Integrating large quantities of Renewable Energy Sources in the electricity grid in Portugal

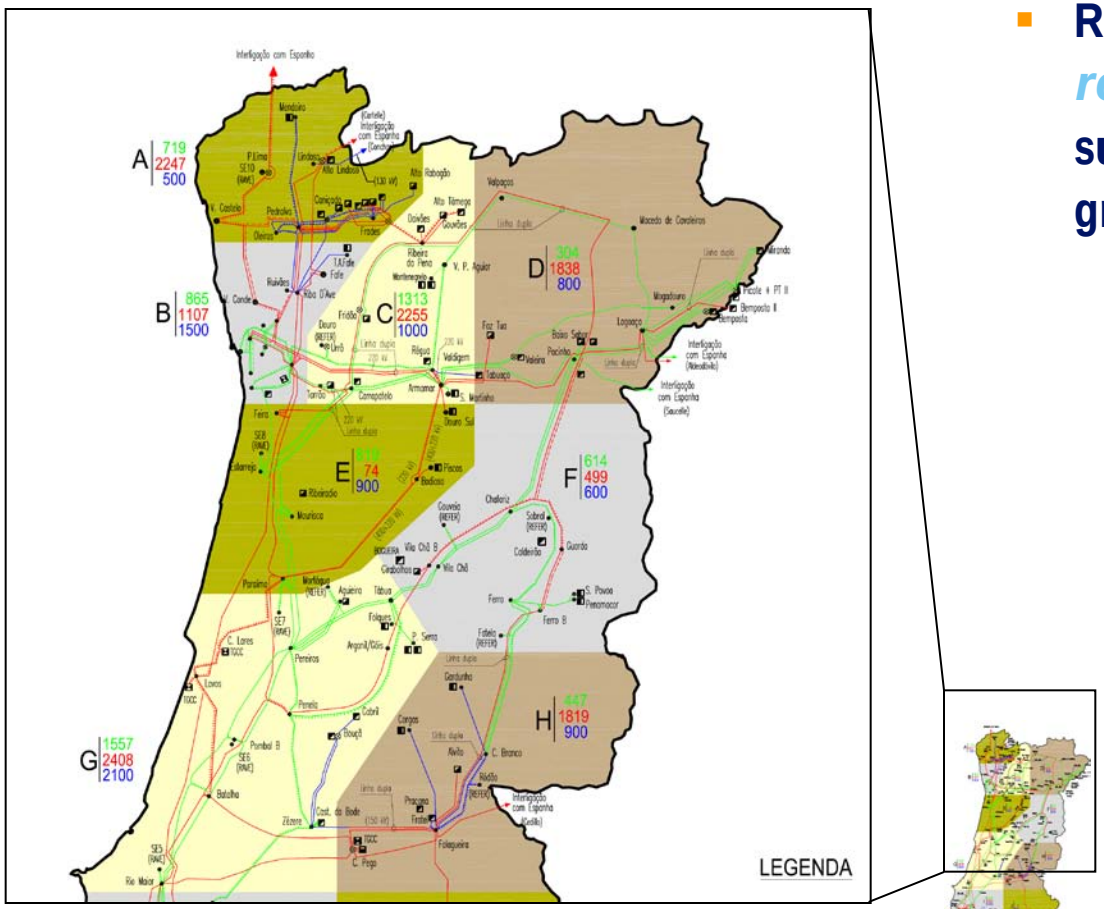
Workshop “High Penetration of PV Systems in Electricity Grids”

11/05/2011

Introduction

- REN has some experience in high penetration of Renewable energy sources (RES), specially in wind generation
- For that experience we can anticipate some issues for a future scenario of high penetration of PV generation
- This presentation describe some procedures and issues experienced by REN regarding high penetration of RES.

The generation access



- **REN calculates *grid generation reception capacities* for all substations/zones according to grid plan**
  - **Annual publication of the reception capacities of the grid in mid term horizon (detailed by substation)**
  - **Publication, every 3 years, the long term reception capacities (indicative values by zone)**

NNNN – Special status generation installed or reserved

NNNN – Ordinary generation installed or reserved

NNNN – Additional reception capacity

The generation access – Procedures

REN

- Define annual reception capacities of grid (public)

Directorate for Energy and Geology (DGEG)

- Receive applications for new generation projects from the promoters and send it to REN or DSO
- Decisions on attribute reserve capacity for the projects

REN

- Receive applications from DGEG
- Give (or NOT) OK for connections
- Define connection solutions
- Build and reinforce the grids (if necessary)

Renewable disperse generation

From late 90's REN has been creating a new paradigm to cope with growing targets in renewable disperse generation, in close cooperation with the Ministry responsible for energy and the Distribution System Operator

