Meeting ENTSOe - AEE

Implementation of Network Codes

28th october 2022

More than 280 members, AEE represents 100% of value chain and more than 95% of the wind sector activity

- Consultancy,
- Developers,
- Manufacturers,
- Engineering
- Logistics
- Services O&M
- Insurance
- Financial
- Legal
- Regional
- Others.

https://aeeolica.org/sobre-aee/nuestros-socios/

Our mission: To promote the growth of wind power by **defending its interests**, R&D, communications and training.

Our vision: Wind power is key for **Spain´s Energy independence**, its economy development and environment´s sustainability.

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SYSTEM INTEGRATION Working Group

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SYSTEM INTEGRATION WG

- Goals: **Technical analysis, positioning papers, advocacy, allegations in public consultations, communication with other organisms**
- With the participation of all AEE members

red eléctrica

GT ED
- Objetivo: **Actualización Especificaciones de Detalle**
- Coordinado por REE y CNMC
- Participación de Asociaciones (por invitación de REE)

GT EMT
- Objetivo: **Propuesta elaboración de Modelos EMT**
- Coordinado por REE (Dpto Fiabilidad del Sistema)
- Participación de Asociaciones (por invitación de REE)

GRAI
- Objetivo: **Análisis de Incidentes**
- Coordinado por REE (Dpto Seguridad del Sistema)
- Participación de Distribuidoras y Asociaciones

CTSOSEI
- Objetivo: **Seguimiento Operación del Sistema Ibérico**
- Coordinado por REE y REN
- Participación de Distribuidoras y Asociaciones

INTEGRACIÓN RENOVABLES
- Objetivo: **Integración de renovables en el sistema**
- Coordinado por REE (Dirección de Operaciones y CECOEL)
- Participación de Asociaciones (por invitación de REE)

National Regulators

CNMC
COMISIÓN NACIONAL DE LOS MERCADOS Y LA COMPETENCIA

GOBIERNO DE ESPAÑA
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

European Stakeholders

Wind EUROPE

ACER
European Union Agency for the Cooperation of Energy Regulators

entsoe

- Meeting: **28 October 2022**
- Implementation of Network codes, Gridforming

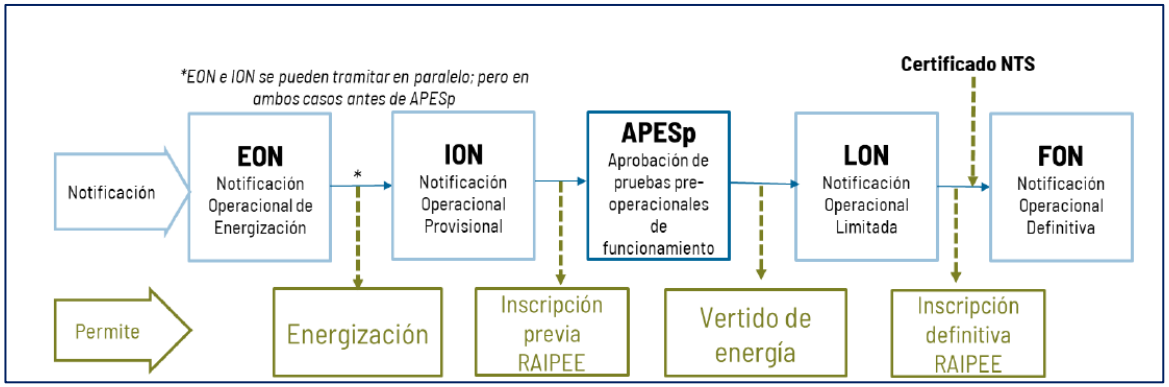
- Public Consultation: **Updating the grid connection network codes to cover e-mobility and storage**
- Deadline: **21st Nov**

https://www.acer.europa.eu/events-and-engagement/news/acer-consults-updating-grid-connection-network-codes-cover-e-mobility

Exceptional mechanism for Operational Notifications

In Spain it has been necessary to implement a **temporary excepcional procedure** to allow power generating modules to connect to the grid, by adapting the existing figure of a **Limited Operational Notification (LON).**

