

Introduction to Real Time Operation

Visit to the new rooms of the Palmiano headquarters

Agenda

- 1 System Operation and Future Challenges and Network Resilience
- 2 Room presentation: CCT
- 3 Room presentation: CNC
- 4 Room visit

RTO Operating Model



CNC

Ensures the balance between electricity consumption and supply in Italy, while guaranteeing system security, adequacy, cost-effectiveness, and service quality

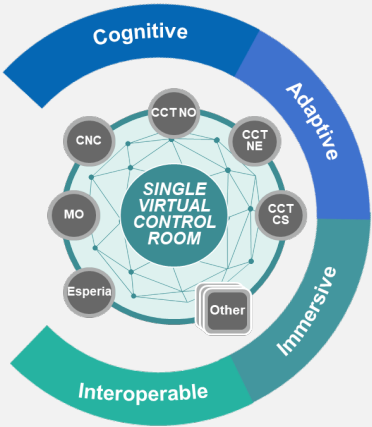
**FOCUS
CNC**

CCTNW	CCTNE	CCTCS
<ul style="list-style-type: none">Maintenance operations authorizationOperation of Terna assets, and activation of first response/emergency interventions (DPRET)Network constraints sizingRES maximizationAuthorization of planned works and testsManagement of emergency supply with other TSOsContinuous contact with generation plants and dispatching of operating orders		
VSO ^[1] – Security evaluations		
DSE ^[2] – Data Monitoring and Technical Support		
MSP ^[3] – Plant Safety & Emergency Mgmt.		

**FOCUS
CCT**

RTO is evolving towards a single virtual control room operating model, according to the following pillar

THE OPERATORS' ACCOUNTABILITIES AND ACTIVITIES ARE INDEPENDENT FROM THEIR PHYSICAL LOCATION



The CPV operating model is a first implementation of the single virtual control room model...

^[1]Valutazioni Sicurezza a supporto Operations, i.e. Security evaluations to support operations ^[3] Messa in Sicurezza Impianti ed Emergency, i.e. Securing assets and emergency mgmt.
^[2]Sistema Dati per l'Esercizio del SEN, i.e. Data System for the National Electric System Mgmt.

The Control and Remote Conduction of the NTG

Control and Monitoring: set of actions to implement in order to ensure:

- Adequacy
- Security
- Economy
- Quality

Conduction: set of actions aimed at maneuvering the organs and securing the elements of the electricity system to:

- Switching operations in normal and emergency operation
- Grid unavailability management and new plants commissioning
- Safety procedures
- Trigger of intervention in grid in case of urgent alarms, fault, etc
- Third parties coordination (DSO, Power Plants, railways company, users etc.)

The real time control and conduction in Terna are performed by:

- **1 National Control Center (CNC):** balancing, adequacy management in real time and cross to real time, control of primary transmission system.
- **3 Control and Remote Conduction Centres (CCT - RCC)** control of sub-transmission grid and conduction.



The Control and Remote Conduction of the NTG

The CCT Control Room and the tools used



The CCT room is responsible for **controlling** and monitoring the grid at voltage less than or equal to 220kV not under CNC competence, aimed at complying with the current and voltage limits of the grid elements and maintaining the power supply of the connected end users.

In addition, the CCT is responsible for the management of Terna's grid elements (including the procedures for securing them), the activation and orientation of emergency response, and coordination with the other grid owners connected to the NTG (e.g. **DSO**).

