation.



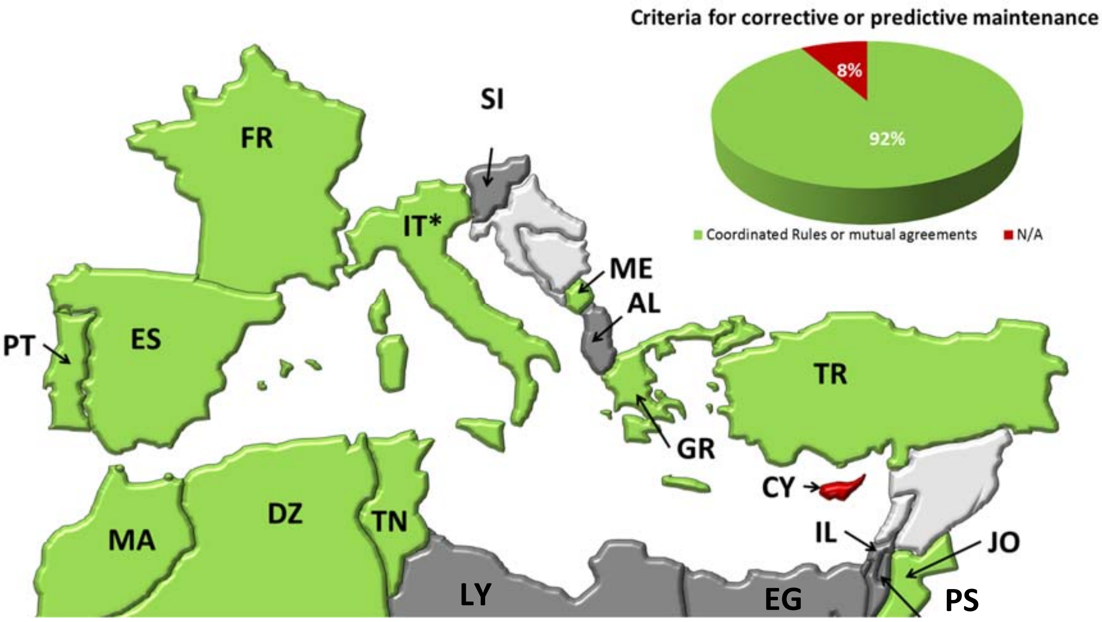
* In Spain and France, HVDC operating in parallel with AC lines

Figure 71. Operation of HVDC technology

4.3.8 Outage coordination

In this chapter the criteria and procedures for outage coordination (corrective or predictive maintenance) between neighbouring TSOs or between TSO and users are analysed, particularly when such operations affect the NTC.

In both cases mentioned above, in all countries that have provided information on this topic (where applicable), corrective or predictive outages are performed in accordance with coordinated rules (such as Operational Handbook and ENTSO-E standards) or mutual agreements between the relevant parties. Few TSOs provided information concerning the remuneration of the affected traders.



* N/A relatively to NTC for outage coordination between TSO and user.

Figure 72. Outage coordination procedure

4.3.9 Load frequency control (FCR, FRR, RR)

In this chapter the management and provision of reserves in each system is analysed. The classification considered in the European Network Codes has been used:

- **Frequency Containment Reserves (FCR)** means the spinning and non-spinning reserves activated to contain system frequency after the occurrence of an imbalance. Times of activation depending on level of frequency deviation (at the limit, to be activated upto 30 s for Continental Europe). *Primary regulation was the former name of this category*.
- **Frequency Restoration Reserve (FRR)** means the active power reserves activated to restore system frequency to the nominal frequency and for synchronous area consisting of more than one Load Frequency Control (LFC) area power balance to the scheduled value.
  - Automatic Frequency Restoration Reserve (aFRR), with activation delay not greater than 30 seconds. *Secondary regulation was the former name of this category.*
  - Manual Frequency Restoration Reserve (mFRR). *This resource would correspond to part of the tertiary reserve. Activation time of less than 15 minutes.*
- **Replacement Reserve (RR)** means the reserves used to restore/support the required level of FRR to be prepared for additional system imbalances. This category includes operating reserves with activation time from time to restore frequency up to hours. *Activation time of more than 15 minutes. This resource would correspond to the remaining tertiary reserve and other slower reserves.*

A. Frequency Containment Reserve (FCR).

In all countries it is mandatory to provide FCR but only in 3 of them (Montenegro, Morocco and Spain) without any restriction while in the other 9 (75% of the total) there are some limitations.

Figure 73. Provision of FCR

The restrictions applied vary from limitations depending on the size of the power plant to the type of generation that has to provide FCR, as indicated in table below.

DZ	> 50MW
CY	>5MW
FR	RES are exempt
GR	>2MW (RES and cogeneration are exempt)
IT	Certified Generation Units
JO	Conventional Generation Units
PT	Conventional Generation > 50 MW
TR	> 50MW
TN	> 100MW

Figure 74. Limitations for the provision of FCR

FCR provision is paid in 5 out of 12 countries, while in the other 7 is a non-paid service.

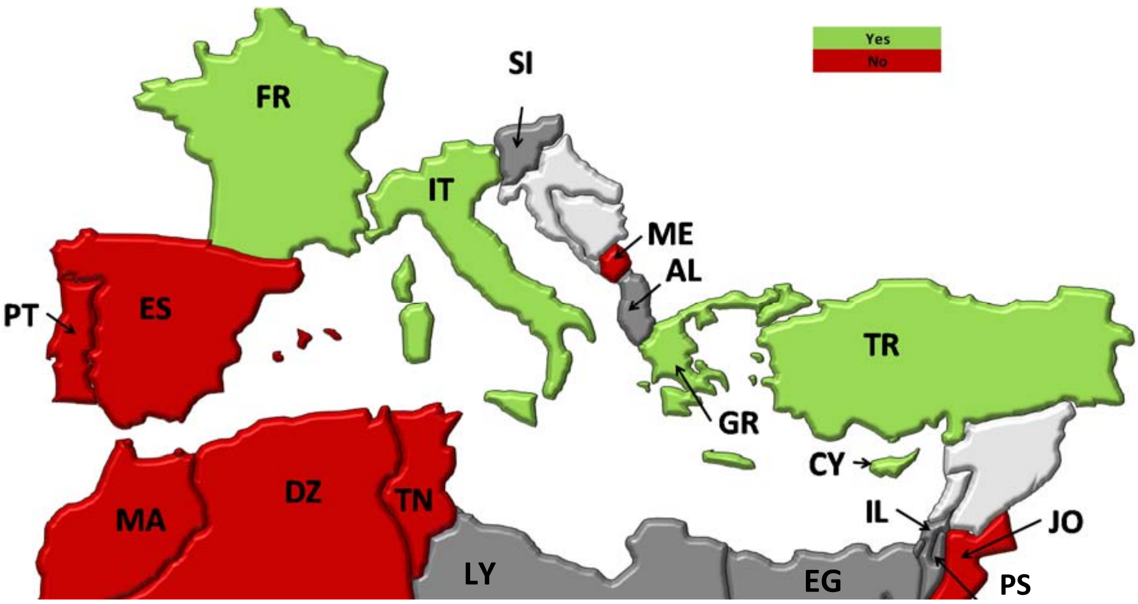


Figure 75. FCR paid service

The criteria used for establishing the quantity of FCR needed can be classified as follows:

- Loss of the biggest generation unit in Algeria, Jordan, Morocco and Tunisia.
- Frequency of past incidents, production unit mix, RES penetration and cost in Cyprus.
- Agreement by TSOs in a regional level in European countries.

Regarding the compliance scheme in 8 out of 12 countries is included in regulation, but only 4 of them (Cyprus, Italy, France and Turkey) have established consequences (mainly economic penalty) for not providing the service.

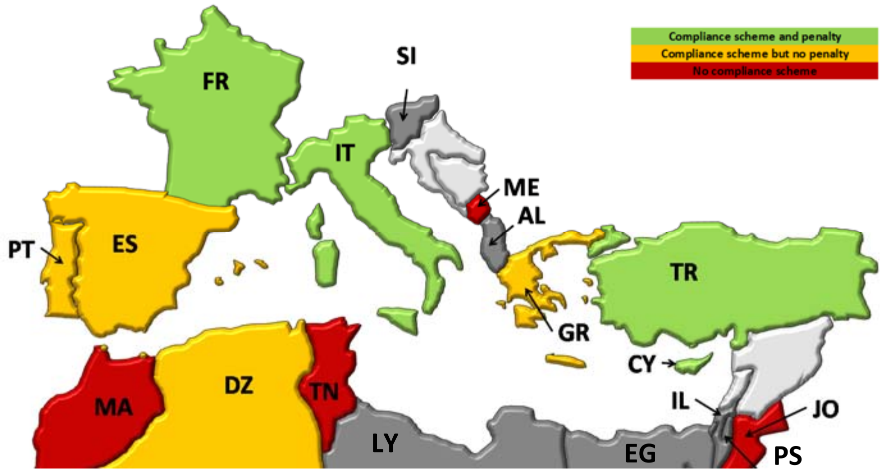


Figure 76. FCR compliance scheme

B. Frequency Restoration Reserve (FRR).

In 8 out of 12 countries it is mandatory to provide FRR but only in Montenegro without any restriction while in the other 7 there are some limitations.

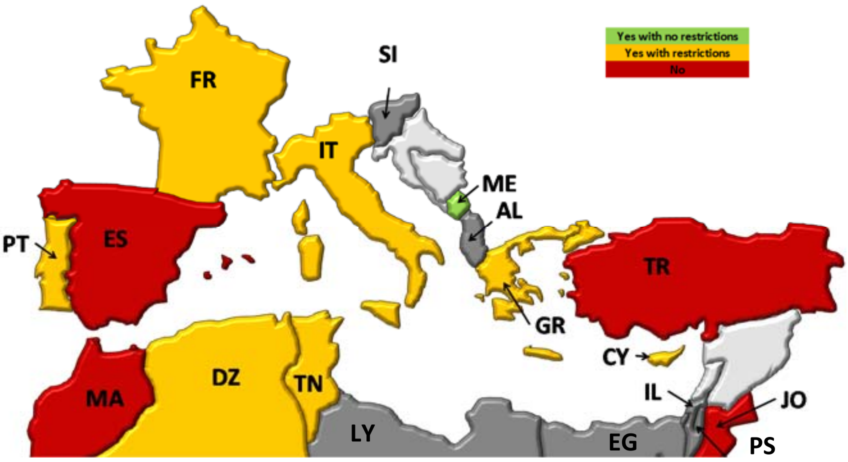


Figure 77. Provision of FRR

The restrictions applied vary from limitations depending on the size of the power plant to the type of generation that has to provide FRR, as indicated in table below.

DZ	>10MW
CY	>5MW
FR	>120MW
GR	>60MW (RES and cogeneration are exempt)
IT	Certified Generation Units
PT	Enabled by the TSO
TN	> 100MW

Figure 78. Limitations for the provision of FRR

FRR provision is paid in 9 out of 12 countries, while in the other 3 is a non-paid service.

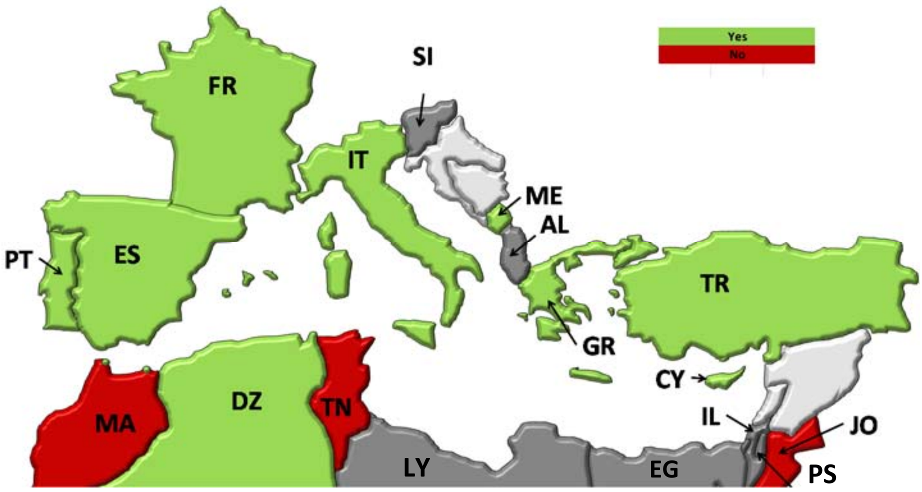


Figure 79. FRR paid service

The criteria used for establishing the quantity of FRR is the loss of the biggest generation unit in all countries except in Cyprus where the frequency of past incidents, production unit mix, RES penetration and cost.

Regarding the compliance scheme in 8 out of 12 countries is included in regulation, but only 4 of them (Cyprus, Italy, France and Greece) have established in it consequences (mainly economic penalty) for not providing the service.

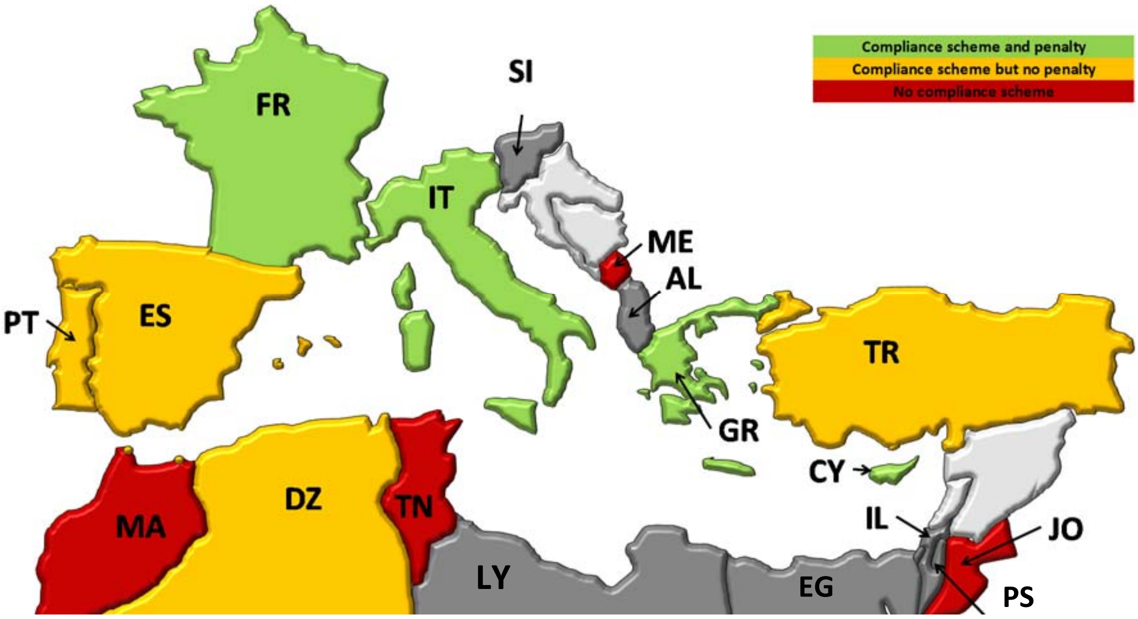


Figure 80. FRR compliance scheme

C. Replacement Reserve (RR).

In 6 out of 12 countries (Algeria, Italy, Montenegro, Portugal, Turkey and Tunisia) it is mandatory to provide RR. In general all generators (in European countries that have participated in wholesale market) are potential providers of this service. In Jordan is the TSO (or the Egyptian TSO through the interconnections between both countries) who can provide this type of reserve.

RR provision is paid in 6 out of 12 countries, while in the other 6 is a non-paid service.

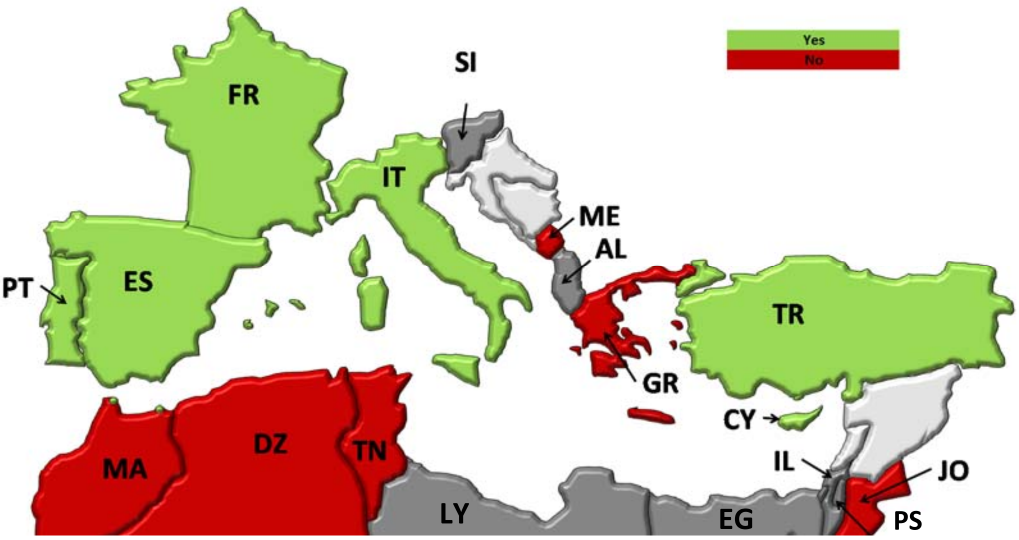


Figure 81. Provision of RR

The criteria used for establishing the quantity can de classified in 2 main blocks:

- Variable, depends on issues such as forecasted market deviations, generation outages, load forecast errors, wind forecasting … (European countries and Jordan).
- Fixed amount in Maghreb countries.

