Med-TSO
MEDITERRANEAN TRANSMISSION SYSTEM OPERATORS

Deliverable 1.3
Models of rules (Procedures/Contracts)

EC DEVCO - GRANT CONTRACT: ENPI/2014/347-006
"Mediterranean Project"
Task 1 "Common Set of Rules for a Mediterranean Power System and Transmission Grid Code"

Med-TSO is supported by the European Union.
This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of Med-TSO and do not necessarily reflect the views of the European Union.

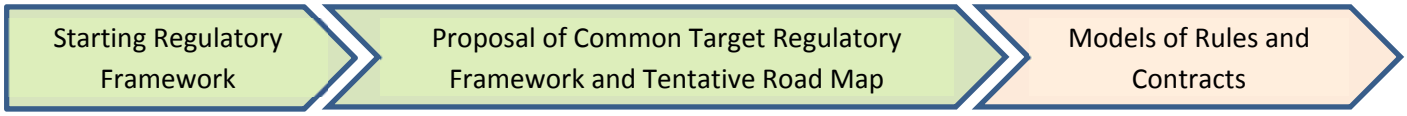
Table of contents

List of figures

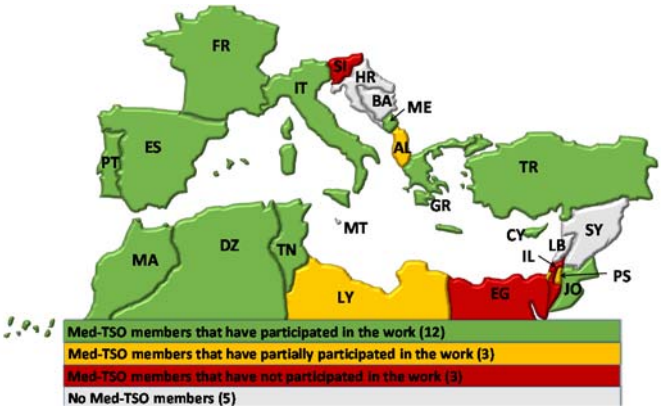
List of tables

1. Executive summary

The present report covers the final stage of Task 1 within the so called Mediterranean Project (MP), an ongoing three-year project performed by Med-TSO and supported by the European Commission, and constitutes the final deliverable of Subtask 1.3 which main goal is to elaborate a draft set of Mediterranean network rules and contracts based on the results obtained from previous subtasks, in which a deep analysis was performed in order to identify the Starting Regulatory Framework (SRF) in the Mediterranean region (Subtask 1.1) and prioritizing the technical issues that should be harmonized and included in the Proposal of Common Target Regulatory Framework (CTRF) and Tentative Road Map (Subtask 1.2).



Considering the abovementioned scheme, the methodology used has been a very collaborative approach between Med-TSO Technical Committee 2 on Regulation and Institution (TC2) members through various surveys that were completed by each TSO in order to understand the situation in each country.



Based on the results of the abovementioned analysis TC2 work has been carried out in order to identify which rules could be tackled and first developed in terms of achieving common models due to their priority in the regulatory harmonization process for the Mediterranean region. With this purpose, a combination of priority areas/aspects/issues involved and potential rule formats have been considered in order to select the 3 following regulations:

- Connection Contract TSO-User for users to connect to the grid.
- Operation Agreement TSO-TSO between neighbouring TSOs.
- Grid Code with the chapters about requirements for connection (GC RC) and about system operation (GC SO).

As a result of this, the present report includes the technical arguments for the mentioned selection, as well as the conceptual proposal guidelines (chapters 3, 4 and 5) which should be included in the rules and a basic simplified model which to be further developed and used in the entire Mediterranean region in order to regulate both TSO-TSO and TSO-User relations. The actual proposals are detailed in annexes A, B, C1 and C2.

In chapter 2 the general methodology is presented, together with some considerations on the practical implementation. CTRF had identified and located - in terms of temporal prioritization - a set of 66 technical issues considered of high interest and prioritization from 4 thematic areas: connection to the grid, operation of the interconnected systems, system service markets and legal and regulatory aspects. As a main output of the analysis

from the 66 issues, 30 have been included in at least one[1] of the 3 regulatory proposals, while the other 36 have not been selected in this first stage. In addition, a new block of 10 issues, related with contractual aspects, has been identified as necessary to be included in the contract proposals. The analysis has also shown that 3 issues that were discarded in previous subtasks have been selected again as of priority importance to be included in the regulatory proposal. In conclusion, the final selection is composed of 79 issues (66 coming from the CTRF, 10 from the contractual area and 3 recovered issues). From these, 43 issues have been included in the proposals of the present document.

SELECTED ISSUES OVERVIEW	Connection	Operation	System Services Market	Legal & Regulatory	Contractual aspects	Total issues considered	…of which included in Del. 1.3 regulatory proposals:
Preselected issues in CTRF	13	32	18	3	0	66	**30**
Added contractual issues					10	10	**10**
Recovered issues (initially discarded at D.2.2)	3					3	**3**
Total issues considered	16	32	18	3	10	79	**43**
Finally included in Del. 1.3 regulatory proposals	**13**	**16**	**4**	**0**	**10**	**43**	

Focusing on the 43 issues included in the regulatory proposals, a complementary analysis has been made, showing the number of issues included in each proposal coming from the different technical areas: connection, operation, system service markets, legal and regulatory and contractual. It can be observed that all connection issues under consideration are included in the TSO-User Connection Contract while most of the operation issues are included in the TSO-TSO Operation Contract. Additionally, both proposals incorporate a set of contractual issues. The proposed Grid Code takes technical issues both from connection and operation areas but none from contractual and system service markets, for its implementation in national and regional regulation.

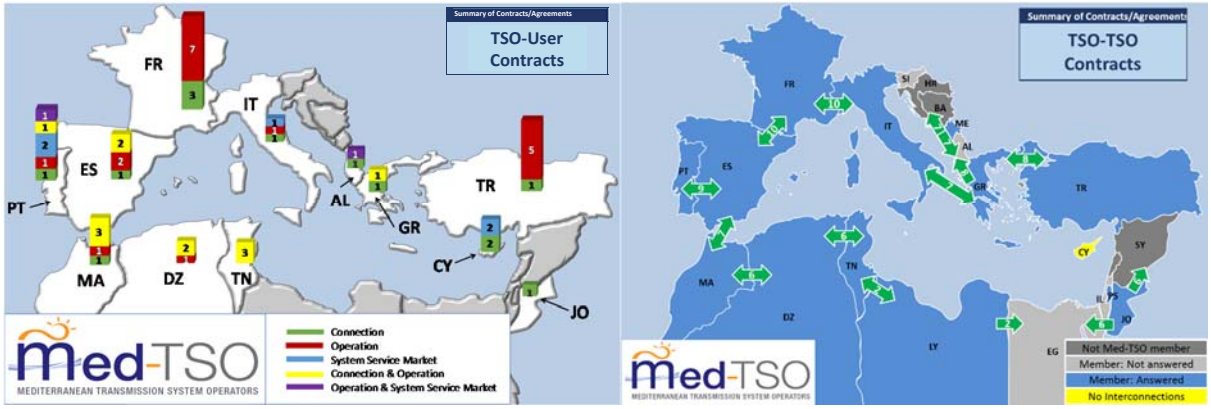
ISSUES SELECTED TO BE INCLUDED IN REGULATORY PROPOSALS: 79 (43 in Del. 1.3)		
Connection (16 -> 13)	**Operation (32 -> 16)**	**System Services Markets (18-> 4)**
• Connection procedure 2 -> 1 • Frequency requirements 3 -> 3 • Voltage requirements 2 -> 2 • Reactive power requirements 1 -> 1 • Short circuit requirements 1 -> 1 • Protection requirements 1 ->1 • Control requirements 3 -> 3 • Power quality 1 -> 1 • Demand disconnection schemes 1 -> 0 • HVDC requirements 1 -> 0	• System states 1 -> 1 • Technical requirements 5 -> 5 • Information exchange 2 -> 2 • Contingency analysis 6 -> 5 • Management of international exchange programs 1 -> 1 • Outage coordination 1 -> 1 • Load frequency control 6 -> 0 • Reserve management 1 -> 0 • Defence plan 6 -> 0 • Restoration plan 1 -> 0 • Training 2 -> 0	• Legal issues 5 -> 0 • Capacity calculation 3 -> 3 • Capacity allocation 5 -> 0 • Dispatching and balancing 3 -> 1 • Transparency 2 -> 0
Legal & Regulatory (3 -> 0)	**Contractual (10 -> 10)**	

In chapter 3 the results on the survey about existing TSO-User contracts are presented. The analysis show that situation varies considerably from one TSO to another, both in form and content. Some TSOs use a single contract containing all

[1] Some technical issues are included in more than one regulatory proposal. For example the frequency ranges to withstand without damage by generation facilities are included both in the Grid Code and in the TSO-User contract.

requisites and clauses rather than approaching the same matter from a sequential perspective. Anyway the need of a connection contract that regulates relationship between the user and the TSO has been selected as the most appropriate to be deeply analysed in order to create a proposal of Connection Contract model that could be widely used in the Mediterranean region. This connection contract mainly includes a set of contractual aspects, together with technical and information requirements and related construction aspects.

Similarly, in chapter 4 the analysis on the survey about TSO-TSO contracts show equal results. The way interconnections are managed throughout the Med-TSO region show a high degree of dispersion among TSO-TSO contracts. The proposal focuses on operation aspects, which have been classified as priority in terms of coordination between TSO: Information exchange and interconnection characteristics; Coordinated management and synchronous operation; Capacity calculation; Outage scheduling; Mutual support mechanisms (including defence plans) and Management of unintentional deviations. A general overview of the existing contracts is shown in the following maps, both for TSO-User (left) and for TSO-TSO (right) contracts.



The proposal on Grid Codes has been developed by directly applying the findings from previous subtasks, selecting a set of 8 issues from the connection area for the GC RC (related basically with technical requirements on frequency, voltage, reactive power, protection and control) and 14 issues from the operation area for the GC SO (dealing with system states, frequency and voltage ranges, information exchange requirements, contingency analysis and outage coordination aspects).

As mentioned before the report also includes the models for all regulatory proposals that can be found in the different Annexes. It is important to note that the regulatory proposals presented in this document are not binding but rather of an indicative nature since they do not have a legal basis. It is not the intention of Med-TSO members to act as a legislator. The potential binding application of the referred proposals should be subject, where relevant, to the transposition into national law by the corresponding national competent regulatory authorities. Alternatively, they could be considered as “Guidelines of Good Practice” (GGP) and could be applied on a voluntary basis by the corresponding Med-TSO members. The overall objective of these Med-TSO regulatory proposals is to develop and share a common set of basic rules, for the interoperability of the Mediterranean power systems aiming at, among other things, facilitating electricity exchanges, development of infrastructures and institutional cooperation.

In practical terms, this constitutes a first proposal considering the TSOs perspective for the core priority issues in a short-medium term scenario of global harmonisation in the Mediterranean region. Consequently, further work will be needed in order to coordinate with other perspectives, advance in the implementation details of priority rules and enlarge the harmonisation perimeter to other issues beyond the priority level and articulate potential intermediate stages where partial harmonization might be achieved. Coordination mainly refer to Regulators, both at national and regional levels, since practical implementation of new rules is in many cases beyond TSOs possibilities, but also to the implication of involved stakeholders; both are vital for contributing to maintain the security of power supply while accomplishing the ambitious objectives of increasing energy sustainability and markets integration.

2. Scope and objectives

2.1. Background

The present report constitutes Deliverable 1.3, as a result of Subtask 1.3 within Task 1 of the Mediterranean Project[2]. This project aims at the progressive harmonization and strengthening of the electricity markets in the Mediterranean region, following a bottom-up approach and with a direct involvement of Med-TSO members, through the following tasks:

a) ***Rules:*** Developing and sharing a common set of basic rules, in cooperation with the association of the Mediterranean Regulators for energy (MEDREG), for the interoperability of the Mediterranean power systems, facilitating electricity exchanges, development of infrastructures and institutional cooperation.

b) ***Infrastructure:*** Preparing and sharing guidelines for Network Planning and implementing a Euro-Mediterranean Electricity Reference Grid for studies and coordinated development of interconnections.

c) ***International Electricity Exchanges:*** Promoting the development of a Mediterranean Electricity System, focusing on methodologies, procedures and mechanisms for sharing resources through cross border exchanges, based on power systems complementarities and the optimized use of generation and transmission infrastructures.

d) ***Knowledge Sharing:*** Establishing a forum among the relevant professionals working in the fields related to the scope of the project, supporting also Med-TSO members and other relevant organizations through the organization of specific and oriented knowledge activities.

e) ***Med-TSO Database:*** Creation of a Mediterranean database for managing all the information shared in the frame of the project, dealing with network characteristics, energy scenarios and market data.

In line with the abovementioned activities and regarding the task about "Rules" (Task 1 of the Mediterranean Project) it has been structured as follows:

Activity 1.1- Compilation of relevant regulatory framework

- ✓ Deliverable 1.1 Starting Regulatory Framework (SRF).

Activity 1.2- Elaboration of common target regulatory framework.

- ✓ Deliverable 1.2.1 Proposal of Common Target Regulatory Framework (CTRF).
- ✓ Deliverable 1.2.2 Proposal of Common Tentative Road Map (CTRM).

Activity 1.3- Elaboration of draft set of Mediterranean network rules.

- ✓ Deliverable 1.3 Models of rules: Contracts and Grid Code.

Med-TSO Technical Committee 2 on Regulation and Institutions (TC2) has been in charge of developing these activities. The first deliverable (D.1.1), "***Starting Regulatory Framework (Technical Rules) in the Mediterranean Region***" which was approved by Med-TSO in May 2016, aimed at presenting an overview and overall analysis of the power sector regulatory framework in Med-TSO countries, with a particular focus on those rules related to TSOs responsibilities and functions, which are associated to the following areas:

[2] Mediterranean Project: a three-year grant project from the European Commission (Directorate General for Neighborhood and Enlargement Negotiations - DG NEAR)

- 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.
- Legal and regulatory issues.

Having established the starting point in terms of the potential issues that could be harmonized (135 issues), the second deliverable (D.1.2.1), ***"Proposal of Common Target Regulatory Framework"*** which was approved by Med-TSO in February 2017, identified a concrete set of requirements (66 technical issues) for compliance that could be translated into rules for the whole region, separated in the 4 thematic areas as indicated in Figure 1.

STARTING REGULATORY FRAMEWORK (SRF): 34 Aspects ⇨ 135 Issues		
1 Regulatory Aspect (11 Issues)		
13 Connection Aspects (41 Issues)	14 Operation Aspects (57 Issues)	6 System Services Markets Aspects (26 Issues)
• *Connection procedure 2* • *Frequency requirements 3* • *Voltage requirements 2* • *Reactive power requirements 1* • Short circuit requirements • *Protection requirements 1* • *Control requirements 4* • Power quality • *Demand disconnection schemes 1* • System restoration capabilities • Demand side response services • *HVDC requirements 1* • Compliance and monitoring	• *System states 1* • *Technical requirements 5* • *Information exchange 3* • *Contingency analysis 5* • Dynamic stability • *Management of international exchange programs 1* • HVDC technologies • *Outage coordination 1* • *Load frequency control 5* • *Reserve management 1* • *Defence plan 5* • *Restoration plan 1* • *Training 2* • Dispatch priority	• *Legal issues 5* • *Capacity calculation 3* • *Capacity allocation 5* • *Dispatching and balancing 1* • Settlement and metering • *Transparency 2*
COMMON TARGET REGULATORY FRAMEWORK (CTRF): 24 Aspects ⇨ 66 Issues		
1 Regulatory Aspect (3 Issues)		
8 Connection Aspects (15 Issues)	11 Operation Aspects (32 Issues)	4 System Services Markets Aspects (16 Issues)

Figure 1. Starting and Common Target Regulatory Framework. In purple, aspects proposed with highest priority to be harmonised and included in the Target.

Furthermore, Figure 2 shows for the different areas the selection ratios by which those issues present in the SRF have been included within the Target Proposal, resulting that 49% of the initial reference of 135 issues have been selected. The Figure also shows how the different areas are present in the Target Proposal, concentrating the operation area the majority of selected issues to be harmonised (32 operation issues represent 48% of the total selected).

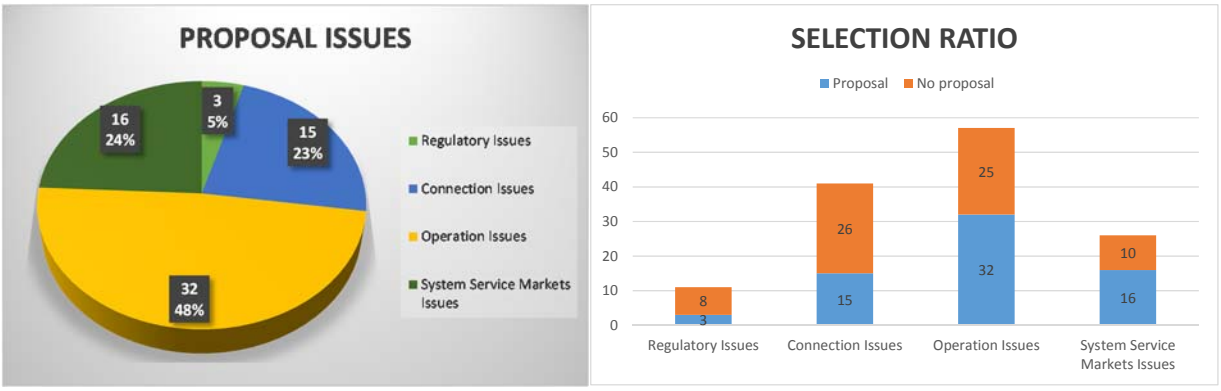


Figure 2. Relative proportion and selection ratios of issues included in CTRF for each area.

This proposal also considered a proposed format for each of the 66 issues differentiating between:

- **Internal regulation**: Agreements or contracts adopted between TSOs or between TSOs and other stakeholders (users and service providers).
- **External regulation**: Regulations approved by competent authorities at national or regional level (either Grid Codes, which may be proposed by TSOs, or higher regulation).

The third deliverable (D.1.2.2), ***"Proposal of Common Tentative Road Map",*** which was approved by Med-TSO in April 2017, included the temporal prioritization that should be applied for the regulatory harmonization of the 66 selected technical issues. In this regard, the proposed tentative time-horizons for regulatory harmonisation are as follows: short-term (2018-2020), medium-term (2021-2025) and long-term (>2025).

Based on the previous results, this report constitutes the forth deliverable (D.1.3 – Models of rules: Contracts and Grid Code) and includes a proposal of models of rules that could be used in the Mediterranean region. In chapter 2.2 the general methodology used to elaborate the proposals is included, while chapters 3, 4 and 5 present the 3 models that have been identified as a priority. The actual proposals are then detailed in annexes A, B, C1 and C2.

2.2. General methodology and structure of regulatory proposals

The methodology used has been a very collaborative approach between Med-TSO TC2 members through various surveys that were completed by each TSO in order to understand the current regulatory situation in each country. As shown in Figure 3, this approach has enabled a major involvement of 15 TSOs through specific task forces for each area.

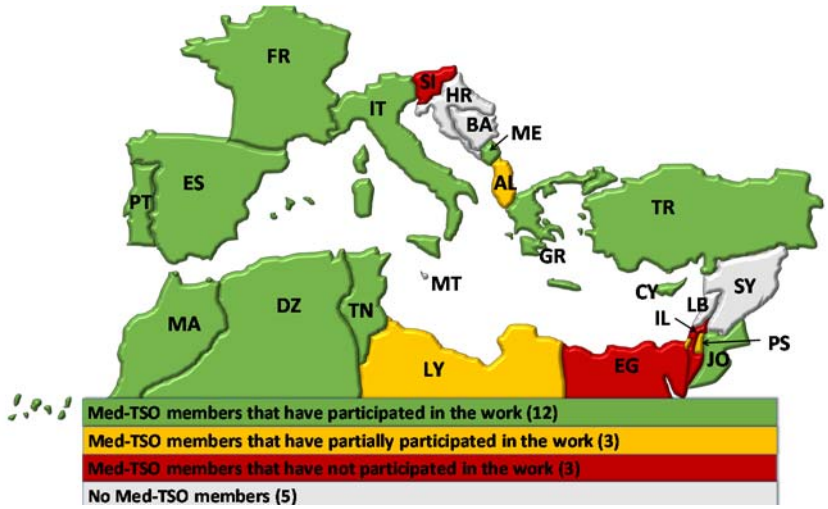


Figure 3. Participation on TC2 subtask 1.3 per country in the Mediterranean region.

Based on the results of the abovementioned surveys and on the work already performed in previous activities (so the 66 selected issues to be included in the Common Target Regulatory Framework) as mentioned in chapter 2.1, TC2 has decided to concentrate at this stage of the project in 3 regulatory proposals:

- A contract model that regulates TSO-User relationship.
- A contract model that regulates TSO-TSO relationship.
- A proposal of Grid Code concentrating on the chapters about requirements for connection and about system operation.

Specific task forces, as indicated in Figure 4, have been created in order to develop each regulatory proposal.

Figure 4. Task force groups description.

The analysis performed as will be presented in the following chapters has identified which of the 66 selected issues from the 3 technical areas[3] should be included in each type of regulation. As a main output of the analysis from the 66 issues, 30 have been included in at least one[4] of the 3 regulatory proposals, while the other 36 have not been selected in this first stage. Most of these issues are related with Load Frequency Control, Management of Reserves, Emergency and Restoration, Capacity allocation mechanisms or even purely legal aspects as the need for unbundling between activities.

In addition, a new block of 10 issues, related with contractual aspects, has been identified as necessary to be included in the contract proposals. The analysis has also shown that 3 issues that were discarded in previous subtasks have been selected again as of priority importance to be included in the regulatory proposal.

[3] Issues coming from the Legal & Regulatory Areas have not been analyzed in detail in this report as are out of the scope of the TSO functions and need a deeper coordination with regulators.

[4] Some technical issues are included in more than one regulatory proposal. For example the frequency ranges to withstand without damage are included both in the Grid Code and in the TSO-User contract.

In conclusion, the final selection is composed of 79 issues (66 coming from the CTRF, 10 from the contractual area and 3 recovered issues). From these, 43 issues have been included in the proposals of the present document. The general overview of issues selection is shown in Table 1.

SELECTED ISSUES OVERVIEW	Connection	Operation	System Services Market	Legal & Regulatory	Contractual aspects	Total issues considered	Included in regulatory proposals (per origin):
Selected issues in CTRF	13	32	18	3	0	66	**30**
Added contractual issues					10	10	**10**
Recovered issues (discarded at D.2.2)	3					3	**3**
Selected issues for D.1.3	16	32	18	3	10	79	**43**
Included in regulatory proposals (per technical area)	**13**	**16**	**4**	**0**	**10**	**43**	

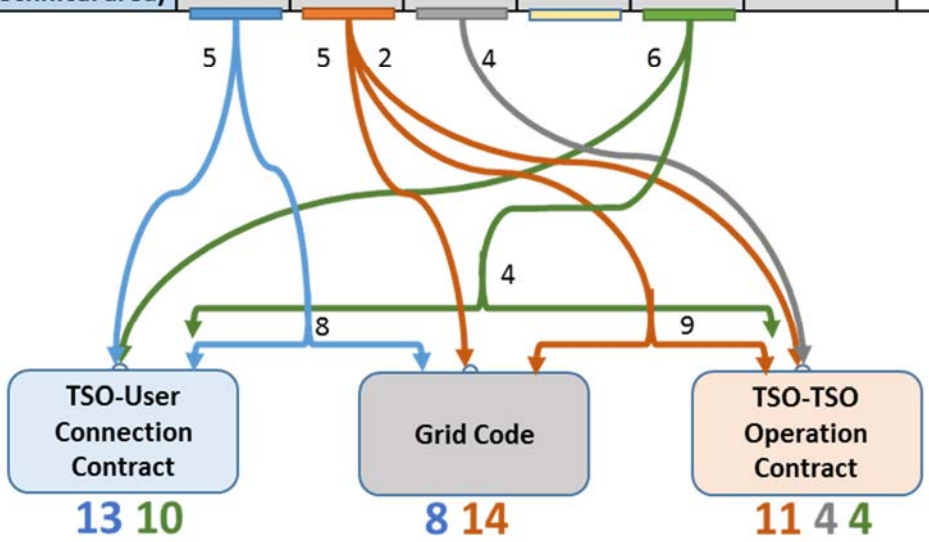


Table 1. Overview of total issues considered and issues finally included in regulatory proposals regarding their origin, the and their distribution across the regulatory proposals.

Focusing on the 43 issues included in the regulatory proposals, a complementary analysis has been made, showing the number of issues included in each proposal coming from the different technical areas: connection, operation, system service markets, legal and regulatory and contractual. The structure of each proposal in terms of the issues that belong to each of them is explained in **¡Error! No se encuentra el origen de la referencia.**, showing common issues between proposals as well.

It can be observed that all connection issues under consideration are included in the TSO-User Connection Contract while most of the operation issues are included in the TSO-TSO Operation Contract. Additionally, both proposals incorporate a set of contractual issues. The Grid Code proposed takes technical issues both from connection and operation areas but none from contractual and system service markets. The approach is to compile the most relevant issues in a Grid Code for its implementation in national and regional regulation.

Finally, an overview of all issues (both considered and discarded) is shown in Table 2, including the potential Grid Code in which every issue could be regulated.

TECHNICAL ISSUES	SUBTASK 1.2		SUBTASK 1.3			
	Included in CTRF	TECHNICAL AREA	TSO-User Contract/Agreement	TSO - TSO Contract/Agreement	Grid Code	
			Connection Contract/Agreement	Operation Agreement	Connection & Operation Grid Code	Potential Grid Code
Studies performed for access and connection	Y	CONNECTION	x			Requirements for Connection
Criteria used for access capacity calculation	Y					Requirements for Connection
Frequency/time range limits for users to withstand without damage	Y		x		x	Requirements for Connection
Rate of change of frequency withstand capability	Y		x		x	Requirements for Connection
Limited frequency sensitive mode – overfrequency and underfrequency schemes	Y		x		x	Requirements for Connection
Voltage/time range limits for users to withstand without damage	Y		x		x	Requirements for Connection
Fault ride through capability	Y		x		x	Requirements for Connection
Limits of reactive power contribution	Y		x		x	Requirements for Connection
Short circuit levels/requirements			x			Requirements for Connection
Telecommunication and protection schemes	Y		x			Requirements for Connection
Power quality			x			Requirements for Connection
Metering			x			Requirements for Connection
Threshold for observability and controlability of non-transmission facilities	Y		x		x	Requirements for Connection
Magnitudes to be provided in real time from non-transmission facilities	Y		x		x	Requirements for Connection
Existence of demand disconnection schemes (low frequency and/or low voltage)	Y					Emergency and Restoration
Specific HVDC requirements or criteria	Y					Requirements for Connection
Classification of system states	Y	OPERATION			x	System Operation & Operational Planning
Frequency ranges (quality parameters) in the different system states	Y				x	System Operation & Operational Planning
Voltage ranges (for unlimited operation) in normal conditions	Y				x	System Operation & Operational Planning
Voltage ranges (for unlimited operation) in extraordinary conditions	Y				x	System Operation & Operational Planning
Reactive power management measures	Y				x	System Operation & Operational Planning
System protection coordination criteria in international interconnections	Y			x	x	System Operation & Operational Planning
List of scheduled and structural data to exchange with other TSOs	Y			x	x	System Operation & Operational Planning
List of real time data to exchange with other TSOs	Y			x	x	System Operation & Operational Planning
Type of contingencies considered	Y			x	x	System Operation & Operational Planning
Contingency list	Y			x	x	System Operation & Operational Planning
Operational security limits	Y			x	x	System Operation & Operational Planning
Operational security limits in the interconnection lines	Y			x	x	System Operation & Operational Planning
List of joint remedial actions agreed between TSOs after a contingency	Y			x	x	System Operation & Operational Planning
Management of international exchange programs between TSOs	Y			x		System Operation & Operational Planning
Criteria and procedure for outage coordination	Y			x	x	System Operation & Operational Planning
Load Frequency Control - FCR common technical requirements	Y					Load-Frequency Control and Reserves
Load Frequency Control - Criteria used for establishing the quantity of FCR	Y					Load-Frequency Control and Reserves
Load Frequency Control - Compliance scheme for FCR	Y					Load-Frequency Control and Reserves
Load Frequency Control - Provision of FRR	Y					Load-Frequency Control and Reserves
Load Frequency Control - Criteria used for establishing the quantity of FRR	Y					Load-Frequency Control and Reserves
Load Frequency Control - Compliance scheme for FRR	Y					Load-Frequency Control and Reserves
Mechanisms of reserves management (exchange and sharing)	Y					Load-Frequency Control and Reserves
Frequency deviation management procedure	Y					Emergency and Restoration
Setting of demand disconnection schemes (low frequency and/or low voltage)	Y					Emergency and Restoration
Voltage deviation management procedure	Y					Emergency and Restoration
Power flow management procedure	Y					Emergency and Restoration
Manual demand disconnection procedure	Y					Emergency and Restoration
Inter-TSO assistance and coordination in emergency state	Y			x		Emergency and Restoration
Rules and types of restoration plans	Y					Emergency and Restoration
Language requirements	Y					System Operation & Operational Planning
Certification of the operators in charge of real time	Y					System Operation & Operational Planning
Periodicity of state estimation calculations ("snapshots")	Y					System Operation & Operational Planning
Contractual requirements for participation on the cross-border electricity trade	Y	SSM				Capacity Allocation and Congestion Management / Forward Capacity Allocation
Current rules for export/import of cross-border electricity	Y					Capacity Allocation and Congestion Management / Forward Capacity Allocation
Presence of a Market Operator	Y					Not applicable
Categories of operators enabled	Y					Not applicable
Technical requirements to satisfy for using interconnections	Y					Capacity Allocation and Congestion Management / Forward Capacity Allocation
Capacity allocation - Methods and procedures	Y					Capacity Allocation and Congestion Management / Forward Capacity Allocation
Capacity allocation - Subject responsible for the management of the allocation procedure	Y					Capacity Allocation and Congestion Management / Forward Capacity Allocation
Capacity allocation - Obligation regarding the use of the capacity allocated	Y					Capacity Allocation and Congestion Management / Forward Capacity Allocation
Capacity allocation - Kind of capacity products allocated (duration and time profiling)	Y					Capacity Allocation and Congestion Management / Forward Capacity Allocation
Capacity allocation - System of liabilities, guarantees and penalties	Y					Capacity Allocation and Congestion Management / Forward Capacity Allocation
Actions to guarantee the exchange programs	Y					Capacity Allocation and Congestion Management / Forward Capacity Allocation
Management of unintentional deviations	Y			x		Capacity Allocation and Congestion Management / Forward Capacity Allocation
Transparency - Public information on Electricity Markets data	Y					Not applicable
Transparency - Public information on international interconnection data	Y					Not applicable
Balancing	Y					Electricity Balancing
Capacity calculation - Security criteria used	Y			x		System Operation & Operational Planning
Capacity calculation - Characteristic process for finalization of NTC	Y			x		System Operation & Operational Planning
Capacity calculation - Reference time horizons used	Y			x		System Operation & Operational Planning
Unbundling of regulated and non-regulated activities	Y	L&R				Not applicable
Coordinated regulation to make feasible and viable international interconnections	Y					Not applicable
Responsible authority for the settlement of disputes among stakeholders	Y					Not applicable
Parties identification		CONTRACTUAL	x	x		Not applicable
General information on facilities to be connected			x			Not applicable
Information on administrative authorizations			x			Not applicable
Connection solution and scheme			x			Not applicable
Duration			x	x		Not applicable
Construction aspects			x			Not applicable
Conditions for coordinated maintenance			x			Not applicable
Conditions for withdrawal			x	x		Not applicable
Transfer of the contract			x			Not applicable
Dispute resolution			x	x		Not applicable

Table 2. Detail on all technical issues and their belonging to each regulatory proposal

2.3. Considerations on implementation of regulatory proposals

The overall objective of these Med-TSO regulatory proposals is to develop and share a common set of basic rules, for the interoperability of the Mediterranean power systems aiming at, among other things, facilitating electricity exchanges, development of infrastructures and institutional cooperation.