Synoptic table

Summary representation of the entire national network of your interest with display of parameters (P, Q, V, f) and system status (open/closed switches)



HEAD OF CONTROL ROOM



MULTISKILL CONTROL ROOM SPECIALIST



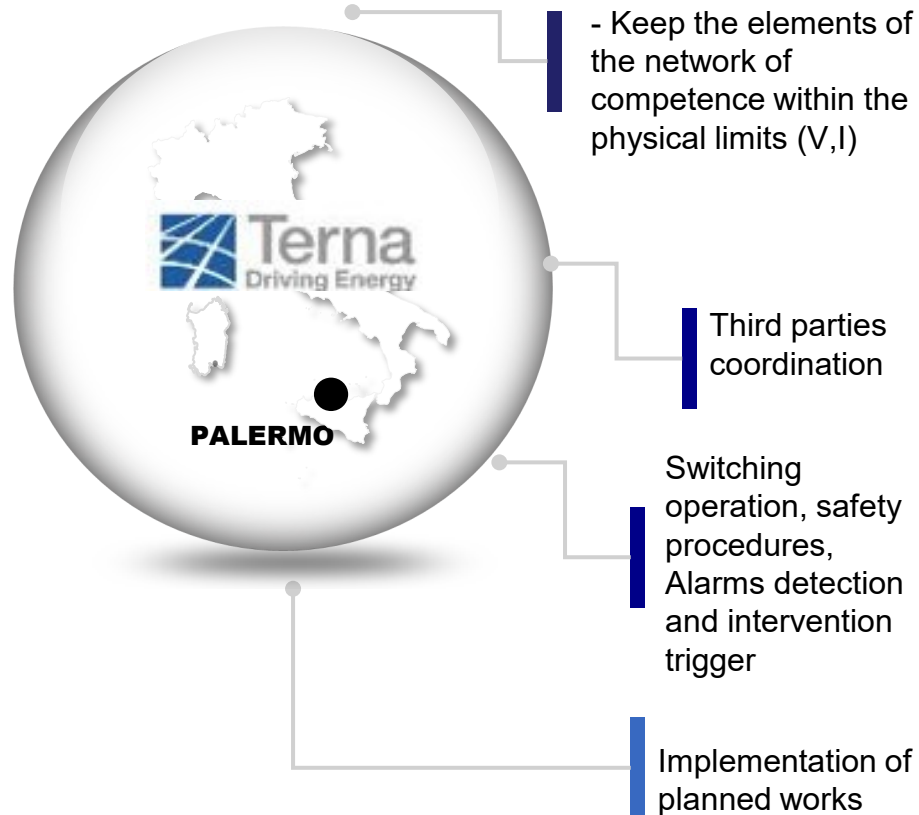