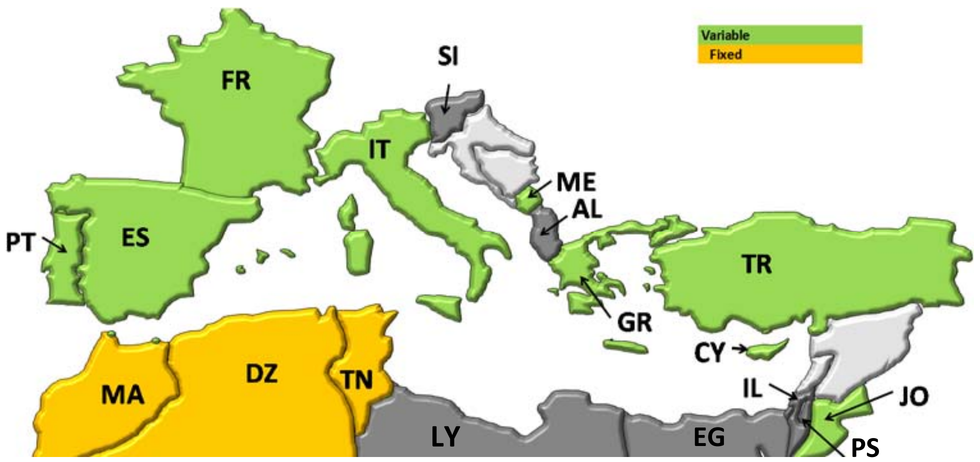


Figure 82. Criteria for establishing the quantity of RR

Regarding the compliance scheme in 9 out of 12 countries is included in regulation, but only 5 of them (Cyprus, Italy, France, Portugal and Greece) have established in it consequences (mainly economic penalty) for not providing the service.

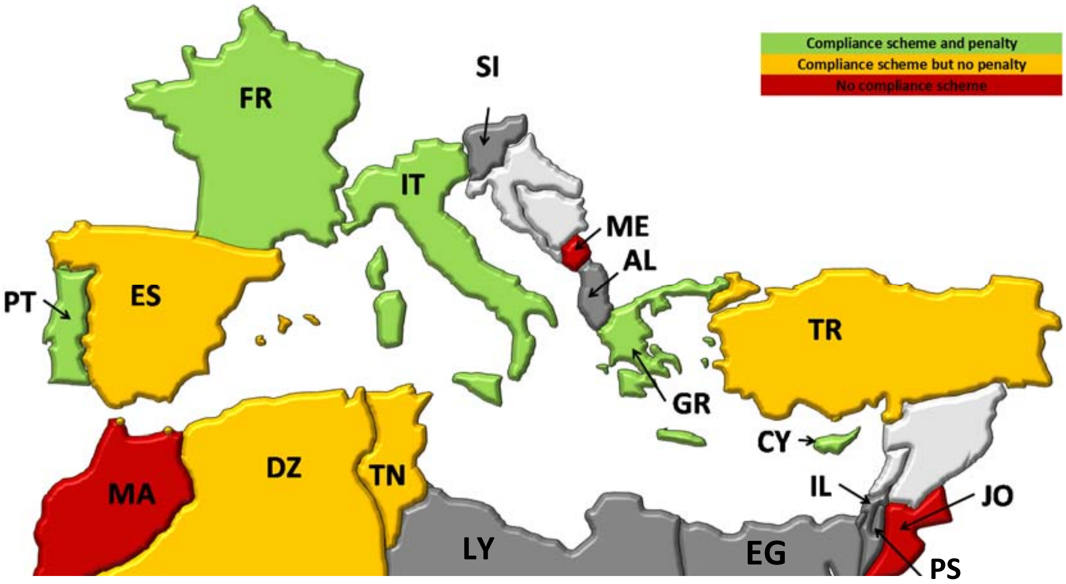


Figure 83. RR compliance scheme

4.3.10 Reserves management

In this chapter an analysis on how the different types of reserves are exchanges and shared between TSOs is presented.

- European countries: Nowadays exchange of reserves apply with some limitations. In the future with the entry into force of the European Guideline in Electricity Balancing a common criteria will apply.
- Maghreb countries: FRR is shared whereas no exchange of FCR and RR is allowed.
  (FRR is shared between neighbouring TSO's according to the loss of the biggest power generation unit in the interconnected system: Algeria contributes with 50% of the power loss, Morocco contributes with 30% and Tunisia contributes with 20%).
- Jordan: FCR and FRR exchange is allowed.

4.3.11 System defence plan

In this chapter the regulation on the system defence plan and the related procedures used in each power system are presented.

A. Frequency deviation management procedure.

In general all TSOs use the same frequency deviation management procedure is done in general automatically using reserves and taking advantage of the interconnections. In addition automatic under frequency control schemes (based on load shedding) and over frequency control schemes (disconnection of generation) are also in use. Other specific details for each country are shown in the following table:

DZ	The frequency deviation management is done automatically using the primary and the secondary reserve and by taking advantage of the presence of interconnections. It also may be done by proceeding automatically to a load shedding. It can be also manually using the tertiary reserve.
CY	Automatic Underfrequency and Overfrequency control.
FR	The French defense plan comprises the following actions: automatic separation of regions that have sustained loss of synchronism, automatic load shedding upon frequency drop, automatic blocking of on-load tap changers of EHV/HV(1) and HV/MV transformers upon voltage drop and automatic disconnection to house load of nuclear and fossil fuel units on their auxiliaries.
GR	In cases of system failure or other operational problems which might affect system frequency or voltage, or might lead to overloads exceeding the thermal limits of any part of the System, demand disconnection schemes are implemented as follows: 1. Actions by the TSO and/or commands to System Owner and the Network Operator: Start or stop generation units; Start or stop pump storage units; Increase or decrease (automatically or on request) production level of generating unit or pumps; Changes of voltage regulator set points on transformers at distribution level. 2. Commands by the TSO to Supply Permit Owners and/or Users connected to the System or the Network. 3. Use of manual or Automatic load shedding due to underfrequency or low voltage. 4. Adapt active LFC control mode.
IT	Generation units; Interruptible load-shedding; Domestic load-shedding
JO	automatic under frequency schemes / power flow management/ intertrip on transformers. Over Frequency Scheme is addpoted in Renewable Energy Sources.
ME	UFLS load shedding plan , updated every year.
MA	5 underfrequency load shedding threshold.
PT	Automatic under-Frequency control scheme Based on automatic Low Frequency Demand Disconnection scheme (LFDD) in order to prevent a further frequency drop and the collapse of the system: - Stepwise demand disconnection - Automatic disconnection of Energy storage before the activation of the LFDD - Automatic demand reconnection is not allowed - Load shedding should be implemented in a regionally evenly distributed way - LFDD plan should avoid disconnecting feeders with connected dispersed generation - Check in common with DSOs (or with other involved parties) at least once a year. Automatic over-Frequency control scheme Based on automatic step-wise linear disconnection of generation. Automatic reconnection is not allowed.

ES	*Automatic under-Frequency control scheme* Based on automatic Low Frequency Demand Disconnection scheme (LFDD) in order to prevent a further frequency drop and the collapse of the system: - Stepwise demand disconnection - Automatic disconnection of Energy storage before the activation of the LFDD - Automatic demand reconnection is not allowed - Load shedding should be implemented in a regionally evenly distributed way - LFDD plan should avoid disconnecting feeders with connected dispersed generation - Check in common with DSOs (or with other involved parties) at least once a year. *Automatic over-Frequency control scheme* Based on automatic step-wise linear disconnection of generation. Automatic reconnection is not allowed.
TR	Primary, secondary and tertiary control is applied. AGC Sytem inside reacts to increase or decrease generation automatically. In severe disturbances Load freaquency relasy acts and shed load from the system.
TN	7 underfrequency load shedding threshold.

Figure 84. Frequency deviation management procedure

B. Voltage deviation management procedure.

In general in all countries the voltage deviation management procedure comprises the same measures:

1. Connection and disconnection of capacitors/reactors
2. Generation reactive power (P, Q curves);
3. Transformers tap changing;
4. Switching of lines;
5. Load shedding in very extreme cases.

Other measures not so widely used are:

1. Power-electronics-based voltage and reactive power management devices, for instance, HVDC systems

2. Instructing transmission connected DSOs and significant grid users to block automatic voltage and reactive power control of transformers or to activate remedial actions on their facilities.

C. Manual demand disconnection procedure.

In general two main blocks could be considered:

- On the one hand the Maghreb countries, in which the manual demand disconnection procedure focuses on risk assessment and determination of the level of the load to be cut.
- On the other hand European countries in which for specific issues, like to prevent voltage collapse or instability or to alleviate congestions on transmission equipment, manual or automatic (local/regional) load shedding can be activated by TSOs.

D. Inter-TSO assistance and coordination in emergency state.

FR*, PT, GR, IT, ES, TR, JO	Inter-TSO assistance and coordination during emergency states is provided according to bi-lateral agreements between neighbouring TSOs.
CY	N/A. No interconnections exist
DZ, MA, TN, ME	The inter-TSO assistance and coordination in emergency state consists in providing mutual aid by performing power exchanges and by sharing the load shedding.

Figure 85. Inter-TSO assistance and coordination in emergency state

*In France, CORESO (which is a supranational control room) gives advice to TSOs to deal efficiently with this issues.

4.3.12 Restoration plan

In this chapter the strategies used in each power system regarding the restoration plan are presented. In general two main strategies are considered:

- **Bottom-up re-energisation strategy**. Strategy where the system (or part of the system) of a TSO can be re-energised without the assistance from other TSOs.
- **Top-down re-energisation strategy**. Strategy that requires the assistance of other TSOs to re-energise the system (or part of the system) of a TSO.

Regarding the bottom-up strategy, in general the rule consists on using generation units equipped with the "black start" capability in order to restore the backbone of the high voltage grid in priority.

- In France the first phase of the French restoration plan is based on the connection of the nuclear power plants. When nuclear power plants are connected to the grid, the load is progressively connected.

Regarding the top-down strategy, is based on the use of the international interconnections and normally through bilateral agreements with neighboring TSOs.

4.3.13 Training and certification

In this chapter different issues about training and certification for system operator employees in r charge of real time operation are analysed.

A. Certification of operators.

Operators need a certification in 75% of the countries (8 out of 12), being under implementation in Turkey. In Jordan, Morocco and Tunisia there is no need for such certification.

In general all countries with a certification, consider also a refresh certification for their operators (except in Cyprus). This certification is in all cases delivered by the TSO.

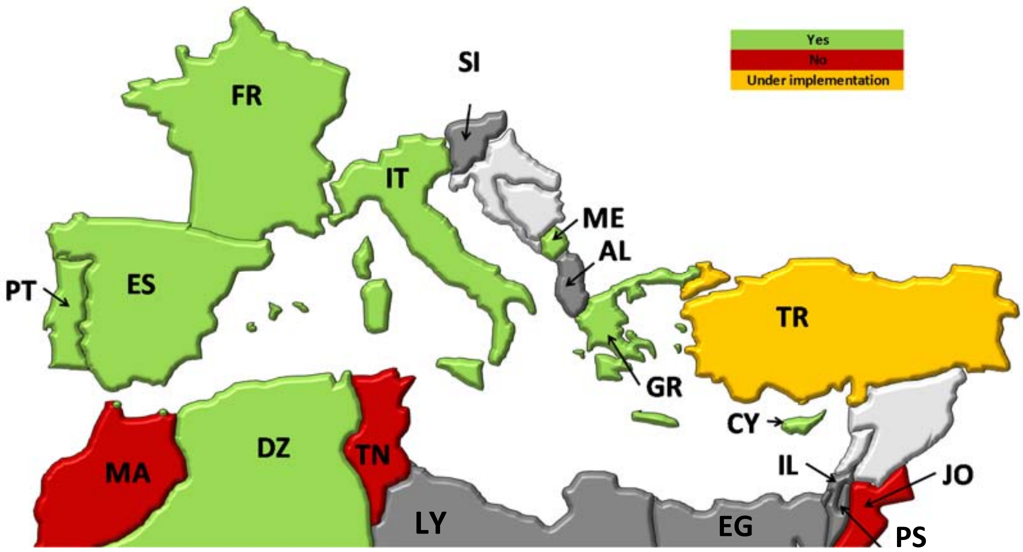


Figure 86. Training certification delivery

B. How long is the certification valid?

The valid period for the certification differs in each country from 6 months in Algeria to 18 months in Spain. In some cases (Cyprus Greece, Italy and Montenegro) there is no limit. Regarding the refresh certification in Algeria is valid for 2 years. Answers provided are shown in the following table:

	First certification	Refresh certification
DZ	6 months	2 years
CY	DOES NOT EXPIRE	N/A
FR	Shall not exceed five years	Continuous training program
GR	No limit	
IT	No limit	
JO	N/A	N/A
ME	No limit	Test of knowledge every 5 years
MA	NA	N/A
PT	Shall not exceed five years	Continuous training program
ES	18 months	18 months
TR	The studies for certification in under implementation.	
TN	NA	NA

Figure 87. Training certification valid period

C. Training courses.

In almost all countries a simulator is used during the training, except in Turkey, Montenegro and Jordan where is expected in the near future.

Regarding the topics included in the training (both for beginners and during the refreshment courses) in all countries technical aspects (including inter TSO coordination) and stress management are included. In Spain training covers additional topics such as negotiation techniques, teamwork, written communication techniques or decision making.

The length of training courses for beginners is normally of between 6 and 12 months (Cyprus, Greece, Italy, Montenegro, Portugal and Spain). In Algeria and Tunisia lasts for 2 weeks each 6 months during the 2 first years; while is not specified in France and in Turkey is under implementation.

Refresh certification are shorter in time, normally of 1 week (each one or 2 years).

Regarding languages requirements, in general apart from the national one, English is needed. French is also needed in Spain and the Maghreb countries.

Each shifts last for 8 hours in all countries except in Montenegro (12 hours).
InterTSO training practices are organized regularly in all countries (except Jordan and Cyprus).

4.3.14 Dispatch priority.

In this chapter is presented the application of dispatch priority in real time operation. The situation is similar in all countries where RES have full priority (in European countries also high efficiency CHP) and after that applies an economic criteria (according to market prices in European counties and economic dispatch in Maghreb countries and Jordan). In the following table answers received are shown.

	A. What dispacth criteria (including priority) applies in your system?
DZ	Dispatch priority is based on merit order of generation (economic dispatch), but RES has first prirority by law.
CY	RES have Priority, Economic dispatch for thermal units
FR	Not specified. EC regulation provides that RES have priority dispatch.
GR	Full priority for RES. Dispatch priority for other plants according to the market day ahead scheduling.
IT	RES has dispatching priority. Dispatching according to market offers, RES dispatched only for security reasons.
JO	Full priority for RES. Availability of fuel, technical limitations of the transmission grid and economic criteria.
ME	Only RES have dispatch priority
MA	RES are first to be used
PT	Res have Priority.
ES	Economic base criteria first, if price is equal RES have priority of dispatch, then high efficiency CHP and then the rest of generation.
TR	N-1 criteria has dispatch priotirty. An Operator Desk for RES operation is being implemented in new SCADA System.
TN	RES have Priority, Economic dispatch for thermal units.

Figure 87. Dispatch priority criteria

4.4 System Markets

The analysis of the contributions of the Med-TSO Members related to System Markets Area has been focused on the management of cross-border electricity interconnections and the impact on the functioning of the internal system (rules and procedures, actors and responsibilities).

The following patterns try to summarize some of the contents provided by Members, in accordance with the "families of issues" identified in specific questionnaires.

The topics of the questionnaire are:

- Legal Issues
- Rules and Methodology for capacity calculation
- Rules and methodologies for capacity allocation
- Dispatching and balancing issues
- Balancing settlement (deviations)
- Metering issues

4.4.1 Legal issues

What are the current requirements for participation on the Electricity Markets in your country?	
Algeria	Marketing authorization and power purchase issued by the Regulatory Authority.
Cyprus	Authorization from NRA is required for participation in the Cyprus Electricity Market.
France	* Sign a contract with a balance responsible entity; * Adhere to the Rules for Access to the French Public Transmission Network for Imports and Exports by signing a Participation Agreement concerning the current rules, so as to be able to make nominations to RTE; * Agree with RTE on an amount of bank guarantee; * Sign up a contract with Distribution Network Operator with which you wish to interact; * Rules on access to the RTE Information System and applications specific to the "Balance Responsible" mechanism.
Greece	All producers, self consumers, suppliers and traders equiped with the relevant permission by the Regulatory Authority of Energy are allowed to participate in the Electricity Market.
Italy	Market players have to sign a Dispatching Contract with Terna.
Jordan	N/A
Morocco	Only producers from renewable energy sources-law 13-09
Montenegro	
Portugal	Parties willing to participate on the Electricity Markets need to be entitled as market participants in the market.
Spain	To be a Market Agent and sign a contract with REE.
Tunisia	The Electricity markets does not yet exist.
Turkey	To have an adequate license from the regulator, to be registered in Market Operator, to present adequate bank guarantees, to sign an agreement with TEIAS.