REN is responsible for stability and security of the electrical transmission system

Priority

- **Need of specifications of new technical requirements**

Portuguese Grid Code

- In 2010 the Ministry of Economy and Innovation made public the new Portuguese Grid code that has a set of technical requirements for wind generation
- One of the main issues is the performance of wind generation during voltage dips and that lead to the specification of FRTC and reactive power injection for wind generators

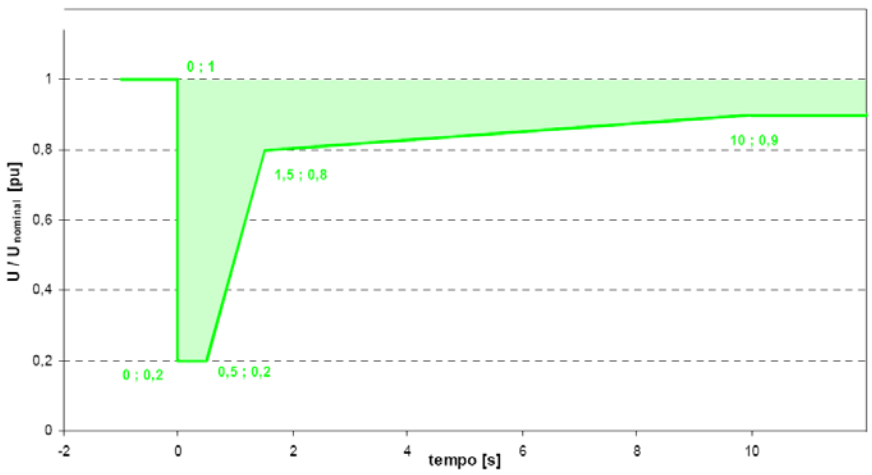


Fig. 1 - WTG Fault Ride Through required curve.

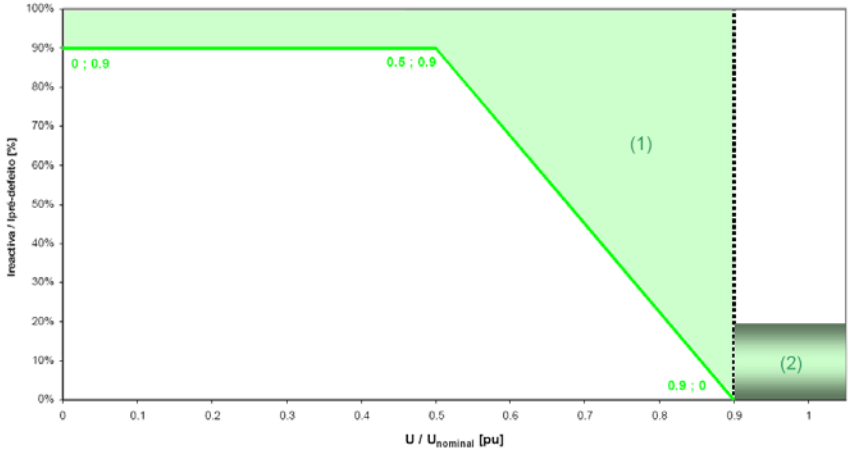
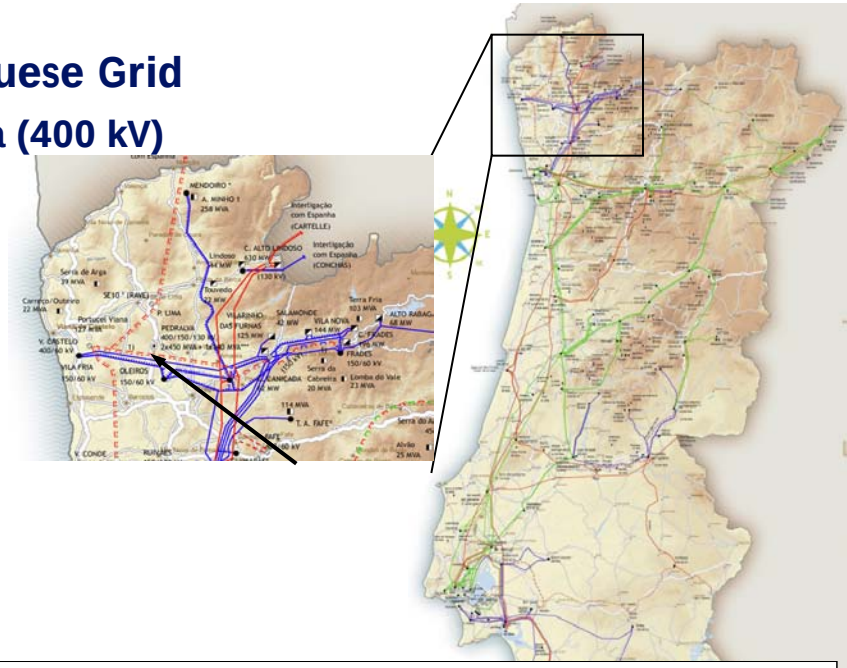


Fig. 2 - Reactive curve supply by the Wind Farms during voltage dips.