More particularly, the proposals aim to provide a shared view between all Med-TSO members of what is understood to be the common regulatory framework regarding the identified areas of interest.

In general, the regulatory proposals apply to TSOs and generation facilities connected (or willing to connect) to the transmission grid. In some cases the proposed regulatory models also apply to generation facilities connected to the distribution grid and to distribution system operators (DSOs). Demand and distribution facilities are out of the scope of this proposal.

Non-binding nature

It is important to note that the regulatory proposals presented in this document are not binding but rather of an indicative nature since they do not have a legal basis[5]. It is not the intention of Med-TSO members to act as a legislator. The potential binding application of the referred proposals should be subject, where relevant, to the transposition into national law by the corresponding national competent regulatory authorities. Alternatively, they could be considered as "Guidelines of Good Practice" (GGP) and could be applied on a voluntary basis by the corresponding Med-TSO members.

Practical implementation

In practical terms, this constitutes a first proposal considering the TSOs perspective for the core priority issues in a short-medium term scenario of global regulatory harmonisation in the Mediterranean region. Consequently, further work will be needed in order to coordinate with other perspectives, advance in the implementation details of priority rules, and enlarge the harmonisation perimeter to other issues beyond the priority level and articulate potential intermediate stages where partial harmonization might be achieved.

Coordination mainly refer to Regulators, both at national and regional levels, since practical implementation of new rules is in many cases beyond TSOs possibilities, but also to the implication of involved stakeholders; both are vital for contributing to maintain the security of power supply while accomplishing the ambitious objectives of increasing energy sustainability and markets integration.

[5] It is worth noting that in the case of the technical codes at European Level, these are developed and approved on the basis of, Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003, and more particularly of Article 6(2) thereof.

3. Model of TSO-User Contract for Connection

The main goal of this chapter is to present the key topics that need to be included at the Proposal for the Model of TSO-User Contract/Agreement for Connection to the grid.

Therefore, this chapter provides an overview of the main issues that were identified as relevant for the TSOs, according to the survey launched among the Med-TSO members. In this chapter it is described topic by topic, the issues that were considered relevant, in order to create a reference Contract model for using among TSOs and users regarding the connection to the grid.

In this study Contract/Agreement is understood as any legal or commercial relationship between the TSO and the User.

3.1. Methodology

In order to define guidelines and requirements for the harmonization of TSO-User contracts, the current situation for each TSO is to be analysed. For such analysis, a survey was designed and distributed. The answers collected are used to conclude the most suitable approach for defining the content and format that a TSO-User contract within the Med-TSO area should have. In other words, the standard contracts that regulates the relationship between the network operator and the users of the network is based on the answers received from each Med-TSO member to the survey distributed within the Technical Committee TC2. The received results does not

This survey contains some technical questions concerning the existing standard contracts that governs the relationship between TSO and user. The template for the survey itself can be found in Annex D. It is composed of three main chapters as follows:

A. **The existing TSO-User contracts in the power system:** in which contracts are presented and classified in technical areas and type of contracts.
B. **General scheme and relationship within processing and other administrative conditions:** in which the general scheme detailing the different actors taking part in legal procedures related with the TSO-User contracts and their relations are explained. It should also include a brief presentation of the current regulations system.
C. **The details of each contract:** For each contract mentioned in part A, some details must be known concerning the main contents and main articles existing in the TSO-User contract. These details are used for the analysis of the different existing cases and to estimate the standardization and harmonization potential.

A great variety of answers to the survey has been received, both in form and in content. On one hand, the approach of each TSO when filling in the survey was different (in terms of the level of detail given or simply due to interpretation related with translation issues). On the other hand, many process are actually approached and carried out in different ways depending on the country, which adds to widening the range of answers received therefore justifying the need for analysis.

The results of the survey does not intend to be an exhaustive compilation of the existing TSO-User contract in each country but the most important ones that could be potentially harmonized in the region.

The upcoming sections will deal with the analysis of the different parts explained above, focusing on remarking those aspects that can be of interest when defining guidelines towards a standard TSO-User contract. First, an overview of the answers collected is performed based on part A of the survey. That is, answers are compared by means of the classification regarding technical areas and type of contracts. Then, the different answers to the general scheme and

relationships are discussed. Finally, as the contents of all contracts imply a considerable amount of data, an overview of the main contents is performed and presented.

The analysis is aimed afterwards at connection contracts. This scope into only connection contracts is justified later on, based mainly on the fact that connection contracts are common ground for all TSOs.

The TSO-User contracts presented and declared by the different members of TC2 account for a total of 50 contracts. The majority of the TSOs presented more than 2 TSO-User contracts with the massive disclosure of RTE (FRANCE) and REN (PORTUGAL) which presented respectively 10 and 6 contracts while NEPCO (JORDAN), IPTO (GREECE) and OST (ALBANIA) have sent 2 or less contracts. It should be clarified that the number of contracts itself is only to be considered from an instrumental point of view, as one single contract can have the same or even more information than several contracts by other TSO. Furthermore, each TSO had its own criteria when choosing which contracts under its domain were of interest for the present study.

Moreover, it should be clarified that the TSO-User contracts presented by the different TSOs do not represent all existing contracts in the different countries of the Med-TSO region, but only those that were considered of interest for the study. Figure 5 shows the number of TSO-User contracts sent by each TSO.

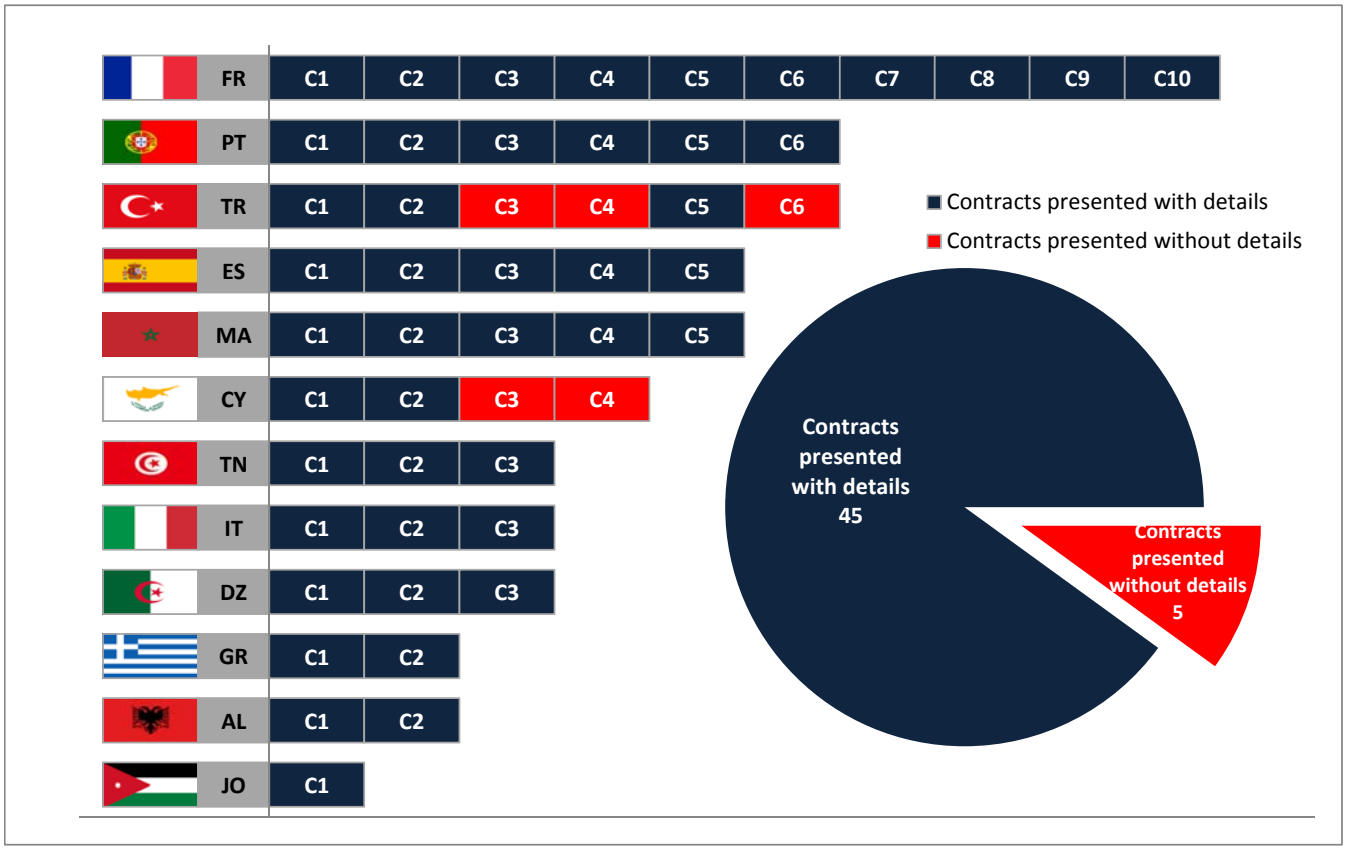


Figure 5. TSO-User contracts presented by each TSO.

Regarding the technical areas of belonging, it is to be noted that most of the contracts presented belong to the connection and operation areas (45 out of the total 50). Considering the connection area alone, 13 contracts were declared while 12 contracts belong to both the connection and operation areas. Contracts in the system service market area were not as numerous as only 7 contracts fall within this area. Figure 6 summarizes the situation of the contracts presented concerning the technical area of belonging.

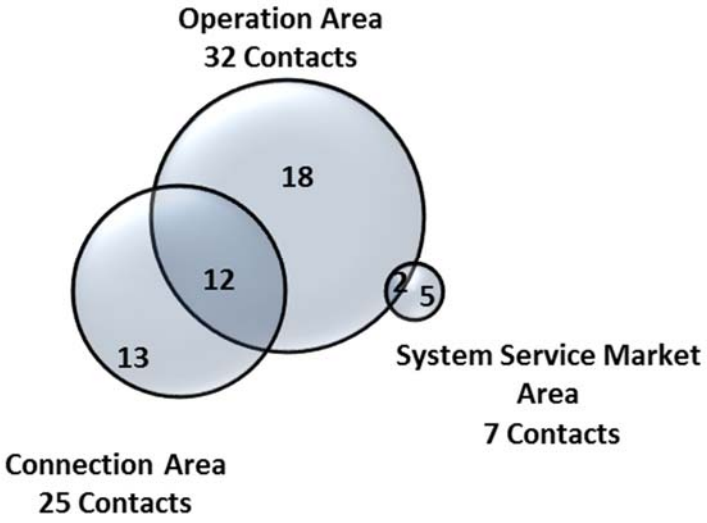


Figure 6. TSO-User contracts presented by technical areas.

Concerning the analysis on the technical areas for the different countries, it is noted that practically all TSOs have presented contracts for the connection and operation areas with the exception of NEPCO (JORDAN) -who presented 1 contract only for the connection area- and TSO CYPRUS -who presented none for the operation area-. Only 3 TSOs presented contracts regarding the system service market: REN (PORTUGAL), TERNA (ITALY) and TSO CYPRUS. Only REN (PORTUGAL) has presented contracts for all areas, even for areas combinations (connection together with operation and operation together with system service market).

Figure 7 and Figure 8 summarize the situation of the contracts presented concerning the technical area for the different Med-TSO members.

	2	3	4	10	2	3	1	5	6	5	3	6	50
O. & S.S.M.	1								1				2
C. & O.		2			1			3	1	2	3		12
S.S.M.			2			1			2				5
O.		1		7		1		1	1	2		5	18
C.	1		2	3	1	1	1	1	1	1		1	13
Areas	AL	DZ	CY	FR	GR	IT	JO	MA	PT	ES	TN	TR	All

Figure 7. TSO-User contracts by technical areas for Med-TSO members.

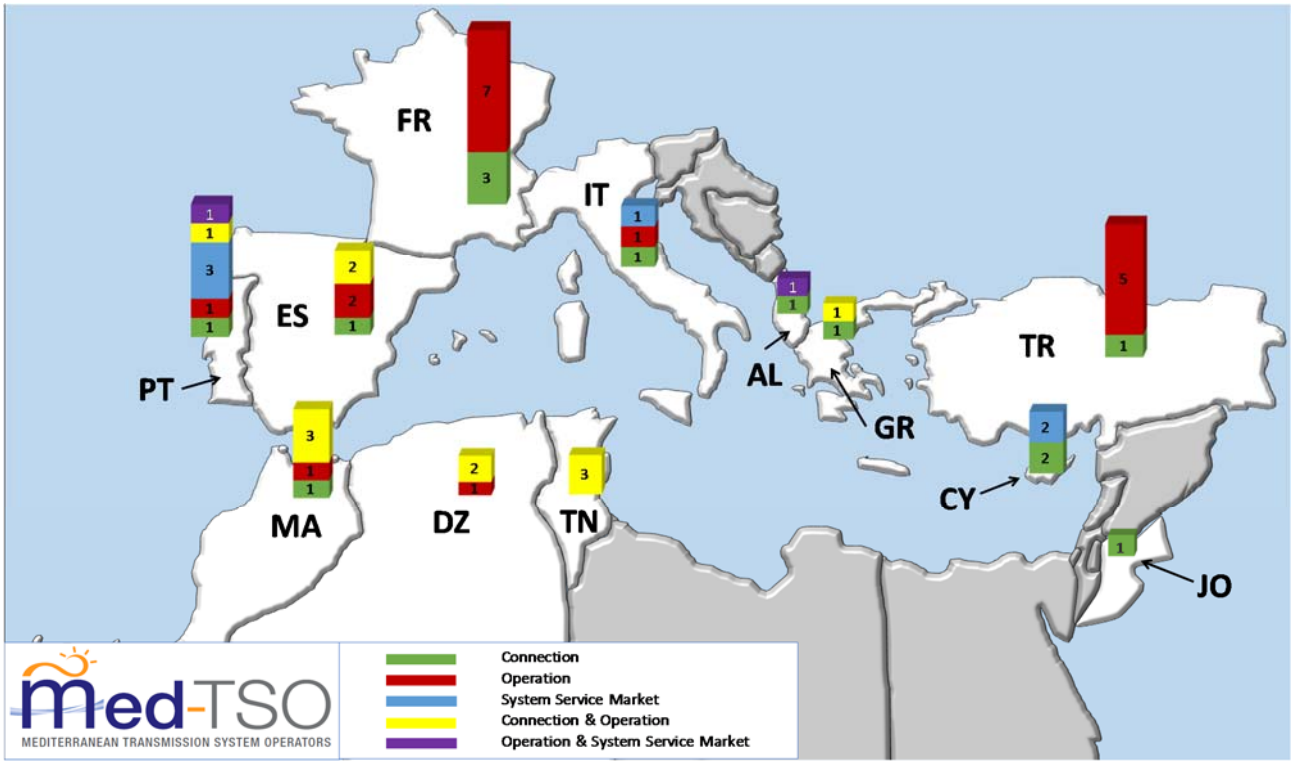


Figure 8. Map of TSO-User contracts by technical areas for Med-TSO members.

Countries in grey have no data either because they are not members of the Med-TSO organization or because they did not take part on the survey. For all other countries (coloured in white), the contracts presented for each technical area are shown. According to the TSO-user survey we distinguish 7 types of contracts, 6 of which were proposed in the template of the survey and an additional type added by a member. The types of contracts presented by the different TSOs are listed below:

- Dealing with access and connection (12 countries) (Type a/ Proposed)
- For construction of transmission facilities (6 countries) (Type b/ Proposed)
- Dealing with the conditions of grid usage (9 countries) (Type c/ Proposed)
- For provision of system services (7 countries) (Type d/ Proposed)
- For coordination in the operation (8 countries) (Type e/ Proposed)
- For installation and maintenance of generation tripping systems (3 countries) (Type f/ Proposed)
- For ancillary services (1 country) (Type g/ added by TEIAS)

Figure 9 and Figure 10 summarize the situation of the contracts presented by each TSO concerning the type of contract per country and checked with the technical areas, respectively.

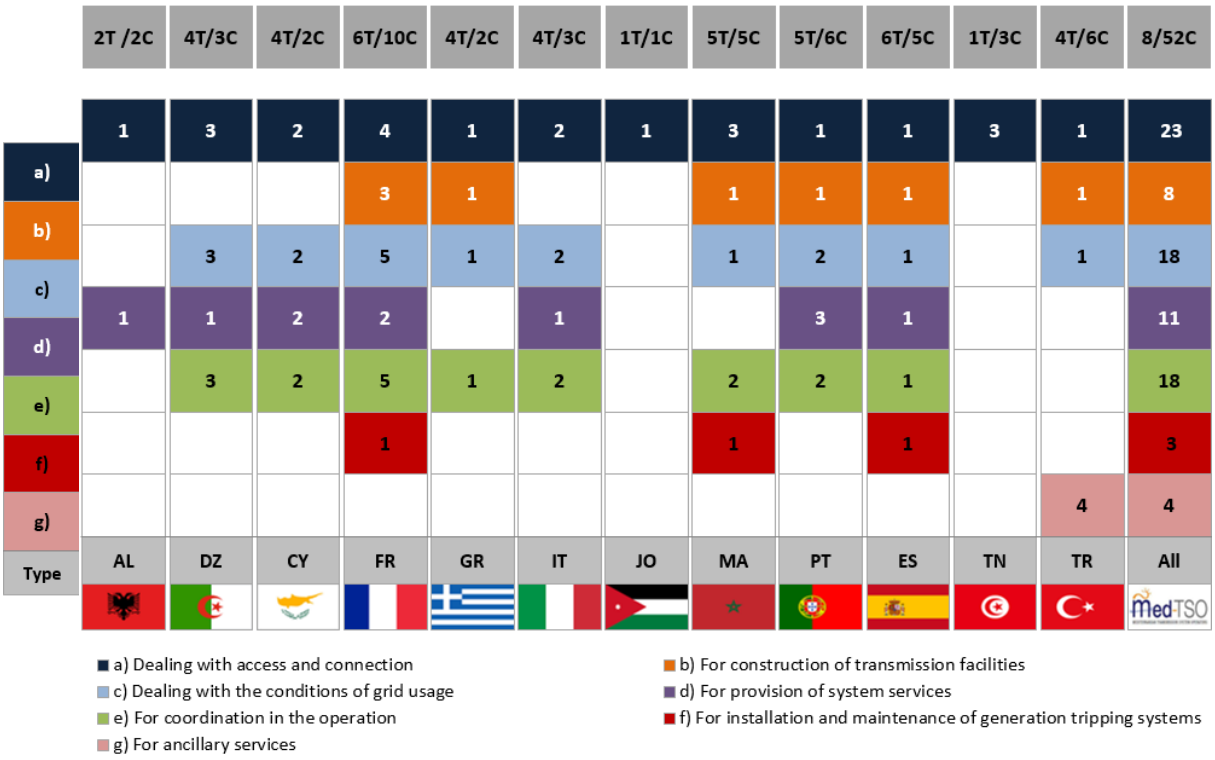


Figure 9. Overview of TSO-User contracts regarding type of contract by country. The above row shows the number of types covered (1st number) and the number of contracts (2nd number), to account for combinations of type of contracts.

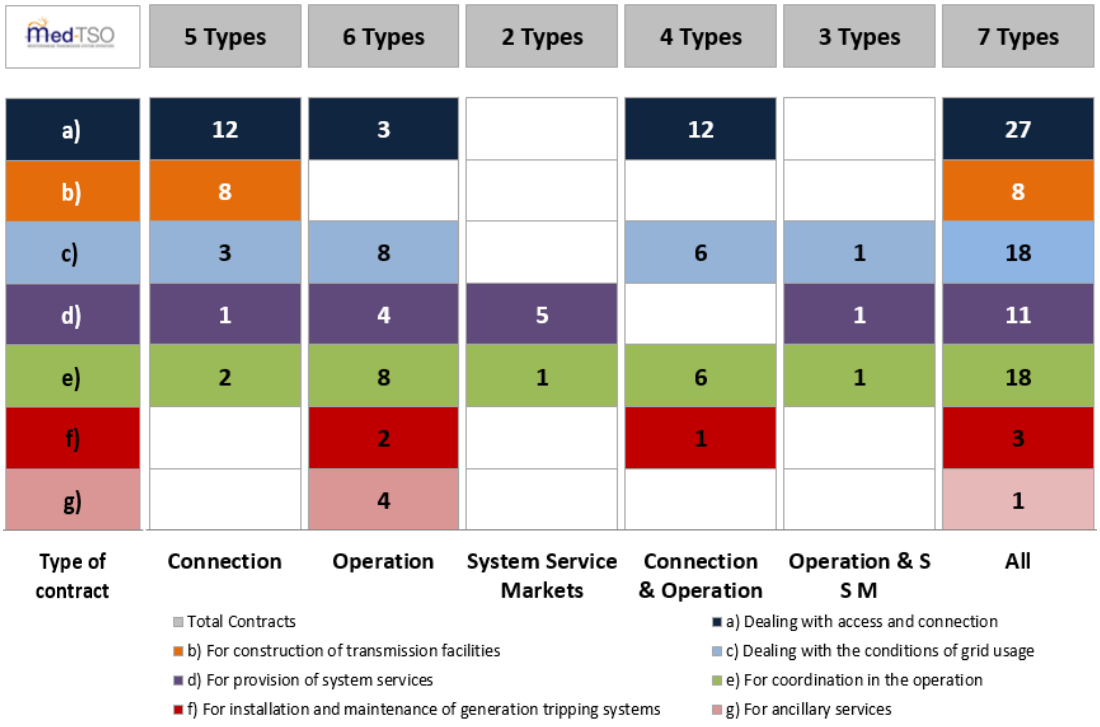


Figure 10. TSO-User contracts by type of contract and technical areas.

Focusing the analysis on the relation between types of contracts with the technical areas, we find that there is certain correlation between these factors. This relation is explained as follows, and shown on Figure 11:

1) Contracts dealing with access and connection belong to the connection and the operation areas but are more involved with the **Connection** area.
2) The contract for construction of transmission facilities belongs only to the **Connection** area.
3) The contract dealing with the conditions of grid usage belongs to all areas but mainly to **Operation** area.
4) The contract for provision of system services belongs to all areas but mainly to **System Service Market area.**
5) The contract for coordination in the operation belongs to all areas but is more involved with **Operation** area.
6) The contract Installation and maintenance of generation tripping systems belongs to the connection and the operation areas but is more involved with **Operation** area.
7) The contract For ancillary services is belonging only to the **Operation** area

			Technical areas		
		Type Name	Connection	Operation	Service system market
Type of Contracts	a	Dealing with access and connection	x		
	b	For construction of transmission facilities	x		
	c	Dealing with the conditions of grid usage		x	
	d	For provision of system services			x
	e	For Coordination in the operation		x	
	f	Ins. and main. of generation tripping systems		x	
	g	For ancillary services		x	

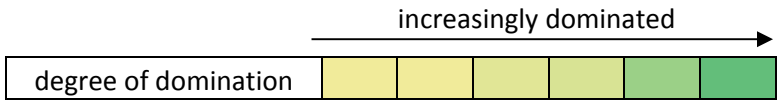


Figure 11. Relationship between technical areas and type of contracts.

It can be concluded that the scope of defining guidelines should be aimed at the connection contract, as it involves all TSOs and therefore allows for efforts towards consistency. Other technical areas shall be dealt with from a different approach, as there is too much discrepancy between TSOs for specific guidelines to be drawn.

Based on what was shown in Figure 10 and Figure 11, those contracts in the technical area of 'Connection' or marked as "access and connection" type (type a), are considered in this section. Applying such criteria results in a total of 23 contracts.

The main objectives of the connection contracts mentioned by most TSOs are:

- Establish the relationship and ownership of linking facility between the TSO and the user regarding the connection to the grid, and
- Define the preconditions, technical requirements, legal specifications and the financial terms for using the connection point, while identifying the user (generator, distributor or consumer).

The results for the TSO-User survey are summarized in Table 3:

Country	Contract	Contract Name	Duration	Identification of...			Pre-conditions	Technical requirements	Construction requirements
				User	Facility	Connection Point			
AL	C1	Connection agreement to transmission network	Indefinite period	full	full	full	Acceptance of connection offer, tariffs, preliminary studies, documentation	Regulation (Grid Code)	Connection works project
DZ	C1	Agreement TSO-Producer	Indefinite period	full	full	(Description)	Maintain capacity level of production, quality of service	Maneuvering in exceptional cases and 1st/2nd regulation settings	N/A
	C2	Contract TSO-Producer	Indefinite period	full	full	(Description)	(No)	(No)	N/A
	C3	Contract TSO-DSO/HVConsumer	Indefinite period	full	full	(Description)	(No)	Protections, communication, metering, ancillary services, control	N/A
CY	C1	RES Connection agreement	Variable	full	full	full	Licenses, building permits, funding, preliminary studies	Connection terms, forecasting, maintenance, communication, operational checks, protections, metering, dispatch programm	Construction aspects in its area of responsibility
	C2	Thermal Connection agreement	Variable	full	full	full	Licenses, building permits, funding, preliminary studies	Connection terms, maintenance, ancillary services, communication, operational checks, protections, metering, dispatch programm	-
FR	C1	Technical & Financial Proposal (TFP)	(until C3)	Legal reps.	full	full	-	-	-
	C2	Commitment & performance agreement	Indefinite period	Legal reps.	-	-	(C1)	Communication, metering, protections, fault isolation	-
	C3	Connection agreement	Indefinite period	Legal reps.	full	full	(C1, C2)	Short circuit capability, metering	Connection works project
GR	C1	Contract for connection to the system	Indefinite period	full	full	Bus bar	Production permits, environmental conditions, licenses, preliminary studies, documentation, Final Connection Offer	Linking facility, grounding, protections, control, metering, communication	-
	C2	Service Level Agreement Contract	Indefinite period	full	-	Bus bar	RAEs (Regulatory Authority for Energy) approval	Linking facility	Connection works project
IT	C1	Contract for connection	Indefinite period	full	full	full	Admin. Authorisation and connection project	Regulation (Grid Code)	Connection works project
JO	C1	Transmission connection agreement	25 years	full	full	full	Licenses, impact studies (grid and environment) for generators, feasibility study for consumers/distributors	Linking facility, grounding, protections, control, ancillary services, communication	Connection works project
MA	C1	Convention D'Accèss	25 years	Legal reps.	full	Bus bar	Admin. Authorisation (for generators)	Regulation (Grid Code)	-
	C2	Protocole D' Accord de Raccordement	Indefinite period	Legal reps.	full	Bus bar	(C1)	Comissioning conditions, ownership of assets	Usage & ownership of site
	C3	Contrat D'Achat	20 years	Legal reps.	full	Bus bar	Admin. Authorisation	Protections, metering, scheme	Connection works project
PT	C1	Contract for project and construction of connection infrastructures	2 years (typically)	Legal reps.	full	Bus bar	Admin. Authorisation	Fault currents, communication, metering, protection, control	Usage & ownership of site, brief general description of substation works
	C2	Operating Protocol	Indefinite period	Legal reps.	full	Bus bar	Construction works finished, prior to commissioning	Linking facility, maintenance, dispatch programm, on-site maneuvers	-
ES	C1	Contract for connection	Indefinite period	full	full	full	Admin. Authorisation (for non-tranmission facilities)	Regulation (Grid Code), additional conditions	-
	C2	Contract for Project Order + Construction	Until comissioning	full	full	full	(C1), Admin. Authorisation (for transmission facilities)	-	Connection works project
TN	C1	Contract for electricity transport from self-producer	20 years	full	full	Bus bar	Certificate of self-producer	Requirements of facility, network and CP; switching, metering	Efficiency criteria
	C2	PPA from independent producer	20 years	full	full	Bus bar	Admin. Authorisation (allocated by tender procedure)	Reliability, performance, communication, maintenance	Connection works project
	C3	Contract for supply of electricity	1 year	full	full	Bus bar	Admin. Authorisation	Regulation (Grid Code), additional conditions	-
TR	C5	Connection agreement	Variable (until end of licence or indefinite)	full	-	full	Preliminary studies, production permits, licenses (for production plants), documentation, Final Connection Offer	Regulation (Grid Code)	N/A

Table 3. Summary of existing TSO-User connection contracts for each Med-TSO member taking part in the survey.

"full" identification of User	Name, type of company, address, tax code, VAT and contact info
"full" identification of Facility:	Ownership, type, location, technical features & scheme
"full" identification of Connection Point:	Ownership, location and topology

Construction works project: Costs, schedules, ownership and responsibilities

According to the survey for the 24 contracts related to dealing with access and connection to the transmission grid (or in the connection technical area) we distinguish the following findings:

a) General aspects: They include 11 contracts, 10 agreements, 2 protocols and 1 proposal, just for naming matters. Some TSOs have presented several contracts for the connection of facilities, due to being these contracts part of a stepwise process. This means that for such TSOs different contracts are used for different aspects of the connection procedure, and generally later contracts require the fulfilment of earlier ones.

b) Identification of participants: 12 contracts are aimed at the connection of generation users only, 1 for the distributor, 2 for consumers (industrial) and 9 are for general users, without specific considerations. In any case, users are generally required to fill a set of information including:

Name of user/company	Type of company	Address	Tax code and VAT	Contact information

The facility to be connected is also identified by means of a set of information, which typically includes:

Name of facility	Ownership	Type of facility	Address	Technical features	Technical scheme

Additionally, the identification of the connection point presents some more discrepancy between TSOs. Typically, the following information is required:

Name of Connection Point	Ownership	Address	Topology and technical scheme

Guidelines regarding identification aspects can be found on chapter 3.2.1.

c) Duration of the contract. Figure 12 shows the duration of validity of all declared connection contracts. It can be seen that there is again a wide range of answers, as some contracts are valid for the whole lifetime of the facility (indefinite duration), while others are meant to be renewed/updated periodically or are only valid until the next contract is signed (being part of a sequential process). In the case of TSO CYPRUS the declared contracts' duration is variable "depending on regulator licenses", or on whether the facility is a generator or a consumer for TEIAS.