A. What are the current requirements for participation on the cross-border electricity trade in your system? B. What are the current rules for export / import of cross-border electricity in your system?	
Algeria	A. Ministry of Energy authorization is needed. B. Bilateral exchange contracts.
Cyprus	N/A
France	For participating in cross border trading where capacities are explicitly allocated, requirements are defined in the Auction Rules. For capacities allocated via implicit mechanism (market coupling / continous trading) no specific requirement for the interconnection, only requirement for participating with the french Market Operator is requested. To be more specific, the players of the European electricity market who wish to use them must make the request to do so according to the particular conditions of each interconnection. Thus, in order to gain access to the interconnections, a market player must: * Adhere to the Rules for Access to the French Public Transmission Network for Imports and Exports by signing a Participation Agreement concerning the current rules, so as to be able to make nominations to RTE; * Adhere to the Rules of the allocation mechanism by signing a specific contract to take part in the allocation process: case of the France-England, France-Germany, France-Spain, France-Belgium, France-Italy and France-Switzerland interconnections; * Attach his export and import transactions to a Balance Responsible scope.
Greece	Any Registered Market Participant willing to take part in the explicit auctions (Y, M, D) have to fulfil the obligations as specified in the relevant allocation rules. (Agreement conclusion and finanacial Warranties). Market Rules, Capacity Allocation Rules.
Italy	According to Auction Rules, for Italian system market it’s necessary to stipulate a dispatching contract (injection and/or withdrawal), to subscribe the Statement of Acceptance of the Auction Rules and a valid signed Congestion Managment Rules (Nomination rules).
Jordan	Bilateral contracts, Interconnection Agreement. Day ahead Program.
Morocco	The cross border are managed by The TSO who carry out the exchanges. Rules for import/export: Spain: OMEL spot Market; Algeria: Commercial contract with SONELGAZ
Montenegro	Acceptance of the Auction Rules.
Portugal	Need to follow the entitlement process described in the relevant allocation rules. Those parties willing to participate on the cross-border trade in the Day Ahead and Intraday timeframes need to be entitled as market participants in the day ahead market. Regulamento de Acesso às Redes e Interligações, Manual de Procedimentos do Mecanismo de Gestão Conjunta da Interligação Portugal-Espanha, MIBEL Market Rules.
Spain	Need to follow the entitlement process described in the relevant allocation rules. Those parties willing to participate on the cross-border trade in the Day Ahead and Intraday timeframes need to be entitled as market participants in the day ahead market. France/Morocco: to be a Market Agent and sign a contract with REE Portugal: to be a Market Agent and sign a contract with REE and OMIE MO-ES and AN-ES interconnections: any party willing to take part in cross-border trade needs to get entitled by the Spanish Ministry. Spanish High Level Regulation; Spanish Operational Procedures; Market Rules; Capacity Allocation Rules.
Tunisia	The electricity markets does not yet exist in tunisia, STEG has the only acces to the network. There is no specific rules for expot/import of cross-border electricity. This task is the responsibility of Steg (TSO). It's necessary to stipulate a bilateral contracts with TSOs (export and/or import). The existing rules are described in the Operating instructions and contracts (export and/or import) agreed between neighbours countrys (TSOs).

Turkey	To have an adequate license from the regulator, to be registered in Market Operator, to be registered in TCAT (TEIAS Capacity Auction Tool) platform. Turkish Grid Code, Import&Export Code, accepptance of the Auction Rules for ENTSO-E borders. Eligibility of CBA Participants to take part to Cross-Border Auctions. Import and Export Regulation approved and published by EMRA (Authority).
What categories of operators are enabled for import/export activities	
Algeria	N/A
Cyprus	N/A
France	Market parties for what is related to market and on some borders for the balancing. TSOs for balancing, emergency help, countertrading
Greece	Producer, self consumer, supplier, trader.
Italy	Market players or subjects compliant with Auction Rules requirements.
Jordan	Single buyer model.
Morocco	TSO is a single buyer.
Montenegro	Registered traders, suppliers, generators, direct consumers, TSO.
Portugal	n.a. Currently the long term allocation is with FTR - Finantial Transmission Rights that are a finantial product by definition. In Day-Ahaed and Intraday the international commercial flows are established by the market.
Spain	Generator, direct consumer and retailer. Market players are entitled to establish bilateral contracts among them. It is not permitted bilateral contracts between TSO and MPs.
Tunisia	Import/export electricity in Tunisia is exclusively managed by operator "STEG". Producers of electricity from renewable energy may be enable to export some of renewlable energy.
Turkey	Private companies who owns the supply licence, and whole sale licence and Turkish Electricity Trading and Commitment Company (TETAS). Companies, who have supply license can import/export. Generators can export only.

Which are the requirements for stipulating and executing contracts with market players relevant for the Cross Border Trade with other relevant market players in your country	
Algeria	N/A
Cyprus	N/A
France	Market players are entitled to establish bilateral contracts among them. It is not permitted bilateral contracts between TSO and Market Participants.
Greece	A Registered Market Participant must conclude a participation agreement with the Allocation Platform (TSO or Auction Office).
Italy	It's necessary to be a market player qualified by the Market Operator (GME in Italy).

Jordan	Contracts between TSO and Grid operators. TSO, Grid Operator and bulk supplier are the same entity (NEPCO).
Morocco	No other entity is allowed to trade electricity but ONEE. However, Law 13-09 makes it possible for "clean energy" producers to export electricity they generate to their customers through ONEE's cross border transmission network.
Montenegro	Contracts between TSO and Market operatator.
Portugal	n.a. Currently the long term allocation is with FTR - Finantial Transmission Rights that are a finantial product by definition. In Day-Ahaed and Intraday the international commercial flows are established by the market.
Spain	Market players are entitled to establish bilateral contracts among them. It is not permitted bilateral contracts between TSO and market players.
Tunisia	Contracts between TSOs and Grid Operators and Contracts between TSOs and producer of renwlable energy. STEG is the electricity monopoly in Tunisia, it manages all the electric activity.
Turkey	Exist typologies of contract with TSO, and with Market Operator. In particular: There is no contract between Market Operator and TSO, the roles and responsibilities have been designed in Electricity Law. There is contract between TSO and Market Players. There is contract between Market Operator and Market Players. Between TSOs, Interconnection Operation Agreement is the main document.

Are there any international agreements on either bilateral or multilateral basis which your country has concluded with other countries concerning further development and liberalization of energy markets?	
Algeria	Bilateral agreements with neighbouring countries and external agent of iberic market
Cyprus	In Cyprus, the TSO is also the Market Operator, but there is currently not a functional electricity market. A new market model, (Net Pool), is currently being implemented by the Market Operator
France	Yes, day ahead market coupling (european wide). French initiatives are fully compliant with the European Third Energy Package. The European Union's Third Energy Package is a legislative package for an internal gas and electricity market in the European Union. Its purpose is to further open up the gas and electricity markets in the European Union. Core elements of the third package include ownership unbundling, which stipulates the separation of companies' generation and sale operations from their transmission networks, [1] and the establishment of a National regulatory authority (NRA) for each Member State, [2] and the Agency for the Cooperation of Energy Regulators which provides a forum for NRAs to work together.
Greece	Greece as a member of EC follows all the necessary procedures towards the establishment of a common European Martket . There are multilateral agreements for market coupling. Also there are multilateral agreements for the operation of common alocation platforms (JAO, SEE CAO).
Italy	* Harmonized Auction Rules; * Bilateral Agreements between TSOs; * Cooperation Agreement for Market Coupling.
Jordan	No
Morocco	No other agreements on either further development or liberalization except the current agreements tying Morocco to neighbouring Countries Spain and Algeria.

Montenegro	Yes, for example, bilateral agreement for exchanging balance energy (tertiary regulation).
Portugal	Yes, the development and liberalization of energy markets in Europe is being driven in the framework of European Legislation.
Spain	Yes, the development and liberalization of energy markets in Europe is being driven in the framework of European Legislation. Long Term management: EU HAR (European Harmonized Allocation Rules) and single common platform as specified in FCA (Forward Capacity Allocation). Market coupling as specified in CACM (Capacity Allocation and Congestion Management) XBID (Cross Border Intraday) market project.
Tunisia	No
Turkey	Regulation (EC) 714/2009 of the European Parliament and the Council. Interconnection Operation Agreements, Turkish Electricity Law and Internal Codes inforce in TEIAS. TEIAS has signed Long Term Agreement with ENTSO-E. With signing this agreement, TEIAS is committed to apply European Unions energy acquis as much as possible. These acquis targets more liberalized energy market, more usage of renewables and better energy efficiency.

Is it possible in your country to buy transmission rights already bought under the Transfer Capacity Allocation (TCA)?	
Algeria	N/A
Cyprus	N/A
France	Yes
Greece	Secondary trading of Long Term Transmission Rights is allowed.
Italy	Yes
Jordan	Not Applicable. The TSO is the counterpart.
Morocco	No
Montenegro	Yes
Portugal	Yes it is possible to transfer via OTC the transmission rights bought. Currently the long term allocation is with FTR - Financial Transmission Rights that are a financial product by definition. In Day-Ahaed and Intraday the international commercial flows are established by the market.
Spain	Yes, secondary trading of Long Term Transmission Rights is allowed. No particular fisical restrictions are applied to these operations.
Tunisia	No
Turkey	Yes

Is there a market operator in your legislation or the TSO is the only counterpart?	
Algeria	Yes, it exists a Market Operator in our legislation, but it is not yet active.
Cyprus	TSO is also the Market Operator. Exsists a prevision of regulation for the opening market.

France	EPEX Spot is the Market Operator.
Greece	LAGIE is the Market Operator.
Italy	GME is the Market Operator.
Jordan	TSO, Grid Operator and bulk supplier are the same entity (NEPCO).
Morocco	TSO is the only counterpart.
Montenegro	COTEE is the Market Operator.
Portugal	OMIE is the Market Operator.
Spain	OMIE is the Market Operator.
Tunisia	TSO is the only counterpart.
Turkey	Electricity Market Operation Company.

How is electricity trade made in your country: between market participants or between TSO's?	
Algeria	Between market participants.
Cyprus	N/A
France	Electricity trade is made between market participants.
Greece	Electricity trade is made between market participants.
Italy	Electricity trade is made between market participants.
Jordan	Market model is not available. Single buyer Model. Power Purchasing Agreements (PPA) are signed between TSO and Generation companies.
Morocco	Between private producer of renewable energy and consumers.
Portugal	Electricity trade is made between market participants.
Spain	Electricity trade is made between market participants.
Tunisia	Between TSO's
Turkey	Trade is made only between Market players. By Law, TEIAS cannot be in electricity buying/selling business.

Which requirements you have to satisfy for using the interconnections (e.g. demand/offer equilibrium, congestion management at national, and if possible, at international level, balancing of the exchange program in real time, coordinated dispatching)?	
Algeria	Demand/offer equilibrium, congestion management at national, balancing of the exchange program in real time, coordinated dispatching.
Cyprus	N/A
France	Security of the system: congestion and maintain of Area Control Error to 0 through a FRR action.
Greece	Congestion management at international level.
Italy	Each operator has to be the appointee of the related transmission right (PTR), but it's not necessary to satisfy demand/offer equilibrium requirements.
Jordan	NEPCO control the flow (TSO of Jordan) and Egypt control their frequency (TSO of Egypt).
Morocco	Capacity Exchange; Demand/Offer balance; Congestion management.
Montenegro	Must be satisfied equilibrium between import-production and export-consumption.
Portugal	Maintain the security criteria in the interconnection and in the network that influences external TSO and maintain the required quality on the Frequency Restoration Control Error (ACE).
Spain	Maintain the security criteria in the interconnection and in the network that influences external TSO and maintain the required quality on the Frequency Restoration Control Error (ACE).
Tunisia	Balancing of the exchange program in real time.
Turkey	Congestion management and maintain of Area Control Error

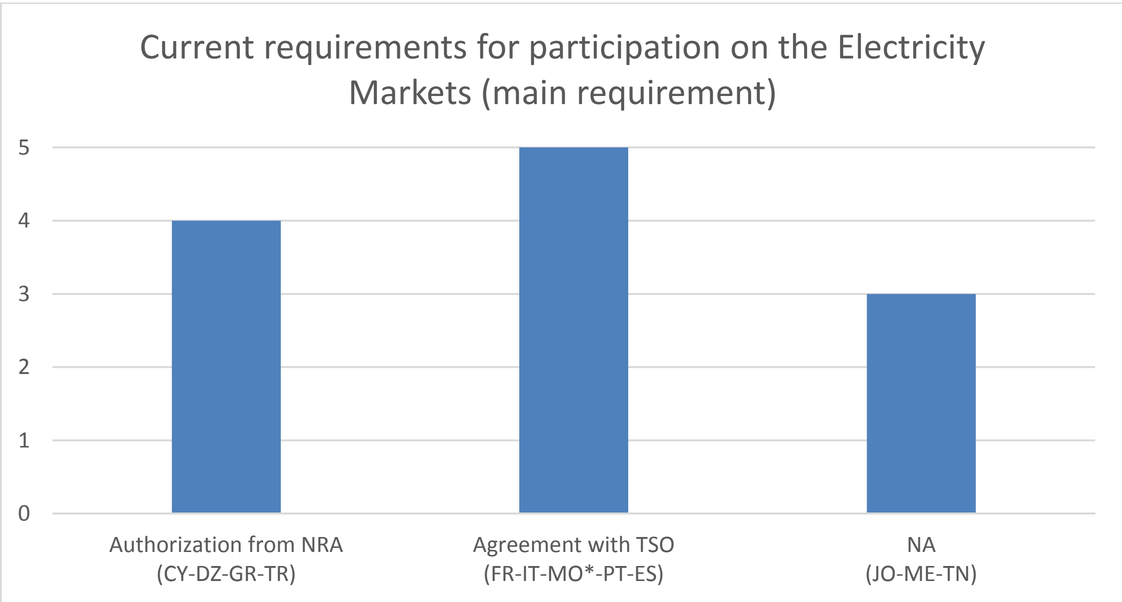


Figure 88. Current requirements for participation on the electricity markets

* In Morocco, private RES production can be traded out of the regulated market, also abroad, but has to be transferred through the ONEE grid.

The requirement to sign an agreement with the TSO is typical of a market structure based oriented. As Morocco represents an exception in this case, the possibility to trade electricity outside the regulated market (in which the entire "electricity chain" is managed by the National Operator ONEE) testifies to the adoption of competitive procedures open to privates.

The need for an authorization from the National sectoral Regulatory Authority (NRA) is similarly associated with a market-based model. Although it is an exception, the presence of NRA in Algeria (currently only case among the Maghreb Countries, but Morocco seems next to its creation) is an example of surveillance and control of legislation on the functioning of the electricity sector.

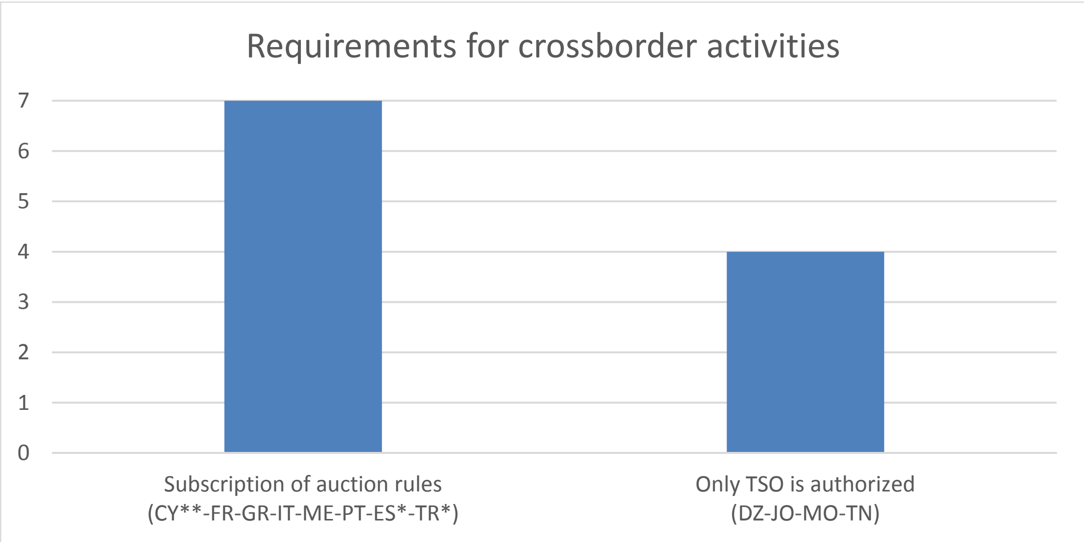


Figure 89. Requirements for crossborder activities

*In Turkey authorization required from NRA or Ministry. In Spain, an authorization from the Ministry is required for the interconnection with Morocco (there is no auction but market players participate in the wholesale market).
** In Cyprus, is in place but not applied yet.

Similarly to the previous requirement, the obligation to subscribe the national Auction Rules for cross-border trading activities is symptomatic of a "Market Based Model" oriented (countries belonging to this category are all in the ENTSO-E perimeter, concrete example of coordinated management of the exchange of energy between different systems).

ONEE (Morocco) and Sonelgaz (Algeria), which usually manage trade through bilateral agreements with the neighboring TSOs, are entitled to operate on the Spanish electricity market (but this right is limited only to some trading products) thanks to the first electrical link between North Africa and Europe (connection Spain - Morocco).

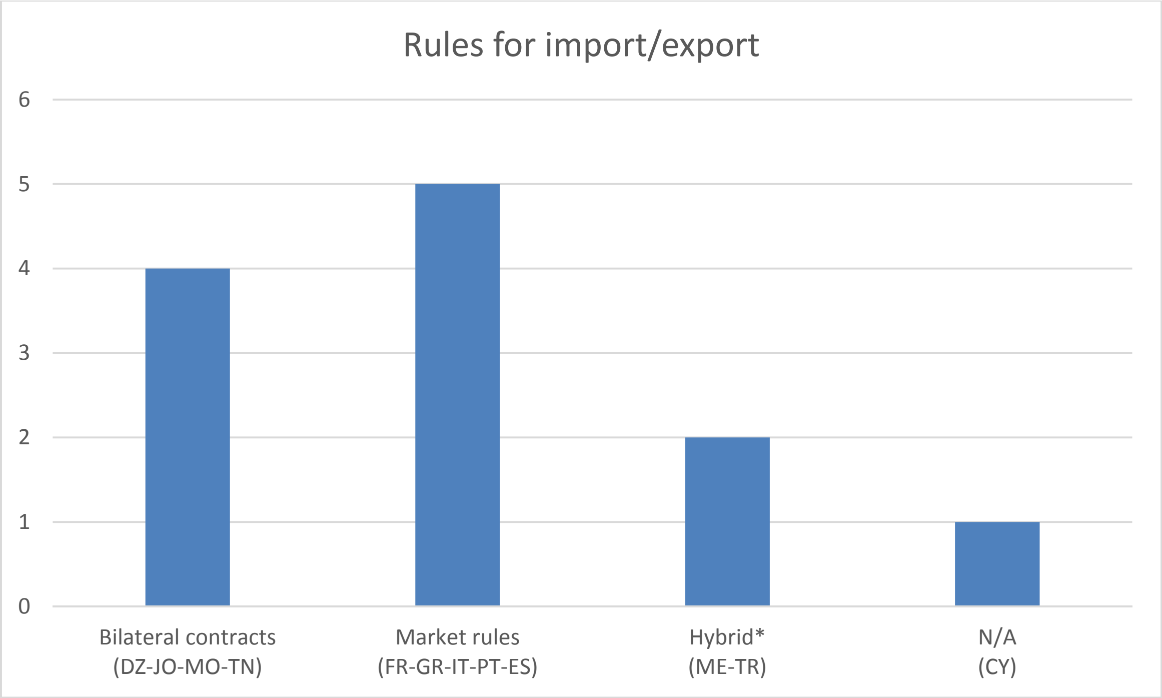


Figure 89. Rules for import/export

* Hybrid model: Market rules and bilateral contracts

The Graph clearly shows the differences between "Market Based" and "No Market Based" systems. But the systemic and geographical peculiarities mentioned consent to justify the classification of "Hybrid" systems, which allow the import/export of energy through bilateral agreements and through multilateral agreements. Montenegro (in the ENTSO-E perimeter and bordering with European countries that are out of this) and Turkey (in the ENTSO-E perimeter, represents the boundary with the Asian and Middle Eastern systems) constitute the most distinctive example.

