A holistic approach to capture flexibility.
The experience of OSMOSE

February 2\textsuperscript{nd} 2022
AGENDA

• OSMOSE project overview
• Holistic approach to capture flexibility: OSMOSE Experience
  1. Sizing and Siting of Flexibility Options
  2. TSO/DSO Flexibility Coordination
  3. IEC 61850 as a Flexibility Enabler
• Main conclusions and final messages
AGENDA

• OSMOSE project overview

• Holistic approach to capture flexibility: OSMOSE Experience
  1. Sizing and Siting of Flexibility Options
  2. TSO/DSO Flexibility Coordination
  3. IEC 61850 as a Flexibility Enabler

• Main conclusions and final messages
OSMOSE project overview

OSMOSE - Optimal System-Mix Of flexibility Solutions for European Electricity

Holistic development of flexibility solutions for RES integration

6 European TSOs
RTE, REE, TERNA, ELES, ELIA, REN

6 manufacturers-integrators
Including generalists (ABB, Schneider Electric, EFACEC), storage specialist (SAFT), power-electronics specialists (GPTECH, INGTEAM)

1 energy service provider
Compendia

5 RES electricity producers
HSE, ENEL, E2i, Edison, Hydro Dolomiti Energia

2 IT. companies
IBM & Engineering

2 consulting and software company
EKC & IT4Power

11 research centres and universities
CEA, EPFL, UPD, UDE, TU Berlin, RSE, ENSIEL, ULPGC, CENER, R&D NESTER, FBK

The project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 773406
OSMOSE project overview

OSMOSE - Optimal System-Mix Of flexibility Solutions for European Electricity

Holistic development of flexibility solutions for RES integration

• Long-term Flexibility Scenarios
  - Optimal Mix of Flexibilities
• Novel Market Designs and Regulations
• Demonstration of Flexibility Technologies for RES integration
Enable the Energy transition to high share of Renewable Energy Sources through holistic approach

Demonstrations with large coverage of flexibility needs will address scaling-up, replicability and interoperability

Pan-European roll-out of flexibility solutions and services will create new market opportunities

Policy recommendations on market design and regulations to ensure cost-effective provision of flexibility.

Through the integration of large share of RES generation it will promote GHG emissions’ reduction at European level.

Real-time dispatching market platform for both National and Cross-border services will maximise the social welfare.
OSMOSE project overview

**TSO-driven Demos**

**WP3 DEMO**: Grid forming for the synchronisation of large power systems by multi-services hybrid storage
- Supercapacitors 1MW-10s
- 0.5MVA-60min Li-Ion battery
- RTE substation
- 720 kVA/560 kWh
- ETO battery
- 25 kWh LOT battery
- EPFL campus

**WP4 DEMO**: Multiple services provided by the coordinated control of different storage and FACTS devices
- STATCOM 4 Mvar
- Supercapacitors 0.8MW
- 1500 V Li-Ion batteries (2MW/0.5MWh)
- CENER 20 kV grid-connected facilities
- Microgrid in CENER
- Different batteries

**WP5 DEMO**: Multiple services provided by grid devices, large demand-response and RES generation coordinated in a smart management system
- 7 Industrial consumers ~120 MW of flexibility
- 2 wind farms ~53 MW +1 battery (2 MW - 2 MWh)
- ENEL, E2i
- 7x150kV lines Dynamic Thermal Ratings Terna

**WP6 DEMO**: Near real-time cross-border energy market
- Soverzeme plant 20MW ENEL
- Santa Massenza plant 70MW HDE
- DEM, TES and SENG plants 135MW HSE
- High voltage grid Terna & ELES
AGENDA

• OSMOSE project overview
• Holistic approach to capture flexibility: OSMOSE Experience
  1. Sizing and Siting of Flexibility Options
  2. TSO/DSO Flexibility Coordination
  3. IEC 61850 as a Flexibility Enabler
• Main conclusions and final messages
AGENDA