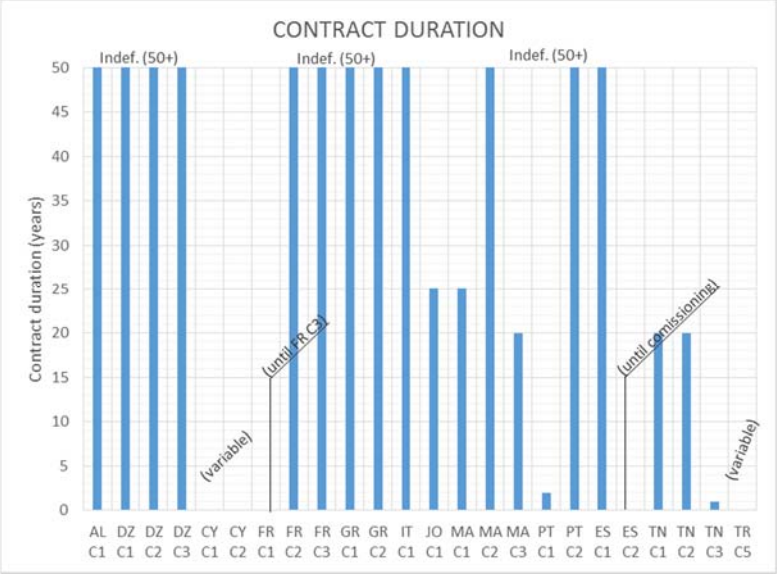


Figure 12. Overview of connection contracts' duration.

It can be concluded that in order to set realistic guidelines regarding contract duration, these guidelines should consider being flexible. The mentioned guideline on this topic can be found on chapter 3.2.3.3.

d) Preconditions. Most of the declared contracts require previous documentation or permits to be fulfilled. These preconditions can be classified as:

External: Typically referred to as "Administrative authorizations" or licenses, permits, etc. A total of 16 contracts require external authorization as a precondition.
Internal: Mainly applicable to contracts part of a stepwise process, related to completing previous steps of the process.

e) Technical requirements. As in the case of preconditions just commented above, a distinction is to be made regarding technical requirements.

External: For many TSOs, the connection contract itself does not require additional technical issues, only to fulfil external regulation, often referred to as "Grid Codes".

Internal: The range of technical requirements answered by the rest of TSOs in the survey includes issues related to protections, metering, communication, control, grounding, maintenance and ancillary services.

Figure 13 shows the distribution of TSOs according to how they deal with technical requirements. Specific guidelines on technical requirements for the connection contract can be found on chapter 3.2.3.4.

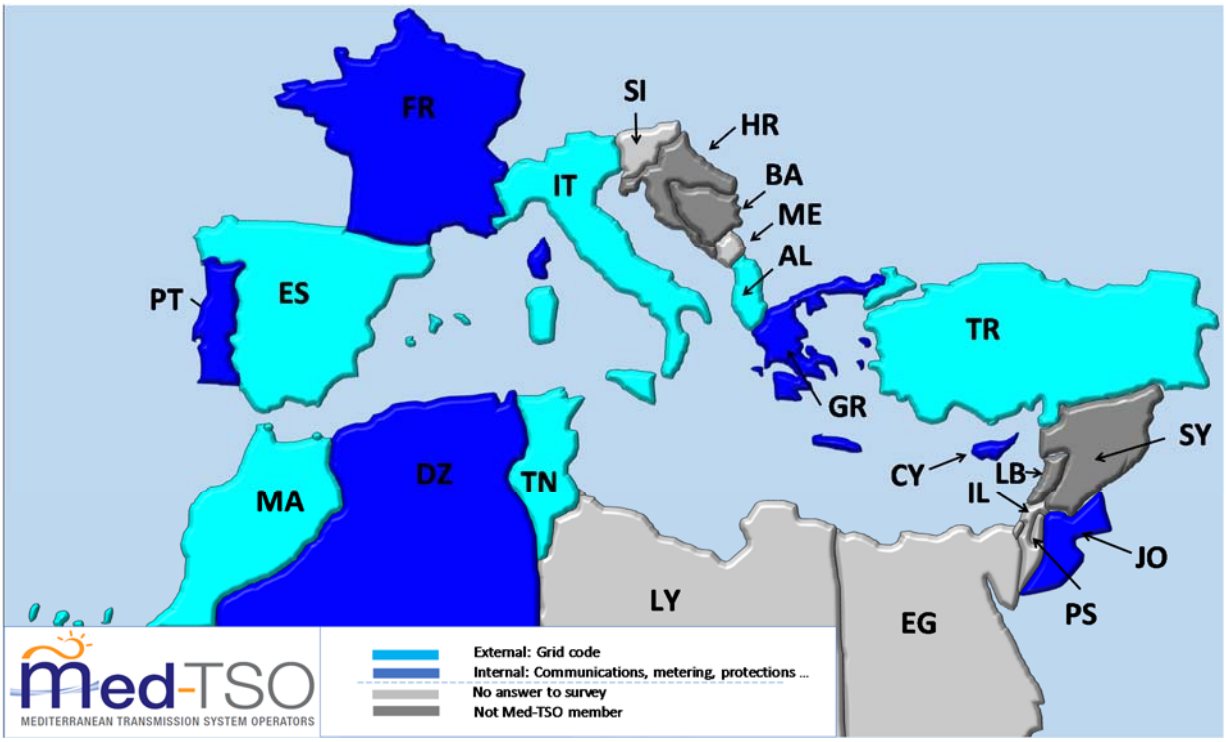


Figure 13. Technical requirements for connection contracts by country, showing the contrast between external regulation and internal/own requirements.

f) Construction requirements. Although construction works are not explicitly necessary when signing a connection contracts, many TSOs include requirements dealing with this issue. These requirements include in general a construction project specifying the costs, time schedule of the works and the ownership and identification of responsibilities. Other TSOs require a lower level of detail regarding construction issues, or even none at all.

Figure 14 shows which Med-TSO members require a full construction project as part of the connection process. Specific guidelines on construction requirements for connection contracts can be found on chapter 3.2.3.8.

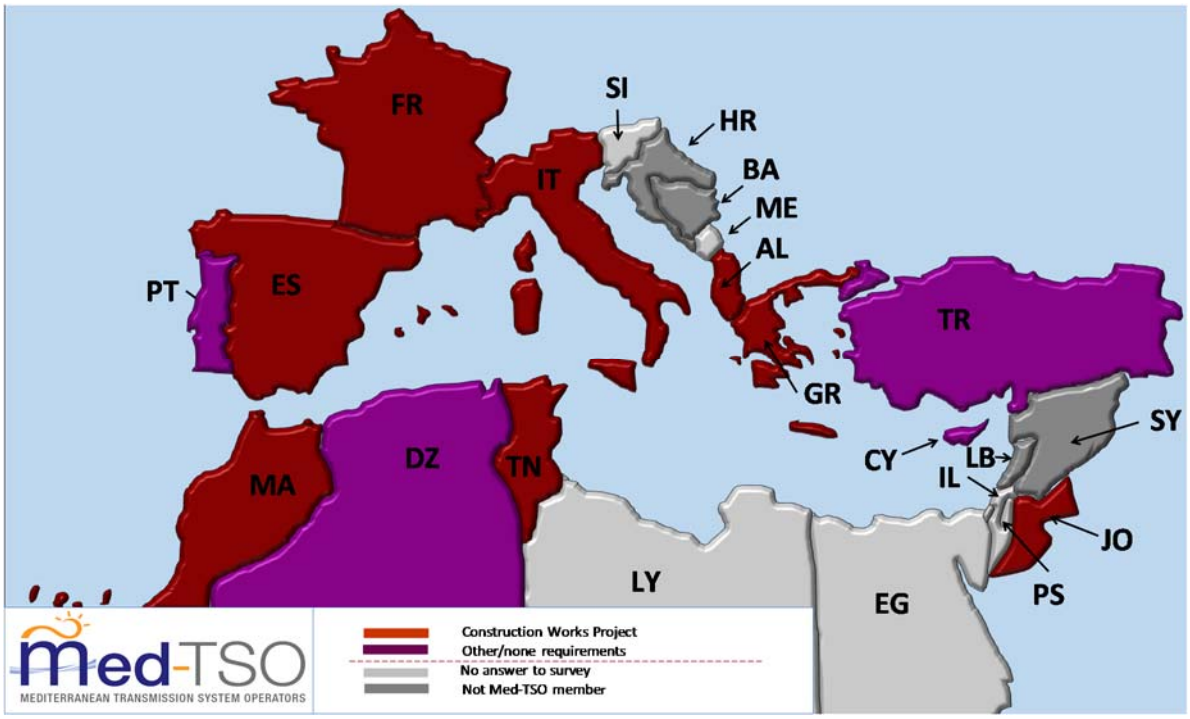


Figure 14. Construction requirements for connection contracts by country, showing the countries that require a full construction project.

3.2. Guidelines and contents for a Connection Contract

In the following chapters the guidelines about the main contents to be included in the Model for a Connection Contract between TSO and user to connect to the transmission grid are presented and detailed. This model contract considered topics like parties identification, detail of facilities to be connected, access and connection permits, determination of the connections point and connection solution, detail information from the connection, technical requirements, construction aspects and dispute resolution, among others.

In particular the Contract is divided in 3 general sections:

- Parties identification;
- Expositive (whereas);
- Agreement clauses.

In Annex A the proposal of Model of Connection Contract between TSO-User with the concrete wording is included. This model includes all the chapters and subchapters that are presented below. The proposal included could be divided into several subcontracts, in a sequential way for the different phases until the commissioning and commercial operation of the facility.

3.2.1. Parties identification (legal representatives)

In this section information about the legal representatives of all parties signing the contract is included. Typically, two sides are identified: on the one hand information of the TSO as owner of the connection point; on the other hand information of the user as owner of the non-transmission facility.

In addition the location of the connection point between transmission facilities and non-transmission facilities should be also stated in this section.

This information is needed in order to identify the legal representatives of the companies signing the contract and to avoid misunderstanding regarding the exact location (connection point) the contract refers to.

3.2.2. Expositive (whereas)

3.2.2.1. Detail of facilities to be connected

In this section basic technical features of the non-transmission facility should be included, at least:

- Type of installation (either generation, distribution - when applicable - or consumption). In general, based on the results of the survey, connection contracts with distribution facilities are not needed in the Mediterranean region so the model proposed will concentrate in contracts with generation and consumption facilities.
- Rated power.
- Voltage level.
- Detail of the installations within the user non-transmission facility, if needed.

Where applicable, the status of the administrative authorizations needed for the non-transmission facility should be detailed in this section mentioning the date and reference of each of them. In case different authorizations are needed for the different installations within the non-transmission facility it should be clearly specified.

All this information needs to be included in the contract in order to detail as much as possible the facility to be connected to the grid. In addition, administrative authorizations of the non-transmission facility could be a precondition for signing the connection contract and should also be included.

3.2.2.2. Summary of access and connection permits

In this section the detail of the access (when applicable) and connection permits obtained for the non-transmission facility should be included. This detail should include dates of the applications and also of the permits. In case different permits are needed it should be clearly specified as well.

The studies that have been required for obtaining the access and connection permits should cover, at least, the following:

- Load flow studies: Main requirements to perform these studies, and definition of who has performed the studies, TSOs or users, and which data the users have provided to the TSOs. In general N and N-1 criteria should be considered (N-2 in some particular cases too).
- Short-circuit analyses/studies: Main requirements to perform these studies. In general only if the facility can affect the short-circuit level, or if it can create some possible impact at the power quality.

- Transient stability studies: Main requirements to perform these studies. In general only in a situation where the impact of the new facility may induce possible stability problems, especially in presence of large power plants or aggregation of several small power plants (taking into account the connection voltage level, the power plant scheme connection to the grid and the power of the non-transmission facility).
- Simulation models: Specification of the simulation models provided by the non-transmission facility which properly reflect its behaviour in both steady- state and dynamic simulations (50 Hz component) or in electromagnetic transient simulations. The contract shall specify that the owner of the non-transmission facility ensures the models provided have been verified against the results of compliance tests defined.
- Other studies when needed by national regulation.

All this information needs to be included in the contract as it is, in many cases, a precondition for signing the contract and also requested by national regulation. In addition main technical conditions are established.

3.2.3. Agreement clauses

3.2.3.1. Introductory clause

This section should clearly detail the purpose of the contract which is establishing the conditions for the connection of the non-transmission facility to the grid in the connection point detailed in the contract and complying with the requirements established in the applicable national and international regulation. In addition it should be stated that the non-transmission facility owner accepts the conditions of the contract.

Is should be also specified that the contract does not give the owner of the non-transmission facility any capacity priority or any guarantee that their production (in case of a generation facility) could be evacuated.

3.2.3.2. Determination of the connection point and connection solution

In this section detailed information from the connection point should be included, with single-line diagrams as an annex. In addition the Model of TSO-User contract for connection should clearly define the connection point and the connection solution, defining the transmission grid node (included the bay of the substation and its topology), the voltage level and the user (power plant) scheme connection to the grid. Regarding the potential schemes for connections to the grid, some possibilities are included as examples (non-exhaustive list and additional schemes could also be considered):

- **Scheme 1 – Interconnection through a dedicated EHV line in the Transmission Network**

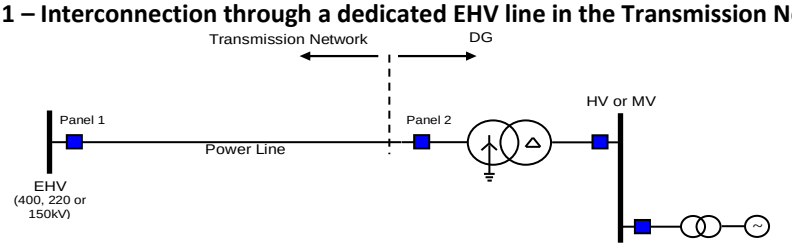


Figure 15. Interconnection through a dedicated EHV line in the Transmission Network (typical scheme)

NOTE: This scheme is the most frequently used in the 400, 220 and 150kV voltage levels of the Transmission Network.

- **Scheme 2 – Tap connection to two ends of the EHV line in the Transmission Network**

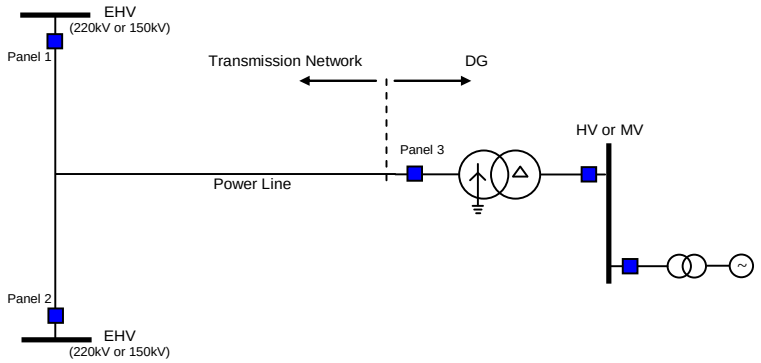


Figure 16. Tap connection to two ends of the EHV line in the Transmission Network (non-typical scheme)

NOTE: This scheme is used in the Transmission Networks of some TSOs (400, 220 and 150kV), but it is not a typical scheme for connection of Users (power plants and consumers).

- **Scheme 3 – Interconnection through a dedicated HV line in the Transmission Network**

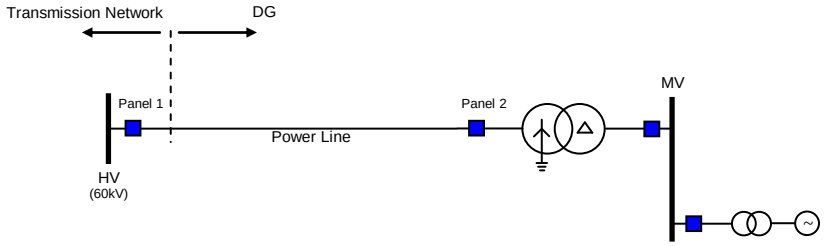


Figure 17. Connection to dedicated HV line in Transmission Network (typical scheme)

NOTE: This scheme is the most frequently used in the 60kV voltage level.

3.2.3.3. Duration of the contract / agreement

In this section the duration of the contract should be included. In general an unlimited duration could be considered although in some case a limited duration could be established based on the life cycle of the non-transmission facility. (The unlimited duration could be specified as *tacit renewal*, as follows: A limited number of years but renewed for the same duration in case there are no changes in the connection point and conditions or none of the parties express interest in making changes to it).

In this section it should be also noted that before the commissioning of the non-transmission facility an operation agreement or procedure should be signed between the TSO and the owner of the non-transmission facility in order to establish the operational conditions and all duties of each party during the lifetime of the project.

In case of sequential contracts the duration of each contract could be limited and a precondition for entering into force or even signature of the next one.

3.2.3.4. Technical requirements

This section should clearly detail the technical requirements that Users should comply with. In general, these requirements are specified in the Grid Code / Regulation, apart from situations not clearly defined in the regulation (only defined in general terms) that should be considered in the contract. Therefore, in the contract a reference to the Grid Code / Regulation should be included or, when needed, the detail (specific figures for each case) of each technical requirement.

Anyway, the contract should list the minimum requirements the non-transmission facility should comply with, namely the following:

1. Frequency requirements
    a) Frequency/time range limits for users to withstand without damage
    b) Rate of change of frequency withstand capability
    c) Limited frequency sensitive mode – overfrequency and underfrequency schemes
2. Voltage requirements
    a) Voltage/time range limits for users to withstand without damage
    b) Fault ride through capability of Power Plant
    c) Insulation requirements for Transformers, Lines and underground cables
3. Limits of reactive power contribution and Voltage control mode
    The contract specifies the reactive power requirements for users, namely the limits of reactive power contribution, the reactive power automatically provided by either voltage control mode, reactive power control mode or power factor control mode, etc. or refer to the Grid Code where values and these specifications are expressed.
4. Short circuit levels/requirements
    The contract specifies the short circuit current limits for users' equipment (substation's equipment, circuit breakers, high voltage transmission lines/cables, etc.), according to the standard values of the TSO for the connection point or refer to the Grid Code where the values and specifications are expressed.
5. Protection requirements
    The contract specifies the technical requirements for protection and control for the users, namely related with the high voltage lines/cables between the users and TSOs, or refer to the Grid Code where the values and specifications are expressed.
6. Power quality
    The contract should specify the power quality standards and requirements for users, namely the limits of harmonic distortion, flicker, etc., or refer to the Grid Code where the values and specifications are expressed.
7. Metering
    The contract should specify the metering standards and requirements for users, or refer to the Grid Code or specific Metering Grid Code (rules) where the requirements/specifications are expressed.

3.2.3.5. Maximum power

In this section, the simultaneous admissible maximum power in the related transmission substation should be specified. In addition, other limitations regarding the maximum power due to short-circuit analysis or other potential

restrictions (e.g.: limitation of power injection defined in the installation license assigned by the competent authority) should also be included.

For this aim, references to the specific studies performed by the TSO (and that are included as an annex to the contract, as for example the report of the viability of the connection conditions included in the access and connection permits) could be done.

According to the conditions established in the applicable Grid Code and depending on the operation conditions, the TSO may have the right to disconnect the user.

3.2.3.6. Information exchange requirements

This section should clearly detail the information exchange requirements between the users and TSOs, namely the following:

a. Telecommunication requirements

The contract specifies the technical requirements for telecommunication between TSOs and users, namely related with the connection to the security telecommunications network. Therefore, in this topic the contract specifies the technical requirements of the telecommunications infrastructures, systems and services required for the interconnection of users to the grid, through to the security telecommunications network. This information may also be included as annex to the contract as a specific technical requirement.

b. Control requirements and connection to the TSO SCADA

The contract should specify the technical control requirements between TSOs and Users, namely the technical requirements for connection with the SCADA TSOs, such as:

- Global architecture and schemes required for controllability and observability of non-transmission facilities connected to the transmission grid.
- Observability of non-transmission facilities by TSO control systems (real time monitoring).
- Magnitudes provided in real time from non-transmission facilities to TSO control centre.
- Controllability of non-transmission facilities by TSO control systems.
- Characteristics required for the communication system.

This information may also be included as annex to the contract as a specific technical requirement.

In general, these requirements presented above, should be included directly in the contract (as well as, in specific technical requirement), or refer to the Grid Code / Regulation where these requirements are specified.

3.2.3.7. TSO commitment for construction of the transmission facilities

This section should detail all the procedures that the users need to comply and agree with the TSOs, related to the permitting and authorizing of the transmission facilities. Therefore, this section needs to specify the equipment life cycle management of the connection infrastructures, the interface between TSO and Users and the ownership of the assets.

This section should specify the entity responsible for the maintenance of this type of equipment which shall promote the appropriate remodelling, without refusal and in its exclusive charge, if this occurs after the depreciation period of the equipment (the depreciation period can be explicit in the contract too).

When applicable (if the contract is signed before the TSO obtains the administrative authorizations), this section should express that there is a precondition for the contract to enter into force: obtainment of the TSO of the administrative authorizations in order to be able to build the transmission facilities. Or, in other words, as long as the TSO does not obtain the corresponding licenses, the execution time will be suspended.

3.2.3.8. Construction aspects of connection facilities

The connection works on the transmission grid will be carried out by the TSO and under its responsibility. These works will be made according to the state of the art and in accordance with the prescriptions, safety decrees and rules of the relevant authority.

The connection schedule should also be established for the works, including the commissioning date. A provisional schedule of the connection construction can be attached.
This date is only indicative, being the final date of availability of the works subject to various hazards, including those listed below:

- Completion of the amicable and administrative procedures. [TSO] will in no way be held responsible for the risks that may affect the time required to complete these procedures (deadlines for obtaining routing agreements and administrative authorizations, contentious appeals, etc.);
- Interruptions attributable to [User], including those caused by late payments;
- Interruptions for force majeure or fortuitous event;
- Additional work requested by [User] or imposed by the administration;
- Programming of the works necessary for the construction of connection works;
- Transmission Grid operating requirements;
- Bad weather, soil quality, discovery of elements of heritage or archaeological interest;
- Modification of the regulations imposing additional constraints for the construction of connection works.

A list of the administrative procedures yet achieved, and their date of achievement can be included in this section as well.

Financial and legal conditions (total costs, payment conditions, completion deadline, conditions for cancellation, etc.), regarding construction, should also be included in the contract. Anyway they are not included in the model as it is not the scope of the document.

3.2.3.9. Conditions for coordinated maintenance

This chapter provides description of the main issues that are identified as relevant for the coordination of maintenance and system tests required on the interface equipment (line, generation and station) as follows:

- Maintenance of any equipment such as line, generation and station equipment comprising the interface shall be coordinated so that undue burdens are not placed on one side by the other. Planned outages shall be mutually scheduled to maintain a high degree of reliability between both parties and to ensure that contractual deliveries of power and energy are met with the least inconvenience and cost to parties.

- In addition to the equipment comprising the interface, maintenance outages of other lines, generation and station equipment that change the operating security of either side or affect the contractual deliveries of power and energy, shall be scheduled by one side with sufficient advance notice to the other so as to allow both parties time to consider the implications and / or to reschedule power deliveries.
- System tests on one side that could affect the security of the other or that could affect the contractual deliveries of power and energy shall be conducted at a time of least inconvenience to both parties, to the extent possible.
- The relevant sections of the parties must mutually agree on system tests and preventive maintenance, which could affect the security of the systems of both parties (breaker switching, unit islanding, load shedding etc.).

Anyway, detailed information about the required coordination for maintenance should be included in the operation protocol to be signed between the non-transmission facility owner and the TSO before the commissioning of the facility.

3.2.3.10. Conditions for temporary suspension or restricted operation

This chapter provides the conditions under which the connection of the non-transmission facility could be temporary suspended. If the user violations are such as to seriously compromise the continuity and safety of the electrical service, the TSO may, on a precautionary basis, have the faculty of suspending, without notice, the connection service or ordering provisional adoption of measures to safeguard the continuity of service.

3.2.3.11. Conditions for withdrawal

This chapter provides the conditions under which the TSO is entitled to terminate the contract. This provision occurs in case of User's behaviours that can compromise the possibility of continuity of the contract at the same conditions, since they refer to the failure to perform essential provisions of the contract (i.e. payments, loss of requirements for accessing and connecting to the grid…)

3.2.3.12. Dispute resolution

In this chapter how to manage dispute resolution between the 2 parties signing the contract should be included. Typically 3 levels are provided:

- In general, the Parties shall in best effort try to reach an amicable settlement.
- If no such amicable settlement can be reached the Dispute shall be brought to the NRAs conciliation.
- In the event that NRAs fail to achieve conciliation, the disputing Party(ies) may submit its/their dispute to arbitration under the ICC Rules of Arbitration.

3.2.3.13. Transfer of the contract

This chapter describes the conditions under which the transfer of the contract of the non-transmission facility to another owner is permitted. In general, it is allowed, by a written permission from TSO which may not be unreasonably denied, the total or partial transfer of the present Contract/Agreement to subjects who have the same requirements as the User. This provision allows the commercial continuity of the contract in particular cases, at the same time ensuring that the new user has the same requirements as the former one.

4. Model of TSO-TSO Contract

This chapter presents the guidelines for the elaboration of a proposal for a model of a contract between TSOs to be implemented in the Mediterranean Area. It is based on the results of Subtask 1.2 on "Proposal of Common Regulatory Framework in the Mediterranean" and also on the information of an ad-hoc survey about the current situation in the region, regarding the TSO-TSO contracts or agreements currently under use. The proposal focuses on **operation aspects**, which have been classified as priority in terms of coordination between TSOs.

4.1. Methodology

In order to define a standard model for TSO-TSO contracts, first a survey (template in Annex E) was developed with the main objective of knowing the current situation of such contracts within the Med-TSO region. Focusing on the existing interconnections, several contract categories were identified to which each TSO had to classify and explain the contracts used nowadays between adjacent TSOs. The answers are analysed so that guidelines towards standard operation contracts can be drawn.

Table 4 shows a summary of the received answers. All participating TSOs declared the existing TSO-TSO contracts in their case, detailing the other signing party for each contract. When necessary, additional information was provided regarding special cases or availability/implementation. Those issues that are considered of interest to be included in the TSO-TSO contracts are highlighted in Table 4.

The following subchapters describe the answers received by means of relational arrows, that can be:

- Two-way: In case answers from both TSOs matched.
- One-way: If only one of the TSOs answered to the specific issue. TSOs not taking part on the survey might still have contracts with other TSOs.

In the case of PETL (Palestine), most TSO-TSO contracts proposed are expected to be included in a long term agreement with IEC (Israel), who is the actual provider of electricity services. Cyprus, on the other hand, has declared no TSO-TSO contracts due to lacking interconnections with adjacent countries.

TSO-TSO Contracts/Agreements		NEPCO	PETL	TEIAS	CYP TSO	IPTO	GECOL	CGES	STEG	TERNA	RTE	SONELGAZ	ONEE	REN	REE
		Jordan	Palestine	Turkey	Cyprus	Greece	Libya	Montenegro	Tunisia	Italy	France	Algeria	Morocco	Portugal	Spain
		28/09/2017	22/10/2017	11/08/2017	28/08/2017	25/08/2017	31/08/2017	21/11/2017	22/09/2017	03/08/2017	20/09/2017	13/08/2017	29/08/2017	10/08/2017	20/07/2017
C1	**CAPACITY CALCULATION**	x	Long-term agreement with IEC under negotation (will not cover all the issues)	x	No interconnections so no agreements with other TSOs	x[1]	x	x	x	x[1]	x[1]	x	x	x	x
C2	**OUTAGE SCHEDULING**	x		x		x[2]		x	x[1]	x	x	x	x	x	x
C3	**INFORMATION EXCHANGE & INTERCONNECTION CHARACTERISTICS**	x		x		x	x	x	x	x	x	x	x	x	x
C4	BALANCING					[3]		x		[2]	x			x	x[1]
C5	**MUTUAL SUPPORT (INCLUDING DEFENSE PLAN)**	x		x		x			x[1]	x[3]	x	x	x	x	x
C6	**UNINTENTIONAL DEVIATIONS**	x		x		x		x	x[1]	x	x	x	x	x	x
C7	MARKET COUPLING									x[4]	x			x	x[1]
C8	**COORDINATED MANAGEMENT & SYNCHRONOUS OPERATION**	x				x[4]		x	x[1]	x[5]	x[2]	x	x	x[1]	x[2]
C9	CAPACITY ALLOCATION			x		x		x		x	x				x[3]
C10	TRANSPARENCY			x		x				x	x		x[1]	x	x[4]
CLARIFICATIONS				Two contracts: one for synchronous interconnection (Greece and Bulgaria) and another with asynchronous (Georgia)		[1] All borders except Italy and Serbia [2] All borders except Serbia [3] No agreements nowadays but will be in place in the near future due to the implement. of the European Electricity Balancing Guidelines [4] In the field of ENTSO-E, under the Operational Handbook (or later agreements that substitute it)			[1] With Ageria, not with Libya	[1] All borders except Greece [2] No agreements nowadays but will be in place in the near future due to the implement. of the European EB Guidelines. [3] All borders except Austria [4] Al borders except Greece & Switzerland [5] In the field of ENTSO-E, under the Operational Handbook (or later agreements that substitute it)	[1] Flow Based Methodology applied within CWE (FR-DE-BE-NL) Area [2] In the field of ENTSO-E, under the Operational Handbook (or later agreements that substitute it)		[1] Only with Spain in the field of IESOE	[1] In the field of ENTSO-E, under the Operational Handbook (or later agreements that substitute it)	[1] All borders except Morocco [2] Specific with Morocco; In the field of ENTSO-E with Portugal and France, under the Operational Handbook (or later agreements that substitute it) [3] Only with France [4] In the field of ENTSOE with Portugal and France; and of IESOE with all

Table 4. Summary of existing TSO-TSO contracts/agreements between Med-TSO members and their connected neighbours.