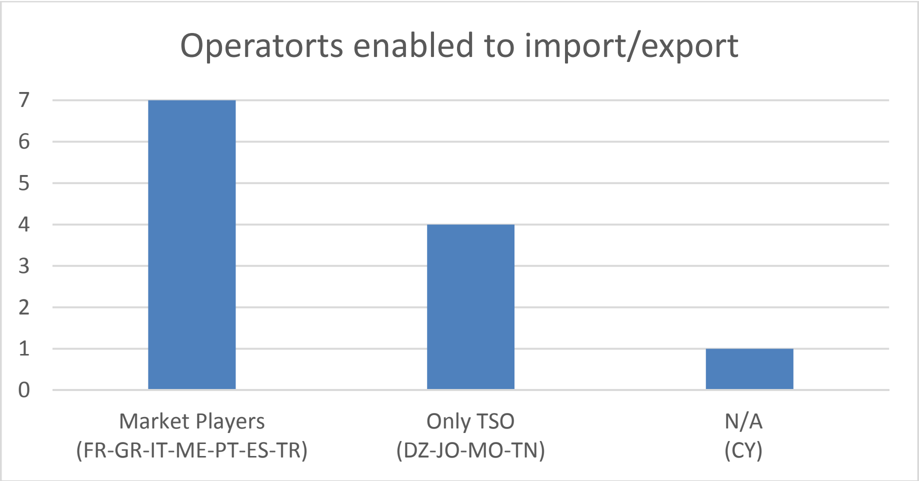


Figure 90. Operators enabled to import/export

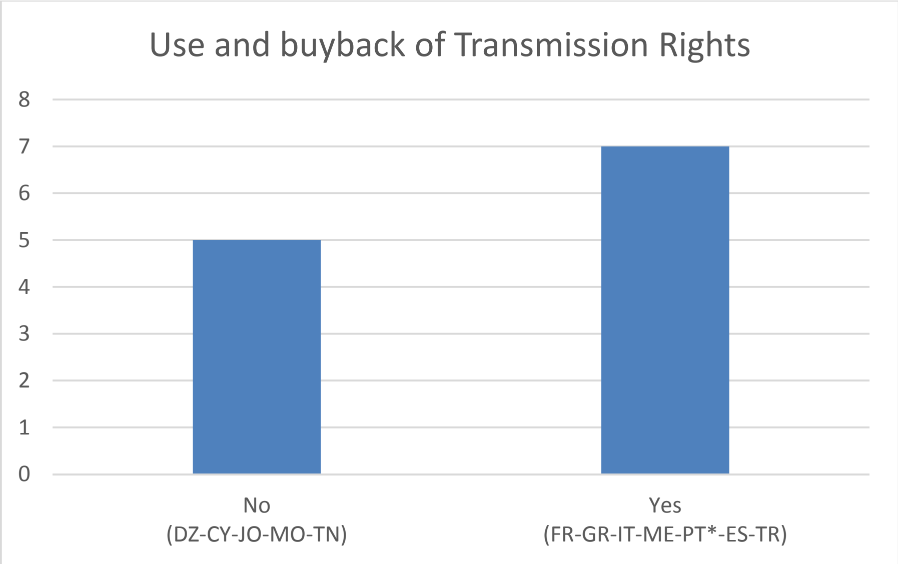


Figure 91. Use and buyback of transmission rights

* Only financial transmission rights only for the PT-ES Interconnection

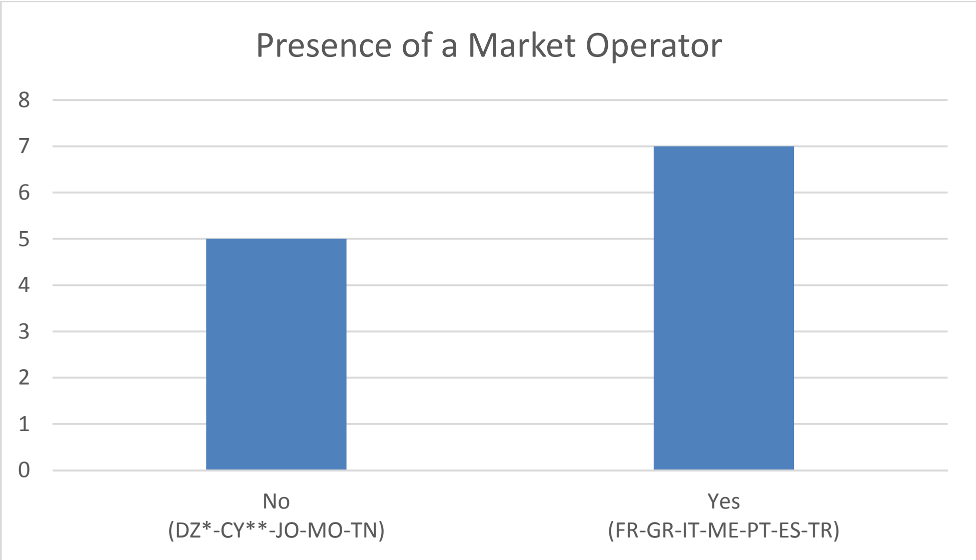


Figure 92. Presence of a market operator

* In Algeria in place but not yet active.
**In Cyprus, the TSO is also the Market Operator. The approved market design is, based on the Net Pool Model and is currently being implemented by the Cyprus TSO, in its role as the Market Operator.

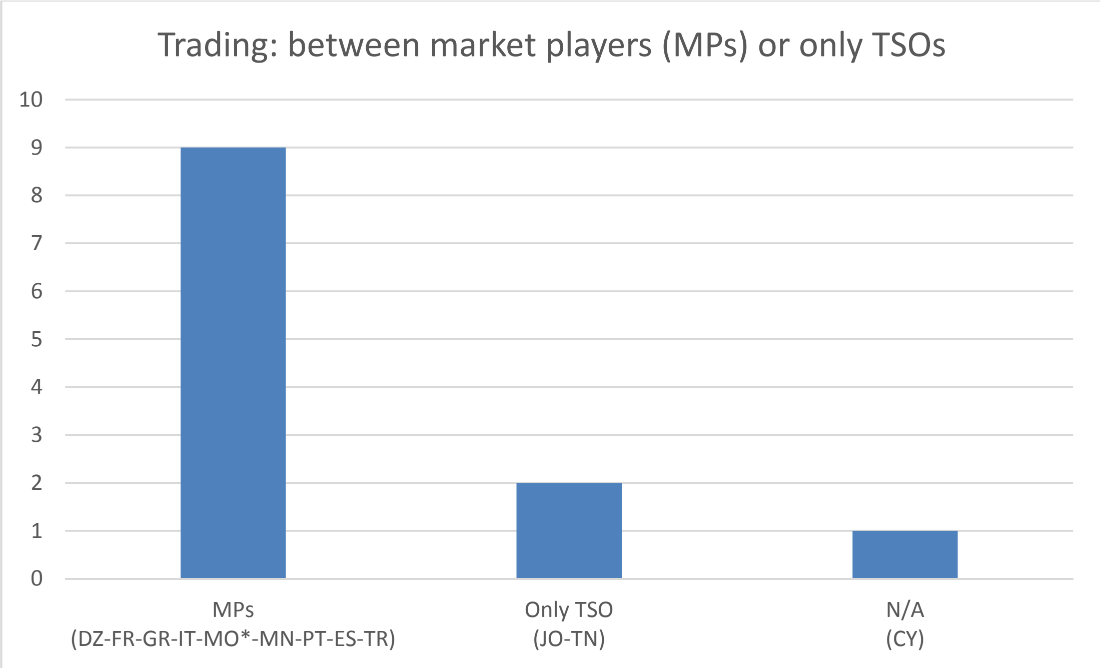


Figure 93. Trading

*In Morocco, trading between MPs for RES.

4.4.2 Rules and methodologies for capacity calculation

Which security criteria is used for calculating the Net Transfer Capacity (NTC)? Do you apply a security criteria?	
Algeria	The criteria used for calculating Net Transfer Capacity consists in avoiding overloads in both interconnection lines and internal networks and avoiding voltage collapses and loss of stability in N-1 condition
Cyprus	N/A
France	TTC (Total Transfer Capability) minus TRM (Transmission Reliability Margin), in N-1 condition security. TTC: the maximum transmission of active power in accordance with the system security criteria which is permitted in transmission constraints between the subsystems/areas or individual installations. TRM: the gap between the transmission capacity and the trading capacity. It constitutes the scope for the momentary regulation variations as a result of frequency regulation around the planned hourly value for transmission. Concerning the CWE region (Belgium, France, Germany, Luxemburg and the Netherlands), a different capacity calculation methodology is applied (Flow-Based Capacity Calculation). The N-1 criteria is also respected but TRM is defined for each line and this is called FRM (Flow Reliability Margin): each monitored line has eventually its own FRM. FR-UK DC cable is an exception, no TRM is applied: the NTC is equal to the physical limits of the cables (i.e TTC).
Greece	N-1 Operational Security criteria is applied for calculating the NTC. Overloading of transmission elements (such as transmission lines, cables and autotransformers) and voltage violations are taken into account in specific limits A Transient Reliability Margin is also taken into account when calculating the NTC.

Italy	TTC (Total Transfer Capability) minus TRM (Transmission Reliability Margin), in N-1 condition security. TTC: the maximum transmission of active power in accordance with the system security criteria which is permitted in transmission constraints between the subsystems/areas or individual installations. TRM: the gap between the transmission capacity and the trading capacity. It constitutes the scope for the momentary regulation variations as a result of frequency regulation around the planned hourly value for transmission.
Jordan	Security of the internal Transmission System. N-1 criteria for internal system. N criteria for interconnection.
Morocco	N-1 criteria (common regional network model for capacity calculation).
Montenegro	The procedure for calculating NTC takes into account: thermal, voltage and stability limits, Total transfer capacity that satisfies n-1 condition security and Transfer reliability margin for undefined issues.
Portugal	N-1 and some N-2 criteria are applied or other more severe contingencies can also be analyzed (in particular cases of network) . A Transient Reliability Margin is also taken into account when calculating the NTC.
Spain	N-1 Criteria is applied. A Transient Reliability Margin is also taken into account when calculating the NTC.
Tunisia	N-1 criteria
Turkey	N-1 criteria. Transient Reliability Margin is also taken into account when calculating the NTC.

What is the process for finalization of Net Transfert Capacity? Please indicate.	
Algeria	The Net Transfer Capacities are calculated by a working group of the Maghrebian Interconnection Commission (CIM) of the COMELEC (Maghrebian Electrical Committee) according to a network analysis, These NTC, after being calculated, are proposed to CIM for validation. The calculation is done in a coordinated manner among the involved TSO's
Cyprus	N/A
France	The calculation is done in a coordinated manner among the involved TSOs. Commercial capacity (NTC) calculated by RTE is the one corresponding both to a secure operation of the grid (no physical limit exceeded), and the complete use of the available physical margin to perform cross border exchanges.
Greece	The calculation is done in a coordinated manner among the involved TSOs. It is finalized following calculation by both TSOs and harmonization of results. In case of differences, minimum values are considered.
Italy	The calculation is done in a coordinated manner among the involved TSOs.
Jordan	Static & Dynamic Simulation.
Morocco	Regarding Morocco's interconnection with Algeria, the Net Transfer Capacities are calculated by a working group of the Maghrebian Interconnection Commission (CIM) of the COMELEC (Maghrebian Electrical Committee) according to a network analysis. These NTC, after being calculated, are proposed to CIM for validation. Regarding Morocco's interconnection with Spain, the NTC is calculated in a coordinated manner between Morocco and Spain.

Portugal	The calculation is done in a coordinated manner among the involved TSOs.
Spain	The calculation is done in a coordinated manner among the involved TSOs.
Tunisia	The Net Transfer Capacities are calculated by a working group of the Maghrebian Interconnection Commission (CIM) of the COMELEC (Maghrebian Electrical Committee) according to a network analysis, These NTC, after being calculated, are proposed to CIM for validation.
Turkey	The Net Transfer Capacities are calculated by the neighbouring TSOs. After their calculations the results are harmonized. In the harmonization process if there is a difference between the calculation of the TSOs then the minimum capacity rule is used.

Which are the time horizons used for capacity calculation? What is the process for calculating capacity in the different time horizons?	
Algeria	The capacity is calculated daily The Net Transfer Capacities are calculated between TSOs according to a network analysis.
Cyprus	Capacity allocation is planned in a 10 year basis and only done internally in an isolated system and on the basis of load predictions
France	Yearly, Monthly and Daily. Once calculated, NTC is split in time profiles according to system requirements and to the "uniformity principle", for the complete allocation of the products in the related time horizons ("without holes").
Greece	Yearly, Monthly and Daily. Merged model of the regional network is considered.
Italy	NTC is calculated on an annual basis for bands (winter, summer, peak and off-peak) and on an hourly basis according to the concrete availability of the lines. Once calculated, NTC is split in time profiles according to system requirements and to the "uniformity principle", for the complete allocation of the products in the related time horizons ("without holes").
Jordan	Yearly Yearly: Technical Study Monthly: Revised Studies Daily: Not applicable Intraday: Not applicable
Morocco	NTC calculation is conducted on an annual basis and can be done whenever it is required.
Montenegro	Yearly, Monthly and Daily. Once calculated, NTC is split in time profiles according to system requirements and to the "uniformity principle", for the complete allocation of the products in the related time horizons ("without holes").
Portugal	Yearly, Monthly and weekly ahead. It is foreseen to also implement two days ahead calculations. TSO-TSO coordinated study based on different grid model and agreed scenarios of demand and generation and coordinated update of Available Transmission Capacity (ATC).
Spain	Yearly, Monthly and weekly ahead. It is foreseen to also implement two days ahead calculations. TSO-TSO coordinated study based on different grid model and agreed scenarios of demand and generation and coordinated update of Available Transmission Capacity (ATC).
Tunisia	NTC is calculated on an annual basis for bands (winter, summer, peak and off-peak) and on an hourly basis according to the concrete availability of the lines. TSO coordinated study based on different grid model and agreed scenarios of demand and generation.
Turkey	Maximum 1 year

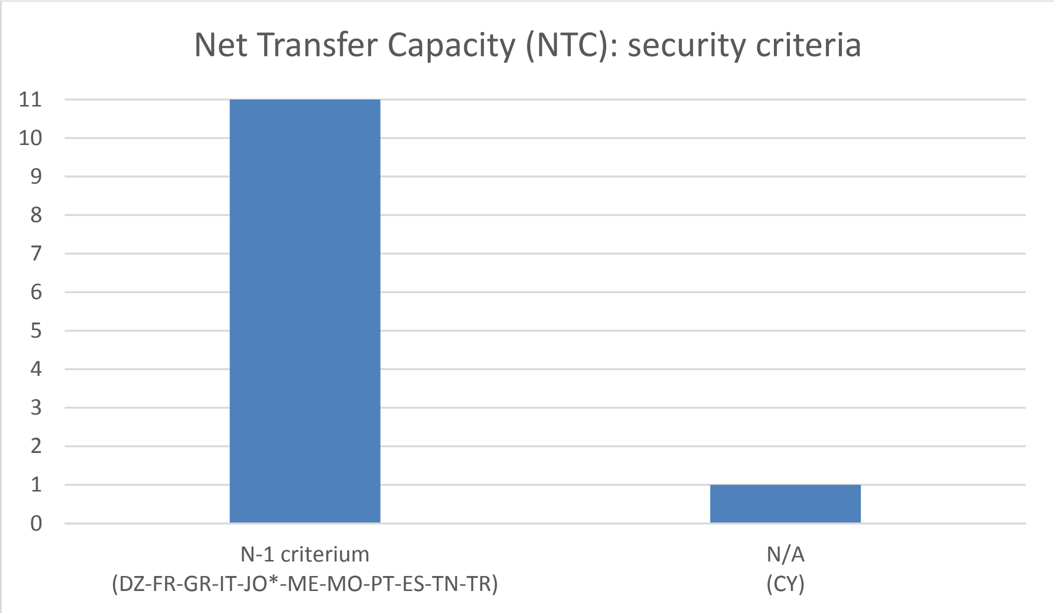


Figure 94. Net Transfer Capacity security criteria

*In Jordan, applied N-1 for the internal system and N for interconnections.