- OSMOSE project overview
- Holistic approach to capture flexibility: OSMOSE Experience
  1. Sizing and Siting of Flexibility Options
  2. TSO/DSO Flexibility Coordination
  3. IEC 61850 as a Flexibility Enabler
- Main conclusions and final messages
Holistic approach to capture flexibility: OSMOSE Experience

Integration of Innovative Flexibility Options in the context of Planning, Operation and Stability

Long-term Flexibility Scenarios

Flexibility Options

- **T1.4.1** Sizing and Siting of Flexibility Options
- **T1.4.2** Cross-Border Reserve Exchange
- **T1.4.3** Stability Aspects
Sizing and Siting of Flexibility Options

- Datasets for the Portuguese system
  - Operating conditions for the 2030 and 2050 scenarios

- Adaptation of the Portuguese transmission network model for time horizons 2030 and 2050
  - Methodology for the redistribution of aggregated datasets at nodal level (up to the TSO-DSO interface at 60kV)

- DESPlan tool analysis for sizing and siting of ES for 2030 and 2050 scenarios
  - Analysis of the effect of the 2030 and 2050 scenarios in the Portuguese system
  - Use of internal tool (DESPlan) for the analysis and sizing and siting (Power, Energy and Location) of energy storage systems
Holistic approach to capture flexibility: OSMOSE Experience

• Sizing and Siting of Flexibility Options

Network model and Redistribution methodology

Portuguese Transmission Network

Detailed up-to the distribution interface (60kV)

OSMOSE T1.1&T1.2 datasets (2030, 2050)

- On-shore cluster
- Rest of the World cluster
- Nord Sea off-shore cluster
- AC link with impedance and GTC
- AC link with GTC only
- DC link
- Equiv. link with RoW
- Equiv. link with Nord Sea cluster

R&D Nester© 2022. Todos os direitos reservados. All rights reserved.
Holistic approach to capture flexibility: OSMOSE Experience

**Simulation Results – Scenario Current Goals 2030**

- Congestions detected in 32% of the period of analysis
- Congestions up to 8% above limits
- ESS solutions between 2MW/20MWh and 28MW/28MWh
Simulation Results – Scenario Current Goals 2050
• Congestions detected in 49% of the period of analysis
• Congestions up to 55% above limits
• Solutions between 15.6MW/15.2MWh and 172.2MW/383.9MWh
AGENDA

• OSMOSE project overview
• Holistic approach to capture flexibility: OSMOSE Experience
  1. Sizing and Siting of Flexibility Options
  2. TSO/DSO Flexibility Coordination
  3. IEC 61850 as a Flexibility Enabler
• Main conclusions and final messages
Holistic approach to capture flexibility: OSMOSE Experience

- **TSO/DSO Flexibility Coordination**
  - Demonstrator overview

### TSO/DSO - EFACEC

**Network Model and Simulation**

- **DSO Network**
- **TSO Network**

**FLEXIBILITY SCHEDULER**

**EXPECTED OUTCOME**

- **Results of FLEXIBILITY SCHEDULER testing**

### Part of the Portuguese Network

- **TSO/DSO Flexibility Coordination**

- **Input Data**
  - DSO Operational Scenarios (real-time & day-ahead)
  - TSO Operational Scenarios (real-time & day-ahead)

- **Day-ahead data includes:**
  - RES/Load Forecast
  - Network topology
  - Maintenance programs

- **Network Model and Simulation**
  - DSO Observability Network
  - TSO Observability Network

- **TSO OWN DATA COLLECTION**
- **TSO-DSO DATA EXCHANGE**
  - including set-points sent through the flexibility scheduler.
  - exchange of measures in the border of the observability area.