MULTISKILL ASSISTANT



CONDUCTION ASSISTANT

The Control and Remote Conduction of the NTG

The CCT Control Room - main activities

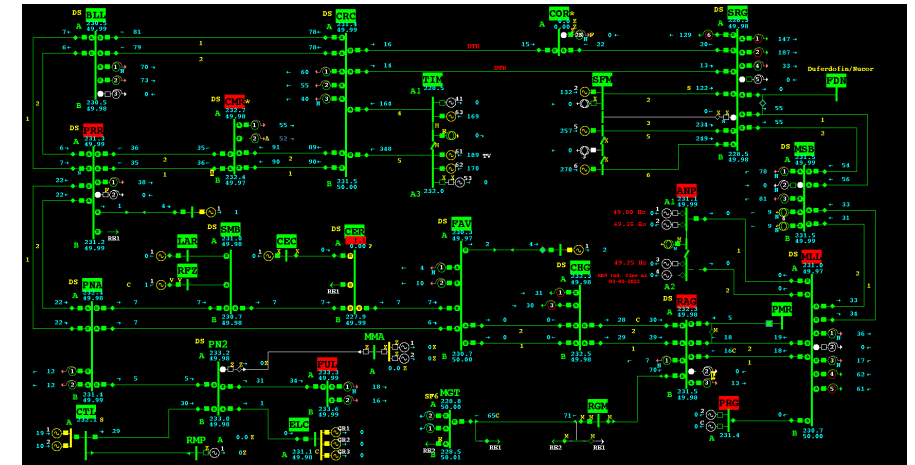
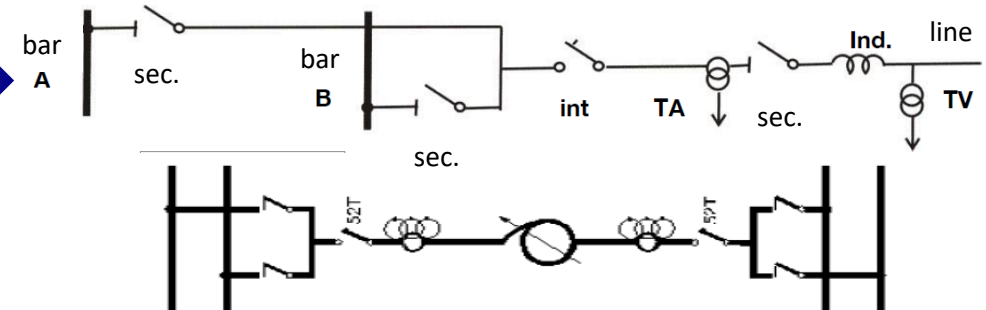
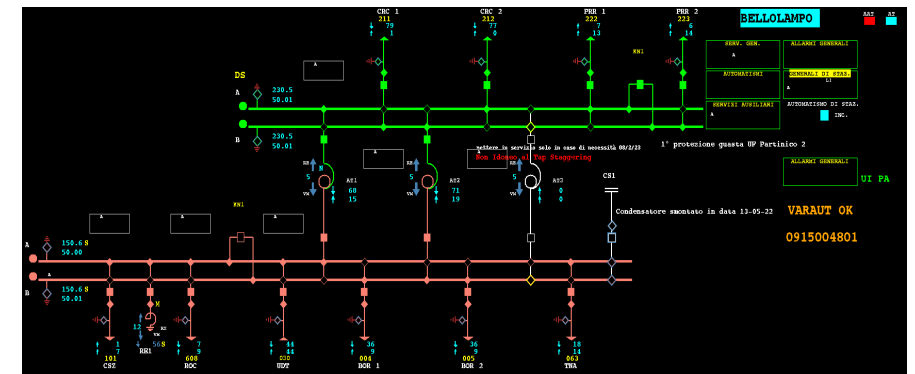