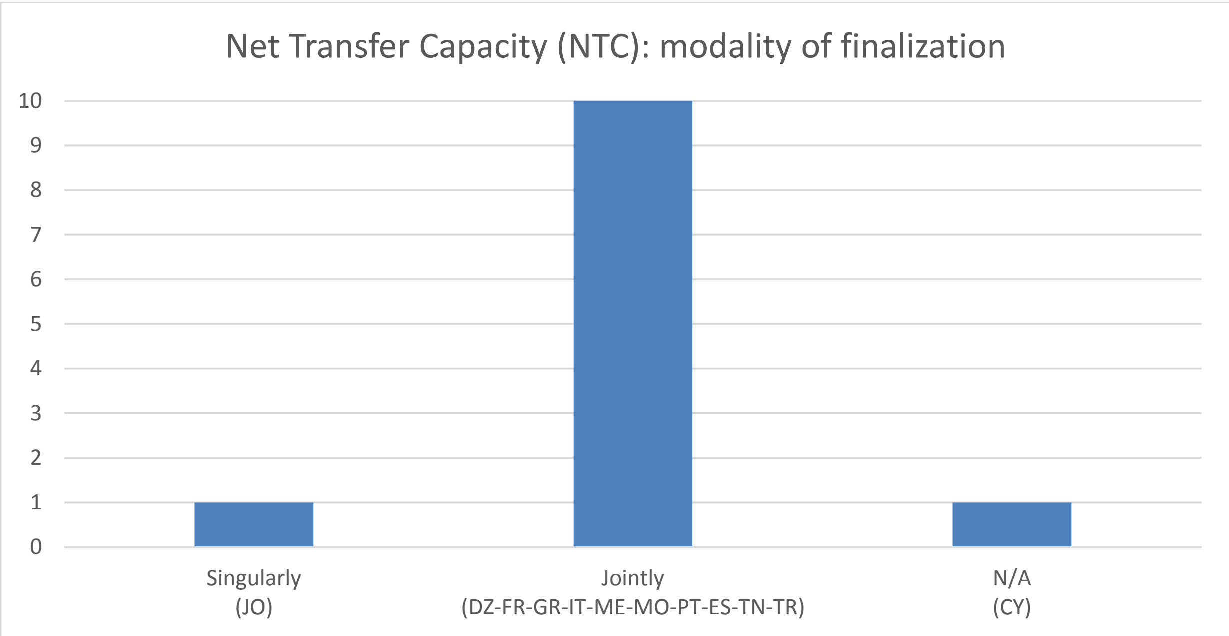


Figure 95. Net Transfer Capacity modality of finalization

ENTSO-E Members generally calculate on yearly, monthly, weekly daily and hourly basis. Others generally calculate on yearly or daily basis.

4.4.3 Rules and methodologies for capacity allocation

Which method applies in your system for transmission capacity allocation?	
Algeria	N/A
Cyprus	N/A
France	PTR (Physical Transmision Right) allocation. Explicit and implicit auctions methods also with market coupling mechanism applied with specific differences between time horizons and borders. Allocation is valid in both directions.
Greece	PTR (Physical Transmision Right) allocation. Allocation is valid in both directions.
Italy	PTR (Physical Transmision Right) allocation. Explicit and implicit auctions methods also with market coupling mechanism applied with specific differences between time horizons and borders. Allocation is valid for all Italian Borders in both directions. Capacity is allocated commonly by the neighbouring TSOs.
Jordan	N/A
Morocco	N/A
Montenegro	PTR (Physical Transmision Right) allocation. Explicit and "first come, first served" auctions methods also with market coupling mechanism applied with specific differences between time horizons.
Portugal	FTR (Financial Transmission Rights) allocation. Explicit and implicit auctions methods applied with specific differences between time horizons and borders. Allocation is valid in both directions.
Spain	PTR and FTR (Physical and Financial Transmission Rights) allocation. Explicit and implicit auctions methods applied with specific differences between time horizons and borders. Allocation is valid in both directions.
Tunisia	Non-market based: bilateral annual contract between two TSOs. The direction depends on the type of contract and the TSO demand.
Turkey	It is market based method by doing bidding for the capacity. Allocation is valid in both directions. Energy imported from Georgia is allocated by Turkish Electricity Trading and Commitment Company, and according to Interconnection Operation Agreement which was signed between Turkish and Georgian TSOs, capacity allocated by the exporter Side.

Obligation to use allocated capacity?	
Algeria	N/A
Cyprus	N/A
France	No, UIOSI (Use It OR Sell It), UIOLI (Use it Or Lose It) mechanism are provided with specific differences between time horizons, auction typologies and borders.

Greece	No, UIOSI (Use It OR Sell It), UIOLI (Use it Or Lose It) mechanism are provided with specific differences between time horizons.
Italy	No, UIOSI (Use It OR Sell It), UIOLI (Use it Or Lose It) mechanism are provided with specific differences between time horizons.
Jordan	N/A
Morocco	N/A
Montenegro	No, UIOSI (Use It OR Sell It), UIOLI (Use it Or Lose It) mechanism are provided with specific differences between time horizons.
Portugal	N/A (In the PT-ES interconnection FTR are allocated).
Spain	No, UIOSI (Use It OR Sell It), UIOLI (Use it Or Lose It) mechanism are provided with specific differences between time horizons.
Tunisia	No
Turkey	No

Kind of capacity products	
Algeria	N/A
Cyprus	N/A
France	Yearly, monthly, daily and intraday capacity allocation (joint). Daily and intraday: for most of France interconnections, market coupling.
Greece	Yearly, monthly and daily capacity allocation (Band with possible maintenance period). GR - IT: Joint ; GR - AL: Split ; GR -FY: Split ; GR - BG: Joint ; GR - TR: Split
Italy	**Yearly Base**: a product with flat validity all over the year. **Yearly Base with Maintenance Period**: product with potentially reduction period (time period during which the product can be set till to 0 MW) during the year. **Monthly base product**: available from the first Day to the last Day of the Month with potentially Reduction Period. **Monthly peak product**: available from Monday to Friday and from 08:00 to 20:00, with potentially Maintenance Period. **Daily** **Intraday**: allocated on an hourly basis
Jordan	N/A
Morocco	N/A
Montenegro	
Portugal	Yearly, daily and intraday capacity allocation (joint).
Spain	Yearly, monthly, daily and intraday capacity allocation (joint).

Tunisia	Yearly, following the network evolution and as part of CIM's work, studies establish the maximum capacity, however they can be updated monthly or weekly or daily basis depending on network constraints
Turkey	Yearly, monthly and daily capacity allocation which shows differences on the borders. Yearly and monthly: band products (same value) for each day (except for the maintenance periods), for 24 hours. Capacity is split (50%,50%) for BG border. Capacity is allocated by SEE CAO 100% for GR border.

What kind of procedures do you use or do you intend to use for the PTR allocation (e.g. public auction, tender procedures, ...)? How do you manage congestions in phase of PTR allocation? Which rules do you have for the management of physical and commercial use of PTR? Which related time schedule?	
Algeria	N/A
Cyprus	N/A
France	Public auction with entitled/registered participants. Congestion is managed via the market mechanism (auctions or market spread) with specific differences between time horizons. Import/export rules for the management of commercial exchanges.
Greece	Public auctions. Merit order, prorata or time stamp in the last offered MWs. UIOSI (Use It OR Sell It), UIOLI (Use it Or Lose It) mechanism.
Italy	Public auctions and market coupling (for daily products) according to mechanism of day ahead market (energy market). Allocation at the marginal price. For long term rights: the nomination for the use of the right assigned through use it or sell it mechanism. In case of missing nomination, the rights can be reallocated. For short term (daily): the nomination for the use is binding.
Jordan	N/A
Morocco	Regarding Morocco's interconnection with Spain, public auction limited to the iberic market; N/A for our interconnection with Algeria.
Montenegro	Public auctions. Allocation at the marginal price or pay as bid with specific differences between time horizons. UIOSI (Use It OR Sell It), UIOLI (Use it Or Lose It) mechanism.
Portugal	Public auction. Explicit FTR allocation.
Spain	Public auction. Explicit PTR and FTR allocation.
Tunisia	Contracts between TSOs. Allocation at the marginal price.
Turkey	Public auctions. For ENTSOE border Allocation at marginal price and when necessary take the time stamp into consideration. For other borders pay as bid. UIOSI (Use It Or Sell It) mechanism for Greek Border and UIOLI (Use it Or Lose It) mechanism for other borders.

<table>
<tr><td colspan="2">Which system of liabilities, guarantees and penalties (technical and commercial) do you apply for each subject involved?

Risk management: The auction rules shall contain provisions concerning risk management, possibly with an obligation for the market participants to offer collateral securities to the auction office. One possibility would be bank guarantees.
Are there any provisions in national legislation which have to be taken into consideration?
Does national legislation permit this tool of risk management?.
Are there any difficulties to be expected with possible different standards for bank guarantees in your country (e.g. concerning terms of duration or the right of the beneficiary to make use of the bank guarantee?) or any other limitations which have to be taken into consideration for the purpose of introducing bank guarantees as a tool for risk management?</td></tr>
<tr><td>Algeria</td><td>N/A</td></tr>
<tr><td>Cyprus</td><td>In Cyprus, the trading and Settlement Rules provide for the submission of financial Guarantees by Market Participant.</td></tr>
<tr><td>France</td><td>The Balance Responsible Entity system provides market parties with the opportunity to carry out all types of commercial transactions within the electricity sector. Any player who becomes a Balance Responsible Entity can create his own activity portfolio, also known as his balance perimeter.

This system allows a player to reduce his financial risk by diversifying his sales and purchases: accumulating physical and/or declared extractions for his clients, physical injections of his production units, declared injections for his counterparts and sales and purchases on electricity exchanges that are active in France.

Market players have to have bank guarantee.</td></tr>
<tr><td>Greece</td><td>It's necessary to have a guarantee.

Difficulties to be expected concern Bank Credit rating level, amount of bank guarantee, duration.</td></tr>
<tr><td>Italy</td><td>In order to participate to the auction it's necessary to guarantee a pre-payment monitored (in real time) during the auction phase.</td></tr>
<tr><td>Jordan</td><td>N/A</td></tr>
<tr><td>Morocco</td><td>N/A</td></tr>
<tr><td>Montenegro</td><td>In order to participate to the auction it's possible to guarantee a pre-payment with specific differences between time horizons and borders.</td></tr>
<tr><td>Portugal</td><td>Yes
Yes
No</td></tr>
<tr><td>Spain</td><td>Bank guarantee</td></tr>
<tr><td>Tunisia</td><td>Does not exist</td></tr>
<tr><td>Turkey</td><td>Yes
Yes
No. Minimum amount and minimum term of such guarantee is written in Auction Rules. Besides, TSO can increase the limit of such tool if it deems necessary. What kind of financial instutions guatantee is accepted is also written in the Auction Rules.</td></tr>
</table>

Who is the subject responsible for the management procedure?	
Algeria	TSO
Cyprus	N/A
France	CASC.EU or TSO with specific differences between products and borders.
Greece	CASC.EU or TSO with specific differences between products and borders.
Italy	European Companies/Offices: CASC (Capacity Allocating Service Company) - JAO (Joint Allocation Office).
Jordan	N/A
Morocco	ONEE
Montenegro	SEE CAO or TSO with specific differences between products and borders.
Portugal	PX – Power Exchange (OMIE)
Spain	CASC.EU, OMIP, PX and TSO.
Tunisia	TSO
Turkey	Based on borders. It is either the TSOs or SEE CAO.

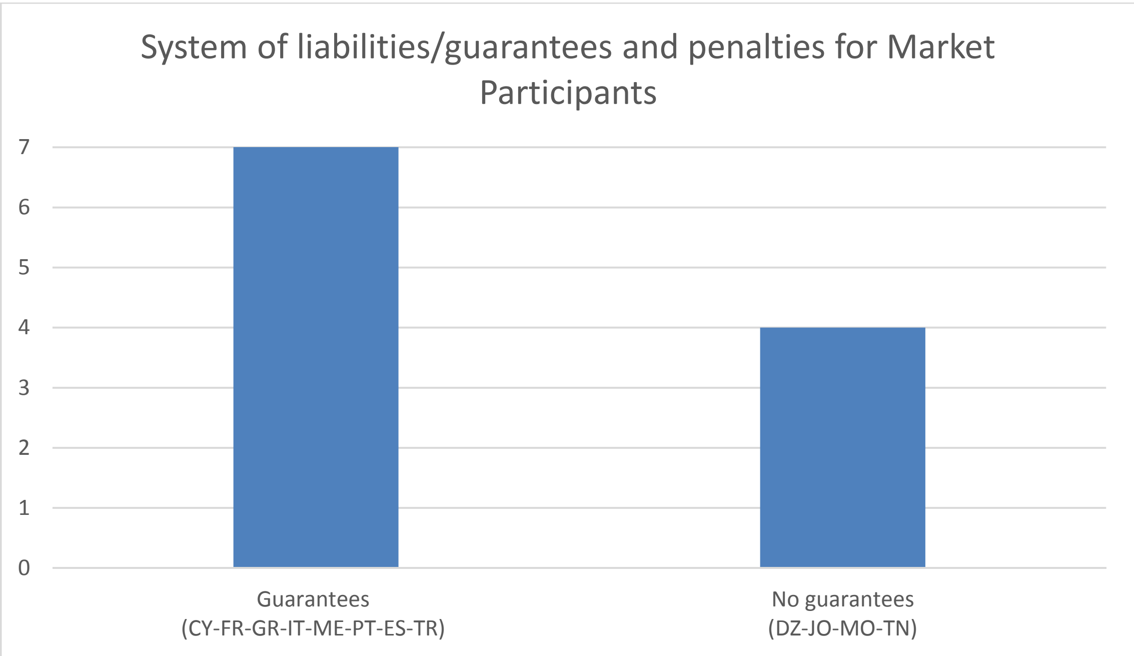


Figure 96. System of guarantees

4.4.4 Dispatching and balancing

Which set of actions (procedures, rules) do you apply in order to guarantee the exchange programs? Which set of remedial actions (ancillary services, black start capability ...) do you apply in order to guarantee the exchange programs? Which set of actions (procedures, rules) do you apply for the balancing services?	
Algeria	Schedulings are checked with corresponding TSO on each border. AGC (Automatic Generation Control, Exchange mode), ancillary services. AGC, secondary and tertiary reserve.
Cyprus	N/A
France	Schedulings are checked with corresponding TSO on each border. Exchange programs are a component of the set-point for automatic FRR regulation. Bids activation on balancing mechanism, internal redispatching, countertrading, Mutual Emergency Assitance with other TSOs.
Greece	Agreement between TSOs. Units Dispatching. Units Dispatching.
Italy	Check of the scheduled exchanges (through National Control Centre) and possible rebalancing on a weekly basis. Dispatching services. Dispatching services.
Jordan	Units Dispatching
Morocco	Units Dispatching
Montenegro	Check of the scheduled exchanges (through Regional Control Centre). Dispatching services. Dispatching services.
Portugal	Coordinated rules for the management of congestions in the interconnections are in place. Countertrading and redispatching actions are contemplated among others. Topology and redispatching among others. Prequalification tests to the units (technical tests, ramping, …) Rules for provision of ancillary services (participation, bid format, timings, allocation procedure, information exchanges), procedures in case of emergency. Rules for monitoring of compliance, rules for settlement.
Spain	Coordinated rules for the management of congestions in the interconnections are in place. Countertrading and redispatching actions are contemplated among others. Topology and redispatching among others. Prequalification tests to the units (technical tests, ramping, …) Rules for provision of ancillary services (participation, bid format, timings, allocation procedure, information exchanges), procedures in case of emergency. Rules for monitoring of compliance, rules for settlement.
Tunisia	Schedulings are checked with corresponding TSO on each border. AGC (Automatic Generation Control, Exchange mode), ancillary services. AGC, secondary and tertiary reserve.

Turkey	Schedulings are checked with corresponding TSO on each border. Dispatching services. Dispatching services.
Please indicate the technical and commercial treatment of involuntary exchanges on international interconnections	
Algeria	The involuntary exchanges are not commertially treated. Compensation mechanisms are set in order to ensure a zero balance between both interconnected TSOs.
Cyprus	N/A
France	The compensation of involuntary exchanges is performed "in kind" (no exchange of money, only energy) - Policy 2 of Operation Handbook (international regulation).
Greece	Involuntary exchanges in international interconnectors are settled "pay in kind" through a schedule in Day Ahead Market.
Italy	The compensation of involuntary exchanges is performed "in kind" (no exchange of money, only energy) - Policy 2 of Operation Handbook (international regulation).
Jordan	Initially the energy is balanced on hourly basis by power interchange control. Commercial treatment on a monthly basis if the hourly balance is managed.
Morocco	Regarding our interconnection with Algeria, we use compensation mechanisms; For Spain, involuntary exchanges are settled.
Montenegro	
Portugal	Imbalances are settled according to the rules approved in the Manual de Procedimentos da Gestão Global do Sistema (portuguese operational procedures). Involuntary exchanges in international interconnectors (unintentional deviations) are settled "pay in kind" through a schedule in Day Ahead Market.
Spain	Involuntary exchanges in international interconnectors (unintentional deviations) are settled "pay in kind" through a schedule in Day Ahead Market.
Tunisia	Involuntary exchange is compensated in the form of energy exchange only (no commercial compensation).
Turkey	For ENTSO-E borders the compensation of the involuntary exchanges is performed "in kind" (no exchange of money, only energy). There is no compensation for other border as they are not in synchronous operation. The metered values are considerd as the energy transferred.

Which users can provide balancing services?	
Algeria	Producers
Cyprus	N/A for Cyprus refers to balancing issues between Network Operators, i.e balancing of interconnected systems. In the Cyprus system, there are provisions for balancing services, and such services are provided by qualified/appointed injection dispatching units.

France	See answers to Operation questionnaire
Greece	All dispatching Units.
Italy	Units appointed for balancing services according to the Italian Grid Code.
Jordan	The system is totally dependent on the interconnection for balancing. In case isolated operation, the simple cycle gas turbines will be used for balancing.
Morocco	Power Plants owned by ONEE
Montenegro	All units that have contract with TSO, supplier, traders, neighbors TSOs.
Portugal	All units that have passed the corresponding pre-qualification tests for the different services.
Spain	All units that have passed the corresponding pre-qualification tests for the different services.
Tunisia	All power plants units
Turkey	Units appointed for balancing services according to the Turkish Grid Code.