- Spanish new grid codes implementing EU Reglament 2016/631, were not published until august 2020.
- Power Park Modules (PPM) were allowed to obtain a LON, to be able to connect to the grid and start operations, without the need to provide NC certificates. PPM owners were given a **2 years deadline** to provide these NC certificates (until august 2022).
- The Spanish Standard for grid code compliance and certification was not published until november 2020.
- Laboratories and Certification bodies needed at least one year to obtain their acreditations.
- Manufacturers and developers could not start the certification process of their WTG and PPMs until laboratories and certification bodies were accredited. This process took more than a year.
- The initial temporary period of 2 years has had to be extended for 18 additional months (until february 2024).



Exceptional temporary procedure

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Exceptional mechanism for Operational Notifications

Lessons Learnt:

- The implementation of new requirements for generators is a long and complicated process, which **requires a strong cooperation between Regulators, TSO, developers, manufacturers and certification bodies**.
- The certification procedure **can take several years to be defined and get running**.
- The delay between Network Codes approval and the availability of certificates **has to be taken into account for future revision of NC**.
- Additionaly, the Wind industry needs to implement a permanent **certification process for "prototypes",** similar to the excepcional temporary mechanism that has been used in Spain, so that new WTG models are allowed to connect to the grid during a certain period (2 years), before providing the NC certificates.

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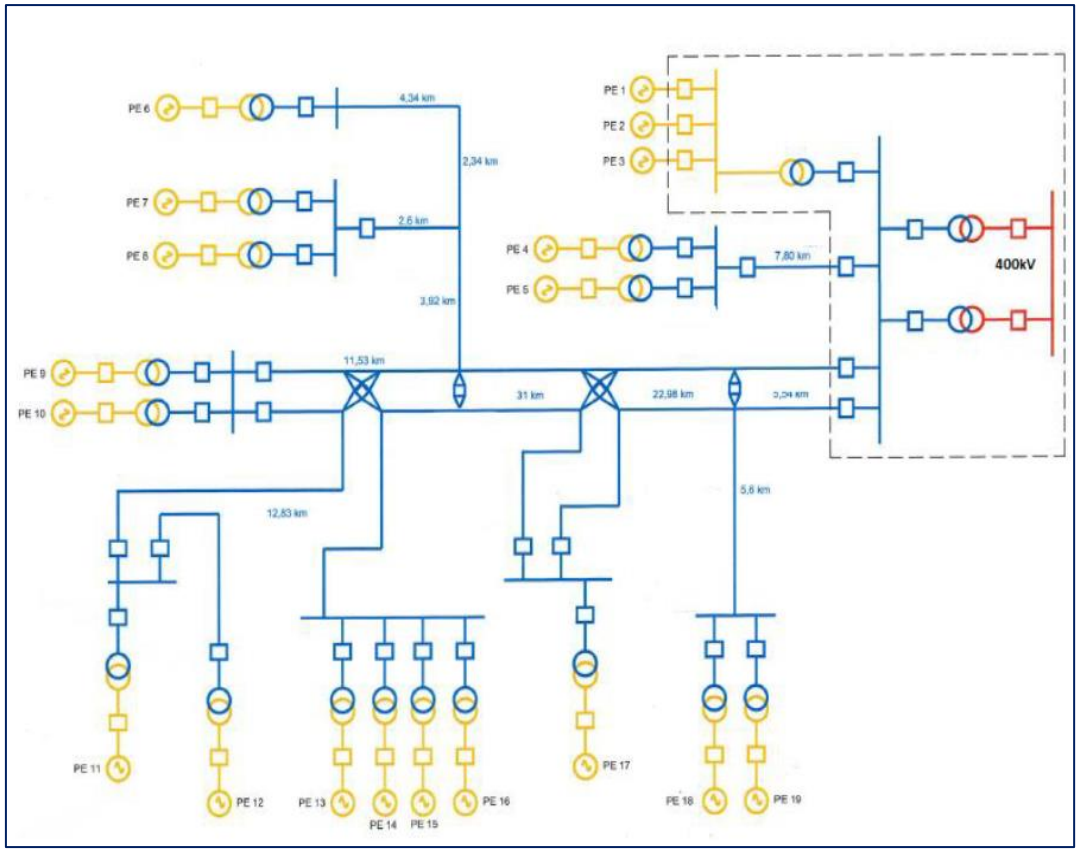
Connection topology in Spain: Shared Connection lines

Regulation in Spain obliges PPM owners to **share the connection infraestructures** (lines, Transformers, etc) up to the Connection Point.