CONTROL

Third parties coordination

CONDUCTION

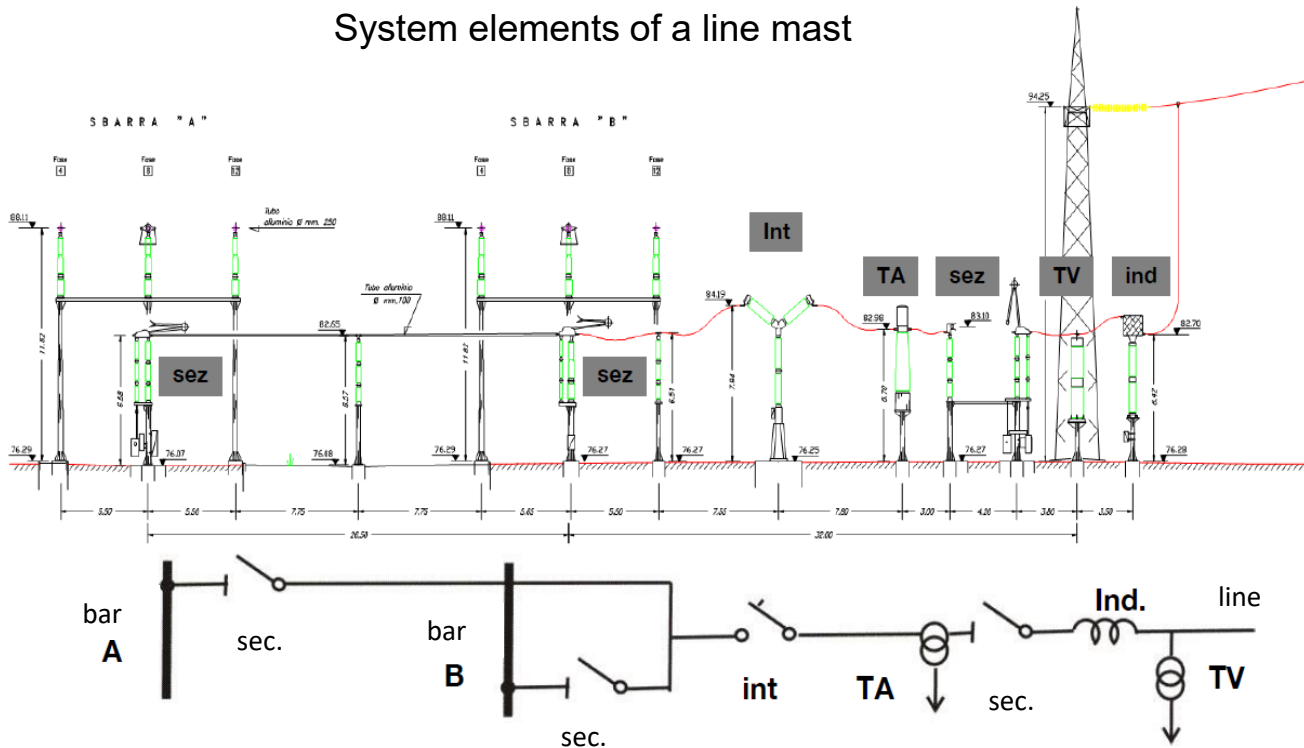
GRID UNAVAILABILITY MANAGEMENT



The Control and Remote Conduction of the NTG

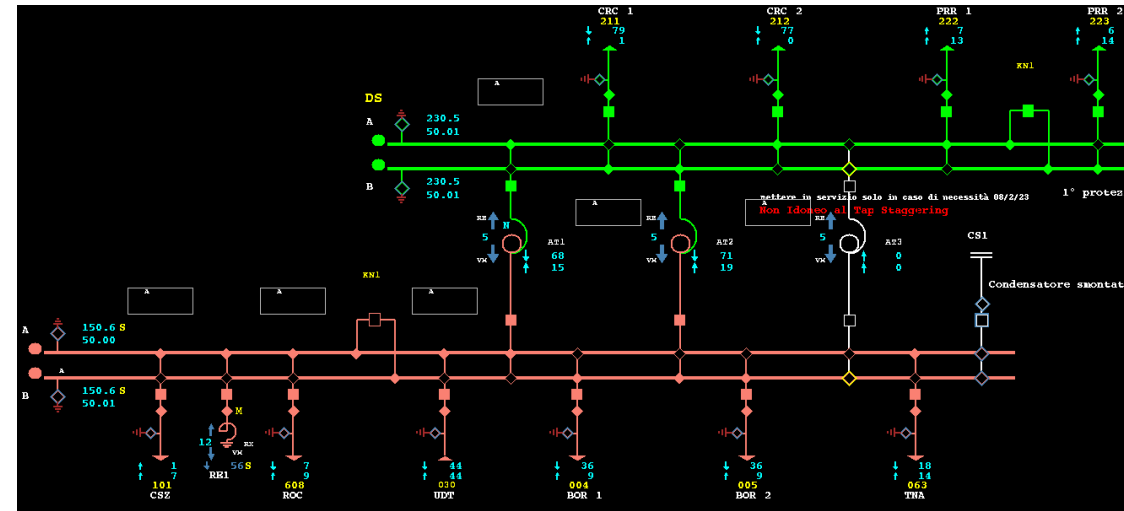
The CCT Control Room – conduction and switching operations 1/2