How is the congestion income distributed?	
Algeria	N/A
Cyprus	N/A
France	Congestion income is taken into account by regulator to define connection tariffs.
Greece	50/50
Italy	National tariff mitigation.
Jordan	N/A
Morocco	
Montenegro	Only between TSOs.
Portugal	Congestion income is not conceived in the current cross border balancing services. Allocation is under a FCFS approach (first come first serve) and only uses available ATC after Intraday markets.
Spain	Congestion income is not conceived in the current cross border balancing services. Allocation is under a FCFS approach (first come first serve) and only uses available ATC after Intraday markets.

Tunisia	N/A
Turkey	For Greek border auction is done by SEE CAO and congestion income is distributed between TSOs. For Bulgarian border capacity is distributed 50/50 and each TSO performs their auctions. For other borders when there is more than one application, auction is held. if there is not more than one application, auction is not held (following an announcement for the applications).

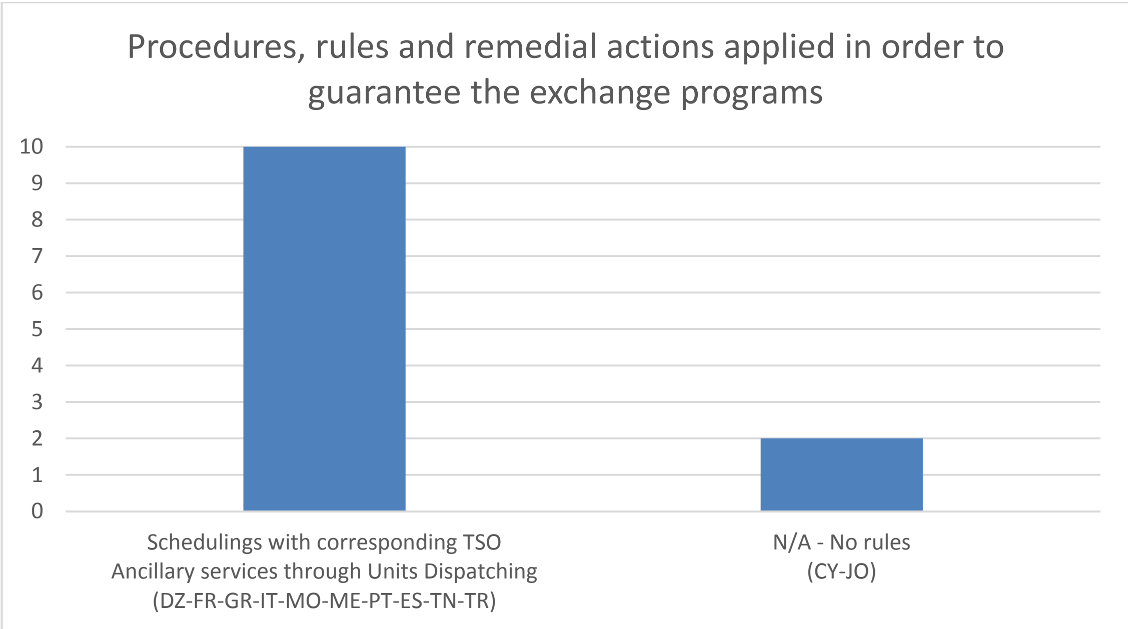


Figure 97. Procedures to guarantee exchange programs

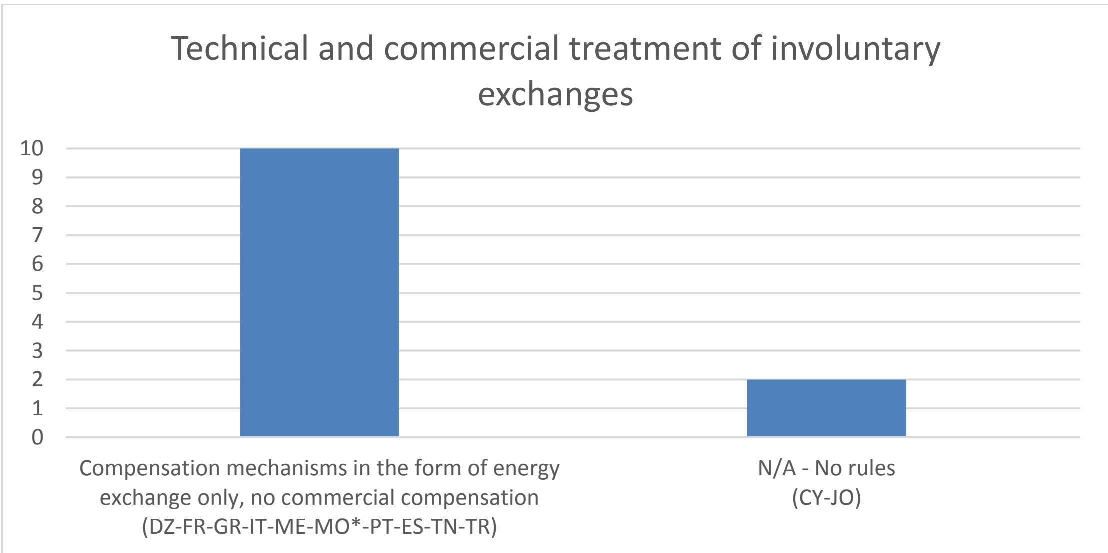


Figure 98. Technical and commercial treatment of involuntary exchanges

* In the interconnections between Morocco and Spain, involuntary exchanges are settled.

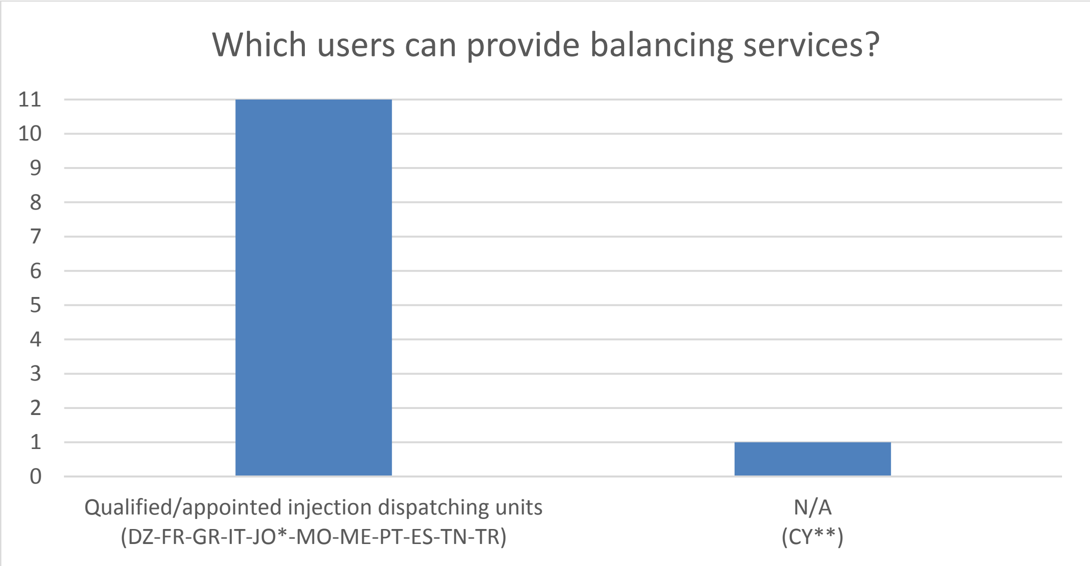


Figure 99. Provision of balancing services

* In Jordan, only in case of isolated operation (for balancing, the system is totally dependent on the interconnection).
** N/A answer refers to balancing issues between Network operators. In the Cyprus system, there are provisions for balancing services, and such services are provided by qualified/appointed injection dispatching units.

The graph refers to balancing issues on International Exchanges, i.e. between Network Operators.

4.4.5 Settlement (imbalances and unintentional deviations) and metering issues

Who is responsible for the settlement in your system?	
Algeria	TSO
Cyprus	Market Operator (Cyprus TSO)
France	TSO
Greece	TSO
Italy	TSO
Jordan	TSO
Morocco	TSO
Montenegro	TSO
Portugal	TSO
Spain	TSO
Tunisia	TSO
Turkey	TSO

How do you identify and attribute the amount of energy injected or withdrawn?	
Algeria	Energetic metering in substations.
Cyprus	Profiled meters (30min interval) exist at all injection and offtake points
France	Management via Balancing Responsible perimeter (RE = Responsable d'equilibre) where Market parties gather their activities and are responsible financially of theirs gaps.
Greece	Balancing Energy is calculated on an hourly basis.
Italy	Check with other system operator and verification on the national market platform.
Jordan	Agreed upon from both parties by direct communication.
Morocco	Counters in Substations (for Spain only there is an hourly metering)
Montenegro	As difference between scheduled energy and settlement energy on an hourly basis.
Portugal	Energy is scheduled on an hourly basis, identified through metering and attributed to BRPs.
Spain	Energy is scheduled on an hourly basis, identified through metering and attributed to BRPs.
Tunisia	Balancing of energy between neighboring systems operators takes place annually and verification of energy delivered and received is calculated monthly, weekly and on daily basis.
Turkey	Balancing Energy is calculated on an hourly basis.

How are imbalances and unintentional deviations settled in your system?	
Algeria	Agreement between TSO's: Load deviation observed during the week is compensated the next week according to an agreed schedule with a last verification at the end of the year such as load deviation balance is null.
Cyprus	Market Rules have specific provisions
France	Incentive mechanism which depends on the orientation of the system and the behavior of the RE (Responsable d'Equilibre). Positive imbalances are paid to the RE, negative imbalances are invoiced to the RE. Unintentional deviations on borders are compensated by physical compensation between TSOs.
Greece	Imbalances are settled on ExPost price on an hourly basis.
Italy	Commercial imbalances payed at the price fixed by law. Unintentional deviations are socialized as cost of the system.
Jordan	By setting the amount of energy deviation hour by hour.
Morocco	N/A regarding our interconnection with Algeria, involuntary exchanges are tolerated except they don't exceed +/-20 MW.

Montenegro	Imbalances and unintentional deviations payed at the price settled according market rules.
Portugal	Imbalances are settled according to the rules approved in the Manual de Procedimentos da Gestão Global do Sistema.
Spain	Imbalances are settled according to dual pricing system (i.e. different mechanism depending on imbalances in favor or against the system imbalance).
Tunisia	The settlement is done by following the indicators of the quality of interconnection of setting the threshold is ±20MW
Turkey	For ENTSO-E border, unintentional deviations are compensated by the ENTSO-E compensation mechanism.

Who is responsible for metering (settlement measures) in the international interconnections?	
Algeria	TSO
Cyprus	TSO
France	TSO
Greece	TSO
Italy	TSO - DSO
Jordan	TSO
Morocco	TSO
Montenegro	TSO
Portugal	TSO
Spain	TSO
Tunisia	TSO
Turkey	TSO

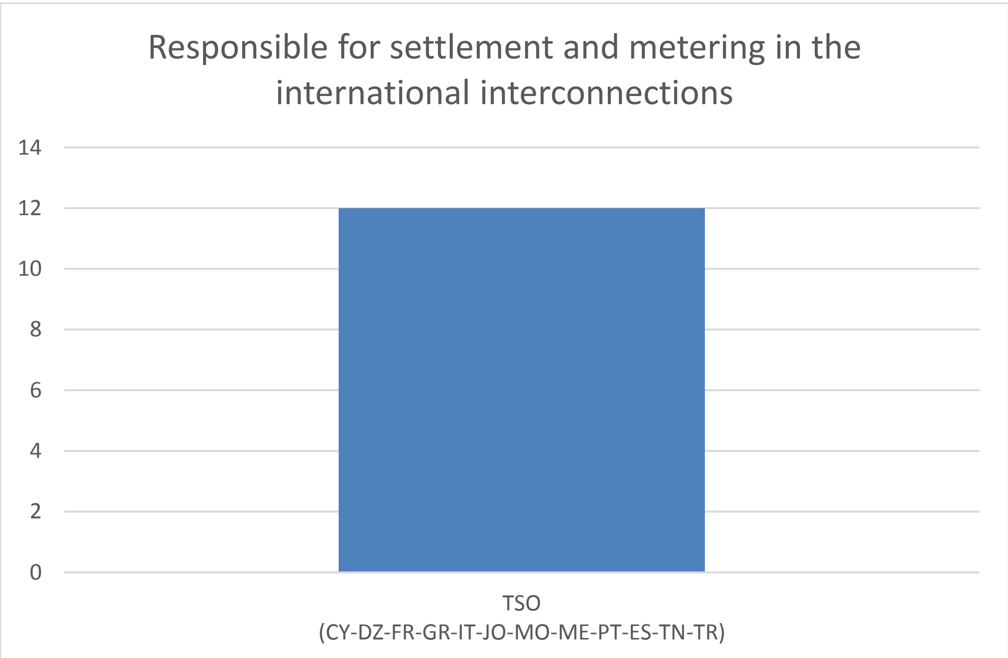


Figure 100. Responsible for settlement and metering in the international interconnections

5. Advance on initial considerations about rules implementation format

As mentioned in previous chapters a decision on which format of regulation should be proposed for every issue to be commonly regulated is needed in order to make the concrete proposal on Common Target Regulatory Framework. For this purpose a classification of the different types of regulations has been adopted:

- Internal regulation for agreements or contracts adopted between TSOs or with other stakeholders that do not need an external approval (i.e. the regulator).

- External regulation for Grid Codes or other type of regulation approved by other entities rather than the TSO. This regulation could be national or regional when it applies to more than one country.

Issues to be Regulated	**Internal TSO-Stakeholders TSO-TSO**		**External National ⇨ Regional**	
	Agreements	Contracts	National	Regional
Technical issues (connection & operation)				
Market issues				

Decision on which type of rule/format should be proposed for every issue

Figure 101. Template between technical issues and type of regulation

In this chapter an advance with some initial considerations regarding rules implementation format is presented taking into account that a deeper and detailed analysis will be presented in following steps of the project, as mentioned in Chapter 7.

A first consideration will be that regional regulation only exists and applies in European countries where European Network Codes and Guidelines are or will be binding in the near future to all EU countries. Most of the issues that have been analysed in this project are included in the European Network Codes under development, except possibly the connection procedure requirements and tasks or the details on power quality or control requirements in terms of controllability or observability.

In general connection requirements are regulated through national regulation while in the system markets areas many aspects (especially regarding capacity allocation) also have internal regulation and in particular agreement between neighbouring TSOs.

HVDC requirements are yet not regulated in a national perspective even though a specific Network Code on HVDC is under development in Europe.

In countries with no liberalized markets the regulation format for system markets issues is really heterogeneous, in some cases not specific regulation (either internal or external) applies while in other cases agreement between TSOs are in use.

Regarding operation issues agreement between TSOs are commonly adopted when talking about power systems from the same synchronous area or when apply operation agreements in an interconnection.

6. Conclusions

In the following chapter the main conclusions from the analysis of the current regulatory framework in the different power systems around the Mediterranean region is shown.

As a primary conclusion we may highlight that full harmonization is not yet achieved in any issue and all those analysed need to be further harmonized in some degree, in order to give a general view of the level of harmonization a simplified classification is summarised in the next table (which for the mentioned reasons must be understood as relative; i.e., high harmonisation is not total).

	HIGH	MEDIUM	LOW
CONNECTION	Control reqs. DSR services	Connection procedure Frequency reqs. Voltage reqs. Short circuit reqs. Power quality Restoration capabilities Compliance	Reactive power reqs.
OPERATION	System states Technical reqs. Outage coordination Dispatch priority	Information Exchange Contingency Analysis Dynamic stability Studies Management exchange programs System defense and restoration Training and certification	Load frequency control Reserves management HVDC operation
SYSTEM MARKETS		Monitoring and settlement	Legal issues Capacity calculation Capacity allocation Dispatching and balancing

Figure 102. Summary of harmonization level of the different issues

GENERAL REGULATORY ISSUES

The overall picture of who is the responsible national authority for the development and/or approval of technical rules is quite homogeneous, showing that in most MedTSO countries the TSOs are responsible for developing the technical rules while the approval of such rules, in the case of some countries it is competence to the NRA whereas in other countries this task corresponds to the competent Ministries (anyway in almost all countries Ministries have to consult the NRA before approving the rules). Morocco us the only country in which the TSO is the responsible boday for approving such rules.

Regarding the responsible authority for the settlement of disputes among stakeholders[15], in most of the Med-TSO countries consulted this competence lies on the NRA. Only in 2 Med-TSO countries this tasks corresponds to the Ministry responsible of Energy (Morocco and Tunisia).

Other aspects analysed are quite homogeneous between all countries, in example, the possibility to appeal, the stakeholder's involvement in the elaboration of technical reules or the allowance of new entrants (market opening to third parties).

Amost all MedTSO countries require the unbundling of activities in a similar way as does the EU legal framework. Only three countries (Morocco, Jordan and Tunisia) do not foresee this unbundling regime for their companies in the near future.

CONNECTION AREA

- ***Connection procedure***

The questions included on this chapter show how the connection procedure is managed in each country. In general, the situation is quite homogeneous regarding the studies performed, the horizons and criteria considered in the studies, the obligations for users to send simulation models, the capacity connection priority or the limiting magnitudes required to connect to the transmission grid (with obvious differences depending on the size of each power system).

Regarding the payment of these connection studies, the situation differs between different countries, but there is not a clear relationship between different countries as could be expected (i.e. between European countries or between Maghreb countries).

In addition the obligation of paying for the transmission assets needed for the connection of non-transmission facilities (generation, distribution or consumption) is again not homogenous with many differences depending on each power system.

- ***Frequency requirements***

Questions on frequency requirements focuses on the requirements requested by the users when they are connecting to the system and focus on three major aspects, namely the frequency/time range limits for users to withstand without damage, rate of change of frequency withstand capability and the application of limited frequency sensitive mode.