- This has result in a **very efficient electrical system** in terms of being able to connect more than 30 GW of PPM without the need of a entanglement of high voltage electrical lines. It is a very **cost effective solution**, with **lower environmental impact** than other models based on individual connections.
- However, European Grid Codes (Reg EU 2016/631) are not designed for shared connection infraestructures.

- New PPM affected by new grid codes must **comply with most requirements at the Connection Point** with the transmission grid.
- However, **existing PPM which were built under the last regulatory framework**, only have to comply with different requirements, and at the PPM terminals.



Real example: 19 PPM connected to a single connection point of the Transmission Grid

Connection topology in Spain: Shared Connection lines

Main problems identified:

- **Coordination of these shared networks is becoming a tough challenge**, that can even compromise the System security.
- **Several PPMs affected by different regulations and network codes**, and owned by different asset operators, have to coexist on the same common infraestructure and comply with different requirements.
- Specific problems with:
  - Coordination of **Voltage Control** in connection point
  - **Reactive power compensation**
  - **Impact from one PPM to their neighbours**, when adding synchronous compensators or other sensible equipment.

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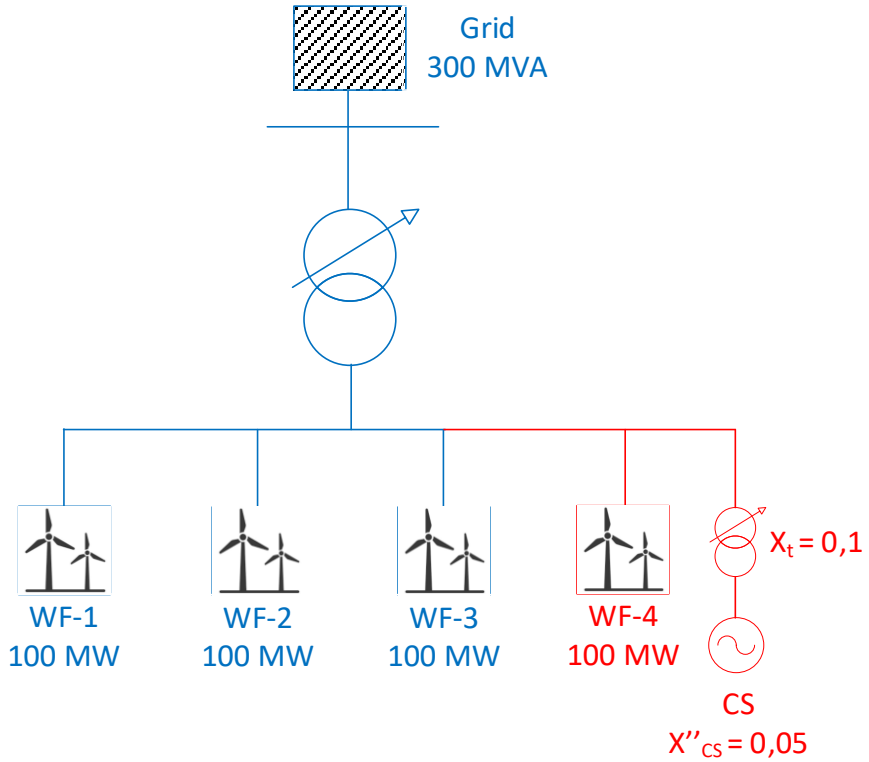
Addition of Synchronous Compensators by individual PPM. Affection to existing PPM



$$Capacidad\ MPE\ adicional\ (MW) = \frac{S_{cc\ aportada\ SC}}{umbral\ WSCR\ del\ nudo}$$