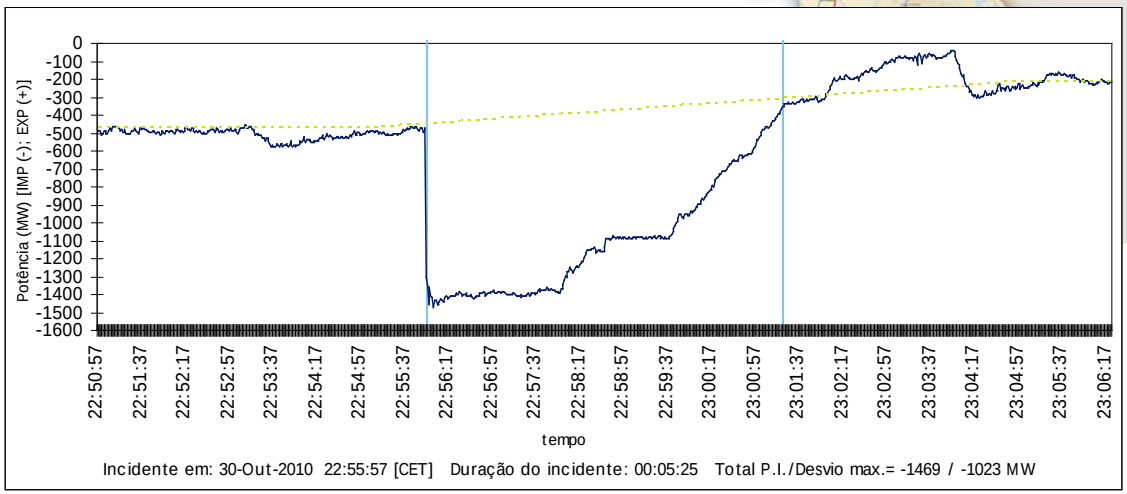
- REN and joint REN/REE dynamic studies justified this need

Example - Incident

- **Incident in 30 of October 2010 in the Portuguese Grid**
  - **Short-circuit in the line Alto Lindoso – Pedralva (400 kV)**



The amount of wind power in that moment was approx. 3000 MW
Loss of 1000 MW of wind power generation