From the analysis of the results it appears that, in all countries that have responded to the survey, operation in the frequency range from 49,5Hz to 50,5Hz is performed without time limitation. In the frequency ranges lower than 47Hz, operation is limited to less than 1min in all countries, with the exception of Turkey and Montenegro, where it applies only for 10 minutes, and Morocco with no time limitation.

[15] Eg. Conflict of third parties´ access of to the network.

The rate of frequency withstand capability ranges from 1 to 2 Hz/sec, with the exception of France and Jordan, where such rate is not specified and Montenegro where the frequency withstand capability is expressed in terms of maximal allowed frequency deviation for quasi-steady and dynamic state.

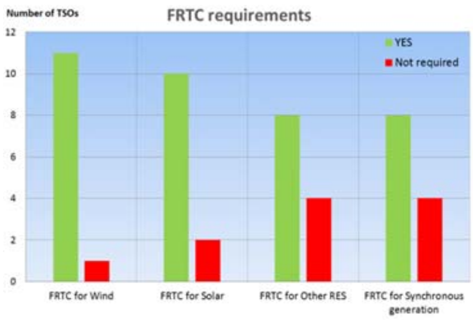
Requirements for overfrequency and underfrequency schemes exist in all countries (where applicable), with the exception of Montenegro and for RES Turkey (overfrequency) and Algeria and for RES Jordan (underfrequency). Above mentioned schemes apply for all generation units above certain MW threshold defined by each TSO. In general, such requirements are harmonised (or there is provision for future regulation) in all European countries including Turkey, while similar provisions exist in the Maghreb countries, where the services are applicable.

- ***Voltage requirements***

The survey questions on **voltage requirements** focus on the requirements requested to the users when they are connecting to the system. The questions focusses on two main aspects, namely the voltage/time range limits for users to withstand without damage and which technologies have to comply with fault ride through capability requirements.

The analysis of the results, despite the different responses received, is possible to conclude that for all countries the operation voltage range from 0,95pu to 1.05pu is performed without time limitation for voltage level between 300kV to 400kV. For voltage level between 110kV to 300kV, the operation voltage range from 0,90pu to 1,11pu[16] is also performed without any time limitation. However, for voltages outside this band, some countries defined time limitations, like 5minutes, 30minutes, 60minutes, 90minutes or others, as it is possible to see above in the report.

Regarding the fault ride through capability requirements for transmission grid users, most of the countries have defined fault ride through (FRT) profiles curves for different technologies, like wind, solar or Synchronous generation.



In some countries, the FRT specification is not yet fully completed for all generation technologies, but it is expected that some of them will have this definition performed soon. In the case of ENTSO-E members, the *Network Code on Requirements for Grid Connection of Generators* is soon expected to be approved and then implemented. In this network code, the requirements will be specified for all generator technologies.

[16] Except for Morocco transmission grid, that in this country the operation voltage range with unlimited time is only between 0,90pu to 1,087pu.

- ***Reactive power requirements***

In 6 out of 12 TSOs (Algeria, Cyprus, Montenegro, Morocco, Tunisia and Turkey), the limits of reactive power requirement are differentiated per technology, while there is no difference in the other 6 (France, Greece, Italy, Jordan, Portugal and Spain).

- ***Short circuit requirements***

On the one hand, TSOs use different short circuit current limits for switch equipment's ranging from 16 kA to 63 kA (depending on the voltage level), except in Italy where is not specified in regulation. On the other hand in most cases short circuit ratio limits are not specified in regulatory frameworks.

- ***Protection schemes***

In most countries (8 out 12) general criteria are applied regarding protection schemes to be used for non-transmission facilities connected to the transmission grid. These criteria generally includes similar aspects in the protection schemes (short circuit, both internal and external, over and under frequency, over and under voltage, demand circuit protection and unit transformer protection).

Redoundancy in the protection schemes is required in all MedTSO countries and the main functions included in the relay are rather similar (distance and differential are the most widely implemented) and they are not specified in internal regulation from TSOsand not in external regulation.

- ***Control requirements***

In all MedTSO countries direct communication between user and TSO control centre is required, except in Spain where in some cases (small renewables), communication is mandatory through intermediate control centres.

Regarding observability and controllability requirements in general it depends on a power limit (between 1 MW and 10 MW) but some countries also include a voltage limit.

The communication system characteristics are similar in all MedTSO countries: IEC standard protocol is always required while double communication channel, optic fiber and dedicated channels are widely required but not in all power sytems.

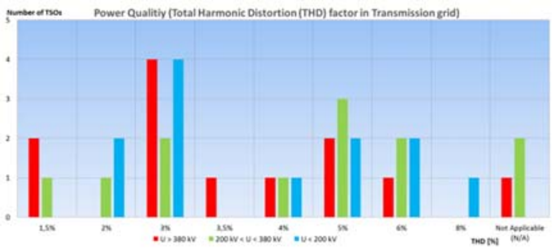
- ***Power quality***

The survey questions on **power quality** focus on the normative and requirements considered in the transmission system. Six main aspects are analysed, namely the normative standards that are used as reference for power quality regulation in the transmission grid, maximum number of voltages dips per voltage level (or node) in the transmission system, the total harmonic distortion (THD) factor, the flicker limit values, the reference levels for voltage unbalances and the reference levels for transient overvoltage in the transmission system.

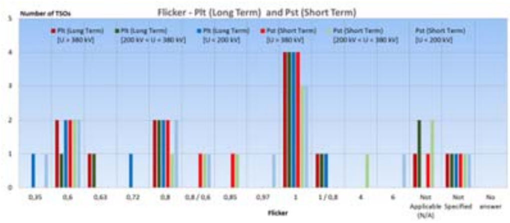
The analysis of the responses concluded that all countries which answered the survey have established normative standards for power quality in their transmission network. Most of the countries consider the IEC 61000 normative in their system and others consider the EN50160 normative or their national grid code.

Regarding the maximum numbers of voltage dips on the network, it was concluded by the questionnaire that only one country has established limit value for voltage dips. However these limits (per voltage levels) are not imposed by any normative but are expected values on the basis of specific measurement campaigns. The resto of the countries that answered the questionnaire haven't established any fixed limit.

Considering the survey on the THD, it is possible to conclude that all 13 countries that responded to the questionnaire have established limits to the THD depending on the voltage level. 70% of countries consider the same THD value for the different voltage levels of the transmission network, while the other 30% of countries consider different THD values per voltage level, and consider the lowest THD values for the highest voltage level. The THD values are between 1.5% and 8% and the THD values equals 3% and 5% are the most common in the Mediterranean region.



Regarding the range of Flicker limits in the Mediterranean area, the survey showed that all 12 countries which responded to the questionnaire have established limits to Flicker depending on the voltage level. However, most countries didn't consider different flicker values per voltage levels. The flicker limit value equal to 1 is the most common in the Mediterranean region.



Regarding the voltage unbalances in the transmission grid, all countries consider some limit levels in their systems. Some of them consider different unbalance limits per voltage range, but most of them do not consider this difference. The unbalance limit values are between 1% and 5% and the most common value is 2%.

Considering the survey on transient overvoltage, it is possible to conclude that 10 of 13 countries have established limits for the transient overvoltage. Some countries consider transient overvoltage limits per voltage range/voltage level and the most common value among countries is 110%.

- ***Demand disconnection schemes***

6 out of 12 TSOs have both low frequency and low voltage demand disconnection schemes while 7 TSOs (including Lybia) have only low frequency demand disconnection scheme.

- ***System restoration capabilities***

In general all countries that include system restoration capabilities requirements in their regulation (both black start and island operation) oblige thermal units to provide this service. In some cases hydro power plants are also included. It is important to stress that many countries do not have this requirements included in their regulation.

- ***Demand side response services***

The provision of DSR services is included being optional in 10 of the 13 countries that have responded to the survey, with the exception of Cyprus, Jordan and Lybia where there is no regulation developed in this aspect yet.

- ***Compliance***

In all MedTSO countries (except Jordan), the TSOs are entitled to perform tests and simulations in order to verify the compliance of the requirements included in their regulation. In 5 of these countries (Cyprus, France, Greece, Italy and Spain) third party entities have the responsibility of certifying compliance; while in Cyprus and Portugal a user declaration could also be used depending on the specific case.

OPERATION AREA

- ***System states***

Regarding system states classification in almost all countries the same 5 states are considered (normal, alert, emergency, black out and restoration); except in Jordan (where system stress state is also considered) and Turkey with a different classification.

- ***Technical requirements***

Frequency ranges are similar in all MedTSO countries. Regarding voltage ranges, we can also consider them quite similar in all countries, especially the maximum values for each voltage level. In 400 kV minimum values differ from 340 kV (in Turkey) to 390 kV (in Spain); the most common value being 380 kV. Regarding maximum value in general all countries consider 420 kV (415 kV in Italy and 435 kV in Morocco). In 220 kV minimum values differ from 198 kV (in Cyprus) to 210 kV (in Morocco). Regarding maximum value all countries consider values between 231 kV and 245 kV. In addition, in most countries (all except Cyprus and France) voltage ranges increase in extraordinary conditions. Specific voltage ranges apply for international interconnections in some countries (Algeria, Greece, Jordan, Montenegro, Turkey and Tunisia).

In general, the measures which apply in each country for reactive power management are similar including the switching of reactors and capacitors; power factor control by distribution companies; on load tap changers transformers; opening lines; HVDC. However, 2 main blocks of countries can be considered regarding the reactive power management for international interconnections:

- On the one side the European countries in which reactive power is managed in a coordinated manner. TSOs interconnected with AC interconnectors shall jointly define the voltage and/or reactive power flow limits on these interconnectors, in order to use the reactive power capabilities in the most efficient way and ensure adequate voltage control.
- On the other side Maghreb countries and Jordan where reactive power is managed autonomously, avoiding Mvar flow through the interconnections.

The system protection coordinated criteria is agreed with neighboring TSOs through common protocols or bilateral agreements/contracts, not being the criteria previously specified in the regulation.

- ***Information exchange***

In general, the contingency list includes both grid (single or double lines, bus bars, transformers) and generation facilities considered as influential (with impact in the neighboring system). Joint remedial actions are agreed and coordinated between TSOs. The most common actions performed are topology actions, countertrading, coordinated re-dispatching, lines tripping and PST tap changing.

Planning models are exchanged in yearly, monthly, weekly and daily time horizons. These models include load curve, generation program, maintenance plan for both transmission and generation assets.

Regarding real time data exchange SCADA values of neighboring substations are exchanged in real time and observed by both TSOs. European countries share additional data.

A heterogeneous situation is considered regarding the exchange of scheduled and structural data, with 3 main blocks: European countries, Maghreb countries and Jordan and Montenegro.

- ***Contingency analysis***

In all countries the N-1 contingency is considered while the loss of the biggest generation plant is considered in all countries except Jordan; and partial N-2 except in Algeria, Jordan and Morocco. The security limit considered in N conditions is always 100% (except in Montenegro where it is limited to 90%), but many specific restrictions are also considered in each power system.

Regarding the periodicity of state estimations calculations, in 6 out of 12 countries, they are performed every 5 minutes. In some cases (France and Greece) the contingency analysis is regularly performed on a daily basis but in case of emergency or system risk it is possible to run it more times during the day.

- ***Dynamic stability studies in real time***

Studies about dynamic stability in real time are performed in 7 out of 12 countries that have provided information on this topic. From those, only Algeria perform them regularly on a day-ahead basis, while in the rest of the countries such studies are performed only occasionally, in specific situations identified as possible risk for the system or upon request.

- ***Management of international exchange programs***

Programming and management of scheduled international exchanges is performed in all the European countries including Turkey, that have provided information on this topic (where applicable), in accordance with coordinated rules and mechanisms (such as Operational Handbook and ENTSO-E standards). From the countries of the Maghreb area that have provided information, Algeria and Tunisia perform day ahead scheduling of international exchanges, while in Morocco and Jordan energy trading is performed according to bilateral contracts and mainly in cases of emergency.

- ***HVDC requirements***

HVDC technology exists in 9 of the 12 countries that have responded to the survey, with the exception of Jordan, Morocco and Cyprus. Among them, only Spain and France have both LCC and VSC technologies installed, while in the rest of the countries only LCC technology exists. In all countries where HVDC technology applies, no special regulation for HVDC has been established yet with the exception of France and Italy that have already developed national HVDC regulation in this aspect. European Network Codes on HVDC were recently approved in comitology by the European Commission and are expected to apply in all European countries.

Only few TSOs report their experience from the operation of the HVDC interconnectors, in particular France from the operation of the LCC link with the UK, in which the need for management of inverse flows and voltage deviations has been identified and Greece form the operation of the LCC link with Italy, which in the past withstood major disturbances in the South East Europe without being affected. The experience from the operation of the VSC link between France and Spain and of the LCC link between Turkey and Georgia is rather short to provide currently any feedback. The HVDC interconnectors of France with the UK and Spain are in fact the only HVDC links in the Mediterranean Region, which operate in parallel with AC lines and until today no special operational problems or unexpected behaviour have been identified.

- ***Outage coordination***

In what concerns the criteria and procedures for outage coordination between TSOs or TSO and users, particularly when outage operations affect the NTC, all countries that have provided information on this topic (where applicable), perform corrective or predictive outages in accordance with coordinated rules (such as Operational Handbook and ENTSO-E standards) or mutual agreements between the relevant parties. Few TSOs provided information concerning the remuneration of the affected traders.

- ***Load frequency control***

The regulatory framework on load frequency control has been analysed using the classification of reserves considered in the European Network Codes (FCR, FRR and RR), that will be binding in the near future for all European countries. In general we could consider the situation quite heterogenous with many differences regarding the obligation to provide the services, if it is or not a paid service or the compliance scheme.

The most harmonized issue is the criteria used for establishing the quantity of reserve needed in which again 2 main blocks could be considered: European and Maghreb countries. Jordan and Cyprus also have some specific criteria due to the characteristics of their power systems.

- ***Reserves management***

  - European countries: Nowadays exchange of reserves apply with some limitations. In the future with the entry into force of the European Guideline in Electricity Balancing a common criteria will apply.
  - Maghreb countries: FRR is shared whereas no exchange of FCR and RR is allowed.
    (FRR is shared between neighbouring TSO's according to the loss of the biggest power generation unit in the interconnected system: Algeria contributes with 50% of the power loss, Morocco contributes with 30% and Tunisia contributes with 20%).
  - Jordan: FCR and FRR exchange is allowed.

- ***System defence plan***

In general all TSOs use the same frequency deviation management procedure, normally automatically using reserves and taking advantage of the interconnections. In addition automatic under-frequency control schemes (based on load shedding) and over-frequency control schemes (disconnection of generation) are also in use.

Regarding the voltage deviation management procedure similar measures are considered in all MedTSO countries, mainly connection and disconnection of capacitors/reactors; generation reactive power (P, Q curves); transformers tap changing; switching of lines and load shedding in very extreme cases.

In emergency states coordintation and inter-TSO assistance is used but some differences appear between European and Maghreb countries.

- ***Restoration plan***

The strategies used in each power system regarding the restoration plan are similar in all MedTSO countries. In general two main strategies are considered:

- Bottom-up re-energisation strategy. Strategy where the system (or part of the system) of a TSO can be re-energised without the assistance from other TSOs, using generation units equipped with the "black start" capability in order to restore the backbone of the high voltage grid in priority.
- Top-down re-energisation strategy. Strategy that requires the assistance of other TSOs to re-energise the system (or part of the system) of a TSO, is based on the use of the international interconnections and normally through bilateral agreements with neighboring TSOs.

- ***Training and certification***

Operators need a certification in 75% of the countries (8 out of 12), being under implementation in Turkey. In Jordan, Morocco and Tunisia there is no need for such certification. In general all countries with a certification, consider also a renewal of the certification for their operators (except in Cyprus). This certification is in all cases delivered by the TSO.

The valid period for the certification differs in each country from 6 months in Algeria to 18 months in Spain. In some cases (Cyprus Greece, Italy and Montenegro) there is no limit. Regarding the renewal of the certification in Algeria it is valid for 2 years.

In almost all countries a simulator is used during the training, except in Turkey, Montenegro and Jordan where it is expected in the near future. Regarding the topics included in the training (both for beginners and during the renewal courses) in all countries technical aspects (including interTSO coordination) and stress management are included. In Spain training covers additional topics such as negotiation techniques, teamwork, written communication techniques or decision making. The duration of training courses for beginners is normally between 6 and 12 months (Cyprus, Greece, Italy, Montenegro, Portugal and Spain), while it is not specified in France and it is under implementation in Turkey. In Algeria and Tunisia there are 2 week training courses delivered every 6 months during the first 2 years. The duration of renewal certification courses is shorter, normally 1 week (each one or 2 years). Regarding languages requirements, in general apart from the national one, English is needed. French is also needed in Spain and the Maghreb countries. InterTSO training practices are organized regularly in all countries (except Jordan and Cyprus).

- ***Dispatch priority***

The situation is similar in all countries where RES have full priority (in European countries also high efficiency CHP) and after that applies an economic criteria (according to market prices in European counties and economic dispatch in Maghreb countries and Jordan).

SYSTEM MARKETS AREA

- ***General legal issues***

The structure of the electricity market in the Countries of the Med-TSO area is based on two reference models:

1. Market based, typically European systems adhering to the ENTSO-E perimeter;

2. No market based, typically North African and Middle Eastern systems.

The guarantee of security, at domestic level and for coordinated management of exchanges at the borders, is the principle that underlies the operation of all the electrical systems analyzed of the Mediterranean perimeter. The other distinctive feature concerns the respect of efficiency standards: in case of open market model, it tends not only to equilibrium between supply and demand of electricity for commercial purposes.

Among the *"Market Based"* systems: Cyprus, France, Greece, Italy, Montenegro, Portugal, Spain and Turkey.

Among the *"No Market Based"* systems: Algeria, Jordan, Morocco and Tunisia.