CASO 1: WF/PV adicional de 100MW

$$100\ MW = \frac{S_{CS}/(X''_{CS} + X_t)}{10} = \frac{S_{CS}/(0,05 + 0,1)}{10}$$

$$S_{CS} = 100 \cdot 10 \cdot (0,05 + 0,1) = \mathbf{150\ MVA}$$

CASO 2: WF/PV adicional de 300MW

$$300\ MW = \frac{S_{CS}/(X''_{CS} + X_t)}{10} = \frac{S_{CS}/(0,05 + 0,1)}{10}$$

$$S_{CS} = 300 \cdot 10 \cdot (0,05 + 0,1) = \mathbf{450\ MVA}$$

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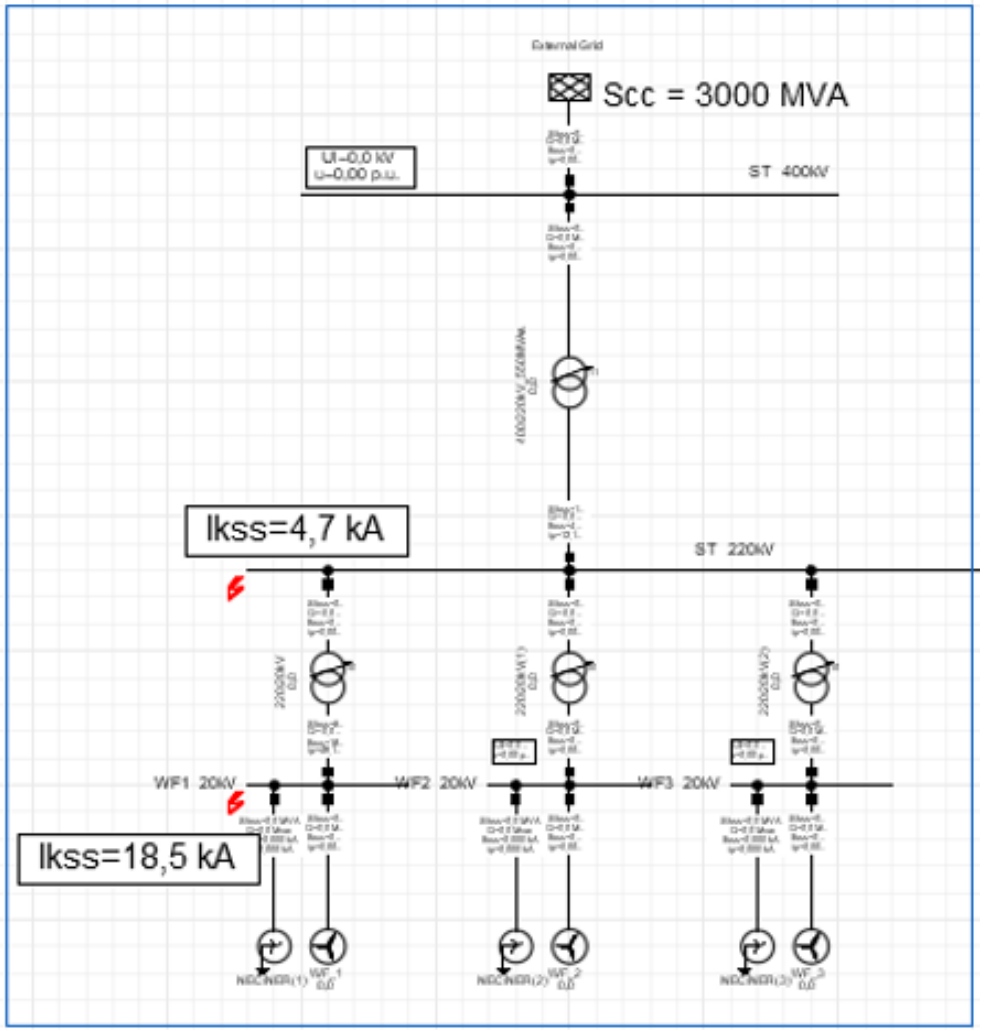
Addition of Synchronous Compensators by individual PPM. Affection to existing PPM