System elements of a line mast



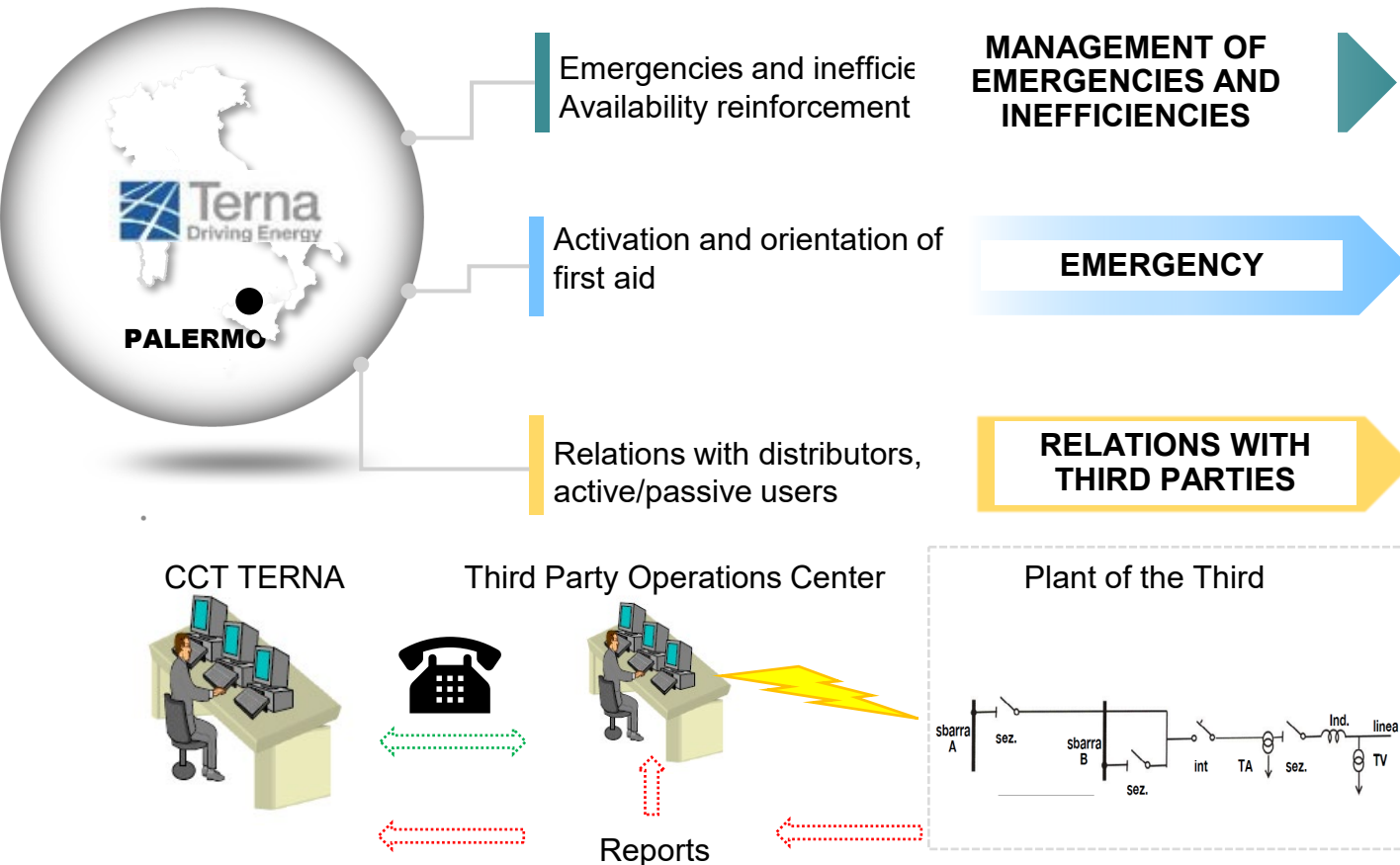
The management activity includes the execution of physical manoeuvres on the TERNA grid elements, the implementation of the safety process for the purpose of accessing them for the execution of works (scheduled or following faults).

Intervention grid triggering and alarms detection is another part of conduction activities.



