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Mediterranean Master Plan of Interconnections Network Analysis Guidelines

Guide for setting up grid models for Network studies



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“Mediterranean Project”

**Task 2 “Planning and development of the Euro-Mediterranean
Electricity Reference Grid ”**



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Guide for setting up grid models for Network studies [V5.0]

Subject and scope

This note is a guide for the external experts and TC1 Members involved in selecting and setting up grid models for Network studies.

To this purpose clear instructions have to be given to Members in order to guarantee consistency between Market and Network studies.

The content of this note is a default procedure. TC1 can endorse simplifications in case of evident lack of reliable data or of similarity in cases.

Definitions

BC	<i>Boundary Conditions</i>	Information (load, productions, exchanges etc.) associated to each PiT, needed to set up an equivalent model of countries outside the studied area.
CL	<i>Cluster</i>	Is a set of projects and related reinforcements that are studied together
CMI	<i>Coordinators of the Member Involved team</i>	With reference to the Project Management Scheme Coordinators are the first operative row of the diagram.
DMO	<i>Dispatch Merit order</i>	Is the rank and marginal cost (€/MWh) of generation sources and load that can be changed to balance load and generation inside a Market zone
EE	<i>External Expert</i>	The set of expertise for performing Network Studies (e.g. external expert)
GR	<i>Grid</i>	Grid is the set of topology and node conditions as defined in the load flow technique. A grid is meant to be a consistent set of data as result from the convergence of a load flow.
MI	<i>Members Involved</i>	Are the MedTSO Members that according to the project management scheme are involved in the calculations for a given Area
ESSTF	<i>ESS TaskForce</i>	A task force within the Working Group Economic Studies and Scenarios (WG ESS), dedicated to Data management, in charge in particular of interface between Market Studies and Grid Studies.
NS	<i>Network Study</i>	Is the set of analysis performed by the EE to assess the behavior of the power system against the connection of the cluster / project. It is made of analyses one for each PiT. Remedial actions, redispatching and reinforcements are assessed and quantified to run the system in N and N-1 security.
OF	<i>Origin Format</i>	The data format for LF calculations used by individual TSOs (e.g. PSS; Spira ; etc.)
PiT	<i>Point in time</i>	By PiT is meant the set of information (load, productions, exchanges etc.) associated to a given hour selected among the 8760 ones simulated in one given year of the the Market studies, see also [1] pg 9 Implementation of a PiT on the Grid is called “planning cases” or “snapshots”.
PR	<i>Project</i>	Is the cross border connection between two or more Countries providing additional exchange capacity, as studied in the market studies. Synonyms: interconnections

R	<i>Region</i>	A Region is made of the TSOs regrouped in the Project Management scheme
SC	<i>Scenario</i>	The four scenarios defined and assessed by the ESS WG
Rb	<i>Round B</i>	Is the final outcome of market studies
T1C		TSOs already connected to 1 of T2C -
T2C		TSOs already Connected to at least 2 of A TSOs. Alias: <i>C (refer to[1])</i>
TDC		TSOs directly connected by the project. Alias <i>AB=A (refer to[1])</i>
TNC		TSOs with no connections with A TSOs – Alias <i>E (refer to[1])</i>

Brief description of the process

The process primarily consists of 5 main steps, summarized in the following.

STEP 1_DELIVERY OF MARKET STUDIES OUTPUT

Market Studies Data

With reference to the round B, a dedicated team of the WG ESS, the ESSTF, shall provide a set of structural data (unchanged for one given scenario) and the hourly Market Studies output (time series) for each of the 4 scenarios simulated.

The selected year shall be taken from the Monte Carlo simulations by considering to avoid problems of Energy Not Supplied.

The set of **Structural data** to be provided shall content:

- The list of detailed Generation categories
- The generation capacity, for each country and each Scenario, associated to variable costs for Merit Order
- The exchange capacity considered in Market studies between each Market node

The excel file will be identified as <<YYMMDD_MedTSO_structural_market_data_for CON_VX.xls>> (where YY is the Year, MM the month, DD the day. V stands for Version and X is the progressive sequence of the version)

The **time series** to be provided in an appropriate Excel format should contain **hourly** output (8760 values) concerning (at least):

- generation output per country, per source (Thermal CCGT, thermal Coal, other Thermal, Wind, Photovoltaic, Hydro, Other RES, etc.) and merit order
- hourly year load profile for each country of the Mediterranean grid.
- hourly year exchange between countries
- hourly exchanges with non-Mediterranean countries.