Simulation in existing node, without synchronous condenser:

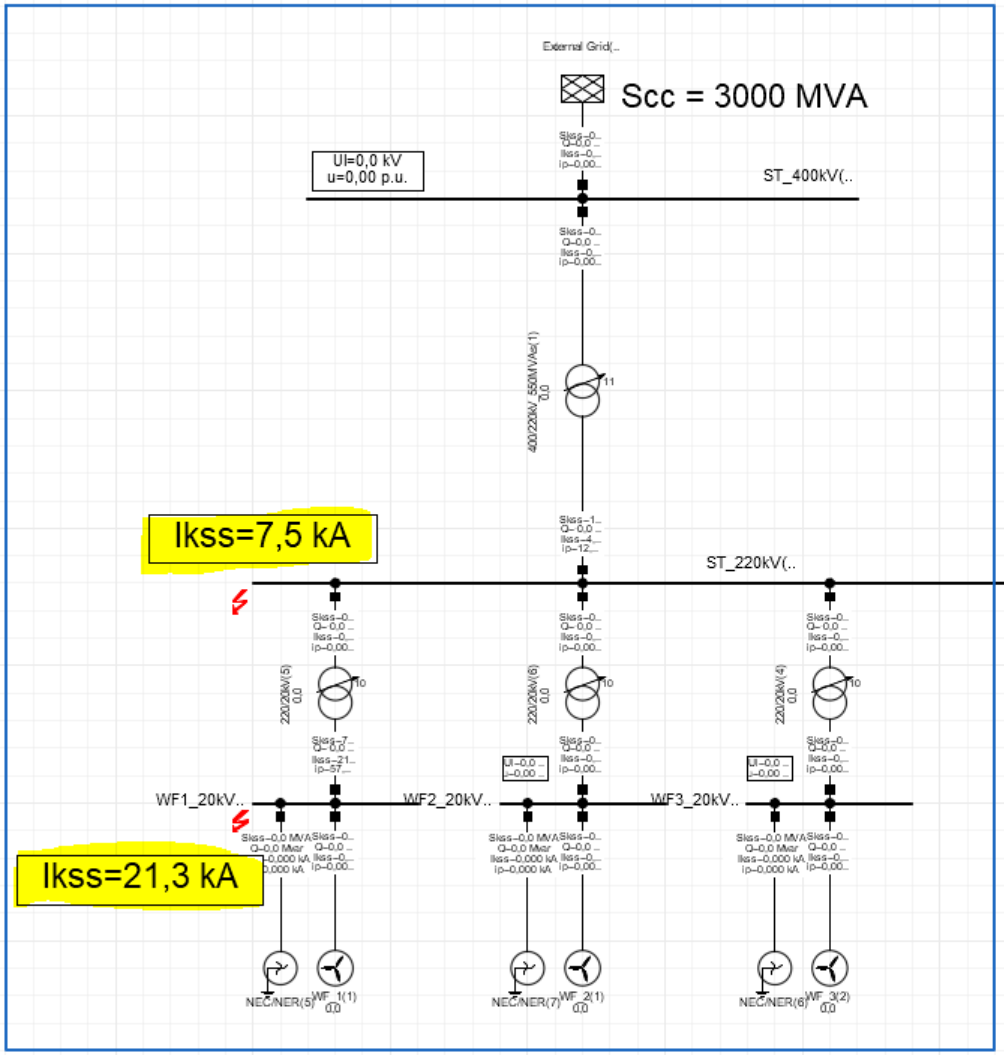
Initial situation:

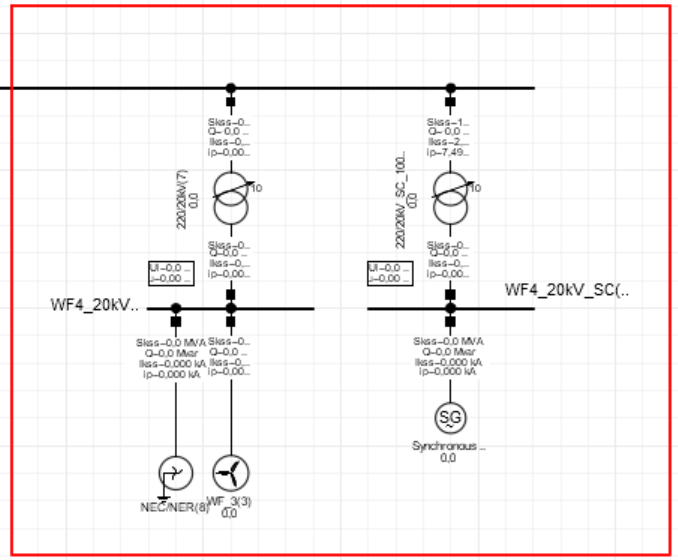
- Network Scc = 3000 MVA
- **Icc 220kV = 4,7 kA**
- **Icc 20kV = 18,5 kA**



Addition of Synchronous Compensators by individual PPM. Affection to existing PPM

Simulation in existing node, adding a synchronous condenser:



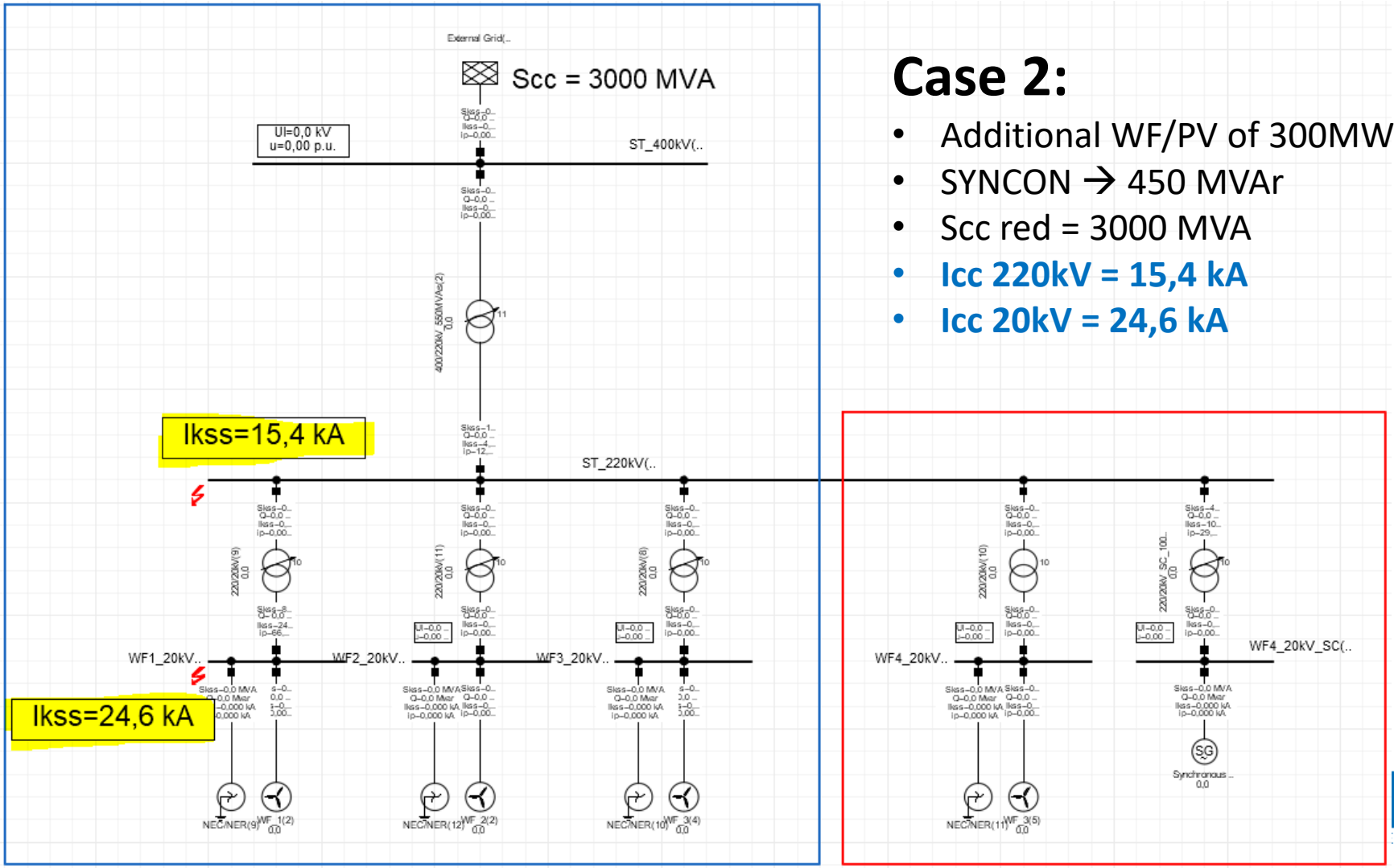


Case 1:

- Additional WF/PV of 100MW
- SYNCON → 150 MVAr
- Scc red = 3000 MVA
- **Icc 220kV = 7,5 kA**
- **Icc 20kV = 21,3 kA**

Addition of Synchronous Compensators by individual PPM. Affection to existing PPM

Simulation in existing node, adding a synchronous condenser:



Case 2:

- Additional WF/PV of 300MW
- SYNCON → 450 MVAr
- Scc red = 3000 MVA
- **Icc 220kV = 15,4 kA**
- **Icc 20kV = 24,6 kA**

Addition of Synchronous Compensators by individual PPM. Affection to existing PPM

Increase of Short Circuit Current can have great impact on existing PPMs:

1. ***CUTTING ELEMENTS:***
   - *Forces to replace switchgear, switches, cells*
2. ***SAFETY OF PEOPLE:***
   - *Variation of short-circuit currents in substations implies variation in step and touch voltages. Need for validation of grounding meshes.*
3. ***BUS BARS, SUPPORT INSULATORS…etc.:***
   - *Variation of short-circuit currents in substations implies variation in mechanical stresses in the busbars, both fixed (tubes) and flexible (pendolons…etc.), support insulators…etc.*
4. ***CABLES:***
   - *Review of insulated cables, screens, bare cables…etc.*

Grid Access Tenders with additional capabilities

The government in Spain is about to launch several **tenders to allocate new connection permits** to the transmission grid.

These tenders **will be awarded taking into account several technical criteria**. The projects that incorporate the following capacities will receive a higher rating:

- Storage.
- Hibrid solutions.
- Synchronous kinetic Energy.
- Short circuit power from synchronous machines.
- Additional reactive power capacity.
- Robustness: Voltage stability.
- Power oscillation damping.
- Automatic power reduction System.

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Grid Access Tenders with additional capabilities

Position of the wind sector:

- These tenders encourage PPM to incoporate additional capabilites and equipments such as synchronous compensators, statcoms, storage, inertia emulation, etc... in order to strive for allocation of new access and connection permits.
- Not all the nodes of the Transmission Grid need the same technical capacities to integrate renewables. The electrical System would only require these extra capabilities in some specific nodes.
- No technical studies or cost-benefit analysis have been provided to justify the suitability of requiring these criteria at PPM level.
- The tenders will oblige all participants to add extra equipment to win, adding a significant extra cost. Thus, the development of renewables is artificially driven up, by demanding extra capabilities compared to the recently approved network codes. In many cases these additional capabilities are not really necessary or will not be used.
- In any case, the requirement of extra capabilities should be implemented through new market services.
- Particular problems in specific nodes of the transmission grid can be solved directly by the TSO, adding the necessary equipment through the Grid Planning process.

