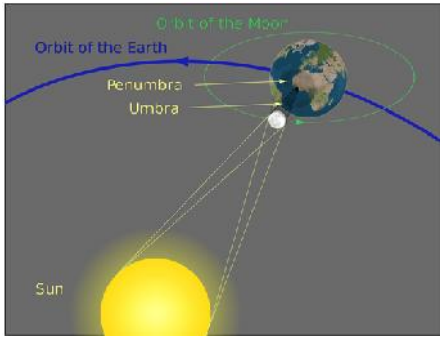
Solar Eclipse – March 20th 2015

WG System Operation 6-03-2015

Solar Eclipse – 20 March 2015



A solar eclipse will pass through the European power system

- Between 07:40 and 11:50 UCT (08:40-12:50 CET)

The reduction in solar radiation will directly affect the output of photovoltaics

- Total PV capacity in Continental Europe is expected to reach ≈ 92 GW in 2015
- Eclipse may potentially cause a reduction of the PV infeed by more than 34 GW during clear sky conditions. Their power gradient is estimated to be 2 to 4 times higher than normal daily ramping.

Although this is perfectly predictable this calls for a careful coordination throughout the entire interconnected power system

- This situation will pose a serious challenge in terms of available regulation capacity, regulation speed and geographical location of reserves.
- For comparison the current primary reserves amounts to 3 GW.

Entso-e vision and countermeasures

- Entso-e mandated a solar eclipse task force to analyse the potential operational issues at pan European level, with particular attention to the Continental Region and:
  - estimate the installed PV capacity on March 20 2015, per country.
  - estimate the PV infeed on March 20th by combining capacity and coincidence factors for each country with radiation data with and without the solar eclipse.
  - Make an inventory of potential mitigation measures, their lead time of preparation/ activation and the level of agreement on European level versus national level.

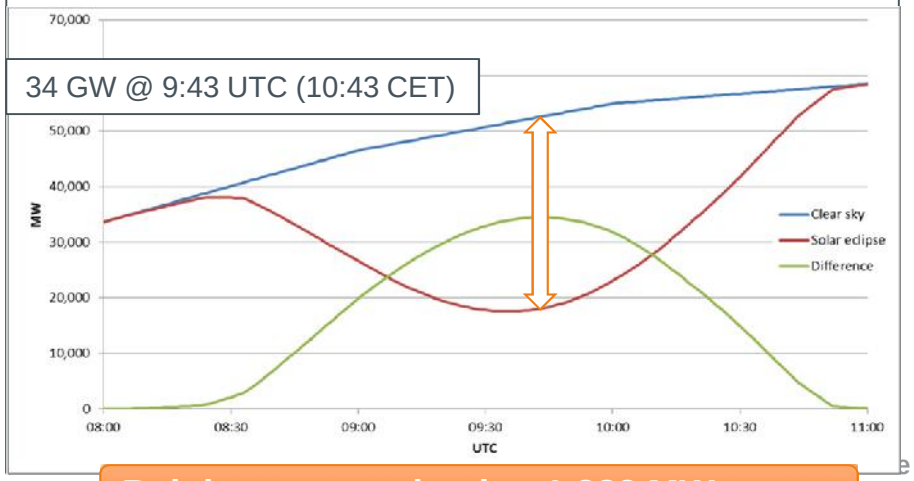
Taskforce Solar Eclipse => Results

Assumptions

- Installed PV capacity in Belgium: 3.245MW
- PV generation is concentrated in one spot per country: Brussels for Belgium
- The duration of the eclipse is considered in each country from its beginning on the western border to its end on the eastern border of the country : in Belgium, start 08:27 UCT (09:27 CET) – end 10:45 UCT (11:45 CET)
- No change of system load is considered (i.e. people stopping work to view the eclipse).