The Control and Remote Conduction of the NTG

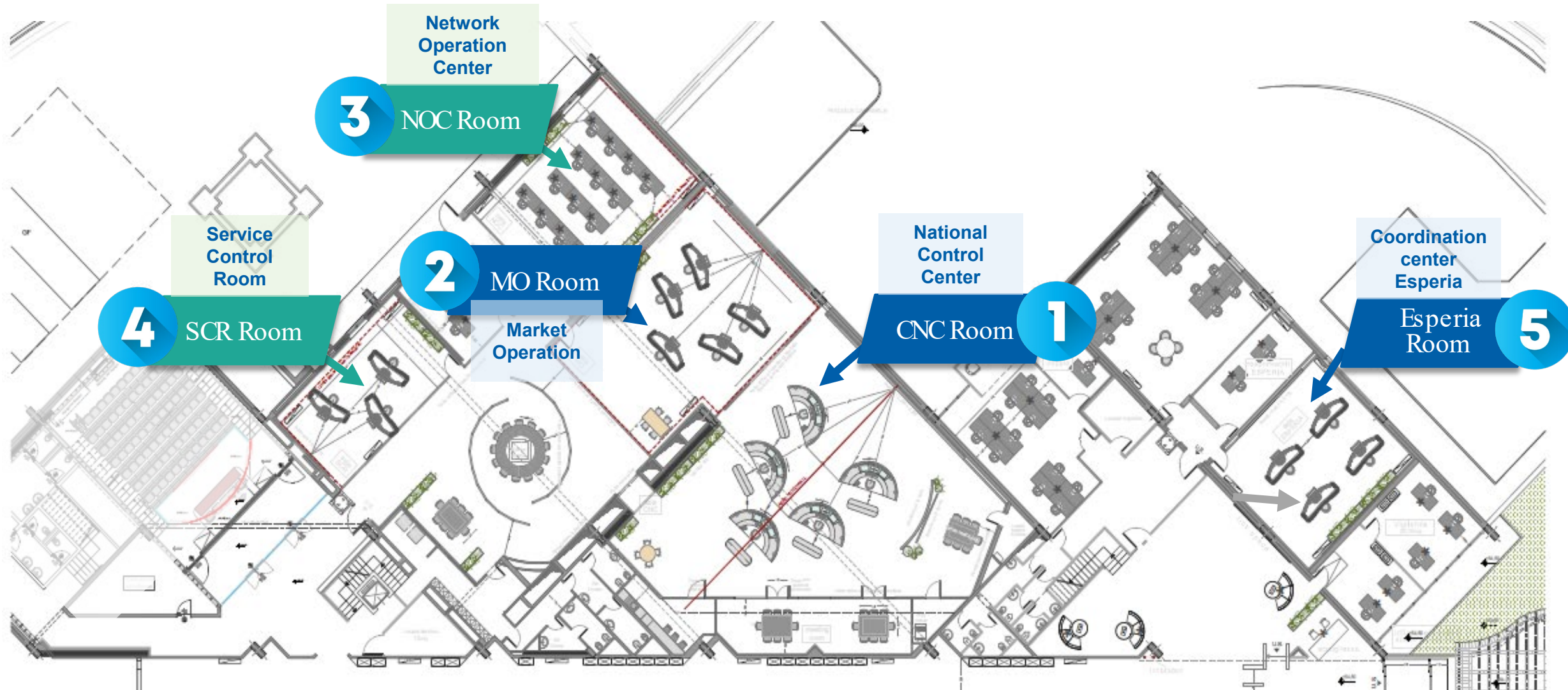
The CCT Control Room - management activities 2/2