- **REAL-TIME POWER SYSTEM SIMULATOR**

- **EXPECTED OUTCOME**

- **R&D NESTER RTPSS LABORATORY**

- **Part of the Portuguese Network**

---

R&D Nester © 2022. Todos os direitos reservados. All rights reserved.
Holistic approach to capture flexibility: OSMOSE Experience

- **TSO/DSO Flexibility Coordination**
  Flexibility Scheduler

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Constraints</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elements of the</td>
<td>Inter-temporal</td>
<td>Initial and final states of all network variables, and power profile at each substation</td>
</tr>
<tr>
<td>Forecasts of power</td>
<td>Flexibility PQ ranges for the primary</td>
<td></td>
</tr>
<tr>
<td>Network topology</td>
<td>Grid technical constraints</td>
<td></td>
</tr>
<tr>
<td>Initial tap settings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of control</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Holistic approach to capture flexibility: OSMOSE Experience

- **TSO/DSO Flexibility Coordination**

  Results

- FS tool results validated using RTPSS
- **Reactive power losses reduced** in average 8.5 Mvar
- Reactive assets’ **activation costs reduced** in 1/3 in average
- **Voltage levels maintained** within operational limits
- **Guidelines for TSO/DSO coordination** on reactive flexibility activation and information exchange are provided
AGENDA

• OSMOSE project overview
• Holistic approach to capture flexibility: OSMOSE Experience
  1. Sizing and Siting of Flexibility Options
  2. TSO/DSO Flexibility Coordination
  3. IEC 61850 as a Flexibility Enabler
• Main conclusions and final messages
Holistic approach to capture flexibility: OSMOSE Experience

IEC 61850 as a flexibility enabler

- Refinement of IEC 61850 engineering process
- Demonstration setup of interoperability with physical and virtual IEDs (Intelligent Electronic Device)
- Demonstration with real-time platform of engineering process proposed for IEC61850
IEC 61850 as a flexibility enabler

- Multiple vendors of devices and engineering tools (interoperability) at R&D Nester Lab

Simulation of bay switchgear equipment

Simulation of power system faults

RTPSS model for HIL simulations
IEC 61850 as a flexibility enabler

- Demonstrator (R&D Nester Lab)

- 2 substations (A and B)
- 1 line bay per substation
  - Line from A to B
- 2 IED per bay
  - BC – Bay Control Unit
  - PROT – Bay Protection Unit
  - 3 different vendors
- 1 different combinations of SST/SCT per substation
Holistic approach to capture flexibility: OSMOSE Experience

IEC 61850 as a flexibility enabler

- Functional Testing – test execution

Example: test of trip by teleprotection function by PROT of SS/B

1. Simulation of fault (phs A) in line at 90% of line length away from substation B
2. Distance function of PROT detects fault in:
   a) Z1 in substation A
      i. trips CB
      ii. sends TP signal to PROT of substation B
   b) Z2 in substation B
      i. trip delay ~ 400 ms
3. PROT of substation B receives TP signal
   a) Trips CB
   b) sends trip information to IED Bay Control Unit (BC)
4. BC receives trip signal initiates Auto reclose function
5. Auto reclose function issues close command to CB after DeadTime
AGENDA

- OSMOSE project overview
- Holistic approach to capture flexibility: OSMOSE Experience
  1. Sizing and Siting of Flexibility Options
  2. TSO/DSO Flexibility Coordination
  3. IEC 61850 as a Flexibility Enabler
- Main conclusions and final messages
Main conclusions and final messages

• **Conclusions**
  
  • Energy transition will bring **new challenges**, but also **new opportunities** to the power systems’ environment, especially in the long-term where higher levels of RES integration are expected.
  
  • Operators must **continue innovating** in order to be able to continue ahead of the challenges.

• **Final messages**
  
  • **Flexibility will be key** for the accomplishment of the long term goals on carbon neutrality, necessary to achieve successful energy transition.
  
  • **TSO/DSO coordination must be enhanced** to capture additional flexibility and promote overall system efficiency, security and resilience.
  
  • The improvement of the engineering process for IEC 61850 is crucial for the **digitalization of the energy system** and **facilitation of interoperability**.

https://www.osmose-h2020.eu/
CREATING A SMART ENERGY FUTURE