C1-CAPACITY CALCULATION

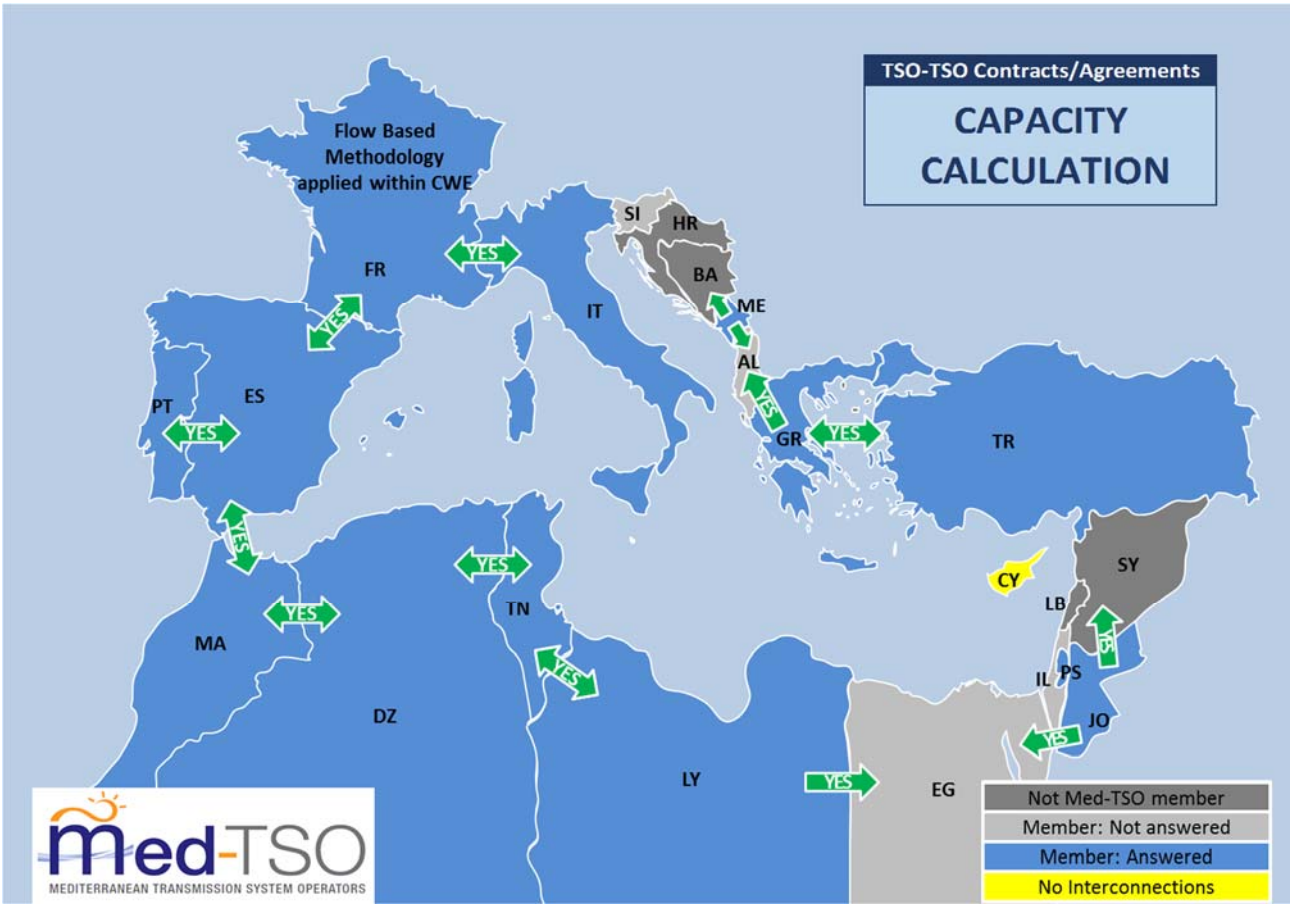


Figure 18. Map for capacity calculation contracts among Med-TSO members.

Capacity calculation contracts between TSOs establish the rules and procedures for determining the comercial capacity of the interconnection, thus allowing for accurate and coordinated exchange of energy.

In the Western and Central regions all TSOs calculate the exchange capacity with their connected neighbours. EU members need to fulfill additional legislation due to the enter into force of the European Network Codes and Guidelines. France for instance has a calculation methodology (Flow Based methodology) agreed with other Central European TSOs to deal with the high degree of meshing between neighbouring countries. In the near future capacity calculation will be performed by the Regional Security Coordinators (RSC), as CORESO in Central-Western Europe (applying to France, Portugal, Italy and Spain in the framework of Med-TSO) or SEE CAO in the Balkans region (applying to Montenegro, Albania, Greece and Turkey in the framework of Med-TSO). Within SEE CAO not only capacity calculation but also capacity allocation will be performed (in this case through the DAMAS platform).

In the case of the interconnection between Greece and Italy, both TSOs declared not having a capacity calculation contract for their DC interconnection, while they do have contracts for the calculation with other neighbours. In the Eastern region NEPCO (Jordan) and GECOL (Libya) declared having capacity calculation contracts with Syria and Egypt (in the case of Jordan) and Egypt (in the case of Libya).

Specific guidelines for capacity calculation can be found in chapter 4.2.3.4.

C2-OUTAGE SCHEDULING

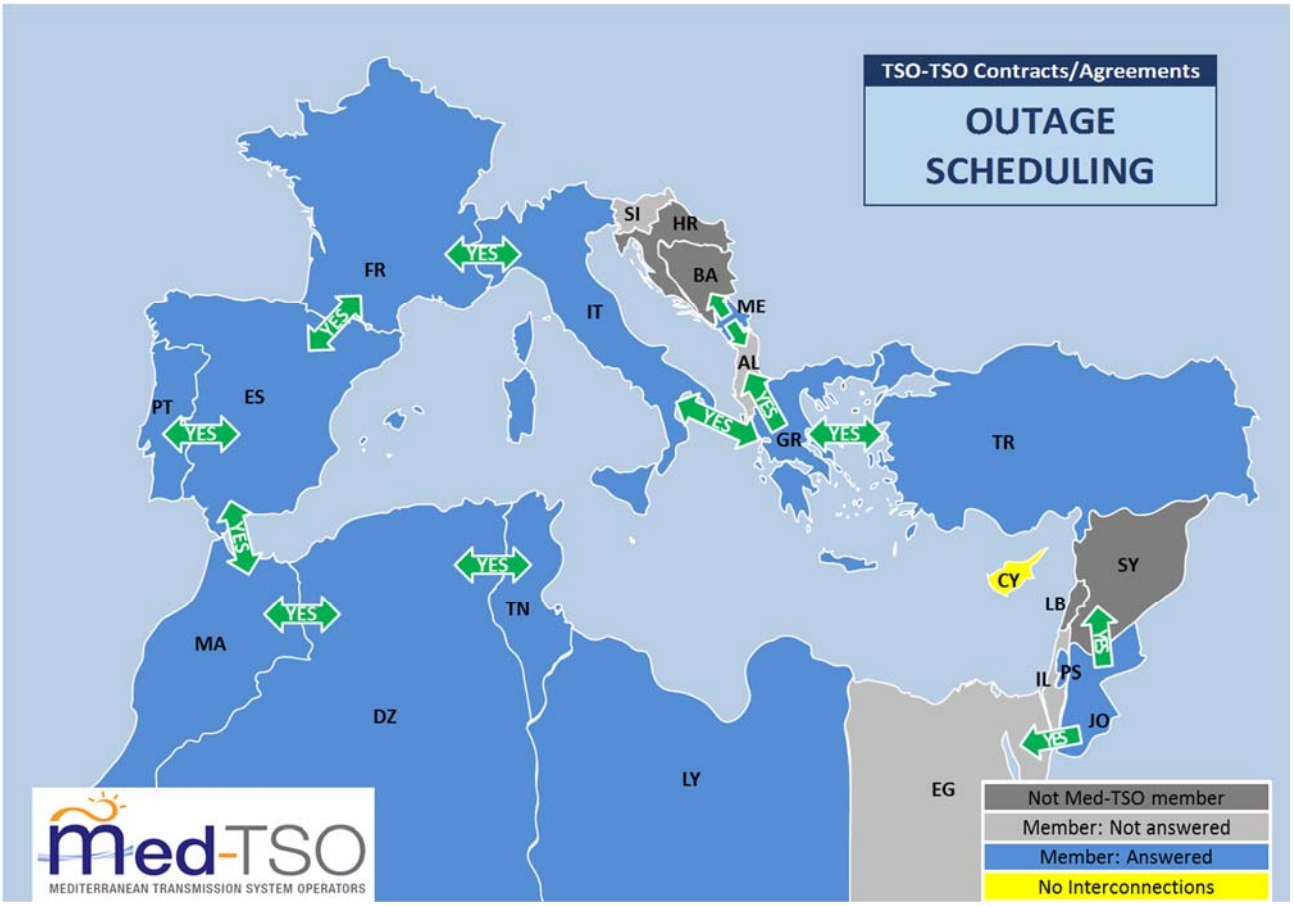


Figure 19. Map for outage scheduling contracts among Med-TSO members.

Contracts for outage scheduling rule the foreseeable or planned (for maintenance purposes for instance) outages of the interconnection facility between two countries. This is soon to be performed at a regional level within European countries in the field of RSC's functions.

Apart from European TSOs (including Turkey), countries in the Maghreb area (Morocco, Algeria and Tunisia) have signed clauses/agreements for the scheduling of outages. This does not extend however to the Tunisia-Lybia interconnection. In the Eastern region NEPCO (Jordan) declared having contracts with Syria and Egypt.

Specific guidelines for outage scheduling can be found in chapter 4.2.3.5.

C3-INFORMATION EXCHANGE & INTERCONNECTION CHARACTERISTICS

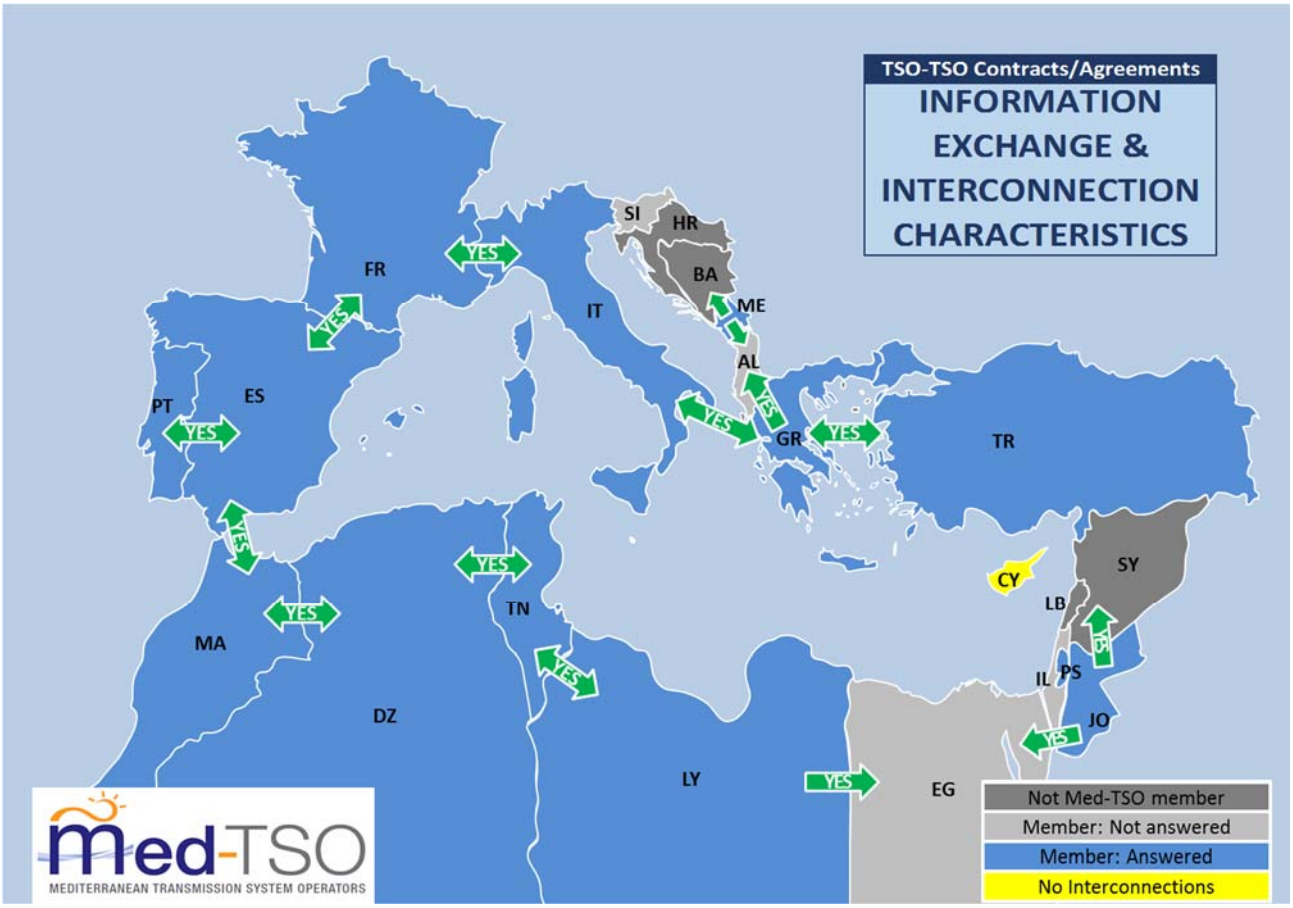


Figure 20. Map for information exchange & interconnection characteristics contracts among Med-TSO members.

Information exchange contracts define the interconnection data and characteristics to be shared between TSOs. As can be understood from Figure 20, information exchange contracts between neighbouring TSOs are applicable for all interconnections within the Med-TSO area. The contents and main aspects of each contract may differ in each case, influenced by regional coordination rules.

Furthermore, although it was not subject of the survey, most TSOs do exchange information with other non-adjacent operators in the field of TSOs associations (such as ENTSO-E or IESOE).

Specific guidelines for information exchange can be found in chapter 4.2.3.2.

C4-BALANCING

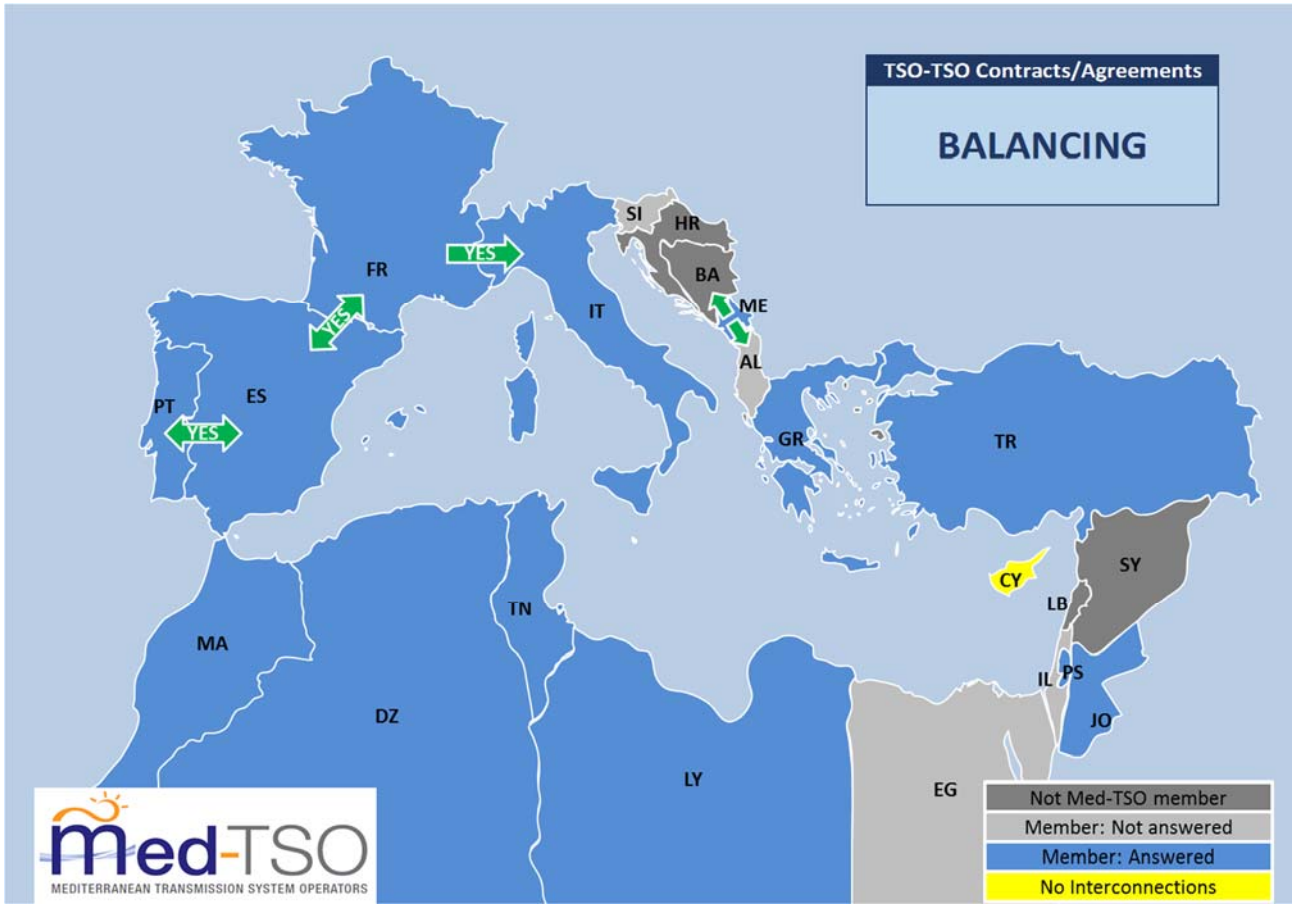


Figure 21. Map for balancing contracts among Med-TSO members.

Adjacent countries may contract foreign reserves for their own balancing of the generation-demand equilibrium. Few Med-TSO members declared having balancing contracts, most due to being members of ENTSO-E, where such practice is under development nowadays and will be in practice in all European countries in the near future. Balancing contracts between European countries will be substituted by the agreements of future projects for the implementation of European balancing platforms (e.g. TERRE project). For other south European countries such as Italy and Greece, no balancing contract exists nowadays, although European Electricity Balancing guidelines are soon to be implemented.

Even though REE (Spain) has contracts for electricity balancing with REN (Portugal) and RTE (France), the interconnection between Spain and Morocco does not consider a balancing contract.

C5-MUTUAL SUPPORT

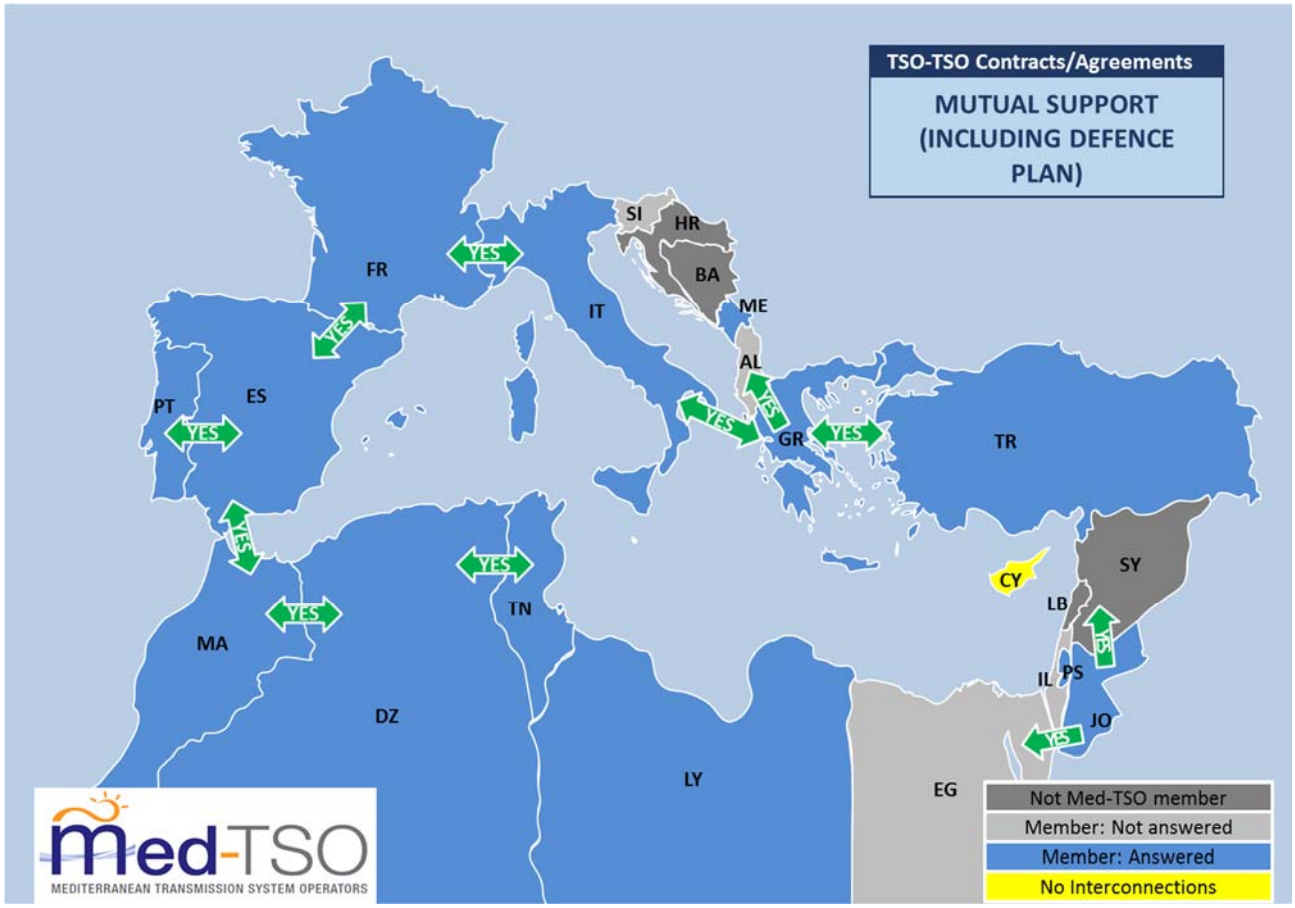


Figure 22. Map for mutual support contracts among Med-TSO members.

Mutual support contracts specify the joint procedure and all the operational aspects for a TSO to support an adjacent TSO in case of emergency events. Except for the Tunisia-Libya interconnection, all TSOs declared having mutual support contracts with their neighbouring TSOs. This is also to be performed and coordinated on a regional basis within Europe. In the case of the interconnection between France and Spain, both TSOs declared to have a restoration plan contract, which includes mutual support mechanisms.

Specific guidelines for mutual support can be found in chapter 4.2.3.6.

C6-UNINTENTIONAL DEVIATIONS

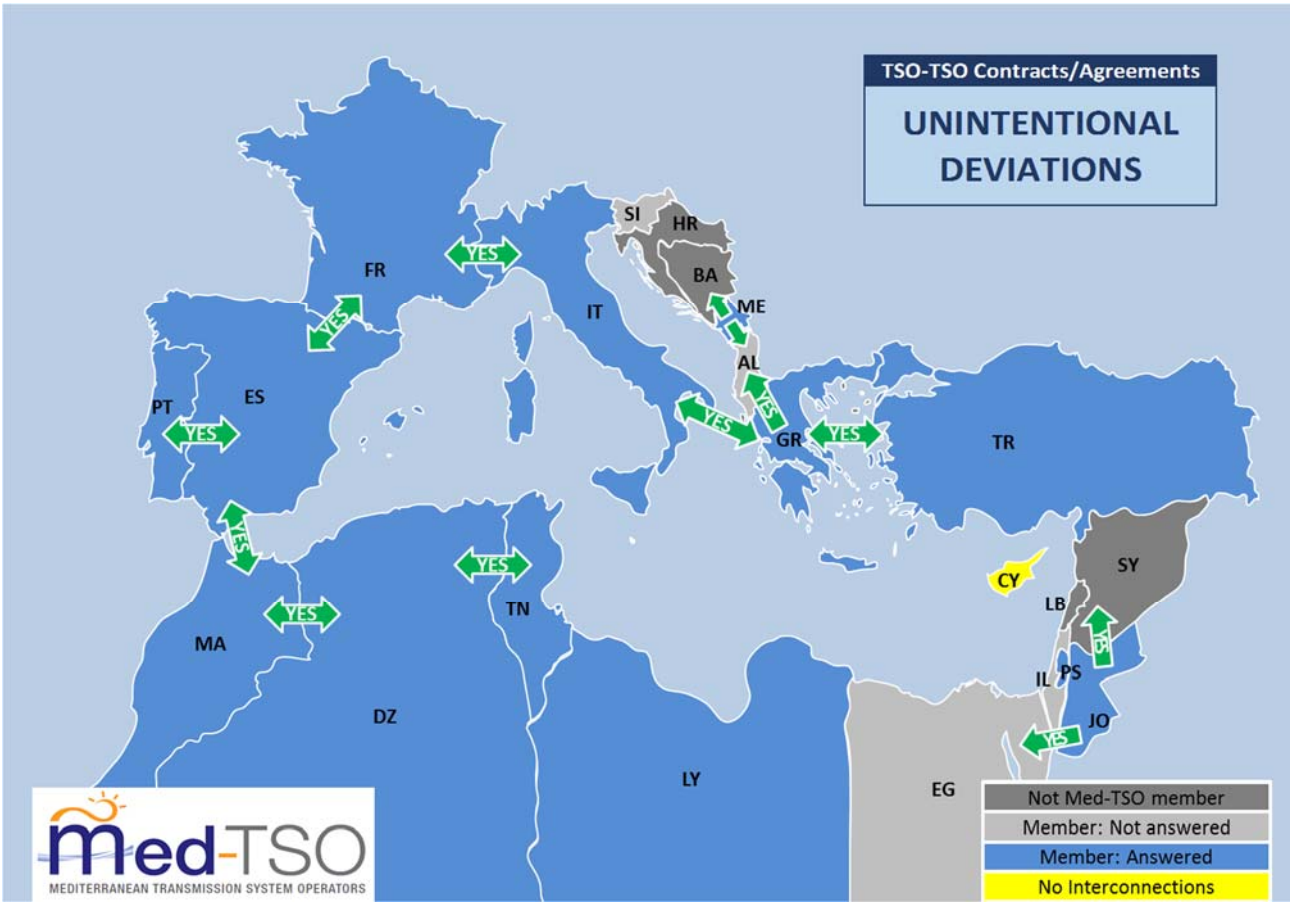


Figure 23. Map for unintentional deviations contracts among Med-TSO members.

Unintentional deviations (from the scheduled energy exchange) may take place and are to be accounted for, thus the necessity for TSO-TSO contracts dealing with such issue. Except for the STEG-GECOL (Tunisia-Libya) interconnection, all TSOs declared having unintentional deviations contracts with their neighbouring TSOs as can be observed in Figure 23.

Specific guidelines for unintentional deviations can be found in chapter 4.2.3.7.

C7-MARKET COUPLING

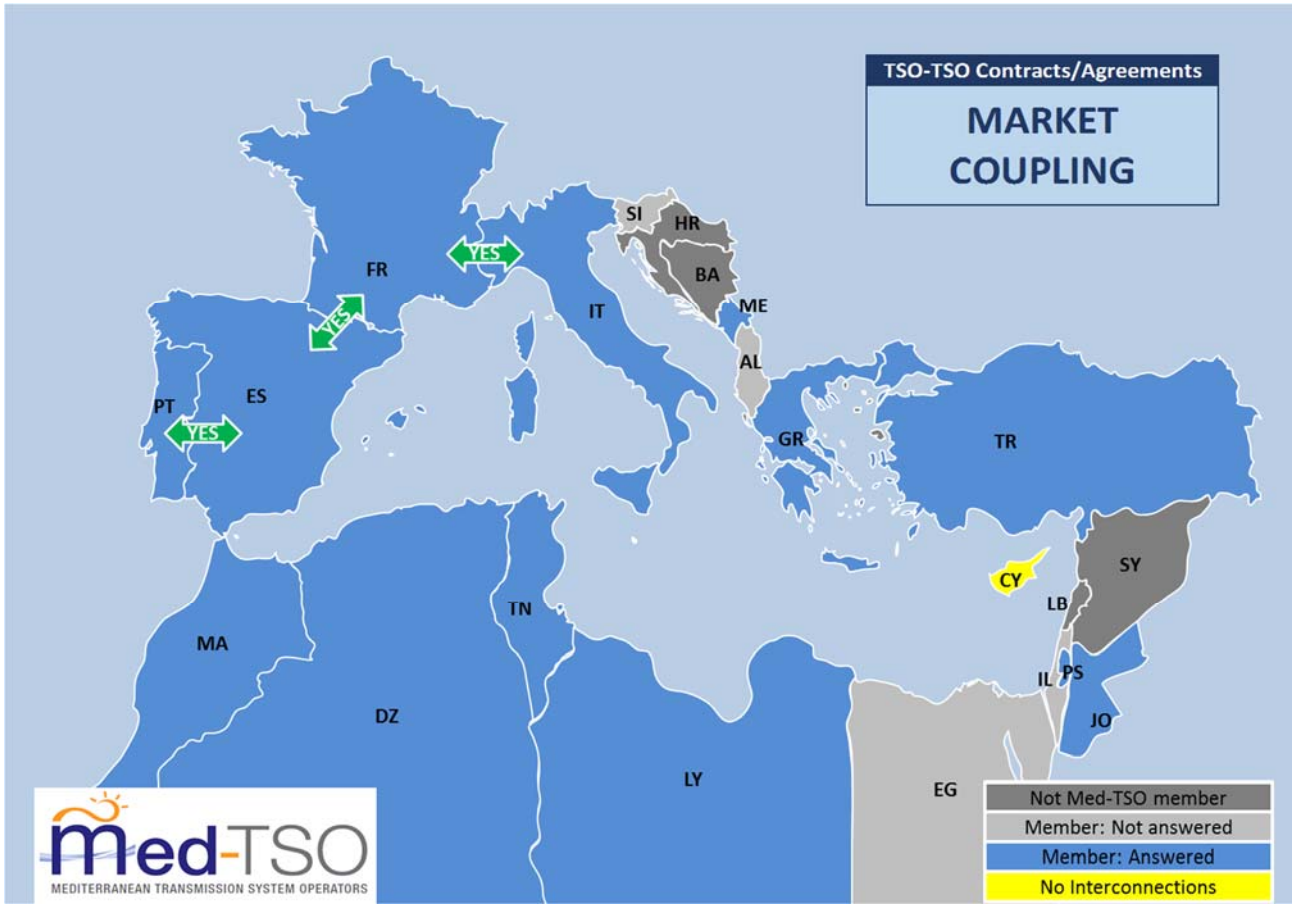


Figure 24. Map for market coupling contracts among Med-TSO members.

In the field of Med-TSO, many members do not have a wholesale electricity market. The system operator in this cases performs an economic dispatch for domestic generation. Therefore, market coupling contracts only applies among European members. The interconnection between Greece-Italy and Spain-Morocco does not allow for market coupling.