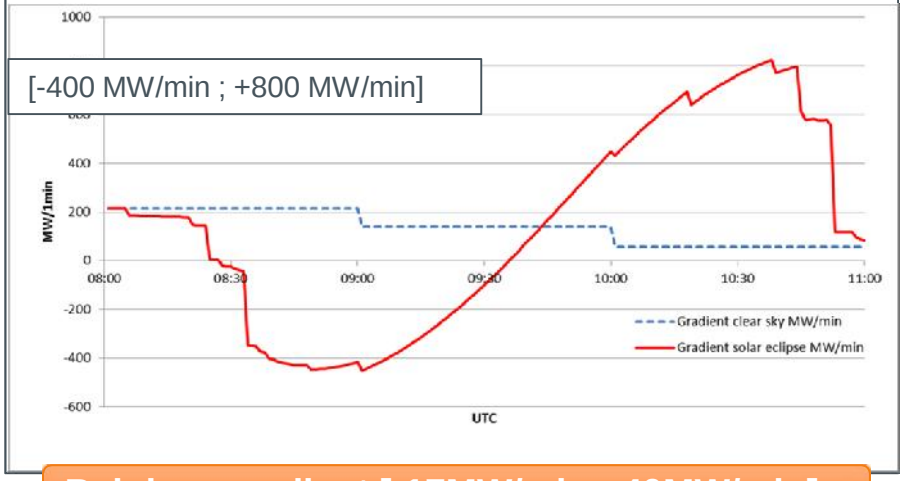
Results

Comparison of expected infeed from solar power **during clear sky conditions** with and without solar eclipse (Cont. Europe)



Belgium max reduction 1.383 MW

Expected power gradient in MW per minute from solar power **during clear sky conditions** with and without solar eclipse (Cont. Europe)



Belgium gradient [-17MW/min ; 40MW/min]

50% of the infeed reduction is expected in Germany and 21% in Italy

Possible countermeasures

Individual TSOs

- Each TSO shall identify and primarily resolve its own operational risks and constraints related to the solar eclipse.
- The infeed from PV is highly depending on cloud coverage. A correct day-ahead forecast of PV is particularly important for March 20th
- Balancing responsible parties are to be made aware of this event so that they take into account the impact on their portfolio (and act accordingly)

Continental Europe synchronous area coordination

- TSOs that foresee a possibility that their operational measures to solve the risks which are related to the solar eclipse will not be adequate, shall agree with their neighbour TSOs solutions to receive help from these neighbours.
- During the eclipse the cross-border capacity on the critical borders could be decreased in order to reserve capacity for balancing.
- Regional security and coordination initiative (RSCI like Coreso) can be involved in D-2, D-1 and ID to check forecast files, detect potential constraints due to reserve exchanges and propose remedial actions.
- If necessary TSOs will set up a strong operational coordination until the day of the eclipse, including real-time teleconference to coordinate real-time frequency management, reserve exchanges and flow management.

Countermeasures foreseen by Elia

1. Elia has requested **BRPs to carefully and proactively analyse this special event and take all necessary preventive measures** (e.g. in relation with the behaviour of their solar forecasting tools) to be able to balance their portfolio during the eclipse.
2. Elia will make sure that **our own forecasts** of PV are as accurate as possible for the 20th of March, including the effect of the solar eclipse.
3. **The residual imbalance** we estimate to handle in the Belgian control area is expected to be in the range of common changes (i.e. to handle RES forecasting errors and/or power plants connection/disconnection), nevertheless, we do foresee the strategic use of pump storage power plants as an additional back-up measure.
    - Based on our D-1 forecasts we will request pumps and/or turbines to be available at the most critical times for switching ON/OFF.
4. **Coreso** will be requested in D-2, D-1 and ID to anticipate for potential constraints.
5. Elia will participate in **online teleconferences** between operational managers of Continental Europe to allow a fast coordination in case, despite all precautions taken, critical frequency deviations would occur.

Questions and/or Comments?

Many thanks for your attention!

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