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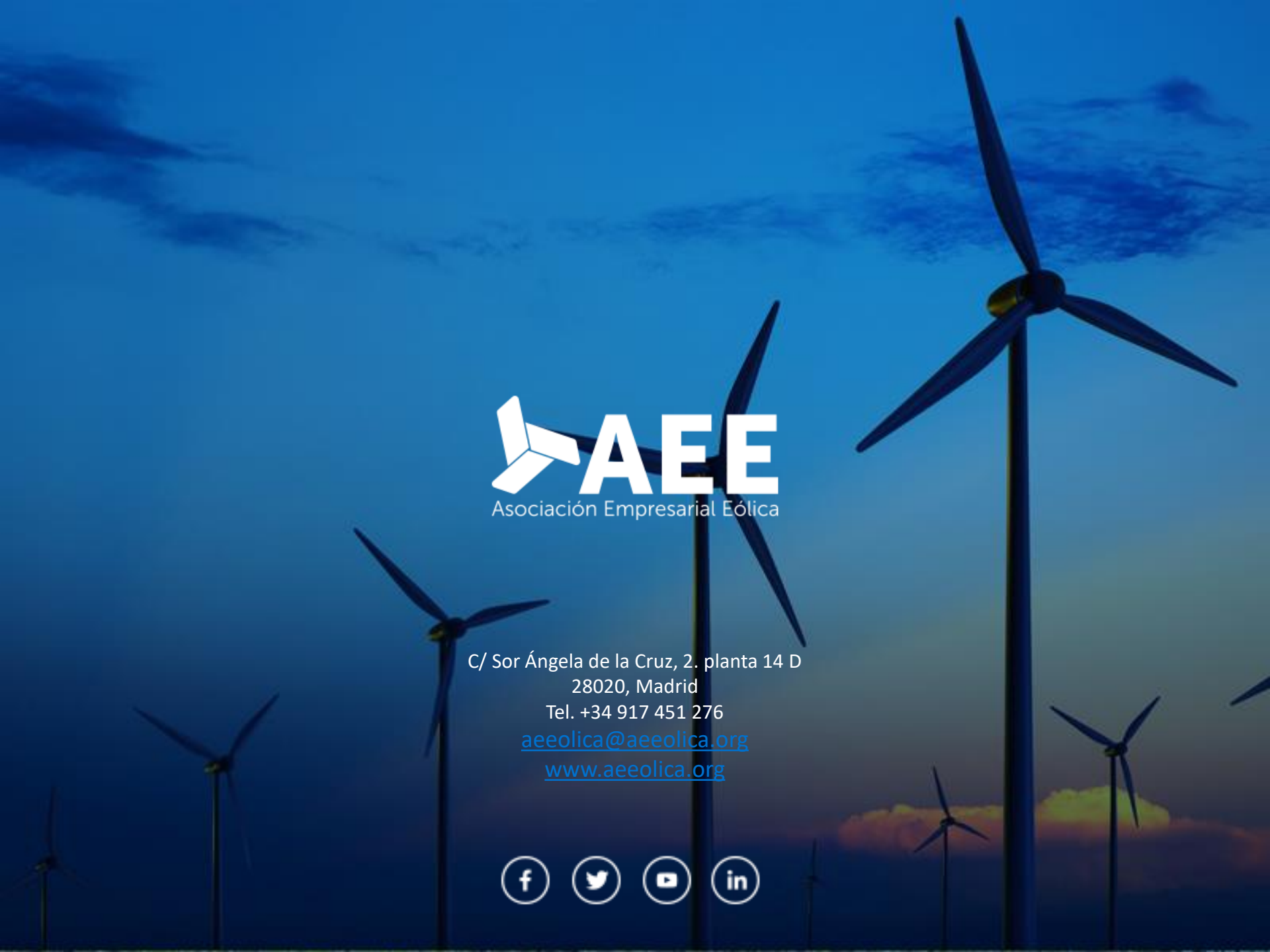

C/ Sor Ángela de la Cruz, 2. planta 14 D
28020, Madrid
Tel. +34 917 451 276
aeeolica@aeeolica.org
www.aeeolica.org