ESSTF shall also provide a set of **two synchronous situations** for each scenario, selected as follows:

Individual Grid Models

- Summer daily peak (July 18th, 3rd Wednesday, 12h GMT)
- Winter evening peak (January 17th, 3rd Wednesday, 18h GMT)

Those situations are taken from the Reference case (existing exchange capacity, no additional interconnection) for each scenario and are common to the whole Mediterranean Power System.

Data are included in one excel files identified as YYMMDD_MedTSO_Common Point_Network data Collection_VX.xls.

The content of the file is the following:

- Two seasonal folder, summer and winter peak, that contain the four scenarios, in MW
- Column A to X, production, load and balance for each Mediterranean country.

- One line is 'Exchange extra' when a country is connected to external countries (only Turkey is concerned, positive value means import).
- Positive 'Balance' means the country is exporting
- Column Z to AB, exchange: within Mediterranean countries; Border condition as defined for the 3 regional zones.

STEP 2_POINTS IN TIME SELECTION

Points-in-Time (PiTs) shall be highly representative situations (hours) for the power grid operation, characterized by significant stress conditions for the power grid. Specifically, situations in which relevant power lines (such as interconnection or the cluster under investigation) are likely to be overloaded or close to their maximum ampacity, situations in which a certain generation and load pattern is likely to determine undesired voltages levels (displacements from nominal conditions) within a certain portion of the power grid or other relevant system operation conditions. The PiTs selection is aimed at representing those demanding situations and shall take into account the experience of the MIs. According to the market output provided by the ESSTF, MIs should jointly select relevant PiTs on Regional basis.

It is recommended to select up to 9 PiTs for each interconnection/cluster to be studied. The PiTs should be selected from the 4 scenarios, according to the criteria above mentioned. The PiTs selection shall guarantee at least 1 PiT per scenario but the total number of PiTs per project cannot exceed 9.

During this step, CMI will be in charge for the coordination of the PiT selection within each Region, providing the necessary support and clarifications to the relevant MIs.

STEP 3_GRID MODELS SUBMISSION TO THE EE AND MERGING

In order to perform network studies, the MIs should provide the EE with up to 4 grids, one for each scenario to be studied, which are representative of the expected grid topology in their own country in the given scenario. However, it is possible that each grid is representative of more than one scenario. The grids referring to the same scenario shall be merged by the EE and used to assess the different clusters/interconnections.

To ensure that all national grid files can be merged regarding the balance and exchanges, MIs will consider common synchronous situations provided by ESSTF and taken from the market Studies, for each Scenario. Two situations are provided, one winter peak and one summer peak, in order to cover a large range of different situation and to take into account the thermal capacity of the lines usually depending on the season.

Additionally, to ensure a total coherency with the Market Studies, MIs shall provide grid files considering the following rules:

- All the loads are total loads, independent from Generation (even if RES locally connected on DSO)
- Generation connected to DSO is locally aggregated, category by category, and connected to the relevant TSO Substation
- Generation is mapped: an attribute is used to identify the type of each Generation Plant (this attribute is The Generation Category, from 1 to 33, similar to the structural data provided by ESSTF).

As the activity of EE is to identify the constraints associated with the new interconnections and to propose and assess the relevant reinforcements, MIs shall operate some grid optimization or simplifications, as:

- Grid reduction to keep only 400 kV and relevant 225 kV (or 154 kV). In this case, all the Generation plants and Loads are aggregated by category and connected to the relevant substation. The loads are to be adjusted to include some grid losses.

- Providing a grid free of pre-existing constraint as far as possible, by adding Grid reinforcement project [yet](#) identified in the NDP
- Providing the EE with a list of constraints not related to the new interconnections, which should not be evaluated

For certain Regional interconnections/clusters, it may be used a simplified/equivalent grid (not all the Regional Grids merged) with only relevant countries merged (countries influenced by the interconnection under investigation) and boundary conditions for the rest of the countries in the Region. This simplification should be agreed between MIs case by case (case = cluster/interconnection).