C8-COORDINATED MANAGEMENT & SYNCHRONOUS OPERATION

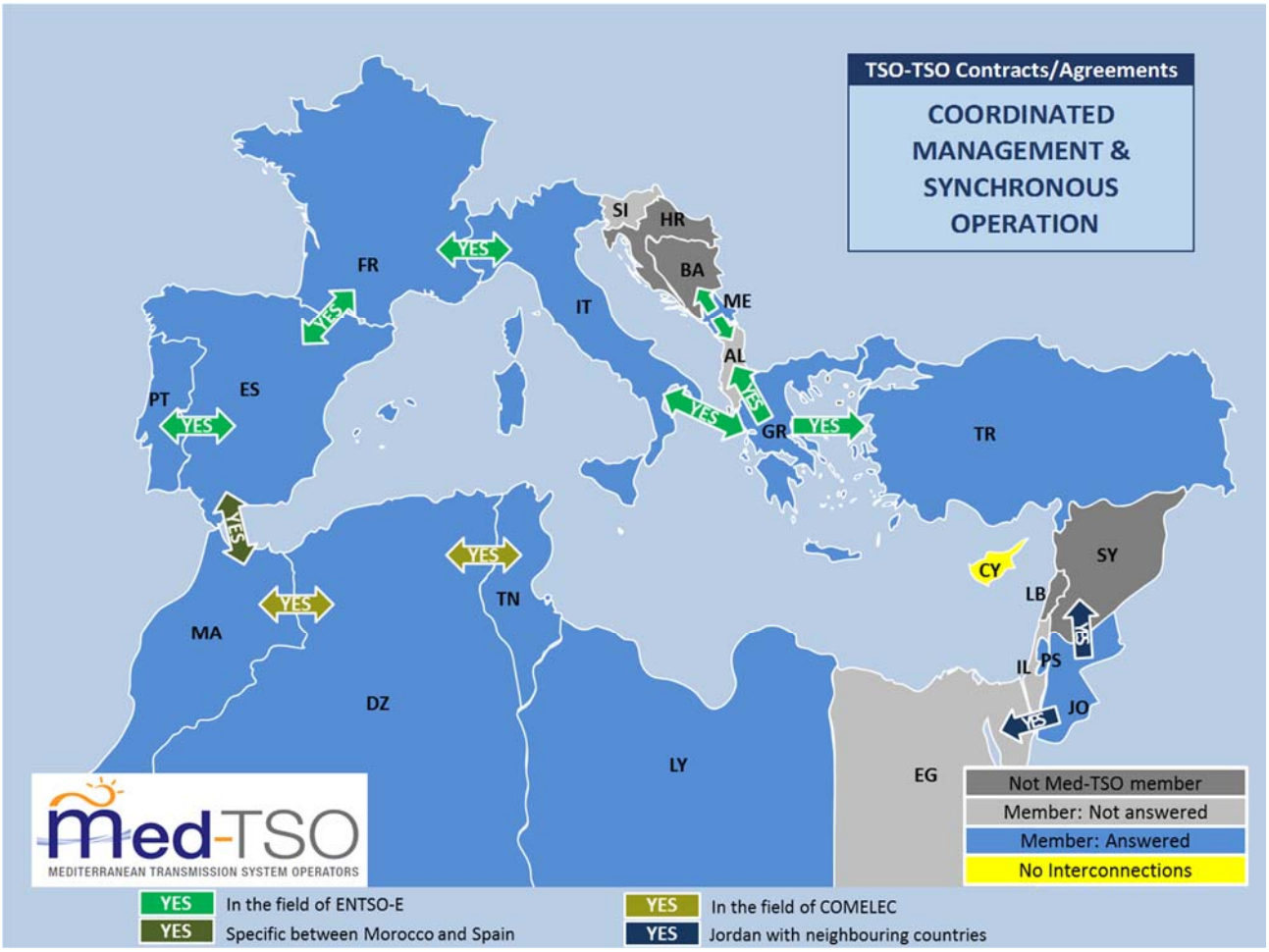


Figure 25. Map for coordinated management & synchronous operation contracts among Med-TSO members.

Coordinated management and synchronous operation contracts are signed among Med-TSO members in different conditions. For instance, such contracts are put in place for Spain-Morocco, Morocco-Algeria and Algeria-Tunisia interconnections in the field of COMELEC. Libya seems to be the only country in the Maghreb region part of COMELEC without such contract. On the other hand, though there are no dedicated contracts, coordinated management and synchronous operation are ensured in interconnections involving Portugal, Spain, France, Italy, and Greece under the ´de facto´ coordination of European Union countries part of ENTSO-E. For Turkey, in the absence of such a contract, it is not mentioned whether coordinated management and synchronous operation is guaranteed under some more general regional agreements. Jordan has declared performing coordinated management and synchronous operation of its interconnections with Egypt and Syria.

Specific guidelines for coordinated management and synchronous operation can be found in chapter 4.2.3.3.

C9-CAPACITY ALLOCATION

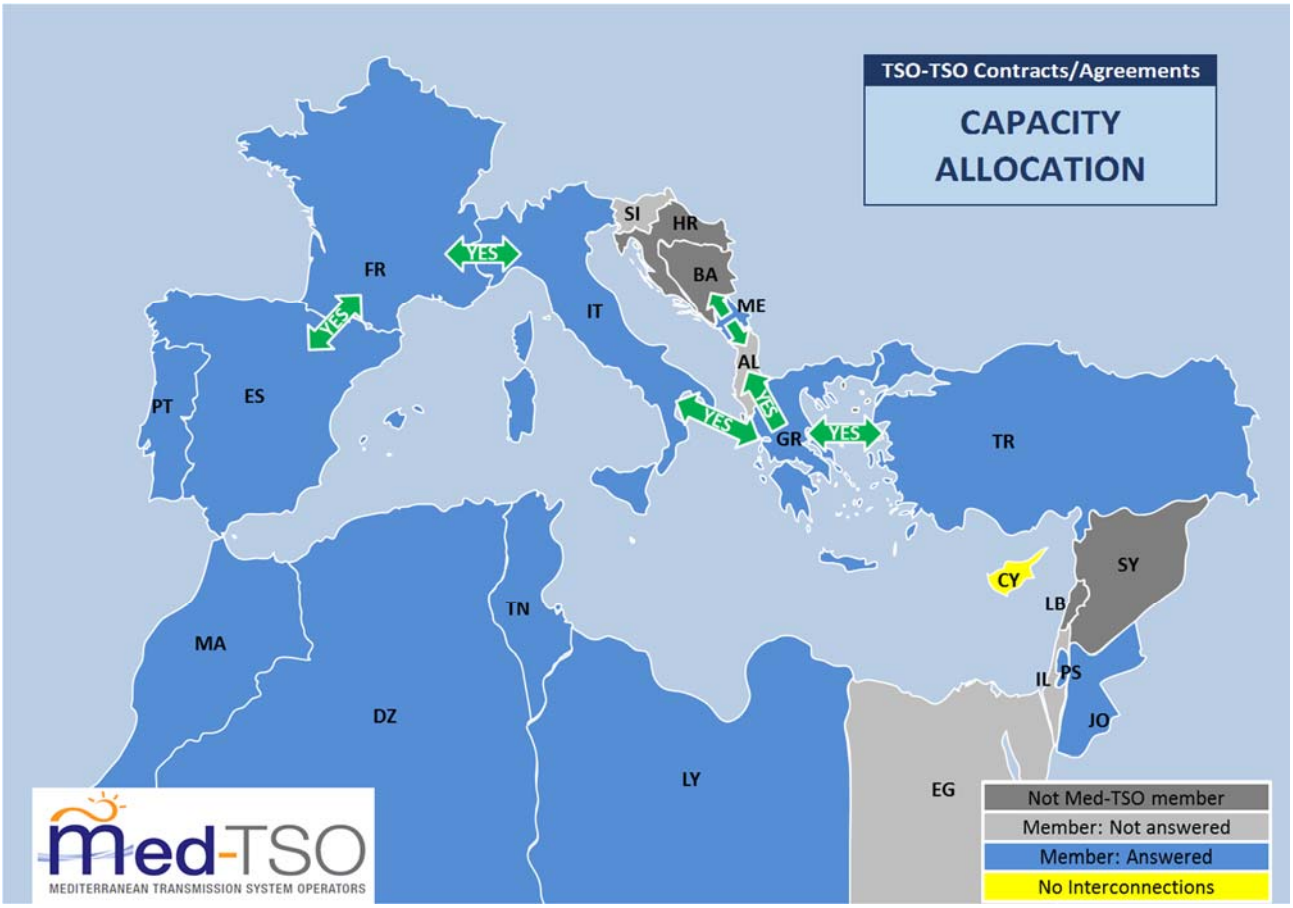


Figure 26. Map for capacity allocation contracts among Med-TSO members.

In the field of Med-TSO, few capacity allocation contracts are found, as such process is only regarded within ENTSO-E members under the JAO (Joint Allocation Office) Platform. In the case of the France-Spain interconnection, this contract does not include daily or intraday allocation, only long-term and shadow allocation process. Countries belonging to the SEE CAO organization perform capacity allocation of their interconnections.

C10-TRANSPARENCY

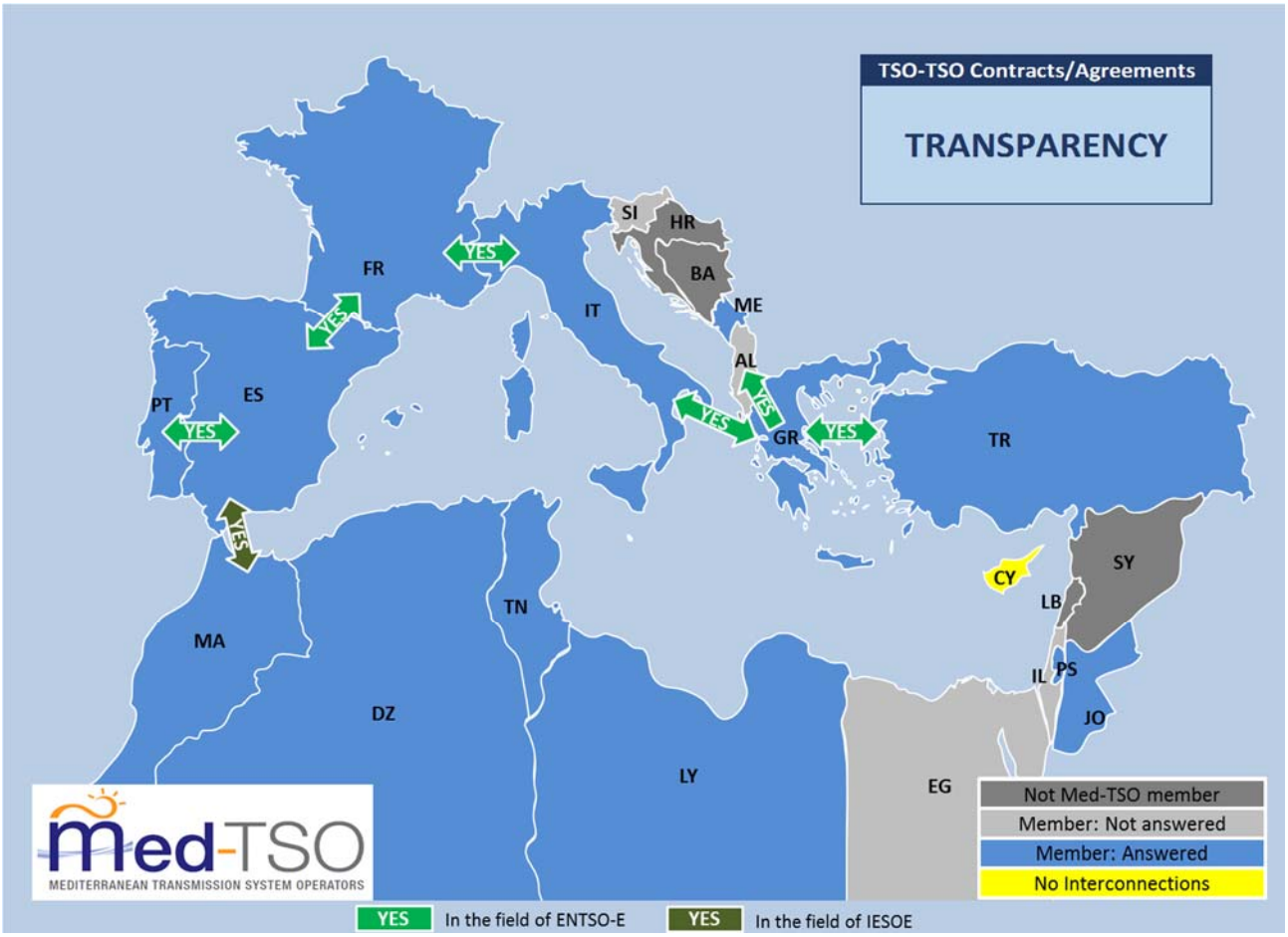


Figure 27. Map for transparency contracts among Med-TSO members.

European countries member of ENTSO-E have transparency contracts signed in order to comply with European transparency regulation. In addition, France, Morocco, Portugal and Spain have signed a contract in the field of IESOE for an information platform for transparency issues on the use of the interconnections between them.

4.2. Guidelines and contents for a TSO-TSO Operation Agreement

In the following chapters the guidelines about the main contents to be included in the Model for a TSO-TSO Operation Agreement are presented and detailed. The Agreement is divided in 3 general sections:

- Parties identification.
- Expositive (whereas).
- Agreement clauses.

Based on results from the survey presented in the previous chapter, the Agreement clauses include 6 operation aspects that have been identified as priority, in particular:

- Information exchange and interconnection characteristics.
- Coordinated management and synchronous operation.
- Capacity calculation.
- Outage scheduling.
- Mutual support (including defence plans).
- Unintentional deviations.

One agreement should be signed for each border between 2 countries, independently on the number of interconnection lines between both countries.

In Annex B a proposal of Model of Operation Agreement between neighbouring TSOs with the concrete wording is included. This model includes all the chapters and subchapters that are presented below.

4.2.1. Parties identification (legal representatives)

In this section information about the legal representatives of all parties signing the contract is included. Typically the representatives of the 2 neighbouring TSOs including the border the agreement refers to.

This information is needed in order to identify the legal representatives of the companies signing the agreement and to avoid misunderstanding regarding the border the agreement refers to.

4.2.2. Expositive (whereas)

In this section any reference to any other multilateral agreement signed by at least one of the corresponding TSOs that could affect the aspects regulated in the bilateral agreement should be included.

In addition this section should include, when applicable and if relevant, a summary of the related background that has ended in the signature of the agreement.

4.2.3. Agreement clauses

4.2.3.1. Introductory clauses

In this section the objective of the agreement should be clearly sated, together with a brief summary of the main chapters in the framework of the agreement.

4.2.3.2. Information exchange & Interconnection characteristics

In general, all TSOs rely on bilateral contracts in order to guarantee a mutual exchange of information relating to interconnection characteristics with neighbouring TSOs as well as other grid components that have direct influence on the interconnection. In all cases, these contracts are meant to be permanent and can be reviewed at the request of one of the TSOs involved in the contract. Some contracts are reviewed systematically at a fixed frequency.

As to the nature of the information exchanged, all TSOs exchange data about interconnection lines characteristics, including PATL[6] and TATL[7] and interconnection lines settings of the protection relays and other devices. It is possible to go a step further and exchange, in addition to the two pieces of information mentioned earlier, data about:

- External observability list of both TSOs, including substation, lines, transformers, power units and voltage compensation facilities;
- External contingency list of both TSOs;
- List of relevant elements;
- List of critical elements.

This information exchange is vital when it comes to maximizing electricity exchange as it enables TSOs to prepare themselves in advance and therefore to know the main characteristics of the neighbouring power system.

Considering the abovementioned, in this section of the TSO-TSO agreement the following 6 subchapters should be included:

1. Interconnection lines characteristics, including PATL (Permanent Admissible Transmission Loading) and TATL (Temporary Admissible Transmission Loading).
2. Interconnection lines settings of the protection relays and other devices.
3. External observability list of both TSOs, including substation, lines, transformers, power units and voltage compensation facilities.
4. External contingency list of both TSOs.
5. List of relevant elements.
6. List of critical elements.

[6] Permanent Admissible Transmission Loading
[7] Temporary Admissible Transmission Loading

4.2.3.3. Coordinated management & synchronous operation

In this section of the TSO-TSO agreement the following aspects should be included.

For coordinated management, these contracts emphasize information about:

- Real time information exchange including which data is to be exchanged and the periodicity of the exchange (between 4 and 12 seconds).
- Interconnection operation conditions including frequency and voltage values; and the use of reactances.
- Procedures to follow in case of tripping of the interconnection, differentiating between the types of protections.

For synchronous operation, these contracts emphasize information about:

- General conditions that establish among others that any other system wishing to connect synchronously should follow these rules and procedures.
- Power frequency regulation characteristics: primary, secondary and tertiary.
- Minimum security rules to be applied, including N-1 criteria and load shedding plans.

In general, the previous aspects could include references to other subchapters of the TSO-TSO agreement.

4.2.3.4. Capacity calculation

In this section of the TSO-TSO agreement the rules, calculation procedures and publication deadlines of the commercial capacity should be established. Also the calculation method should be established (Flow Based or Available Transfer Capacity in principle).

First of all it should be clearly defined the concept of commercial capacity, i.e. the Net Transfer Capacity (NTC). The maximum value of exchange program in MW available in certain period of time for commercial purposes is typically taken as NTC. The effective value of the interconnection's capacity finally published is the minimum of the NTCs declared by each of the TSOs.

The calculation procedure and methodology to be applied should also be determined.

Regarding the different capacity calculation horizons it should be included which horizons are applicable for the specific interconnection. In principle the following horizons could be considered: yearly, monthly, weekly, and daily. The concrete deadlines for capacity publications and the spokespersons in each horizon should also be established.

The applicable regulation where the security criteria is established should be mentioned. If possible, a summary of the criteria could be included.

4.2.3.5. Outage scheduling

In this section of the TSO-TSO agreement the norms to follow when scheduling outages of the installations within the international interconnections or other installation which could affect the interconnections should be established.

More in particular the procedure to follow when scheduling outages differentiating between the different time horizons. In principle annual maintenance planning, weekly maintenance planning and short-term outages. This procedure should include the specific deadlines to communicate and update the outage scheduling plans; and also the list of spokespersons in the different time horizons. If needed a specific subchapter with information regarding how to manage outages could also be included.

Within the scope of application it should be stated that any installation, despite not being an interconnection, which may have a significant impact on the other system should follow the procedure included in this contract. All these installations are included in chapter 4.2.3.2 on "Information exchange and interconnection characteristics".

In addition this section should detail the procedure for coordinated safeguard plans.

4.2.3.6. Mutual support (include defence plans)

In this section of the TSO-TSO agreement the joint procedure for the management of mutual support mechanisms between neighbouring systems should be established.

System security is an important aspect for the operation of the power systems. For this purpose both mutual support mechanisms and system defence plan, which introduces all the measures to be implemented to prevent the propagation of an incident in the system, have to be considered as important aspects.

System defence plan is not comprised of a single method and a tool but it is comprised of a set of various power system control mechanisms and procedures. Among those methods and procedures especially harmonisation of frequency deviation management procedure, voltage deviation management procedure, demand disconnection schemes with respect to low frequency and/or low voltage and inter-TSO assistance and coordination in emergency state are considered of high importance and should be included.

Concrete definitions to be used are needed, especially regarding how to establish the conditions under which the mutual support procedures should be put in practice.

In addition the detailed procedures should be determined, including the information exchange procedure "ex-ante" and "ex-post" of the mutual support; how to manage the cost of the energy used during the mutual support (even the additional generation programmed); and also to treat the deviations during the mutual support actions as unintentional deviations.

4.2.3.7. Unintentional deviations

In this section of the TSO-TSO agreement the procedure to meter, account and settle the unintentional deviations between two neighbouring power systems should be established.

For this aim the metering and accounting equipment in each interconnection line should be detailed.

Calculation procedure (including how to consider the interconnection line losses and the principles for the calculation of the compensation deviations) should be agreed, together with the accounting period.

Data exchange and validation process (including deadlines for process the information) could also be included.

4.2.3.8. Duration of the contract

In this section of the TSO-TSO agreement the duration of the agreement should be included. In general an unlimited duration could be considered although in some case a limited duration could be established based on other conditions (commissioning of new interconnections lines, other multilateral agreements or new binding regulation to enter into force. For this aim, the unlimited duration could be specified as tacit renewal, as follows: A limited number of years but renewed for the same duration in case there are no changes in the operation conditions or none of the parties express interest in making changes to it).

4.2.3.9. Conditions for withdrawal

In this section of the TSO-TSO agreement the conditions under which each TSO could cancel the agreement should be included.

4.2.3.10. Dispute resolution

In this section of the TSO-TSO agreement how to manage dispute resolution between the 2 parties signing the contract should be included. Typically 3 levels are provided:

- In general, the Parties shall in best effort try to reach an amicable settlement.
- If no such amicable settlement can be reached the Dispute shall be brought to the NRAs conciliation.
- In the event that NRAs fail to achieve conciliation, the disputing Party(ies) may submit its/their dispute to arbitration under the ICC Rules of Arbitration.

5. Model of Grid Code

This chapter presents a proposal of model of common rules in the form of a Grid Code (GC), to be implemented in the Mediterranean area.

The process for the implementation of the GCs in the power system at national level is not defined in the code itself but left to subsidiarity, thus allowing adequate space to Member States to define what processes should be employed.

However every Member State currently has processes to assess and apply requirements to existing and prospective users of its transmission and distribution networks. These existing processes, as detailed in the above mentioned surveys conducted by TC2, should be the starting point for national implementation and can in many cases be readily adapted for use to apply Grid Codes. An adequate transition period should be given after the entry into force of the Network Code, allowing for modification of these national implementation processes. This transition period also grants sufficient time for necessary changes to be made to existing contractual arrangement, e.g. example connection agreements with users to which the Grid Code shall apply.

5.1. Methodology

On the basis of the Starting Regulatory Framework (SRF), which was defined in the frame of Subtask 1.1, the reference for the selection of the issues to be included in this proposal have been the Surveys carried out among the TSO members in the frame of Subtasks 1.2 for the Common Target Regulatory Framework (CTRF) and 1.2.2 on the need of harmonization of the regulatory framework for the a Common Tentative Road Map (CTRM), with focus on the aspects selected to be harmonized by external regulation (GC) or other external rule in the areas of Connection and Operation. More specifically, from the 135 technical issues identified in the SRF, 49% (66) have been classified as priority and a concrete rule for the harmonization of each of them has been proposed in the frame of CTRF.

More specifically, in the areas of Connection and Operation the issues prioritized for future harmonization were:

- 15 issues from the connection area, the majority of which related to frequency, voltage and control requirements and connection procedure;
- 32 issues from the operation area, the majority of which related to technical requirements, information exchange and contingency analysis,

From the above selection, general guidance on some major issues is provided below, with the aim to help the TSOs to define their own parameters/requirements at national level

5.2. Guidelines and contents for Grid Codes

This chapter presents a proposal of guidelines for the implementation of Grid Codes, focusing on a selection of so-called non-exhaustive requirements, with the aim to provide guidance to determine the main criteria/motivation for their definition. These non-exhaustive requirements are the ones to be determined at national level, but for which a wider sharing and in some cases collaboration between TSOs on the criteria can be necessary. Non-exhaustive parameters for any requirement may vary across different types of

significant grid users. Similarly non-exhaustive parameter requirements may be applied regionally. In both cases of varying applications, these need to be justified, comply with the network codes and do not lead to more stringent or detailed rules that would be incompatible with the national codes.

Current system characteristics and their evolution have to be taken into consideration for the definition at national level of non-exhaustive requirements. To this respect the choice of most of the non-exhaustive parameters shall be linked to the level of renewable energy sources penetration in each country at the entry into force of the GC, but account also for the future, as system characteristics are expected to change continuously and differently in each country. In this context, it is recommended to consider at national level the expected changes in network needs over the next 15-20 years, in order to define these parameters.

In general, determining factors to be considered for the definition at national level of the non-exhaustive requirements, could be:

- Maintaining existing requirements and performance, that are already foreseen from previous national regulations, where their need and benefit is demonstrated by operational experience
- Taking into consideration national generation portfolio characteristics and their evolution (e.g. level of penetration of RES)
- Taking into consideration national system characteristics and its evolution (e.g. rural/urban conditions, density of load and generation)
- Ensuring that requirements needed for guaranteeing security of supply will be fulfilled at any time even considering the peculiarity of each electricity system

With the aim to provide adequate explanations for the implementation of the GC at national level, the issues prioritized for future harmonization in the areas of Connection and Operation have been clustered on major categories for which a set of guidelines is presented in the following paragraphs, focusing on the:

- Presentation of the underlying principles of each requirement
- Definition of the elements to be further specified
- List of various conditions to be considered
- Identification of possible interdependencies with other requirements and/or regulation

Such guidelines are neither mandatory, nor tabulate the outcome of all Med-TSO Members implementations, which are often driven by further detailed studies and interlinked with other national grid code or other requirements. The guidelines are complemented by a proposal of model of Rules to be commonly implemented in the Mediterranean area, provided in annexes: Annex C1 for the Grid Code on Requirements for Connection and Annex C2 for the Grid Code on System Operation.

5.2.1. Grid Code on Requirements for Connection

Due to the large penetration of renewables connected in the transmission systems (in particular wind and solar), both existing and anticipated in the future, the impact of which in the neighbouring countries can be significant depending on their scale, high level of harmonization is required in general towards requirements for connection of new non-transmission facilities and in particular generation, with particular focus in aspects with high impact to network frequency and voltage.

The Grid Code “Requirements for connection (GC RC)” defines the minimum performance capabilities in context of cross border implications for all classes of new grid connections, which contribute to the overall objective of increasing the security of electricity supply in the Mediterranean area. Such requirements have

a cross-border impact, but need to be tailored to manage and make best use of local system characteristics (network, load, generation portfolio and technology).

The GC RC contains a number of non-exhaustive requirements in the grid connection domain. A non-exhaustive requirement within a GC does not provide for a full harmonization of that requirement. This means that the GC does not contain all the information or parameters necessary to apply these requirements immediately and thus they need to be further specified at national level. This specification will result in rendering the non-exhaustive requirements exhaustively defined as a national or project specific rules. As mentioned above, this may require updating and amending respective technical regulations (e.g. existing national grid codes) accordingly. As explained, adequate transition period from the date of entry into force of the GC until its application allows for such a national implementation procedure. Anyway as stated in chapter 2.3 on "General guidelines" the non-binding nature of this proposals should be kept in mind and considered a voluntary application by the countries in the Mediterranean area.

Based on the results of the previous subtasks performed within the Mediterranean Project, 7 issues have been selected to be included in the proposal of RC and are presented in Table 5. For those issues, a proposal of guidelines to be commonly adopted in the Mediterranean area are further described and clarified in the following paragraphs and the model of Grid Code that could be used for their implementation at national level is presented in the Annex C1.

Requirements for connection of generation and demand facilities		
Requirement	**Type**	**Scope**
Frequency/time range limits for users to withstand without damage	Frequency requirements	Frequency stability
Rate of change of frequency withstand capability	Frequency requirements	Frequency stability
Limited frequency sensitive modes – over and under frequency schemes	Frequency requirements	Frequency stability
Voltage/time range limits for users to withstand without damage	Voltage requirements	Voltage stability
Fault ride through capability	Voltage requirements	Robustness of Generating Units
Limits of reactive power contribution	Reactive power requirements	Voltage stability
Observability and controllability requirements (including magnitudes to be provided in real time)	Control requirements	General system management

Table 5. Proposal for Grid Code on Requirements for Connection (GC RC).

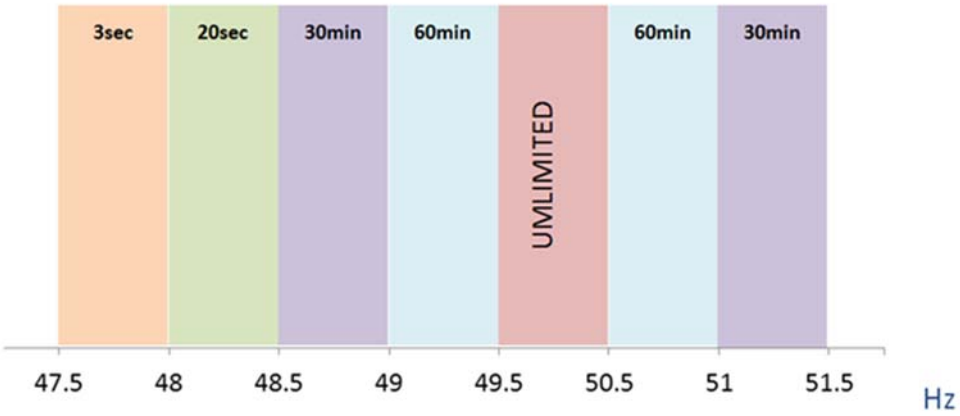
5.2.1.1. Frequency/time range limits for users to withstand without damage

Secure system operation is only possible if there is close cooperation between generation facility owners and TSOs. In particular, the functioning of the system under abnormal operating conditions depends on the response of generation facilities to deviations from the reference frequency value within a synchronous area. The requirement of frequency/time range limits for users to withstand without damage specify the ability of

the generation facilities to remain connected to the network and operate within the frequency ranges and time periods required by each TSO to preserve or to restore system security.

Large penetration of renewables increases the impact of this requirement, both for the system to which they are connected, and for the neighbouring systems, depending on their scale.

For this reason, the GC RC requires for a high level of harmonization towards the requirement of frequency/time range limits for users to withstand without damage. According to the SRF for the Mediterranean area, the frequency/time range limits which are common in all Med-TSO countries are presented in Figure 28.



The figure shows the minimum common time period for all Med-TSO countries during which a generation facility has to be capable of operation on different frequencies, deviating from a nominal value, without disconnecting from the network.

Figure 28. Frequency/time range limits for users to withstand without damage common time period for all Med-TSO countries.

However, for the current and future challenges at the operation of transmission networks, it is strongly recommended in the GC RC, that the generation facilities shall be capable of staying connected to the network and operating within the ranges of the network frequency and for the time periods specified in Annex C1, Article 4.

5.2.1.2. Rate of change of frequency withstand capability

Given the uncertainty on system characteristics and their future evolution, generation facilities need to be robust against changes to the system and shall provide rate of change of frequency (df/dt) capability which accounts for these varying system conditions.

The requirement on rate of change of frequency withstand capability aims at ensuring that generation facilities that are connected to the network will remain connected when a rate of change of frequency (df/dt) occurs after severe system incidents (such as loss of a large generating unit or an AC or HVDC interconnection link) and therefore allow control responses from devices (notably generation) to stabilize and restore the network to normal operating conditions.

Taking into account that generation and demand on a synchronous network basis mostly covers more than one TSO, coordination between TSOs within the same control area is strongly recommended to ensure that a coordinated rate of change of frequency withstand requirement is placed on all plant and equipment. As a result of this coordination, a single minimum value of rate of change of frequency withstand capability should

be proposed to ensure stability within each synchronous area. This single value of rate of change of frequency withstand capability does not inhibit TSOs asking for further inherent withstand capabilities at national level.

5.2.1.3. Limited frequency sensitive modes – over and under frequency schemes

The requirement on limited frequency sensitive modes (over and under frequency schemes) – LFSM OF & UF aims at automatically changing (reducing or increasing) the active power output of generation facilities (SPGM-Synchronous Power Generating Modules[8] and PPM-Power Park Module[9] using the wording coming from the European Grid Codes recently approved) and, in case of over or under frequency, restoring the frequency back towards its target value (normally 50.0 Hz) for cases of severe imbalance (excess or shortfall of generation), resulting in significant frequency deviations.

This may occur in cases of major disturbances to the system such as large loss of demand (e.g. loss of exporting HVDC link) or in more extreme cases in case of a system split, but also sudden increase of production. The requirements aims to change the active power output proportionally to the frequency deviation to restore the balance of generation and demand. The capability to change active power output is needed in emergency situations in order to stabilize the system and avoid further decrease of frequency and more severe disturbances, i.e. frequency collapse in a synchronous area possibly leading to cascade tripping, system splitting, load shedding, major faults and even blackouts.