- ***Capacity Calculation and Allocation***

Within “Market Based” Countries an additional classification can be made to enable a more detailed analysis of each individual model: there are intermediate patterns, *"hybrids"*. The distinction is linked to the existence of cases different from the model of coordinated management of the capacity allocation at the borders. Within the ENTSO-E perimeter, some systems (usually those geographically frontline of that perimeter) allocate transit capacity bilaterally (typically through bilateral contracts and/or agreements). For example, the presence of a market operator in charge of the commercial management of transits (at the national perimeter) does not automatically implies a “Market Based” model.

Among the most indicative examples of a hybrid model there are the systems of Turkey (bordering on the Middle East and Asia) and Montenegro (some Balkan countries not included in the ENTSO-E perimeter, or at least not apply all the requirements provided). There are other national cases that provide exceptions, such as France (procedure for the capacity allocation at the border with the United Kingdom) and Greece.

Although the compliance with the requirements of safety and efficiency highlights a substantial homogeneity in the design of general principles (security criteria N-1) fully applied), the detailed procedures for the allocation of capacity, particularly in “Market-Based” Countries, show differences on the products to be allocated (eg. physical and/or financial rights for the management of transits) related to time horizons (eg. calculation and allocation of capacity on an annual, monthly, daily, hourly basis).

7. Next steps

Once the analysis of the Starting Regulatory Framework in the Mediterranean region has been made and presented in this deliverable (chapters 6, 7 and 8) the following step is to elaborate the Common Target Regulatory Framework (CTRF) and also the Roadmap for adoption and compliance which consists on subtask 1.2 from the Mediterranean Project. For this purpose a prioritization of issues to be commonly regulated needs to be done. The cooperative approach between all MedTSO members will continue to be the methodology used to obtain the objectives.

During the identification of the CTRF an evaluation on the possibility of identifying and because of the complexity of the Mediterranean region, more reduced Interconnected Electricity Exchanges Zones (IEEZ) may be used in order to apply rules harmonisation in 2 or more different speeds. IEEZ definition could be an input from other tasks in the Mediterranean Project, especially, the ones dealing with market and network studies.

For the proposal of the CTRF an analysis on rules implementation format is needed in order to agree and propose which regulatory format type (internal or external regulation, agreement or grid code, contract between TSO and user) needed for each aspect, issue or requirement to be commonly regulated. For this concern an advance on rules implementation has been presented in Chapter 5. In a further step the third subtask from Mediterranean Project consists on the elaboration of a draft set of Mediterranean rules that could be voluntary adopted in the region.

Annex. Questionnaires

GENERAL REGULATORY ISSUES

A. Who is the responsible body for the development and/or approval of technical rules
B. Who is the responsible authority for the settlement of disputes among stakeholders? (eg. Conflict of access to the network, ...)
C. Can decisions issued by the corresponding regulatory authority be challenged before a higher instance? (i.e. Regional/national court, Ministry, …?)
D. Does the national regulation provide for the involvement of stakeholders in the elaboration of technical rules/ regulations? (i.e. consultative bodies within the NRA or other...)
E. Does National Regulation allows the posibility for new entrants (transmission/generation/suppliers) to operate in your country?
F. Does your national regulation require the unbundling of regulated (transmission and distribution) and non regulated activities (generation/supply), similarly to the EU model?

CONNECTION ISSUES

1. Planning issues	A. Criteria used for transmission grid planning (n, n-1, n-2, in lines and/or transformers)
	B. Horizons used for transmission grid planning
	C. Planning tools used for transmission grid planning
2. Connection procedure	A. Which type of studies are performed for access and connection (load flow, short circuit, transient stability, phisycal feasibility, ...? Please specify.
	B. Which horizons are used for access capacity calculation (last approved planning horizon, current horizon, …)?
	C. Whic criteria is used for access capacity calculation (N, N-1, …..)?
	D. Tools used for access to the grid assessment (same as for transmission grid planning, specific ones, …)
	E. Are TSOs connection studies payd by the applicants or otherwise (tariffs, cost recognition by Regulator)?
	F. Who pays for the transmission assets needed for the connection of generation? (user, system, …) If necessary differentiate between commissioning and maintenance.
	G. Who pays the transmission assets needed for the connection of distribution ? (user, system, …) If necessary differentiate between commissioning and maintenance.
	H. Who pays the transmission assets needed for the connection of consumption ? (user, system, …) If necessary differentiate between commissioning and maintenance.
	I. Are ther any limiting (minimum, maximum) magnitudes (power, distance to grid, …) required to connect to the transmission grid? Please include, for the different voltage levels if applicable.
	J. Design criteria used for new transmission facilities needed for connection (substation topology -1 busbar, 2 busbars- ,lines, …)
	K. Design criteria used for new non-transmission facilities (substation topology -1 busbar, 2 busbars- ,lines, …)
	L. Is there any obligation for users to send simulation models to network operators? If yes, specify
	M. Are there any relevant additional requirements for connection to the transmission grid? (i.e. mesh node connection requirement, topology conditions, …)
	N. Is there capacity connection priority? (e.g., for renewables, for the first applications, …)
	O. Is there any binding relationship between planning and connection authorization?
	P. What procedures does establish the TSO for Physical Connection and Energisation of non-transmission facilities (Operational Notification Procedure)? Please describe briefly.
3. Frequency Requirements	A. What are the frequency/time range limits for users to withstand without damage?
	B. What is the rate of change of frequency withstand capability?
	C. Limited frequency sensitive mode – overfrequency and underfrequency schemes

4.Voltage requirements	A. What are the voltage/time range limits for users to withstand without damage?
	B. What technologies have to comply with fault ride through capability requirements? Please detail and attach different profiles curves for each type.
5. Reactive Power Requirement	A. What are the limits of reactive power contribution?
6. Short Circuit Requirements	A. What are the short circuit current limits (in Kilo Amperes) for switch equipments in the transmission grid?
	B. Which are the short circuit ratio limits for thermal, combined cycle gas turbine, hydroelectric power plants? (when applicable)
7. Protection	A. General criteria or particular one for each case?
	B. Which aspects are included in the protection schemes for non-transmission facilities connected to the transmission grid? (i.e. external short-circuit, internal short-circuit, over and under frequency, over and under voltage, demand circuit protection, unit transformer protection, backup schemes)
	C. Which are the isolation levels in the transmission grid?
	D. Which redoundancy is required for telecommunication and protection schemes (e.g. simple, double, …)
	E. Which main functions are required inside the multifunctional relays installed in the transmission grid?
8. Control Requirements	A. Which global architecture and schemes are required for controlability and observability of non-transmission facilities connected to the transmission grid?
	B. Which facilities are required to be observable by TSO control systems (real time monitoring at TSO control centre)? Please specify threshold according to relevant magnitudes (for facilities over X MW, connceted to ≥ kV, ...)
	C. Which magnitudes must be provided from non-transmission facilities to TSO control centre in real time? Please specify (P, Q, V, …)
	D. Which facilities are required to be controlable by TSO control systems (possibility for real time istructions/setpoints to be received from TSO control centre)? Please specify threshold according to rrelevant magnitudes (for facilities over X MW, connceted to ≥ kV, ...)
	E. Which communication system is required or allowed? (double communication channel, dedicated or not, physical or not, fiber or not, gps, …) Which protocol is required?
10. Power Quality	A. Which normative standards are used as reference for power quality regulation in the transmission grid? (e.g., EN 50160, IEC 61000...)
	B. VOLTAGE DIPS. What are the limit total number of voltages dips per node in your system? (separate per voltage level if needed)
	C. HARMONIC DISTORTION. Which is the Total Harmonic Distortion (THD) factor in your system?
	D. FLICKER. Which are the flicker limit values in your system? Please include planning/emision limits.
	E. UNBALANCE. Which are the reference levels for voltage unbalances in your system?
	F. OVERVOLTAGE. Which are the reference levels for transient overvoltage in your system?
12. Demand Disconnection schemes	A. Do you have demand disconnection schemes (low frequency and/or low voltage) in your system? If yes, specify. *Consider answer in Questions 14 A and B from the Operation Area*
13. System Restoration Capabilities	A. Which technologies need to have Black Start Capability?
	B. Which technologies need to have Island Operation Capability?
	C. Do you use any other System Restoration Capability?
14. Demand Side Response Services	A. Do you use demand side response services in your system? If yes, specify.
15. HVDC requirements	A. Do you have HVDC specific requirements or criteria in your system? If yes, specify.
16. Compliance	A. What compliance scheme is used in your system? (TSO tests, 3rd party certification company, user declaration, other)

OPERATION ISSUES

1. System States	A. What is the classification of system states in your system? (Normal, Alert, Emergency, Blackout, Restoration, …). Please specify briefly the conditions of each one.
	B. Which parameters are monitored in real time? If there are differences between system states explain.
2. Technical requirements	A. Frequency/time ranges in your system?
	B1. Voltage/time ranges in your system?
	B2. Specific voltage ranges for international interconnections (where applicable)
	C. Which measures apply in your system for reactive management? (opening lines, reactors, distribution support,..)
	C2. Specific reactive power management for international interconnections (where applicable)
	D. Limit criteria for short-circuit management
	E. System protection coordination criteria(not already included in question 7.D from Connection Area) or coordination protocols between TSO and other users.
3. What type of information is exchanged between TSOs in the following topics?	A. What issues are included in the contingency list? (both for internal and external contingencies)
	B. Joint remedial actions agreed between TSOs after a contingency in each operation time horizon?
	C. Operational planning models in each operation time horizon?
	D. Real time data (including criteria used for defining network limits shared between TSOs - observability area)
	E. Scheduled data for different time horizons
	F. Structural data (grid electrical parameters, topology, ...)
	G. State estimation data exchange
4. Contingency analysis	A. Operational security limits in different system states and contingencies considered (full n-1, partial n-1, full n-2, partial n-2, loss of the biggest generation plant…)
	B. Which studies are made for state estimation? Periodicity of these studies?
5. Dynamic stability	A. Are stability studies performed in day ahead or real time?
6. Principles of management of international exchange programs between TSOs	A. Scheduled exchanges programming and management
	B. Unintentional deviations management (including compensation of unintentional deviations
7. HVDC technology	A. Specific operation security limits (where applicable)
	B. Do you have HDVC technology based on LCC or VSC in your system? If yes, describe briefly.
	C. Do you have HDVC interconnection lines based on LCC or VSC in your system? If yes, describe briefly: - Experience on operation. - How do you deal with tripping of an HVDC interconnection line? (when all the interconnection lines are HVDC). - Special protection and control schemes, when used. - Specific operation procedures considered in order to keep system in security limits.
	D. Do you have HDVC interconnection lines based on LCC or VSC in your system that are operated in parallel with AC interconnection lines? If yes, describe briefly: - Operational procedures to operate all interconnection together. - Unexpected behaviour related to power system in the interconnected areas, if exist. - Special protection and control schemes, when used. - Specific operation procedures considered in order to keep system in security limits.
9. What are the criteria and procedure for outage coordination (corrective or predictive maintenance) when affects NTC?	A. Between TSOs
	B. Between TSO and user

11. Load Frequency Control	A1. Primary regulation / Frequency Containment Reserve (FCR) technical minimum requirements by Synchronous Area
	A2. It is mandatory to provide FCR? Who?
	A3. Are users paid for providing FCR? How?
	A4. Which users can provide FCR?
	A5. Criteria used for establishing the quantity of FCR needed?
	A6. Is there any compliance scheme for FCR?
	A7. Are there any consequences (i.e. economic penalties) for not providing FCR?
	B1. Frequency Restoration Reserve (FRR) technical minimum requirements by Synchronous Area.
	B2. It is mandatory to provide FRR? Who?
	B3. Are users paid for providing FRR? How?
	B4. Which users can provide FRR?
	B5. Criteria used for establishing the quantity of FRR needed?
	B6. Is there any compliance scheme for FRR?
	B7. Are there any consequences (i.e. economic penalties) for not providing FRR?
	C1. Replacement Reserve (RR) technical minimum requirements by Synchronous Area
	C2. It is mandatory to provide RR? Who?
	C3. Are users paid for providing RR? How?
	C4. Which users can provide RR?
	C5. Criteria used for establishing the quantity of RR needed?
	C6. Is there any compliance scheme for RR?
	C7. Are there any consequences (i.e. economic penalties) for not providing RR?
12. Reserves management (exchange and sharing)	A. Possibilities of reserve exchange and share between TSOs. Implementation mechanisms of each type of reserves FCR, FRR and RR. *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
14.System defence plan	A. Frequency deviation management procedure (Automatic Under/Over-Frequency control scheme) *Consider Connection Area Questions 12 A and 12B where*
	B. Which are the setting of demand disconnection schemes (low frequency and/or low voltage) in your system?
	C. Voltage deviation management procedure
	D. Power flow management procedure
	E. Manual demand disconnection procedure
	F. Inter-TSO assistance and coordination in emergency state
15. Restoration plan (rules and types of restoration plans at local/national level and through interconnections)	A. Bottom-up re-energisation strategy
	B. Top-down re-energisation strategy. Inter-TSO assistance and coordination
16. Training and certification of system operator employees in charge of real-time operation.	
	A. Is there certification of the operators in charge of real time?
	B. The certification is delivered by the TSO or another entity?
	C. How long time the certificate is valid?
	D. The TSO use a simulator for the training?
	E. The training of operators realised by the TSO and what kind of topics (including stress management)?
	F. The periodicity of the training of each operator and the duration of one session?
	G. The different levels of the operators and the criteria of the classification?
	H. How long time the activity of the operator in real time?
	I. Is there any language requirement for operators?
	J. Is there any systematically established interTSO training scheme or practice?
	J. Do you have similar requirements for operators in other control centres (not operated by the TSO)?
18. Dispatch priority and RES operation Management	A. What dispatch criteria (including priority) applies in your system?

SYSTEM MARKET ISSUES

1. Legal issues	A. What are the current requirements for participation on the cross-border electricity trade in your system? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	B. What are the current rules for export / import of cross-border electricity in your system? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	C. What categories of operators are enabled for import/export activities in your country (e.g. single buyer, operator, customers ..)? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	D. Is there a commercial register for import/export operators in your country? Which information has to be included on it? (e.g. technical, like the ability to produce/selling the energy to exoprt or import, and financial, like the maximum volume of energy per day or per month enabled to trade) *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	E. Which are the requirements for stipulating and executing contracts with market players relevant for the Cross Border Trade with other relevant market players in your country (i.e. contracts between TSO and Grid Operators, Contracts between TSO and Market operators and Contracts between market operators and Grid Operators) *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	F. Are there any international agreements on either bilateral or multilateral basis which your country has concluded with other countries concerning further development and liberalization of energy markets? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	G. Is it possible in your country to buy transmission rights already bought under the Transfer Capacity Allocation (TCA)? Are these operation taxed in your system? Are there any other fiscal restrictions which have to be taken into account? Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges
	H. Is there a market operator in your legislation or the TSO is the only counterpart?
	I. How do you define the electrical frontiers?
	J. Which kind of functions at the frontier are under the responsibility of the TSO? (e.g. guarantee of the program of exchanges, metering, settlement, only some of them?)
	K. Which requirements you have to satisfy for using the interconnections (e.g. demand/offer equilibrium, congestion management at national, and if possible, at international level, balancing of the exchange program in real time, coordinated dispatching)?
2. Rules and methodologies for capacity calculation (eg. in the long-term, day ahead or intraday time horizons), including different management modalities for transmission capacity calculation	A. Which security criteria is used for calculating the Net Transfer Capacity (NTC)? Do you apply a security criteria? Do you apply a margin reserved to the TSO operations? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	B. Do you use a common regional network model for capacity calculation? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	C. Which are the time horizons used for capacity calculation?
	D. Do you have long term (more than 1 year) capacity allocation in your international interconnections? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	E. What is the process for calculating capacity in the different time horizons? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
3. Rules and methodologies for capacity allocation (eg. in the long-term, day ahead, intraday time horizons)	
	A. With method applies in your system for transmission capacity allocation? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	B. Joint or Split *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	C. Obligation to use allocated capacity *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*

	D. When is the auction performed? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	E. What kind of products are allocated (band, peak,…)? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	F. Is the capacity free of charge? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	G. Qualification of the involved parties (network operators and users)
	H. Which system of liabilities, guarantees and penalties (technical and commercial) do you apply for each subject involved?
	I. The method is approved by the regulator? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	J. How is the capacity divided in the different time frames? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	K. What kind of procedures do you use or do you intend to use for the PTR allocation (e.g. public auction, tender procedures, ...)?
	L. How do you manage congestions in phase of PTR allocation ?
	M. Who is the subject responsible for the management procedure?
	N. Do you have procedures for management of PTR after their allocation for ant-trust reasons?
	O. Which rules do you have for the management of physical and commercial use of PTR? Which related time schedule?
	P. Which procedures do you use or do you intend to use for verifying the correct behavior of the appointed operators (e.g. verification that each operator's program is covered by a correspondent availability of generation/withdrawal capacity)?
	Q. Is there a secondary market to transfer Physical Transmission Rights (PTRs)? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
	R. On which time bases the related products (PTR) are allocated?
	S. Possibilty to re-selling capacity? *Complete with the same answer than in TC3 Questionnaire on International Electricity Exchanges*
4. Dispatching and balancing issues between network operators	A. Which set of actions (procedures, rules) do you apply in order to guarantee the exchange programs?
	B. Which set of remedial actions (ancillary services, black start capability, ...) do you apply in order to guarantee the exchange programs?
	C. Which set of actions (procedures, rules) do you apply for the balancing services?
	D. Which users can provide balancing services?
	E. Are cross border balancing services in use in your system?
	F. How is the congestion income distributed?
	G. Criteria used to deliver balancing services?
5. Balancing settlement issues (imbalances and unintentional deviations).	A. How do you identify and attribute the amount of energy injected or withdrawn?
	A. How are imbalances and unintentional deviations settled in your system?
	B. Who is responsible for the settlement in your system?
6. Metering issues	A. Who is responsible for metering (settlement measures) in the international interconnections?
	B. What accuracy do meters installed in the interconnections have?
	C. Who has the possibility to access to this measures remotely? For what purpose (security, settlement…)

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