Even if already provided by ESSTF in the structural data, each MIs, according to his own country common practice, shall provide the EE with the generation merit/dispatching order (DMO) if any additional information (must run, specific constraint ...). This information will be taken into account by EE when performing network studies. Specifically, to solve lines violations in the network studies, the EE should re-dispatch country's generation on the basis of the merit order provided by MIs.

During this step, each member should be responsible of managing any further request for clarification or additional data, related to the national models, provided directly with the EE.

STEP 4_NETWORK ANALYSIS RUNNING

The clusters/interconnection identified as of potential interest for the Euro-Mediterranean area shall be assessed in the frame to the PiTs selected. The EE shall simulate up to 9 PiTs for each cluster/interconnection. During this step, each member should be responsible for managing any further request for clarification or additional data, related to the national models provided, directly with the EE.

Network studies shall include Load Flow analyses in N and N-1 conditions, highlighting all the actions (if any) such as redispatching, topology remedial actions, grid reinforcements needed to run the system in security. TDC shall provide information on operation practices and details to assess the plausibility of the proposals.

STEP 5_RESULTS ANALYS

The EE should provide a comprehensive preliminary per project report (in one or more documents) to MIs about the Network Studies performed. This report should include at least the following information:

- Information provided by the MIs
- Assumptions made by the EE
- Summary of the PiTs investigated
- Criteria and Re-dispatching amounts adopted
- Load flow results according to the reference grids in each scenario/PiT (power exchange per lines, violations found, losses calculated, etc.)
- Load flow results for the project assessed according to TOOT/PINT (power exchange per lines, violations found, losses calculated, etc.)
- Further comments and conclusions by EE

MIs may propose to perform further analysis or review some of the assumption made by EE.

A final report will be as well delivered to all MIs after the validation of results by TC1.

All data to be delivered to the EE must be uploaded on Med-TSO website in the dedicated folder following the procedures set up in the Document Common Repository.

NOTE

Despite the necessity to perform selections and studies with big support of experience if MIs and taking into account the peculiarities of the Power Systems in question, uniformity and coherence of criteria have to be guaranteed within the single region and among Regions.

Description of the selection process

This is the “default process”. In case were the “proximity” of TNCs is weak, simplifications are allowed and recommended to limit the number of network studies. Simplifications can be suggested by the EE or MIs and approved by the CMIs of the region and shared among MIs of the same Region. CM

STEPS

step	who	Notes	
>	Do loop scenario	Repeat for 4 scenarios	
	ESSTF	<ul style="list-style-type: none"> • With reference to round B ESS makes available data and projects • Rank projects in terms of complexity, status, etc 	<ol style="list-style-type: none"> 1. How quantify each scenario at TSO level. What level of agreement is needed. 2. scenarios are the same for each project?
>	End of loop scenario		
>	Do loop Region	Process Regions	Proceed in parallel for West, East and Centre
>	Do loop scenario		For each Scenario
	TDC + T2C	<ul style="list-style-type: none"> • MIs of Region provide the EE with one grid for each scenario. In general the Projects are not included in the grid unless already simulated in the NDPs 	<ol style="list-style-type: none"> 3. <u>The grid should reflect the effect of the scenario.</u> For example any additional internal project that is already planned in order not to have overload/congestion with the production/load assumptions of the green scenario should be included in the grid used for this scenario.
>	End of loop scenario		
>	Do loop Project	To select Project	Proceed project by project
>	Do loop PiT		Max 9 times
	TDCs	<ul style="list-style-type: none"> • To bilaterally agree on 9 PiTs to be analysed for each cluster/interconnection. 	<ol style="list-style-type: none"> 4. Pit for one cluster/interconnection shall be the same for the countries involved in one cluster/interconnection. For the second cluster/interconnection another 9 Pit, possibly different that the previous ones, even if the countries involved are the same. 5. Significant relevant situations in terms of stress of the systems have to be selected as well saturation on the cluster/interconnector
	T2Cs +T1Cs	<ul style="list-style-type: none"> • Accept the 9 selected PiTs 	
	TDC+T2C+T1C +TNC	<ul style="list-style-type: none"> • To provide information related to the 9 PiTs and/or • To provide “dispatch merit order” 	<ol style="list-style-type: none"> 6. The level of information provided by each category of MI should be defined
>	End of loop		
>	End of loop		
>	End of loop		