Based on the SRF for the Mediterranean area, the GC RC foresees:

- a certain level of harmonization to be introduced in the overfrequency and underfrequency schemes adopted by interconnected transmission systems
- a level of generation disconnection (as a percentage of system size) to be introduced at least at synchronous area level
- in systems where there is high penetration of renewables (both existing and anticipated in the future), this generation category to be also included.

With respect to the above, the GC RC requires that the frequency thresholds for the activation of the overfrequency and underfrequency schemes are harmonised at least at synchronous area level, considering the relevant requirements for generators included in the ENTSO-E GC.

TSO-TSO coordination to agree droop and threshold within one synchronous area is strongly recommended, with the aim to minimize unplanned power flow between the countries after activation of LFSM. In addition, cooperation with representatives of manufacturers is recommended to define time of activation for typical existing technology (reference active power activation) taking into account real system needs and each technology's constraints, which are the same irrespective of place of installation. Size of synchronous area will influence the choice of frequency threshold, with high frequency value for smaller synchronous areas and lower frequency for very large synchronous areas.

[8] Synchronous Power Generating Module - means an indivisible set of installations which can generate electrical energy such that the frequency of the generated voltage, the generator speed and the frequency of network voltage are in a constant ratio and thus in synchronism;

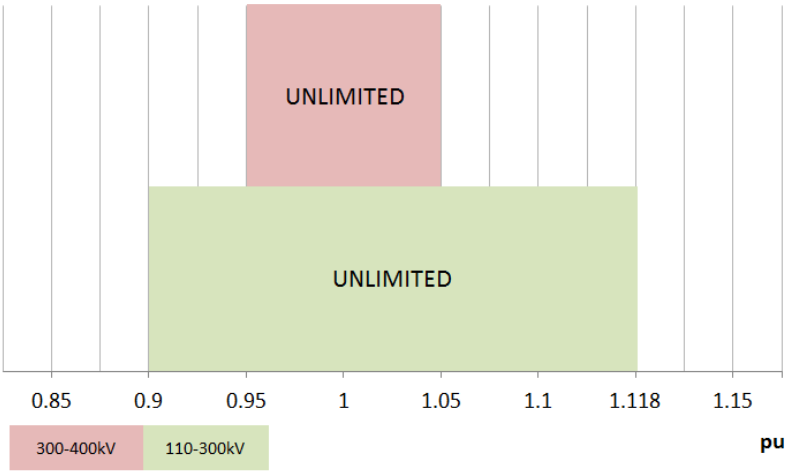
[9] Power Park Module - means a unit or ensemble of units generating electricity, which is either non-synchronously connected to the network or connected through power electronics, and that also has a single connection point to a transmission system, distribution system including closed distribution system or HVDC system;

TSO – Grid User coordination is implicitly established by the GC RC (not on a case-by-case basis, but on generation technology level), because the selection of the full set of parameters to exhaustively define LFSM, should take into consideration technology-specific characteristics and constraints.

5.2.1.4. Voltage/time range limits for users to withstand without damage

As mentioned above concerning the frequency, the functioning of the system under abnormal operating conditions depends on the response of generation facilities to deviations from the reference 1 per unit (pu) values of voltage. In the context of system security, the networks and the power-generating modules should be considered as one entity from a system engineering point of view, given that those parts are interdependent. Therefore, as a prerequisite for grid connection, relevant technical requirements should be set for generation facilities. The requirement of voltage/time range limits for users to withstand without damage specifies the ability of the generation facilities to remain connected to the network and operate within the voltage ranges and time periods required by each TSO to preserve or to restore system security.

Due to the large penetration of renewables, the impact of this requirement can be significant depending on their scale, both for the system to which they are connected but also for the neighbouring countries. Therefore, the GC RC requires for a high level of harmonization towards the requirement of voltage/time range limits for users to withstand without damage. Based on the SRF for the Mediterranean area, the voltage/time range limits which are common in all Med-TSO countries are presented in Figure 29 (voltage at the connection point expressed by the voltage at the connection point related to the reference 1 pu voltage and for the time periods specified).



The figure shows the common minimum time periods all Med-TSO countries during which a generation facilities must be capable of operating for voltages deviating from the reference 1 pu value at the connection point without disconnecting from the network where the voltage base for pu values is from 110 kV to 400 kV.

Figure 29. Voltage/time range limits common in all Med-TSO countries.

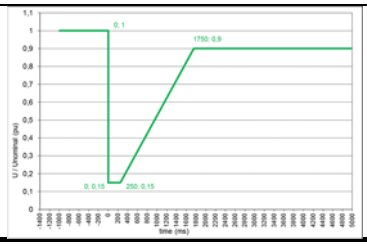
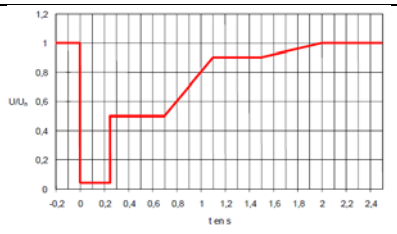
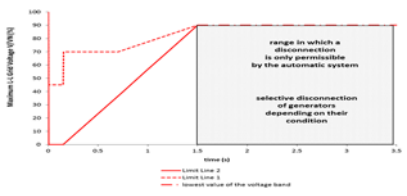
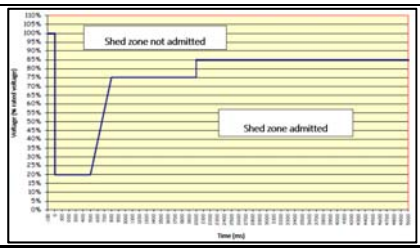
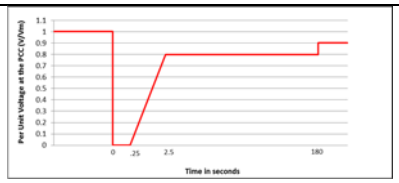
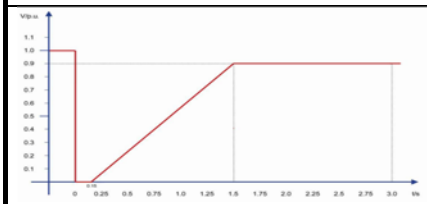
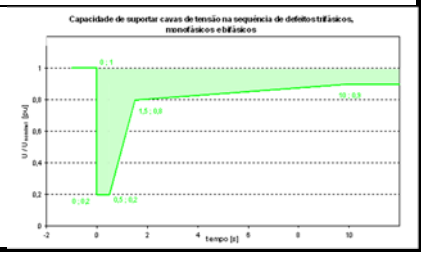
However, for the current and future challenges at the operation of the transmission networks it is strongly recommended in the GC RC, that the generation facilities shall be capable of staying connected to the network and operating within the ranges of the network voltage and for the time periods specified in Annex C1, Article 6.

5.2.1.5. Fault-ride through capability

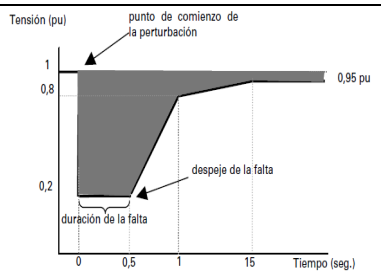
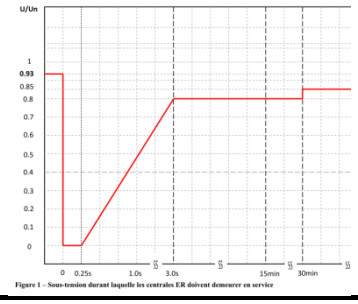
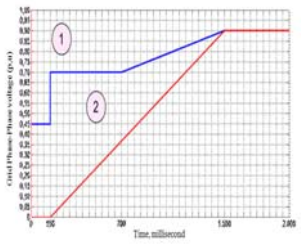
The requirement of fault-ride through capability aims at preventing from the disconnection of generation facilities after a secured fault[10] on the higher transmission level. The objective is to limit the potential loss of generation after a fault on the distribution or transmission system at voltage levels of 110 kV or above in order to avoid more severe disturbances, i.e. frequency collapse in a synchronous area causing demand tripping and unexpected power flows resulting in overloads both on internal transmission lines and tie lines with neighbouring systems possibly leading to cascading tripping, system splitting, load shedding, major faults, brownouts and even blackouts.

In the case of a fault on the transmission system level a voltage drop will propagate across large geographical areas around the point of the fault during the period of the fault. Distributed generation needs to be tolerant to such faults, especially where the total installed volume of embedded generation possibly affected by a transmission system fault exceeds the maximum designed generation loss of the system. It is also possible that the fault consists precisely on the trip of a large generator, depending upon the exact fault location. Unless this capability is established, the total loss would then be the sum of this large generator plus any lower level distributed generation tripping.

In the SRF for the Mediterranean area in 2016, each TSO specified the voltage-against-time-profile which expresses the lower limit of the course of the phase-to-phase Voltages on the Network Voltage level at the Connection Point during a symmetrical fault, as a function of time before, during and after the fault. This profile represents the worst voltage variation during a fault and after its clearance (retained voltage during a fault and post-fault voltage recovery) and is presented in Figure 30.

<table>
<tr><th colspan="3">FRT profile curves considered for the wind technology in Med-TSO region</th></tr>
<tr><td>DZ</td><td>CY</td><td>FR</td></tr>
<tr><td>Not Required*</td><td>  </td><td>  </td></tr>
<tr><td>GR</td><td>IT</td><td>JO</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>ME</td><td>MA</td><td>PT</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
</table>

[10] a fault which is successfully cleared according to the system operator's planning criteria

ES	TN	TR
		

*In Algeria the Grid Code for renewables is currently under development. There are no wind farms currently in the interconnected Algerian grid (the only wind farm that exists, is connected to an isolated network in the South of Algeria).

Figure 30. FRT profile curves considered for the wind technology.

However for the current and future challenges at the operation of the transmission networks, it is strongly recommended in the GC RC, that the fault-ride through profile of synchronous and non-synchronous generation facilities is set within the limits specified in Annex C1, Article 7. This proposal also includes the profile coming from the European Grid Codes that will be applicable in European countries in 2019.

5.2.1.6. Reactive power requirements

Reactive power is a key component in terms of voltage stability, which in turn is the foundation for cross border trading. The influence on overall system voltage stability is essential for generation facilities especially in situations where the possible impact of the generation can appear, like generation facilities near the neighbouring countries and will vary with location. Requirements on reactive power focus on the provision of reactive power from the generation facilities in the steady state to allow the relevant Network Operator having a sufficient reactive power reserve to keep voltages within the admissible limits, when the generation facilities is operating at the limits of its active capacity (max or min).

The importance of a wide reactive power capability range is defined by the constantly increasing necessity of effective voltage regulation in the whole network. Voltage regulation becomes more complex because of the continuous change of network topology and characteristics, in particular driven by increasing long-distance power flows due to changes in the generation portfolio. This situation requires from each generation facilities to be capable to participate in system voltage regulation.

5.2.1.7. Observability and controllability requirements

Based on the SRF for the Mediterranean area, the GC RC foresees the harmonization of the communication between Users and TSO Control Centres. This is mainly required due to the large penetration of renewables, the impact of which in the neighbouring systems can be significant, depending on their scale. For the same reason, the need for observability and controllability of non-transmission facilities from the TSO control room should also be included for harmonization. More specifically, harmonization of the control requirements focuses in the following aspects:

- ***Observability and Controllability of non-transmission facilities***

GC RC foresees that the observability and controllability of generation facilities should be harmonized, without explicitly specifying the global architecture of the communication schemes between users and TSO Control Centres. This may be done also following agreements between TSOs Communication should comply with performance requirements (speed, reliability, etc.) and may be direct user-TSO or via intermediate Control Centre designated by user. Generation facilities should be observable and controllable by TSO Control Centres, with respect to their size.

- ***Magnitudes to be provided in real time***

GC RC foresees that at least the magnitudes of V, P, Q and status (On/Off) of the circuit breakers should be provided from generation facilities to TSO control systems. In addition other magnitudes like current may be provided.

5.2.2. System Operation Grid Code

The main objective of the Grid Code on System Operation (GC SO) is to elaborate regulation on those subjects that need coordination between TSOs and ensure the functioning of the interconnected power systems in a safe, secure, efficient and effective manner considering the expected high penetration of renewables that will provoke a high impact in the system operation.

Based on the results of the surveys conducted by TC2, from the issues of the operation area that have been promoted to be regulated by this category of external rule, 12 have been selected to be included in the proposal of GC SO and are presented in Table 6. For those issues, a proposal of guidelines to be commonly adopted in the Mediterranean area are further described and clarified in the following paragraphs and models for their implementation at national level are presented in the Annex C2.

Grid Code on System Operation (GC SO)		
Requirement	**Type**	**Scope**
Classification of System States	System states	System Operation
Frequency ranges in the different system states	Frequency requirements	
Voltage for unlimited operation	Voltage requirements	
Reactive power management measures	Reactive power requirements	
System protection coordination criteria	Protection requirements	
List of structural data to exchange between TSOs	Information exchange	
List of scheduled data to exchange between TSOs	Information exchange	
List of real time data to exchange between TSOs	Information exchange	
Contingency analysis	Contingencies	Operational Planning
Operational security limits	Contingencies	
List of joint remedial actions	Contingencies	
Outage coordination	Outage coordination	

Table 6. Proposal for Grid Code on System Operation (GC SO).

5.2.2.1. Classification of system states

Adequate information exchange between system operators and generation facilities owners is a prerequisite for enabling system operators to maintain system stability and security. System operators need to have a continuous overview of the state of the system, which includes information on the operating conditions of generation facilities, as well as the possibility to communicate with them in order to direct operational instructions.

The states of the system should be classified in the GC SO in a consistent manner, with specific characteristics clear for each state (operational security limits, frequency criteria, reserves, contingency list, and activation or restoration plan). In principle, the system states that should be considered are: **Normal, Alert, Emergency, Blackout, and Restoration**.

- **Normal state**: No violation of operational security limits, even after the occurrence of an incident or contingency. The frequency and voltage deviation of the steady-state system is within the standard range.
  In general, a system is in a normal state if it is within the operational security limits in situation N and after the occurrence of a contingency, taking into account the effect of the corrective actions available.
- **Alert state**: No violation of operational security limits, in general, a system is in alert state if is within operational security limits, but a contingency has been detected, for which in case of occurrence, the available remedial actions are not sufficient to keep the normal state.
- **Emergency state:** A system is in a state of emergency if the operational safety limits are violated and at least one of the operating parameters is outside the respective limits.
- **State of blackout:** At least one of the following conditions is fulfilled as: unexpected loss of more than 50% of the total national demand or total absence of voltage.
- **Restoration state:** When a recovery plan measurement is enabled, partially in full.

5.2.2.2. Frequency ranges in the different system states

The frequency of the electrical system is the indicator of the balance between electricity production and consumption.

Generation facilities must be able to withstand frequency and voltage deviations under normal and extraordinary operating conditions while minimizing the amount of active power and must be designed to allow exceptional operation for limited times in the 47 to 53 Hz range.

The nominal frequency of the interconnected electrical systems is 50 ± 0.5 Hz and is normally controlled within the limits defined in the GC RC.

The minimum operating ranges are included in Annex C2 article 5.

The Grid Code will establish the frequency quality parameters taking into account the state of the system in each frequency range. These quality parameters are nominal frequency, standard frequency range, maximum instantaneous frequency deviation, maximum steady state frequency deviation and time to restore frequency.

5.2.2.3. Voltage ranges for unlimited operation

The voltage ranges may vary in each country. In general this values have been proposed by the TSO in consultation with the facilities connected to the grid.

A classification of voltage ranges for unlimited operation under normal conditions should be considered in the GC SO. Wider ranges in extraordinary conditions could also be established at national level.

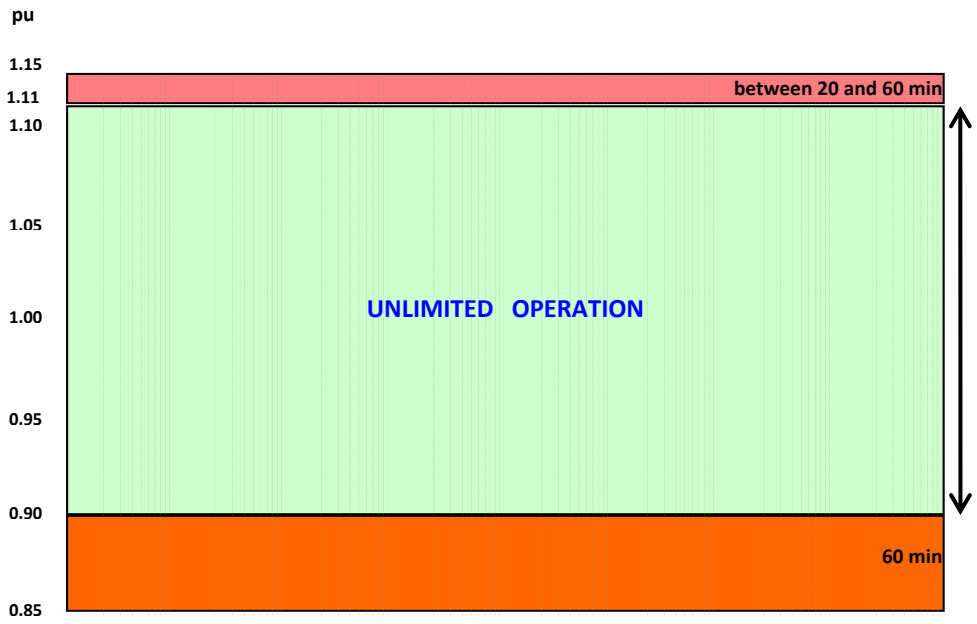


Figure 31. Voltage ranges for unlimited operation according to the time duration.

5.2.2.4. Reactive power management measures

Information about the reactive power requirements, which is considered as a key component in terms of voltage stability, is introduced in section 5.2.1.6. Reactive power being an important aspect of the system, the measures regarding the management of it is also an important issue in the operation of the power systems.

Based on the results of the survey performed in the study, classification of the possible remedial actions to manage reactive power is proposed. The classification of the remedial actions which could be in an external rule should cover:

- switching of reactors and capacitors
- on load tap changes transformers
- instruction to distribution companies
- set points to generation facilities, HVDC, etc.

These remedial actions should be applied by a TSO when the voltage is outside the ranges defined for unlimited operation.

In addition, specific management of reactive power flows in the international interconnections should be included in internal agreements between neighbouring TSOs to respect common operational security limits.

5.2.2.5. System protection coordination criteria

For achieving the secure operation of the power systems, protections systems have been installed in the power systems of the countries which participate to the study. Some of the member countries' power systems which are being operated interconnected with their neighbouring countries power systems had already developed some coordination mechanism for their system protection of the interconnection lines.

Based on the results of the Survey performed in the study, it is proposed to include criteria for system protection coordination in the interconnection lines in the internal agreements between neighbouring TSOs. The agreement should also cover the definition of the set points and coordination prior to implementation.

5.2.2.6. List of structural data to exchange with other TSOs

In order to understand the general structure of the neighbouring power system and to perform the security analysis of the system, power system operators will need some information about their neighbouring power systems. The basic data needed for the purpose is the structural data of system assets which are in the observability area.

The list of structural and forecasted data to be exchanged between TSOs should be included in the internal agreements but the need to exchange data should be regulated in the GC SO.

The list of structural data should include at least the following data from the observability area that should be agreed between neighbouring TSOs (in principle, at least border substations should be included in the observability area):

- Normal topology of substations.
- Technical data on transmission lines.
- Technical data on transformers, including phase-shifting transformers.
- Technical data on HVDC systems.
- Technical data on reactors, capacitors and other.
- Reactive power limits from generation facilities.
- Operational security limits.
- Protection set points of transmission lines included as external contingencies.

5.2.2.7. List of scheduled data to exchange with other TSOs

In addition to the structural data, to perform the security analysis of the systems, system operators need scheduled information about the neighbouring power systems.

The GC SO should include that, to coordinate operational security analysis, TSOs from the same synchronous area should exchange at least the following:

- Topology of the transmission grid above 220 kV (including 220 kV).
- Model of the transmission grid below 220 kV, which has a significant impact.
- Thermal limits of the transmission elements.
- Aggregated generation forecast in each node of the transmission grid.
- For dynamic stability studies, additional data should be exchanged.

5.2.2.8. List of real time data to exchange with other TSOs

Sharing critical information about the power systems between the system operators helps the system operators to have information about their neighbouring systems. Having information about the neighbouring power systems yields to achieve more secure system operation. Through this perspective and based on the on the results of the survey performed in the study, it is proposed to include criteria for sharing some real time data.

The list of real time data to be exchanged between TSOs of the same synchronous area should be included in the GC SO. This list should include at least the following:

- Frequency
- Frequency restoration control error
- Active power exchange between control areas
- Aggregated generation
- System state
- Set point of the load frequency control

Also the list of real time data from the observability area to be exchanged between neighbouring TSOs should be included the GC SO. The observability area should be agreed between neighbouring TSOs in the internal agreements. In principle, at least border substations should be included in the observability area. The list of information to be exchanged should include at least:

- Substation topology (including availability).
- Active and reactive power in line bay or transformer bay, including transmission and distribution
- Active and reactive power in generation bay
- Reactive power in reactor bay and capacitor bay
- Bus bar voltage
- Restrictions (if any) and outages.
- Positions of tap-changers transformers.

5.2.2.9. Contingency analysis & Operational security limits

In operational planning and scheduling a coordinated behaviour of all the power systems and interconnected transmission grids shall be ensured in order to be prepared for real time operation.

For this aim the GC SO shall include the principles for perform security analysis (contingency, voltage stability) in the different time horizons of operational planning. This simulations shall ensure than the system meets the operational security limits under the different levels of contingencies.

In addition the Grid Code shall also include the remedial actions to be developed in case of major incidents in the power system. A specific chapter on this issue is included.

Regarding operational planning, an additional chapter on scheduling of relevant outages should also be included. The relevant outages should be determined. A specific chapter in this issue is included.

The Grid Code includes the type of contingencies to be considered on the basis of whether it is ordinary, exceptional or out-of-range, taking into account the probability of occurrence. In principle N-1 contingencies should always be considered and “partial” N-2 contingencies in specific situations that could be determined at national level. It also includes the list of external and internal contingencies that should be considered

when performing the contingency analysis. It is also developed a procedure that details how and when each TSO should inform neighbouring TSOs about the external contingencies and also about any topological changes included in the external contingency list.

A specific chapter on which limits could be considered when performing the contingency analysis should be included. These limits could be the following (the 3 first ones should always be considered):

- Voltage limits.
- Short-circuit current limits.
- Stability limits.
- Current limits in terms of thermal rating including the transitory admissible overloads.

In case of operational security limits for the interconnections lines the Grid Code should establish that exact limits for each interconnection line (or calculation method) should be determined between the concerned TSOs. In case of differences in the calculation method the more restrictive limits should be considered.

5.2.2.10. List of joint remedial actions

In system operation, the general criteria to increase the system security is to isolate an event in an area and to stop its' spreading to larger area(s). Some contingency events occurring in a power system have a potential effect on the neighbouring power system(s). For this purpose, the development of coordination between the power system operators plays a crucial rule in increasing the security of the system. Based on the results of the survey performed in the study, classification of the list of joint remedial actions should be included in the GC SO.

The Grid Code should include the different categories of remedial actions that TSOs could use in case of a contingency (either when need or not need to be managed in a coordinated way) and also the criteria that shall apply. The remedial actions could be the following:

- Topological actions
- Reschedule of maintenance through the duration of outages
- Voltage control and reactive power management
- Re-dispatch of generation
- Countertrading
- Modification of active power flows through HVDC links

5.2.2.11. Outage coordination

In order to ensure a coordinated behaviour of the interconnected systems the criteria to perform both long term and short term scheduled relevant outages is included in this chapter of the Grid Code. As relevant outages all TSOs should define the concrete assets with cross border relevance (so affecting the NTC). In principle the following could be considered: transmission grid, significant generation, distribution grid. In general it could be stated that the Grid Code should include the general procedure to ensure the need of coordination between neighbouring TSOs in case of an outage that could affect NTC. It should also establish that the concerned TSOs should go a step further and agree on the concrete procedures to make clear the way to deal with situations of outage affecting NTC.

Annex A. Model of Contract TSO – User: Connection Contract

1 PARTIES IDENTIFICATION (LEGAL REPRESENTATIVES)

In [*city*], at [*date*],

CONNECTION CONTRACT WITH REFERENCE NUMBER [*]) IN [*Identification of the substation*]

Between:

[*User*], a company established under the laws of [country in which it is located], whose registered offices are located in [detailed address], [company form], with registration number [*], validly represented by [*Legal representative*] with ID [*], in his/her capacity of [*Position in the company*] and duly authorized for that purpose

Referred to hereinafter as the **"Grid User"**

And:

[*TSO*], a company established under the laws of [country in which it is located], whose registered offices are located in [detailed address], [company form], with registration number [*], validly represented by [*Legal representative*] with ID [*], in his/her capacity of [*Position in the company*]

Referred to hereinafter as the **"TSO"**

NOTE: The "**TSO**" designation can be replaced by the company name (**"…."**).

[Grid User] and [TSO] hereinafter jointly referred to as "the parties"

2 EXPOSITIVE

In accordance with the applicable laws and regulations, the parties commit to lay down their contractual rights and obligations in relation to the Connection to the TSO grid.

2.1. Detail of facilities to be connected

[*Grid User*] is owner of the following [*type of facility: generation, distribution, demand*] facility:

- [*Name of installation*] with [*] MW of rated power at [*] voltage level.

[*Grid User*] has obtain the corresponding administrative authorizations with date [*] and number/reference [*]. **Annex I.**

(If more than one non-transmission facility it should be included here).

2.2. Summary of access and connection permits

[*Grid User*] has obtained the corresponding access and connection permits elaborated by [*TSO*] with dates [*] and [*] respectively and number/references [*] and [*] respectively. **Annex II (access) and Annex III (connection).**

These permits include the following studies that have been performed under [*national or regional regulation*]:

- Load flow studies.
- Short circuit studies.
- Transient stability studies (if applicable).
- (…)

The studies have been performed with the simulation models provided by [*Grid User*] of [name of installation].

3 AGREEMENT CLAUSES

Considering the above [*Grid User*] and [*TSO*] agree as follows:

3.1. Introductory clause

This Contract governs the Connection to the transmission grid, owned by [*TSO*], of the [*Name of installation*], owned by [*Grid User*] in the [bay] of substation [*] at [*] kV located in [*city*].

Connection point details are the ones clearly detailed in the connection permit (**Annex III)**.

3.2. Determination of the connection point and connection solution

[*Grid User*] has obtained the corresponding connection point and the connection solution elaborated by [*TSO*] with date [*] and number/reference [*]. **Annex IV.**

The technical and functional characteristics of the Connection Facilities are to be specified by TSO in the Annex IV.

In addition to, and without prejudice to the provisions of the Grid Codes applicable, the parties agree that the Connection Point shall be located in one of the following places:

a) In case the first Connection Bay is located in an substation of the TSO Grid: the connectors of the first Connection Bay on the busbar of the substation;

b) In case the first Connection Bay is located in a branch on a line or cable of the TSO Grid: the point of the branch on said cable or line.

[Leave one of the following options in the contract]

Option a)

The [*Grid User*] and *[TSO*] agree that the connection point is in the transmission grid node designated [……..] which this substation has the typology [……. *single busbar configuration, double busbar configuration, double busbar with transfer bus configuration, breaker and half configuration, ring bus configuration, etc*……..] in the substation bay number [……..]. The voltage level of the connection point is […….kV].

Option b)

The [*Grid User*] and *[TSO]* agree that the connection point is in the transmission line designated [……..] which this line has the typology [……. *Double or single line*……..] in the tower number [……..]. The voltage level of the connection point is […….kV].

[*Grid User*] and *[TSO]* agree the following scheme for connection point and connection solution:

[Regarding the potential schemes for connections to the grid one possibility is included as example (additional schemes could also be considered by the TSO)]

- ***Scheme 1 – Interconnection through a dedicated EHV line in the Transmission Network***

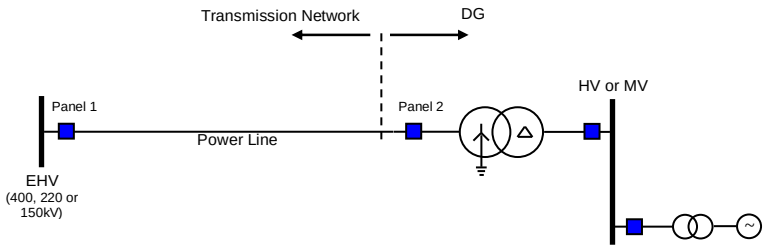


Figure 1. Interconnection through a dedicated EHV line in the Transmission Network (typical scheme)

The connection point and the connection solution are expressed and agreed between the TSO and Grid User, defining:

- the transmission grid node (included the bay of the substation and bay/substation typology);
- the nominal voltage level of the Connection Point;
- the User (power plant) scheme connection to the grid;
- the geographic location;

3.3. Duration of the contract / agreement

[Leave one of the following options in the contract]

Option 1. This Contract has an unlimited duration (until the end of the life cycle of the non-transmission facility), unless the conditions change or the non-transmission facility is decommissioned.

Option 2. This Contract has a duration of [*] years, renewed for the same duration in case no changes in the conditions.

Both options. The commissioning of the non-transmission facility is subject to the prior signature of an operational agreement between [*Grid User*] and [*TSO*] as a necessary condition.

In case of sequential contracts different durations could be established.

3.4. Technical requirements

In addition to the requirements defined in the applicable Grid Codes, the parties agree that the following requirements shall be applicable to the [Grid User]: [include only those not defined in the Grid Code]

a. Frequency requirements
- Frequency/time range limits for users to withstand without damage
- Rate of change of frequency withstand capability
- Limited frequency sensitive mode – overfrequency and underfrequency schemes

b. Voltage requirements
- Voltage/time range limits for users to withstand without damage
- Fault ride through capability of Power Plant
- Insulation requirements for Transformers, Lines and underground cables

c. Reactive power requirements: Limits of reactive power contribution and Voltage control mode.

d. Short circuit levels/requirements for equipment's of the Grid User (substations equipment's, circuit breakers, high voltage transmission lines/cables, etc.), according the standard values of the TSO for the connection point.

e. Protection requirements: Technical Requirements for Protection and Control for the Users, namely related with the High voltage lines/cables between the Users and TSOs.

f. Power quality standards and requirements for Grid User, namely the limits of harmonic distortion, flicker, etc.

g. Metering standards and requirements for Grid User.

h. Requirements for the Grid User interconnection transformer (isolation requirements and the type of connection of the main windings of the interconnecting transformers (grounding)).

The [*Grid User*] needs to fully comply with all the requirements included in the applicable Grid Code, and in the particular technical specifications that would eventually be agreed by the parties and provided by the [*TSO*] in Annex to this contract, and which shall be an integral part of it.