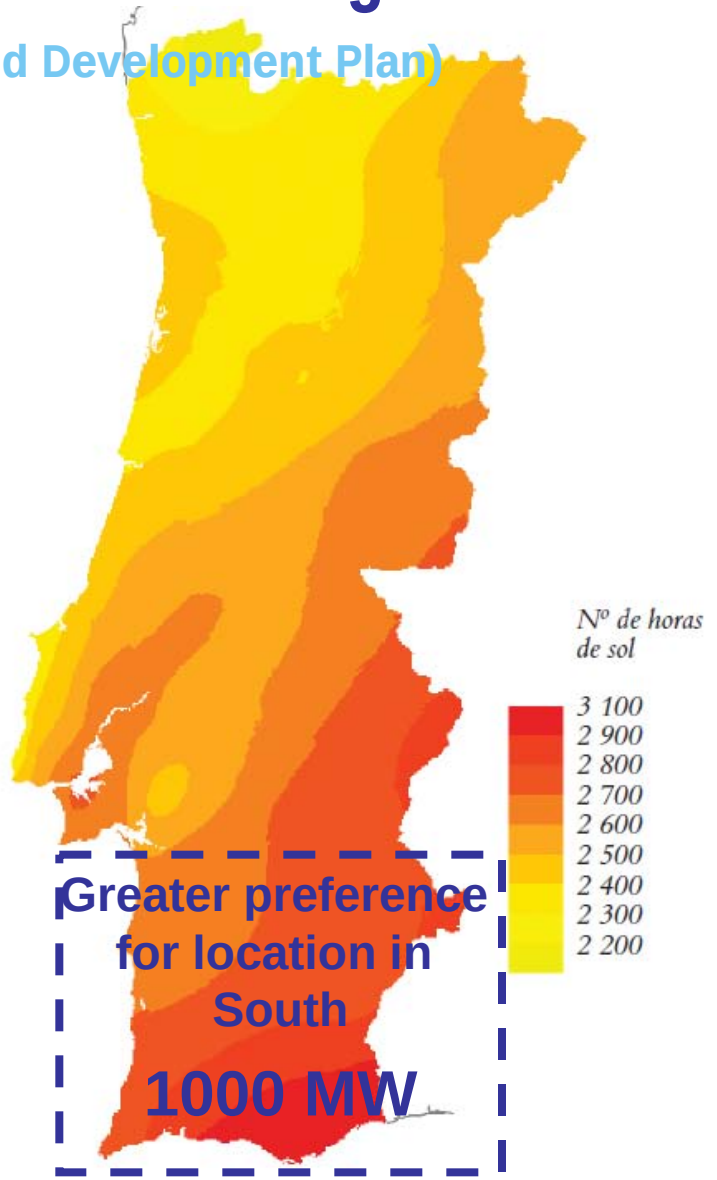


Implementation of FRTC in wind generators is necessary to avoid losses and other grid problems

Scenario of solar generation in Portugal

(Perspective of PNAER* used in the new Grid Development Plan)

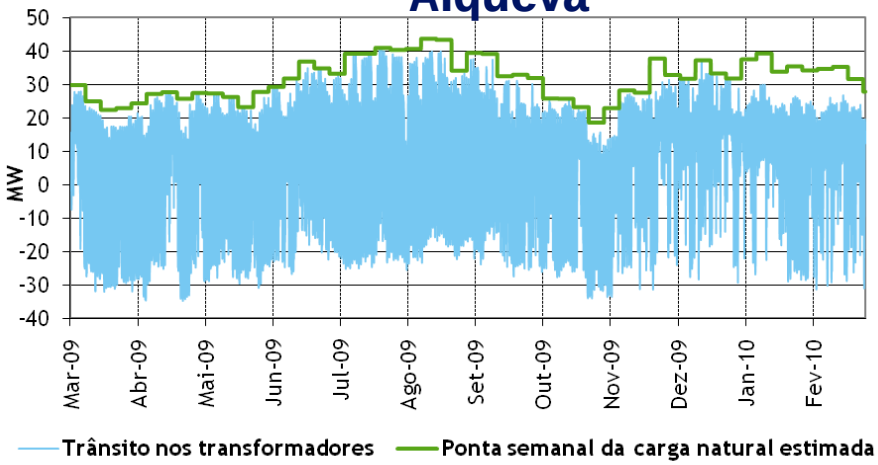
- Goal of 1500 MW in 2020
  - ✓ Around 1000 MW in Alentejo e Algarve
  - ✓ Remaining power dispersed at the national level (focusing more on micro-generation), especially in areas of higher population density
  - ✓ Need to reinforce the Alentejo and Algarve regions where it justifies the higher concentration of solar projects



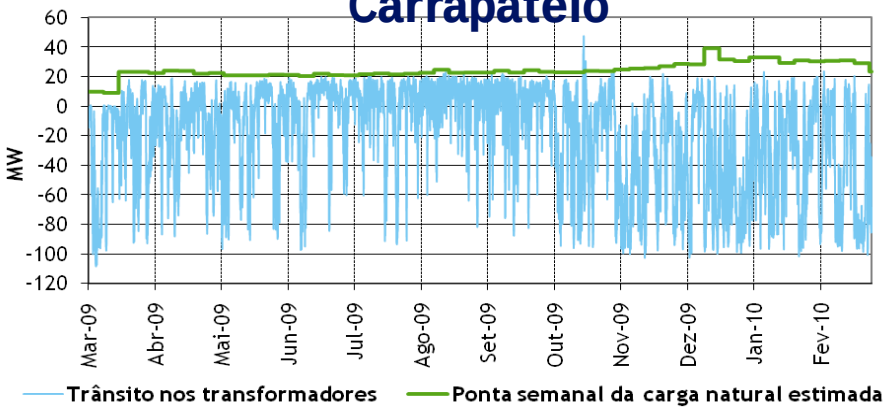
* Programa Nacional de Acção para as Energias Renováveis 2010-2020

Example - Power flow in Substations

Alqueva



Carrapatelo



In some substation the power flow is reversed

From lower to higher voltage

- **Different approaches on planning reinforcements of the grid**
- **It's frequent the reinforcement need in transformation is due to distributed renewable generation**

Conclusions

- High penetration of renewable generation is a challenge for TSO
- Cooperation and coordination between TSO and DSO's and also with neighbour TSO's and RES associations are also necessary
- New issues in planning, construction and operation of electrical grids are necessary and must be implemented in time
- Revision of codes and rules must be done at an early stage of the process
- Specification of new technical requirements for stability, security and operation of electrical grids is key

Thank you.