REFERENCES

[2] ENTSO-E Guideline for Cost Benefit Analysis of Grid Development Projects -FINAL- Approved by the European Commission - 5 February 2015

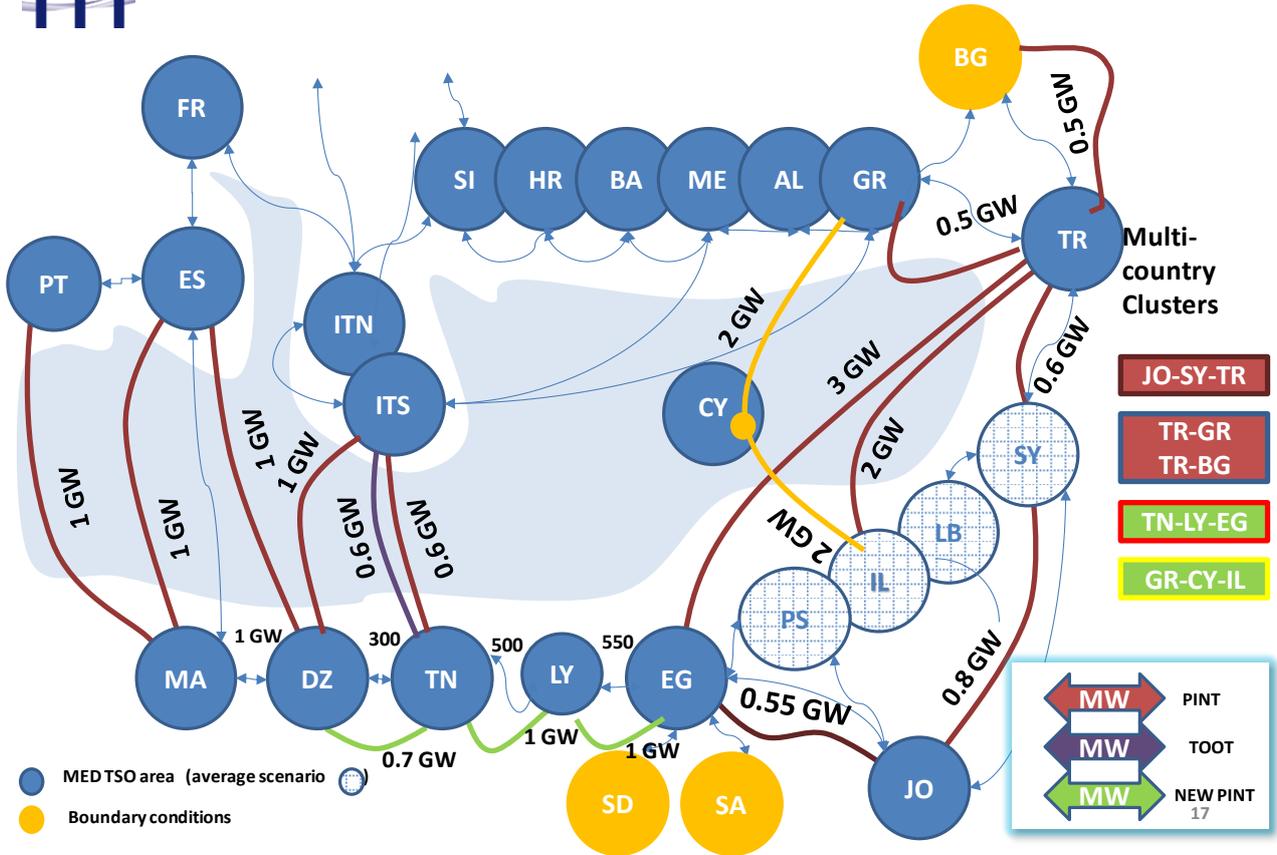
[1] Stamatina Estathiou



General proposal for
PIT+Proposal Eastern



Long term projects > 500MW



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