3.5. Maximum power

The maximum simultaneous admissible production for the generation facilities connected to the [bay] of substation [*] at [*] are established in the access and connection permits (**Annex II and Annex III**). This value should be established for each single facility and also for the aggregation of facilities.

The establishment of these values does not mean that [*Grid User*] has the right to produce that value in every moment. Real time operation by [*TSO*], following [*national regulation*], or transmission grid maintenance needs may vary these values. Major limitations are included in **Annex II and Annex III**.

3.6. Information exchange requirements

In addition to the requirements defined in the applicable Grid Codes, the parties agree that the following requirements shall be applicable to the [Grid User]: [include only those not defined in the Grid Code]. This request cannot be denied for unreasonable reasons.

a. Telecommunication requirements for Telecommunication between [TSO] and [Grid User], namely related with the connection to the security telecommunications network.

b. Control requirements and connection to the TSO SCADA between [TSO] and [Grid User], namely the technical requirements for connection with the SCADA TSO, such as:
    - Global architecture and schemes required for controllability and observability of non-transmission facilities connected to the transmission grid
    - Observability of non-transmission facilities by TSO control systems (real time monitoring)
    - Magnitudes provided in real time from non-transmission facilities to TSO control centre
    - Controllability of non-transmission facilities by TSO control systems
    - Characteristics required for the communication system

The [*Grid User*] shall comply with the requirements included in the Grid Code (declaring which Grid Code is applicable), and in the particular technical specifications that would eventually be agreed by the parties and provided by the [*TSO*] in Annex to this contract, and which shall be an integral part of it.

3.7. Commitment for permitting and authorization of the transmission facilities

The parties agree on the following preconditions and clauses:

The entry into force of this contract shall be subject to the obtaining by the TSO of the administrative authorizations from the competent authority (national/regional/local) to build the transmission facilities.

Regarding the future maintenance, the parties agree that the equipment's life cycle management of the connection infrastructures are established by the [TSO], as well as the ownership of the assets of connection facilities.

The maintenance of the transmission assets and of the user assets shall be the responsibility of the TSO and the Grid User respectively.

Notwithstanding their respective maintenance obligations, the [Grid User] shall, upon [TSO] requests, comply with its maintenance obligations of its assets. The [Grid user] shall bear the costs of its own maintenance activities where these occur after the period of depreciation of the assets.

The period of depreciation for the assets is defined in the applicable legislation, namely [……] or in the absence thereof, shall be deemed to be defined as in Table 1 and Table 2.

Type of equipment	Depreciation period (maximum values)
Very High Voltage High Voltage Equipment (e.g., circuit breaker, measurement transformers, disconnectors, cables)	….. years
Auxiliary power systems	….. years

Table 1. Maximum reference depreciation periods for primary equipment.

Type of equipment	Depreciation period (maximum values)
Command, control, protection and monitoring systems	….. years
Communication systems	….. years
Computer equipment: computers and monitors	….. years

Table 2. Maximum depreciation reference periods for secondary equipment.

3.8. Construction aspects of connection facilities

The connection works performed by the TSO on their respective assets shall be carried out under their own responsibility. These works shall be made according to the state of the art and in accordance with the applicable rules and regulations (e.g. prescriptions, safety decrees and rules of the [National Standard Organization, or any relevant authority]).

The estimated duration of the connection works is … months from …

The commissioning date of the connection is programmed on *Month Year.*

A provisional schedule of the connection construction is attached to the Contract.

[TSO] will not notify the delivery or start-up orders to its suppliers and service providers once the Contract enters into force, with the possible exception of supplies and works covered by specific commitments of the Customer and agreed in the framework of the Connection Agreement.

[TSO] will notify the effective date of the Provisioning of the Connection. This date will be revised in case of an event beyond the control of [TSO], in hypotheses of various hazards including those listed below:

- Completion of the amicable and administrative procedures. [TSO] will in no way be held responsible for the risks that may affect the time required to complete these procedures (deadlines for obtaining routing agreements and administrative authorizations, contentious appeals, etc.) ;
- Interruptions attributable to [User], including those caused by late payments ;
- Interruptions for force majeure or fortuitous event;
- Additional work requested by [User] or imposed by the administration;
- Programming of the works necessary for the construction of connection works;
- Transmission Grid operating requirements;
- Bad weather, soil quality, discovery of elements of heritage or archaeological interest;
- Modification of the regulations imposing additional constraints for the construction of connection works.

Option: In case of non-compliance with this date resulting either from the duration of the work or a lack of due diligence by [TSO] in the conduct of the administrative and amicable proceedings remaining to be carried out on the date of signature of this agreement, [TSO] will pay to the Customer, as damages and interest, an indemnity release equal to xx% of the lump sum of the connection price per week of delay attributable to [TSO]. This compensation will be capped at xx% of this lump sum.

3.9. Conditions for coordinated maintenance

[TSO] and [Grid User] shall coordinate themselves for the maintenance of the equipment in the interface between the transmission and non-transmission facilities, including required system tests.

Planned outages shall be mutually scheduled between [TSO] and [Grid User] in order to maintain a high degree of reliability between both parties and so as to ensure that contractual deliveries of power and energy are met with the least inconvenience and cost to parties.

The parties shall share with each other, with sufficient time in advance, the schedule about the maintenance outages of each other lines, generation and station equipment that may affect or change the operating security of either side or affect the contractual deliveries of power and energy.

[TSO] and [Grid User] shall agree on a specific operation protocol with detailed information on maintenance coordination before the commissioning of the facility.

3.10. Conditions for temporary suspension or restricted operation

Where [Grid User] violations of the provisions of the present Agreement are such that seriously jeopardize the continuity and safety of the power supply, [TSO] may, as a precautionary measure, suspend, without prior notice, the connection service or adopt any other provisional measures to safeguard the continuity of service.

3.11. Conditions for withdrawal

Except for the right of compensation for damage, [TSO] is entitled to terminate the present Agreement in case of occurrence of one of the following behaviour of the [Grid User]:

a. Non observance of the obligations under this contract, as well as the executive project positively verified by [TSO];
b. Loss of one or more requirements for accessing and connecting to the grid;
c. Non-compliance with technical-economic conditions of access to the grid and interconnection, including the non-compliance with payment or other financial conditions and obligations mentioned in this contract during the construction period;
d. Failure to comply with the information commitments from [TSO];
e. Any other behaviour that could compromise the security and continuity of the electrical service or which explicitly contravenes the provisions of the applicable legislation/regulation, including the national Network Codes.

3.12. Dispute resolution

For all disputes, controversies, claims, differences which may arise between the Parties, ("Dispute") out of, or in relation to, or in connection with, this Agreement, the Parties shall in best effort try to reach an amicable settlement. If no such amicable settlement can be reached the Dispute shall be brought to the NRAs conciliation.

In the event that NRAs fail to achieve conciliation, the disputing Party(ies) may submit its/their Dispute to arbitration under the ICC Rules of Arbitration.

Any dispute arising out of or in connection with this Agreement or its negotiation shall be finally settled following the Rules of Arbitration of the International Chamber of Commerce as in force at the time of initiation of the arbitral procedure, by arbitrators appointed in accordance with these Rules. The arbitration panel shall be composed of three arbitrators, unless the disputing Parties agree on a greater odd number of arbitrators. The arbitration shall be held in XXX. The proceedings and award shall be in the XXX language. The arbitral award shall be final and binding on the Parties.

3.13. Transfer of the contract

It is allowed, by a written permission from [TSO] which may not be unreasonably denied, the total or partial transfer of the present Contract to subjects who have the same requirements of [Grid User].

In case of transfer of this contract, the new Grid User must fulfill the same technical, financial and administrative conditions and guarantees as his predecessor.

[Grid User] have to notify [TSO] in written form, 3 months in advance.

The transfer involves rights and obligations under the present Contract/Agreement and its effectiveness is subject to verification of [Grid User] requirements.

Before the transfer of the contract, [Grid User] may be subject to obtain the applicable administrative authorizations, when required.

Annex B. Model of Contract TSO – TSO: Operation Agreement

1 PARTIES IDENTIFICATION

In [*city*], on the [*date*],

OPERATION AGREEMENT WITH REFERENCE NUMBER [*] FOR [*Interconnection*]

Between:

[*TSO A*], a company established under the laws of [country in which it is located], whose registered offices are located in [detailed address], [company form] and registration number [*], validly represented by [*Legal representative*] with ID [*], in his/her capacity of [*Position in the company*] and duly authorized for this purpose.

Referred to hereinafter as **"TSO A"**

And:

[TSO B], a company established under the laws of [country in which it is located], whose registered offices are located in [detailed address], [company form] and registration number [*], validly represented by [Legal representative] with ID [*], in his/her capacity of [Position in the company] and duly authorized for this purpose.

Referred to hereinafter as **"TSO B"**

[TSO A] and [TSO B] hereinafter jointly referred to as "**the parties**"

2 EXPOSITIVE (WHEREAS)

In accordance with the applicable laws and regulations, [*TSO A*] and [*TSO B*] shall lay down their contractual rights and obligations in relation to the operation agreement for the [*Country A and Country B] interconnection*.

3 AGREEMENT CLAUSES

Based on the above [*TSO A*] and [*TSO B*] agree as follows:

3.1. Introductory clause

This Contract governs the operation relations between [*TSO A*] and [*TSO B*] for the [*Country A and Country B] interconnection* in the following fields:

- Information exchange and interconnection characteristics.

- Coordinated management and synchronous operation.
- Capacity calculation.
- Outage scheduling.
- Mutual support mechanisms.
- Unintentional deviations.

3.2. Information exchange & Interconnection characteristics

This chapter of the Agreement between [*TSO A*] and [*TSO B*] regulates the information to be exchanges between both TSOs, including the interconnection characteristics.

The characteristics of the interconnection lines between [TSO A] and [TSO B] are included in Table 1.

Interconnection	Voltage Level	PATL[11]	TATL[12]	Length	Additional comments

Table 1. Interconnection line characteristics.

The parties agree to exchange the following data about the abovementioned interconnections:

- Interconnection lines settings of the protection relays and other devices.
- External observability list of both TSOs, including substation, lines, transformers, power units and voltage compensation facilities.
- External contingency list of both TSOs.
- List of relevant elements.
- List of critical elements.

By the present agreement the parties commit to operate their respective power systems according to the information and data exchanged on the basis of the present agreement.

3.3. Coordinated management & synchronous operation

This chapter regulates both the coordinated management and the synchronous operation conditions.

With regard to coordinated management, the parties agree to exchange the following set of information:

- Real time information, including data specified in chapter 3.2 and the periodicity of the exchange (between 4 and 12 seconds).
- Interconnection operation conditions including frequency and voltage values; and the use of the reactances.

[11] Permanent Admissible Transmission Loading;
[12] Temporary Admissible Transmission Loading;

- Procedures to follow in case of tripping of the interconnection, differentiating between the types of protections.

As to synchronous operation information, the parties must provide to the TSO of the connecting power system, the following required information:

- General conditions that establish that the connecting power system wishing to connect synchronously to the power system of Country A or Country B should follow the applicable laws and regulations, including the rules and procedures included in the present Agreement.
- Power frequency regulation characteristics: primary, secondary and tertiary.
- Minimum security rules to be applied, including N-1 criteria and load shedding plans.

3.4. Capacity calculation

This chapter defines the rules to be followed when performing the capacity calculation of the interconnection between [*country A*] and [*country B*].

In the framework of the present agreement, "capacity" should be understood as the commercial capacity or Net Transfer Capacity (NTC) between power systems of [*country A*] and [*country B*]. In general, this value is the maximum value of exchange program for commercial purposes in MW available in a certain period of time that is compatible with the security criteria. The applicable security criteria defined by each TSO are attached (to the present agreement) as ANNEXES I and II.

The capacity calculation is performed using the [*Flow Based or Available Transfer Capacity*] method. In the studies performed each TSO will include its own power system and the transmission grid elements of the neighbouring power system considered relevant, taking into account each TSO´s external contingency list.

The NTC value to be published in each direction of active power flow will be the lowest value between the NTC values calculated by the two TSOs.

Both TSOs will perform the calculation and publish NTC in the following time horizons:

- Yearly calculation to be published before [date of Y-1].
- Monthly calculation to be published before [date].
- Weekly calculation to be published before [day of the week].
- Daily calculation to be published before [hour of D-1].

The parties will agree on the files format of the data to be exchanged in order to perform the calculation.

Spokespersons: (depending on the different time horizons spokespersons may change)

Yearly horizon:

- [*TSO A*]: name, email and phone number.
- [*TSO B*]: name, email and phone number.

Monthly horizon:

- [*TSO A*]: name, email and phone number.
- [*TSO B*]: name, email and phone number.

Weekly horizon:

- [*TSO A*]: name, email and phone number.
- [*TSO B*]: name, email and phone number.

Daily or intraday horizon:

- [*TSO A*]: name, email and phone number.
- [*TSO B*]: name, email and phone number.

3.5. Outage scheduling

This chapter determines the rules to be followed when scheduling the outages concerning the installation within the interconnection between [Country A] and [Country B] or any other installation that could affect this interconnection.

It applies to all planned outages in the abovementioned elements. This list of elements corresponds to the external contingency list included in chapter 3.2 ("Information exchange") of this Agreement. The planned outages of these elements should be approved by the two TSOs, especially if, in specific operation conditions, the outage of an element could have a relevant impact in the other power system.

The parties agree to share all the information needed to manage outages under the procedure established under chapter 3.2 ("Information exchange".

The procedure for maintenance planning is included below in the following time horizons:

- Annual maintenance.- Each TSO should send the request of outages before [date]. The definitive schedule should be approved and published by both TSO before [date]. This schedule should be updated every [x] months.
- Weekly maintenance.- Each TSO should send the request of outages before [day of the week]. The definitive schedule should be approved and published by both TSO before [day of the week].

In both cases, the outage request should include for each specific outage at least the following information: element affected, duration, desired date, description of the work, time needed for reconnection in case of an emergency during the outage.

Short-term outages (less than weekly) should be requested to the other TSO as soon as possible.

This chapter also regulates the procedure for coordinated safeguard plans in cases when a study performed by one TSO shows an operation limit violation that needs the adoption of certain

measures by the neighbouring TSO. Coordinated safeguard plan should be discussed as soon as possible and validated by both TSOs.

Spokespersons: (depending on the different time horizons spokespersons may change)

Yearly horizon:

- [*TSO A*]: name, email and phone number.
- [*TSO B*]: name, email and phone number.

Monthly horizon:

- [*TSO A*]: name, email and phone number.
- [*TSO B*]: name, email and phone number.

Weekly horizon:

- [*TSO A*]: name, email and phone number.
- [*TSO B*]: name, email and phone number.

Daily or intraday horizon:

- [*TSO A*]: name, email and phone number.
- [*TSO B*]: name, email and phone number.

3.6. Mutual support

This chapter establishes the joint procedure for the management of mutual support mechanisms between the parties.

In general, the parties agree to support each other under a major incidence in one of the power systems that could affect system security. The conditions in which to apply the mutual support mechanism and the procedure to follow are those described below:

- Conditions:
  - [*]
- Procedure:
  - [*]

In each case, a similar format should be followed: contingency and detailed list of actions to be performed to return the system to the situation before the incidence.

3.7. Unintentional deviations

This chapter establishes the procedure to meter, account and settle the unintentional deviations in the international interconnection between [Country A] and [Country B].

For this aim Table 2 summarizes the relevant equipment in each tie line (if not included in chapter about interconnection characteristics).

Name of tie line	Voltage level (kV)	Substation TSO A	Substation TSO B	Metering equipment in TSO A	Metering equipment in TSO B	Accounting point in TSO A	Accounting point in TSO B	Metering point in TSO A	Metering point in TSO B

Table 2. Relevant equipment list in each tie line.

The parties agree to exchange the data needed for metering and accounting using the [agreed format]. In Annex 1 the concrete information to be exchanged is included.

The parties agree to perform the accounting with a resolution of 1 hour, unless a different period is agreed.

Depending on the precise location of the accounting point (substation in TSO A, in TSO B, in the border) line losses should be included in the calculation process. The formula to calculate the line losses is [*].

Data validation and the calculation of the compensation deviations shall be performed following the procedure established below.

- [DESCRIPTION OF THE PROCEDURE]

Spokespersons: (depending on the different time horizons spokespersons may change)

Yearly horizon:

- [*TSO A*]: name, email and phone number.
- [*TSO B*]: name, email and phone number.

Monthly horizon:

- [*TSO A*]: name, email and phone number.
- [*TSO B*]: name, email and phone number.

Weekly horizon:

- [*TSO A*]: name, email and phone number.
- [*TSO B*]: name, email and phone number.

Daily or intraday horizon:

- [*TSO A*]: name, email and phone number.
- [*TSO B*]: name, email and phone number.

3.8. Duration of the contract

The present Agreement shall have an unlimited duration, unless the operation conditions change due to commissioning of a new interconnection line between both countries or new binding national or regional regulation is enacted or any other development which introduces relevant variations in the interconnection conditions. In these cases a new agreement should be signed in order to include the new conditions.

Where one of the TSOs considers that there are reasons that justify the revision of this document, the said TSO shall contact the other TSO in order to agree on an update.

3.9. Conditions for withdrawal

Each TSO is entitled to terminate the present Agreement in the following cases:

1) Non observance of the obligations under this contract, with particular reference to the failure to comply with the following obligations:

a. Information exchange and interconnection characteristics.
b. Coordinated management and synchronous operation.
c. Capacity calculation.
d. Outage scheduling.
e. Mutual support mechanisms.
f. Unintentional deviations.

2) Any other behaviour that could jeopardize or which contravene the provisions of the relevant legislation/ regulation, including the national Network Codes.

3.10. Dispute resolution

The Parties will attempt, in good faith, to resolve any dispute or claim arising out of or in relation to the present Agreement through negotiations between the representatives of each of the Parties involved. The Parties shall make their best effort to try to reach an amicable settlement. If no such amicable settlement can be reached the Dispute shall be brought to the NRAs concerned for conciliation[13].

In the event that NRAs fail to achieve conciliation, the disputing Parties may submit their Dispute to arbitration under the International Chamber of Commerce (ICC) Rules of Arbitration.

Any dispute arising out of, or in connection with this Agreement or its negotiation shall be finally settled following the Rules of Arbitration of the ICC as in force at the time of initiation of the arbitral procedure, by arbitrators appointed in accordance with these Rules. The arbitration panel shall be composed of three arbitrators, unless the disputing Parties agree on a greater odd number of arbitrators. The arbitration shall be held in [XXX]. The proceedings and award shall be in the [XXX] language. The arbitral award shall be final and binding on the Parties.

[13] There should be a legal basis for this – For instance, under EU law the Agency for the Cooperation of Energy Regulators – ACER – is competent to issue a decision in cases of dispute between TSO. In the Mediterranean area a regional body could be competent for this purpose.

Annex C1. Model of Grid Code: Requirements for Connection

Article 1. Subject matter

This network/technical code aims at laying down the requirements for grid connection of generation facilities, to the interconnected system. It, therefore, helps to ensure system security and the integration of renewable electricity sources, and to facilitate Mediterranean-wide trade in electricity.

Article 2. Definitions

For the purposes of this Regulation, the following definitions shall apply:

(1) "*relevant system operator"* means the transmission system operator or distribution system operator to whose system a generation facility, demand facility or distribution system is or will be connected;

(2) "generation facility owner" means a natural or legal entity owning a power-generating facility;

(3) "synchronous generation facility" means an indivisible set of installations which can generate electrical energy such that the frequency of the generated voltage, the generator speed and the frequency of network voltage are in a constant ratio and thus in synchronism;

(4) "connection point" means the interface at which the generation facility is connected to a transmission system, distribution system, as identified in the connection agreement;

(5) "non-synchronous generation facility" means a unit or ensemble of units generating electricity, which is either non-synchronously connected to the network or connected through power electronics, and that also has a single connection point to a transmission system or to a distribution system;

(6) "fault-ride-through" means the capability of electrical devices to be able to remain connected to the network and operate through periods of low voltage at the connection point caused by secured faults;

Article 3. Scope of application

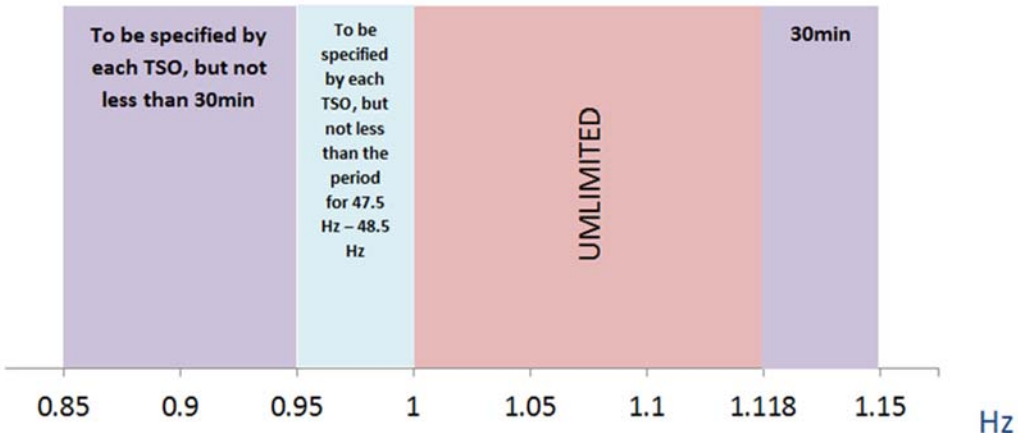
The connection requirements set out in this Regulation shall apply to new generation facilities, connected both to the transmission and the distribution grid.

The relevant system operator shall refuse to allow the connection of a generation facility which does not comply with the requirements set out in this Regulation. The relevant system operator shall communicate such refusal, by means of a reasoned statement in writing, to the generation facility owner and to the relevant regulatory authority or other responsible body of the Member State.

Article 4. Requirements related to frequency stability

a) With regard to frequency ranges:

i. a generation facility shall be capable of remaining connected to the network and operate within the frequency ranges and time periods specified in Figure 1;



The figure shows the requirement of the GC RC for all Med-TSO countries for the minimum time period during which a generation facility has to be capable of operation on different frequencies, deviating from a nominal value, without disconnecting from the network

Figure 1. GC requirement of frequency/time range limits for users to withstand without damage

ii. the relevant system operator, in coordination with the relevant TSO, and the generation facility owner may agree on wider frequency ranges, longer minimum times for operation or specific requirements for combined frequency and voltage deviations to ensure the best use of the technical capabilities of a generation facility, if it is required to preserve or to restore system security;

iii. the generation facility owner shall not unreasonably withhold consent to apply wider frequency ranges or longer minimum times for operation, taking account of their economic and technical feasibility.

b) With regard to the rate of change of frequency withstand capability, a generation facility shall be capable of staying connected to the network and operate at rates of change of frequency up to a value specified by the relevant TSO, unless disconnection was triggered by rate-of-change-of-frequency-type loss of mains protection. The relevant system operator, in coordination with the TSO, shall specify this rate-of-change-of-frequency-type loss of mains protection. Based on the results of the survey of TC2 in the Mediterranean area, it is required by the GC RC that the rate of change of frequency withstand capability is set between 1 and 2 Hz/sec.

Article 5. Requirements related to limited frequency sensitive modes – over and under frequency schemes

Each TSO should specify the actual frequency threshold and droop in order to provide the active power frequency response according to Figure 2 and Figure 3.

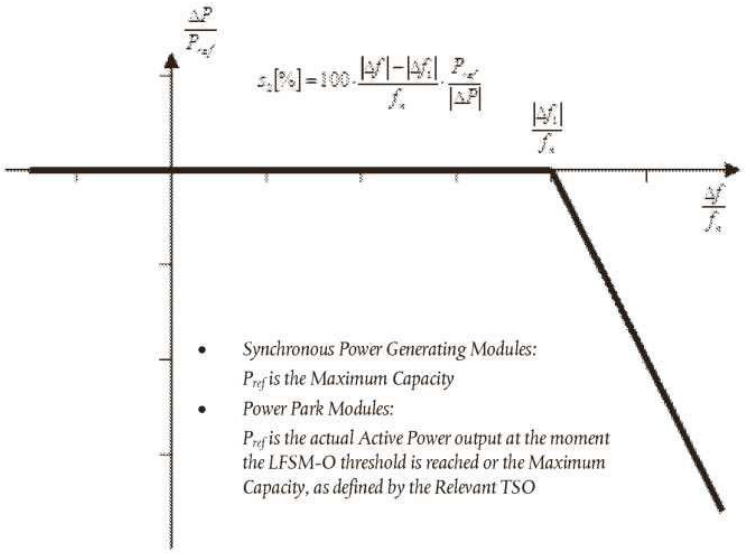


Figure 2. Active power frequency response capability of generation facilities in LFSM-O

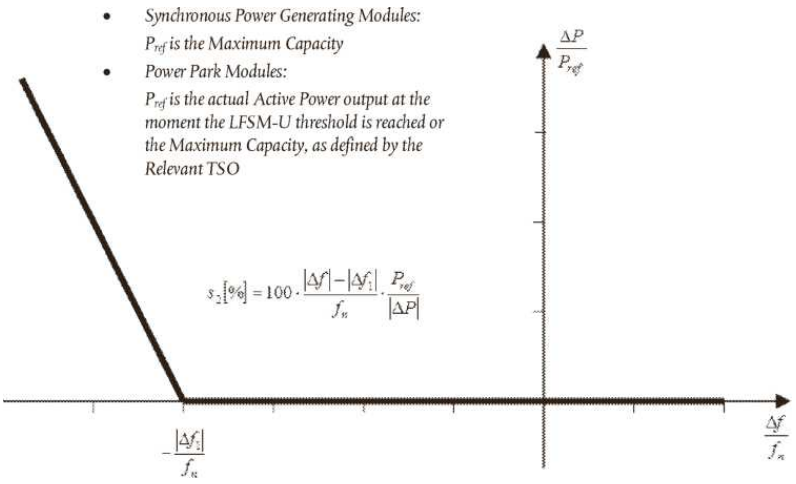


Figure 3. Active power frequency response capability of generation facilities modules in LFSM-U

Synchronous Power Generation Modules and Power Park Modules is the terminology used in the European Grid Codes, recently approved by European Commission. For the purpose of this Regulation we will use synchronous generation facilities and non-synchronous generation facilities respectively.

The generation facility shall be capable of activating active power frequency response as fast as technically feasible with an initial delay that shall be as short as possible and reasonably justified by the generation facility owner to the TSO. The generation facility shall be capable of either continuing operation at minimum regulating level when reaching it or alternatively further decreasing active power output, the choice to be defined by the TSO. This choice should be informed by system characteristics (including needs of the synchronous area / defence plan) and also the capability of the generating technology.

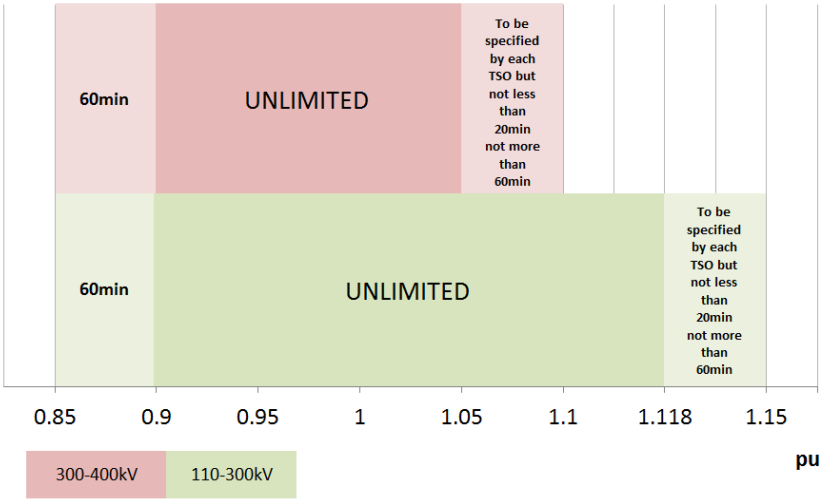
The actual delivery of active power frequency response in LFSM-U mode depends on the operating and ambient conditions of the generation facility when this response is triggered, in particular limitations on operation near maximum capacity at low frequencies and available primary energy sources.

In general, parameters such as droop, time and speed of active power activation can vary for different power generating units, depending also on the constraints of each technology, but it is important that the time of activation is as short as possible in order for this requirement to contribute to system stability.

TSO-TSO coordination to agree such parameters within one synchronous area is strongly recommended, with the aim to minimize unplanned power flow between the countries, after activation of LFSM. Furthermore, TSO – Grid User coordination is implicitly established (not on a case-by-case basis, but on generation technology level), because the selection of the full set of parameters to exhaustively define LFSM, should take into consideration technology-specific characteristics and constraints.

Article 6. Requirements related to voltage/time range limits for users to withstand without damage

Each TSO should establish the requirements so that the power generating modules shall be capable of staying connected to the network and operating within the ranges of the network voltage and for the time periods as specified in Figure 4.



The figure shows the requirement of this GC for all Med-TSO countries for the minimum time periods during which a power-generating module must be capable of operating for voltages deviating from the reference 1 pu value at the connection point without disconnecting from the network where the voltage base for pu values is from 110 kV to 400 kV

Figure 4. Voltage/time range limits requirement in the GC

Article 7. Requirements related to Fault-ride through capability

The fault-ride-through profile of synchronous and non-synchronous generation facilities is set within the limits specified in Figure 5 and Figure 6:

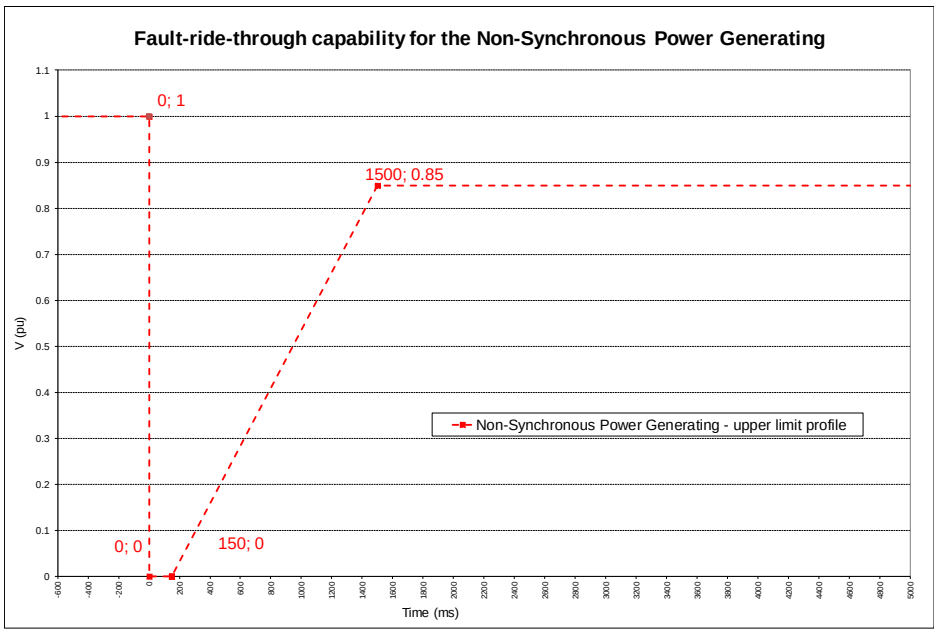


Figure 5. FRT capability for non-synchronous generation facilities

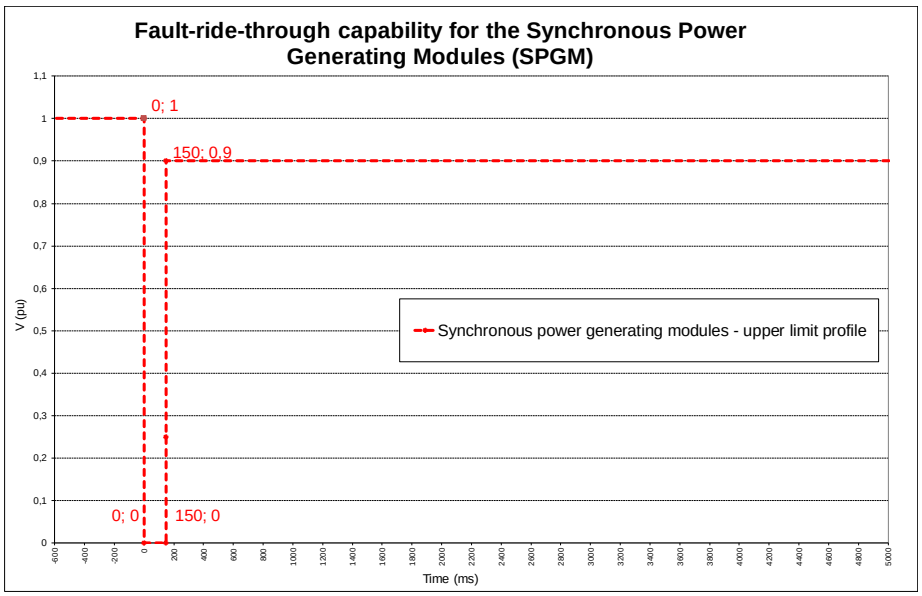


Figure 6. FRT capability proposal for synchronous generation facilities

Generation facilities shall be capable of remaining connected to the network and continue to operate in a stable manner, when the actual course of the phase-to-phase voltages on the network voltage level at the connection point during a symmetrical fault remains above the limit of fault-ride-through profile specified by Med-TSO countries according to the limits in the figures above, unless the protection scheme for internal electrical faults requires the disconnection of the power generating module from the network. The protection schemes and settings for internal electrical faults must not jeopardize fault-ride-through performance.

With regard to fault-ride-through capabilities in the case of asymmetric faults, they must be specified by each TSO, but it is strongly recommended to consider profiles similar or equivalent to those presented above.

Article 8. Reactive power requirements

Each TSO should define the reactive power provision capability requirements in the context of varying voltage and active power. Especially related to the reactive power contribution for the different technologies, it should be set as an interval of adequate reactive requirement (the maximum range of Q /Pmax = between - % of P and + % of P), especially in situations where the possible impact of the generation can appear, like generation plants near the neighbouring countries. However, there should be a difference in limits of reactive power contribution, for synchronous and non-synchronous generation facilities.

Synchronous generation

In context of varying voltage, the TSO shall specify power provision capability requirement, which is defined by the U-Q/P_{max} profile within the boundaries of which the synchronous power-generating shall be capable of providing reactive power at its maximum capacity. Therefore, the U-Q/P_{max} profile considered at the connection point, and it has to be represented through a diagram (see below - **¡Error! No se encuentra el origen de la referencia.**), expressed by the voltage at the connection point (ratio of actual value and its nominal value, i.e. per unit) against the ratio of the reactive power (Q) and the maximum capacity of the synchronous power-generating (P_{max}).

Therefore, each TSO should specify U-Q/P_{max}-profile by the inner envelope in the **¡Error! No se encuentra el origen de la referencia.**. The dimensions of the U-Q/P_{max}-profile envelope (Q/P_{max} range and voltage range) shall be within the range specified for synchronous area:

- Maximum range of Q/P_{max}: **0,95**
- Maximum range of steady - state voltage level in PU: **0,225**

The position of the U-Q/P_{max}-profile envelope shall be within the limits of the fixed outer envelope in **¡Error! No se encuentra el origen de la referencia.**;

Non-Synchronous generation

In context of varying voltage, the TSO shall specify power provision capability requirement, which is defined by the U-Q/P_{max} profile within the boundaries of which the non-synchronous power-generating shall be capable of providing reactive power at its maximum capacity. Therefore, the U-Q/P_{max} profile considered at the connection point, and it has to be represented through a diagram (see below - **¡Error! No se encuentra el origen de la referencia.**), expressed by the voltage at the connection point (ratio of actual value and its nominal value, i.e. per unit) against the ratio of the reactive power (Q) and the maximum capacity of the non-synchronous power-generating (P_{max}).

Therefore, each TSO should specify U-Q/P_{max}-profile by the inner envelope in the **¡Error! No se encuentra el origen de la referencia.**. The dimensions of the U-Q/P_{max}-profile envelope (Q/P_{max} range and voltage range) shall be within the range specified for synchronous area:

- Maximum range of Q/P_{max}: **0,75**
- Maximum range of steady - state voltage level in PU: **0,225**

The position of the U-Q/P_{max}-profile envelope shall be within the limits of the fixed outer envelope in **¡Error! No se encuentra el origen de la referencia.**.

For the non-synchronous power-generating, the P-Q/P_{max}-profile shall be specified by each TSO too, in conformity with the following principles: **a)** the P-Q/P_{max}-profile shall not exceed the P-Q/P_{max}-profile

envelope, represented by the inner envelope in **¡Error! No se encuentra el origen de la referencia.**; **b)** the /P_{max} range of the P-Q/P_{max}-profile envelope is specified for the synchronous area as mentioned above for the Non-Synchronous generation; **c)** the active power range of the P-Q/P_{max}-profile envelope at zero reactive power shall be 1 pu; **d)** the P-Q/P_{max}-profile can be of any shape and shall include conditions for reactive power capability at zero active power; and **e)** the position of the P-Q/P_{max}-profile envelope shall be within the limits of the fixed outer envelope set out in **¡Error! No se encuentra el origen de la referencia.**.

Therefore and as mentioned above, each TSO should specify within the following boundaries for U-Q/Pmax and P-Q/Pmax profiles for synchronous and non-synchronous generation facilities:

- A fixed outer envelope, exhaustively defined in the GC RC.
- An inner envelope for which maximum dimensions (Q/P_{max} range and Voltage range) are defined for each synchronous area in the GC RC.

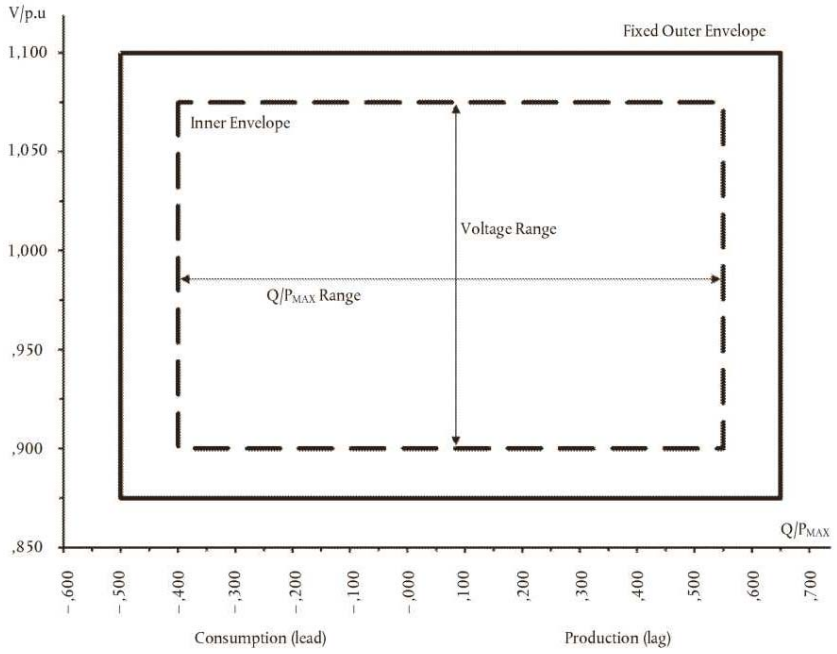


Figure 7. U-Q/P_{max}-profile of a synchronous generation facilities

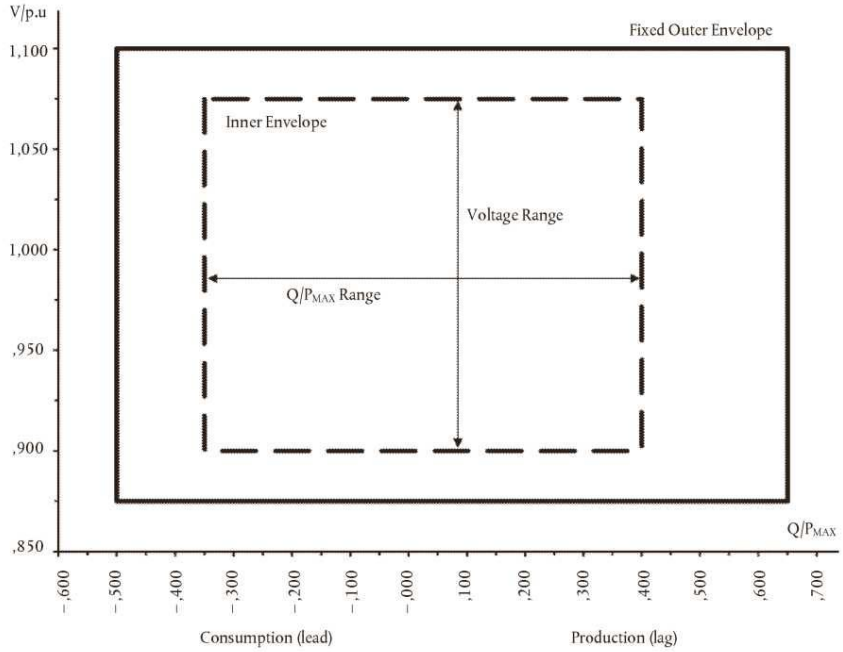


Figure 8. U-Q/P_{max}-profile of a non-synchronous generation facilities

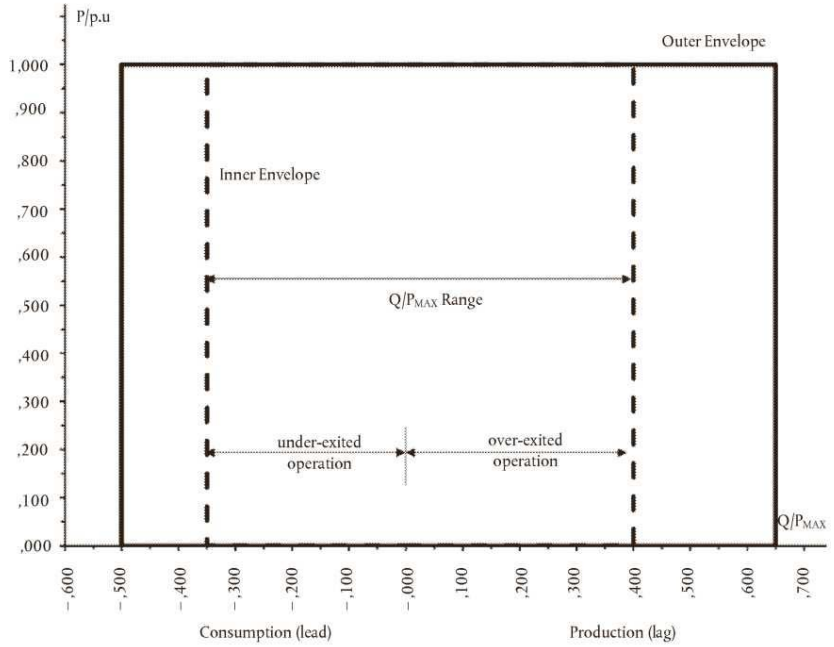


Figure 9. P-Q/P_{max}-profile of a non-synchronous generation facilities

It should be noted that the position, size and shape of the inner envelope in the diagrams above are indicative. The inner envelope shall be adequately located by each TSO within the fixed outer envelope and define its own U-Q/Pmax and P-Q/Pmax profile within the inner envelope. Regional needs regarding reactive power capability shall be taken into account and as a consequence more than one profile is appropriate when regional system characteristics vary significantly within the area of responsibility of a network operator. This U-Q/Pmax and P-Q/Pmax profile shall take any shape that does not need to be rectangular.

Article 9. Observability and controllability requirements

Each TSO should define the observability and controllability requirements from the TSO Control Centres of generation facilities connected to the transmission grid or the distribution grid

Generation facilities shall be observable and/or controllable by TSO´s Control Centres, depending on their installed capacity:

a. Generation facilities with more than 1MW of installed capacity shall be observable from TSO Control Centres.
b. Generation facilities with more than 10MW of installed capacity shall be controllable by TSO Control Centres.

The communication between TSO and generation facilities shall comply with performance requirements (speed, reliability, etc.) and shall be directly between the user and the TSO or, alternatively, via an intermediate Control Centre designated by the generation facility.

The magnitudes of V, P, Q and the status (On/Off) of the circuit breakers shall be provided from non-transmission facilities to TSO Control Centres. In addition, other magnitudes like the current magnitude or other requirements and conditions may also be established at national level or for a specific interconnection.

Annex C2. Model of Grid Code: System Operation

Article 1. Subject matter

This Regulation/ grid code aims at establishing the main principles about frequency quality parameters, the requirements concerning operational security, the requirements on outage coordination and the data exchange rules between TSOs.

Article 2. Definitions

For the purposes of this Regulation, the following definitions shall apply, in addition to the ones included in the GC RC:

'operational security' means the transmission system's capability to retain a normal state or to return to a normal state as soon as possible, and which is characterised by operational security limits

´contingency list' means the list of contingencies to be simulated in order to test the compliance with the operational security limits;

'N-situation' means the situation where no transmission system element is unavailable due to occurrence of a contingency;

'(N-1) situation' means the situation in the transmission system in which one contingency from the contingency list occurred;

'internal contingency' means a contingency within the TSO's control area, including interconnectors;

'external contingency' means a contingency outside the TSO's control area and excluding interconnectors, with an influence factor higher than the contingency influence threshold;

'contingency analysis' means a computer based simulation of contingencies from the contingency list;

'system state' means the operational state of the transmission system in relation to the operational security limits which can be normal state, alert state, emergency state, blackout state and restoration state

'frequency deviation' means the difference between the actual and the nominal frequency of the synchronous area which can be negative or positive;

'observability area' means a TSO's own transmission system and the relevant parts of distribution systems and neighbouring TSOs' transmission systems, on which the TSO implements real-time monitoring and modelling to maintain operational security in its control area including interconnectors;

'neighbouring TSOs' means the TSOs directly connected via at least one AC or DC interconnector

´operational security analysis' means the entire scope of the computer based, manual and automatic activities performed in order to assess the operational security of the transmission system and to evaluate the remedial actions needed to maintain operational security;

Article 3. Scope of application

This Regulation shall apply to all transmission systems, distribution systems and interconnections between the countries in the Mediterranean region.

In addition, the requirements included in this Regulation shall apply to existing and new generation and demand facilities connected to the transmission grid or any provider of ancillary services and/or of demand response services.

Article 4. Classification of system states

A transmission system can be in the following system sates:

- Normal state. The following conditions should be fulfilled:
  - No violation of operational security limits, even after the occurrence of a contingency from the contingency list.
  - Steady state system frequency deviation is within the standard frequency range or not larger (in absolute value) than the maximum steady state frequency deviation without entering in alert state.
  - Active and reactive power reserves are sufficient to withstand contingencies from the contingency list without violating operational security limits.

  In general a system is in normal state if is within operational security limits in the N-situation and after the occurrence of any contingency, taking into account the effect of the available remedial Actions.

- Alert state. No violation of operational security limits and at least one of the following conditions:
  - (i) At least 1 contingency from the contingency list leads to a violation of the operational security limits (even after activation of remedial actions);
  - (ii) Steady state system frequency deviation is not larger (in absolute value) than the maximum steady state frequency deviation and has continuously exceed 50% of the maximum steady state frequency deviation for period larger than the alert state trigger;
  - (iii) Reserve capacity is reduced more than 20% for more than 30 minutes with no possibility to compensate in real time operation.

  In general, a system is in alert state if is within operational security limits, but a contingency has been detected, for which in case of occurrence, the available remedial actions are not sufficient to keep the normal state.

- Emergency state: At least one of the following conditions should be fulfilled:
  - (i) At least one violation of operational security limits;
  - (ii) Frequency does not meet criteria of normal or alert states;
  - (iii) One measure of the defence plan is activated;
  - (iv) Unavailability of TSO tools for more than 30 minutes.

  In general, a system is in emergency state if operational security limits are violated and at least one of the operational parameters is outside of the respective limits.

- Blackout state. At least one of the following conditions should be fulfilled:

- (i) Unexpected loss of more of 50% of the total national demand at a particular point in time;
- (ii) Total absence of voltage for at least 3 minutes.

At a national level a "Partial Blackout state" could also be defined, if the blackout affects only a part of the system (not fulfilling the previous requirements).

- Restoration state: When any measure of the restoration plan is activated, partially of fully.

Article 5. Frequency ranges in the different system states

The frequency of the electrical system is the indicator of the balance between electricity generation and consumption. Generation facilities must fulfil the following requirements as established in GC RC:

• withstand frequency and voltage deviations under normal operating conditions;
• withstand frequency and voltage deviations under exceptional operating conditions;
• allow exceptional operation for limited times in the range of 47 to 53 Hz.

The GC SO establishes the frequency quality parameters taking into account the state of the system in each frequency range. These quality parameters are:

▪ Nominal frequency: 50 Hz.
▪ Standard frequency range: between 20 and 200 mHz, but in the future should be harmonized to at least 50 mHz.
▪ Maximum instantaneous frequency deviation: between 700 and 1500 mHz, but in the future should be harmonized to at least 800 mHz.
▪ Maximum steady state frequency deviation: between 200 and 500 mHz, but in the future should be harmonized to the lower value (200 mHz).
▪ Time to restore frequency: 10 to 20 minutes. In the future could be harmonized to the average value (15 minutes).

Article 6. Voltage ranges for unlimited operation

Each generation facility must have the constructive ability to contribute to voltage regulation by providing and absorbing reactive power fulfilling the following requirements as established in GC RC

- be designed to withstand voltage drops and spikes;
- supply or absorb reactive energy without disconnecting from the network;
- be designed to operate continuously in the voltage range around the rated voltage at the operating point

The GC SO establishes voltage ranges for unlimited operation in normal conditions depending on the voltage level:

- Between 110 kV and 300 kV the voltage should stay between 0.9 pu and 1.118 pu.
- Between 300 kV and 400 kV the voltage should stay between 0.9 pu and 1.05 pu.

Anyway, more exigent conditions could also be established at national level.

At national level voltage ranges for unlimited operation in extraordinary conditions (unexpected conditions not studied in real time by the TSO) should also be established, differentiating by voltage level.

Article 7. Reactive power management measures

The GC SO establishes the list of potential remedial actions to manage the reactive power that could be applied by TSOs when the voltage is outside the ranges defined for unlimited operation:

- switching of reactors and capacitors;
- on load tap change transformers;
- instruction to distribution companies;
- set points to generation facilities or HVDC installations.

Each TSO shall be entitled to use all available transmission-connected reactive power capabilities within its power system for effective reactive power management and maintaining the voltage ranges set in "Voltage ranges for unlimited operation" section.

Each TSO shall ensure reactive power reserve, with adequate volume and time response, in order to keep the voltages within its power system and on interconnectors within the ranges set out in "Voltage ranges for unlimited operation" section.

For each interconnector each TSO shall agree with the neighbouring TSO on common operational security limits. TSOs interconnected by AC interconnectors shall jointly specify the adequate voltage control regime in order to ensure that the common operational security limits established in accordance with the mutually agreed common operational security limits.

Article 8. System protection coordination criteria

Each TSO shall operate its transmission system with the protection and backup protection equipment in order to automatically prevent the propagation of disturbances that could endanger the operational security of its own transmission system and of the interconnected system.

Each TSO shall specify setpoints for the protection equipment of its transmission system that ensure reliable, fast and selective fault clearing, including backup protection for fault clearing in case of malfunction of the primary protection system.

Before protection and backup protection equipment entry into service or following any modifications, each TSO shall agree with the neighbouring TSOs on the definition of protection setpoints for the interconnectors and shall coordinate with those TSOs before changing the settings.

Article 9. List of structural data to exchange with other TSOs

The GC SO establishes the list of structural data that TSOs shall be entitled to exchange with the neighbouring TSOs to perform Operational Security Analysis.

The list of structural data shall include at least the following data from the observability area that shall be agreed between neighbouring TSOs (in principle, at least border substations shall be included in the observability area):

- Normal topology of substations.

- Technical data on transmission lines.
- Technical data on transformers, including phase-shifting transformers.
- Technical data on HVDC systems.
- Technical data on reactors, capacitors and other.
- Reactive power limits from generation facilities.
- Operational security limits.
- Protection set points of transmission lines included as external contingencies.

Article 10. List of scheduled data to exchange with other TSOs

The GC SO establishes the list of scheduled data to exchange to coordinate operational security analysis. TSOs from the same synchronous area shall exchange at least the following:

- Topology of the transmission grid above 220 kV (including 220 kV).
- Model of the transmission grid below 220 kV, which has a significant impact.
- Thermal limits of the transmission elements.
- Aggregated generation forecast in each node of the transmission grid.
- For dynamic stability studies, additional data should be exchanged.

Article 11. List of real time data to exchange with other TSOs

The GC SO establishes the list of real time data to be exchanged between TSOs of the same synchronous area as follows:

- Frequency
- Frequency restoration control error
- Active power exchange between control areas
- Aggregated generation
- System state
- Set point of the load frequency control

In addition the list of real time data from the observability area to be exchanged between neighbouring TSOs shall include at least the following:

- Substation topology (including availability).
- Active and reactive power in line bay or transformer bay, including transmission and distribution
- Active and reactive power in generation bay
- Reactive power in reactor bay and capacitor bay
- Bus bar voltage
- Restrictions (if any) and outages.
- Positions of tap-changers transformers

Article 12. Contingency analysis

Each TSO shall perform contingency analysis in its observability area to identify contingencies which may endanger operational security limits, as established in article 13 and also identify the remedial actions that may be needed to solve the contingency, as established in article 14. Each TSO shall ensure that potential

violations of the operational security limits which are identified by the contingency analysis do not endanger the operational security of its transmission system or of interconnected transmission systems.

Each TSO shall assess the risks associated with the contingencies after simulating each contingency from its contingency list and after assessing whether it can maintain its transmission system within the operational security limits in the (N-1) situation. When a TSO assesses that the risks associated with a contingency are so significant that it might not be able to prepare and activate remedial actions in a timely manner to prevent non-compliance with the (N-1) criterion or that there is a risk of propagation of a disturbance to the interconnected transmission system, the TSO shall prepare and activate remedial actions to achieve compliance with the (N-1) criterion as soon as possible. In case of an (N-1) situation caused by a disturbance,

Each TSO should inform neighbouring TSOs about the external contingencies and also about any topological change included in the external contingency list.

Each TSO shall establish a contingency list, including the internal and external contingencies of its observability area, by assessing whether any of those contingencies endangers the operational security of the TSO's control area. The contingency list shall include both ordinary contingencies and exceptional contingencies.

The external contingency list should be agreed by neighbouring TSOs in the bilateral corresponding internal TSO-TSO agreements.

Article 13. Operational security limits

Each TSO shall specify the operational security limits for each element of its transmission system, taking into account at least the following physical characteristics:

- Voltage limits in accordance with article 6.
- Short-circuit current limits
- Stability limits.
- Current limits in terms of thermal rating including the transitory admissible overloads

In case of changes of one of its transmission system elements, each TSO shall validate and where necessary update the operational security limits. For each interconnector each TSO shall agree with the neighbouring TSO on common operational security limits.

Article 14. List of joint remedial actions

The GC SO establishes the categories of remedial actions that TSOs could use in case of a contingency (either when need or not need to be managed in a coordinated way) as follows:

- Topological actions
- Reschedule of maintenance through the duration of outages
- Voltage control and reactive power management
- Re-dispatch of generation
- Countertrading
- Modification of active power flows through HVDC links

Article 15. Outage coordination

The outage coordination regions within which the TSOs shall proceed to outage coordination shall correspond with the two neighbouring TSO, unless the transmission system of another TSO is affected by an outage in the two neighbouring TSO. Due to the importance of quick access to information about outages, all TSOs should perform the two following steps:

- Definition of assets (network elements and generation and consumption units) with cross border (XB) relevance, to be included in the contingency list that should be agreed by neighbouring TSOs in the bilateral corresponding internal TSO-TSO agreement.
- On a year ahead timeframe, outage planning agents of XB relevant generation and consumption shall provide their proposals for outages (Availability Plans) to the connecting TSO.

In the bilateral corresponding internal TSO-TSO agreement the following requirements should be agreed:

- Perform individual assessment of XB relevant units (generation and consumption) outages, detecting possible incompatibilities (adequacy or network problems). If Outage Incompatibilities are detected, each TSO has to provide a solution, in coordination with the impacted Outage Planning Agents. In the event that no coordinated solution is reached, the lowest impact solution is proposed by the TSO. TSO informs the NRA of the not coordinated solution and of its technical and financial impacts for all parties. The conducted coordination processes are handled according to and in line with the current existing practices (regulations, law, contracts) as they are installed in the different Member States.
- Plan based on Availability Plans provided by Outage Planning Agents the Availability Statuses of its Relevant Grid Elements. The outages on the Relevant Grid Elements should minimize their impact on the market and preserve operational security. When a TSO detects outage incompatibilities, it should initiate coordination with the impacted parties in order to reach a solution taking into account if the work of the outage is relevant for maintaining the Operational Security.
- Share among them their individually assessed "preliminary Year-Ahead Availability Plans" (units and grid elements).
- Define the perimeter of the electrical interdependent (in terms of mutual affection of outages) region (Outage Coordination Region) in which has sense to jointly coordinate outages.
- Jointly assess, within the same Outage Coordination Region, the preliminary Y-A Availability Plans. If Outage Incompatibilities arise when combining the Availability Plans of all the Relevant Assets within the Outage Coordination Regions, a solution is found for each Outage Incompatibility in coordination with all concerned TSOs, each TSO being responsible for coordinating with its connected concerned Outage Planning Agents.
- Publish a final Y-A Availability Plan
- Update Year-Ahead Availability Plan. After a change has been initiated, the impact on the overall Availability Plans is assessed and a coordination phase is set up between affected TSOs, which coordinate possible Outages Incompatibilities with their connected Outage Planning Agents as affected, according to the applicable legal framework.

Annex D Template of survey about national situation on TSO – User contracts

A. EXISTING CONTRACTS TSO-USER IN YOUR POWER SYSTEM

Please name all the contracts TSO-User and select for each of them the corresponding technical area(s) and the type of contract(s).

Name of the contract		Technical area			Type of contract							
		C	O	SSM	1	2	3	4	5	6	7	8
C1		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
C2		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
C3		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
C4		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
C5		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

TECHNICAL AREAS	
C	Connection
O	Operation
SSM	System Service Markets

TYPE OF CONTRACTS	
1	Contracts dealing with access and connection
2	Contracts for construction of transmission facilities
3	Contracts dealing with the conditions of grid usage
4	Contracts for provision of system services
5	Contracts for coordination in the operation
6	Contracts for installation and maintenance of generation tripping systems

B. GENERAL SCHEME AND RELATIONSHIP WITHIN TRAMITTING AND OTHER ADMINISTRATIVE CONDITIONS

Please explain below the general scheme detailing the contracts TSO-user used in your national power system.

C1. MAIN CONTENTS. Please complete one file for each contract detailed in A.

NAME OF CONTRACT 1

Objectives and scope of the contract
Is the signature of the contract with the TSO required to the user by any regulation?
Is there a unified contract model to be used always?
If yes, is the unified model approved by any regulation? Which regulation?
Indicate the time referred in the general scheme (B) in which the contract is signed?
Are there any pre-conditions to sign the contract? If yes, detail the pre-conditions
Is the contract a condition for further steps? If yes, detail the further steps
Main chapters of the contract. Please detail
Identification of the user.
Identification of the non-transmission facility.
Administrative information.
Identification of the connection point.
Technical requirements.
Construction aspects.
Provision of system services.
Coordination in the operation.
Conditions for temporary suspension or cancellation.
Conditions for suspension or cancellation.
Duration of the contract
Additional information

Annex E. Template of survey about national situation on TSO – TSO contracts

A. CONTACT INFORMATION. Please complete below		
Country	**Date**	**TSO**

B. EXISTING CONTRACTS TSO-TSO IN YOUR POWER SYSTEM						
Please name all the contracts TSO-TSO and select for each of them the counterparty (TSO or other) you sign the contract with (specifying the international interconnection to which apply)						
NAME OF THE CONTRACT		**INTERNATIONAL INTERCONNECTION**				
		TSO1 (AA-BB)	**TSO2 (AA-BB)**	**TSO3 (AA-BB)**	**TSO4 (AA-BB)**	**Other (MO, NRA, etc)**
C1						
C2						
C3						
C4						
C5						
C6						
C7						
C8						
C9						
C10						
C11						
C12						

MO: Market Operators

(Please include additional lines for other contracts if you may need it)

C1. MAIN CONTENTS. Please complete one file for each contract
NAME OF CONTRACT 1. Please include the same name as the one included in B.
Number and identification of parties in the contract
Application field and scope of the contract
Contract duration. Please detail cancellation conditions (if any)
Are there any pre-conditions to sign the contract? If yes, detail the pre-conditions
Is the contract a condition for further steps? If yes, detail the further steps
Main chapters of the contract. Please detail

DISCLAIMER

This document contains information, data, references and images prepared by the Members of the Technical Committees "Planning", "Regulations and Institutions"; "International Electricity Exchanges" and Working Group "Economic Studies and Scenarios", for and on behalf of the Med-TSO association. Whilst the information contained in this document and the ones recalled and issued by Med-TSO have been presented with all due care, the Med-TSO Members do not warrant or represent that the information is free from errors or omission.

The information are made available on the understanding that the Med-TSO Members and their employees and consultants shall have no liability (including liability by reason of negligence) to the users for any loss, damage, cost or expense incurred or arising by reason of any person using or relying on the information and whether caused by reason of any error, negligent act, omission or misrepresentation in the information or otherwise.

Whilst the information is considered to be true and correct at the date of publication, changes in circumstances after the time of publication may impact on the accuracy of the information. The information may change without notice and the Med-TSOs Members are not in any way liable for the accuracy of any information printed and stored or in any way interpreted and used by a user.

The information of this document and the ones recalled and issued by Med-TSO include information derived from various third parties. Med-TSOs Members take no responsibility for the accuracy, currency, reliability and correctness of any information included in the information provided by third parties nor for the accuracy, currency, reliability and correctness of links or references to information sources (including Internet Sites).