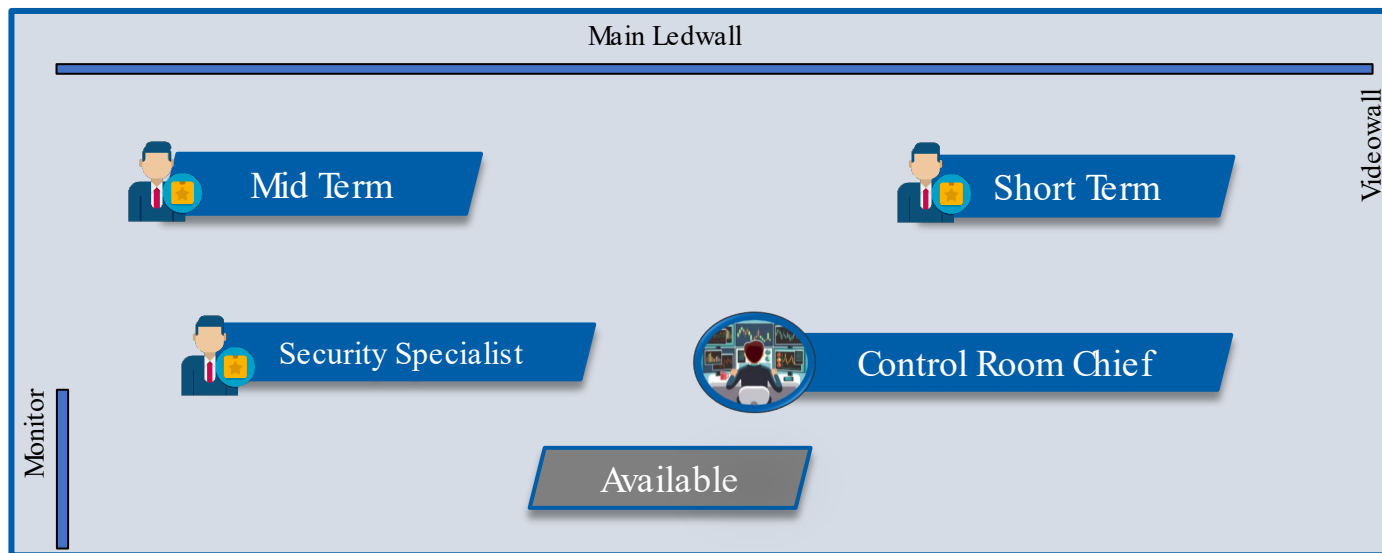
The CCT coordinates with third parties connected to the NTG (DSO, HV Users, Railway feeder, etc..) in the event of outage of the connection network elements, the need for network maneuvers or inefficiencies that impact these, which maneuver the elements under their competence.

Digitalisation and new technologies for the transition of the electricity system

The Control Rooms of Palmiano



National Control Center Room



Mid Term

- Forecasting and foreign coordination security checks and calculations (up to D+2)

Security Specialist

- Balancing, security constraints, voltage regulation, defense systems, HVDC link management
- Unique CNC-CCT safety coordination

Short Term

- Safety assessment and analysis between 0 (real-time) and 4 hours for the purpose of reserve margin assessment/optimisation and for the safe management of the SEN

CONTROL ROOM CHIEF

- Supervision and coordination
- SEN Exercise Risk Management
- Security assessment of last resort
- SEN Emergency Management

OUR MISSION

- Guarantee, at all times, The balance between consumption and input of electricity in Italy, in compliance with the standards of safety, of adequacy and cost-effectiveness and quality of service



OUR OPERATIONS

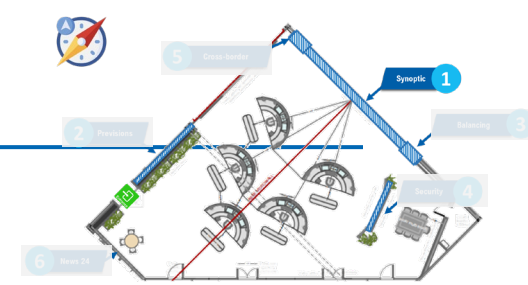
- Operation of the transmission grid and the interconnection network with foreign countries
- Single coordination for the safety of the SEN
- Sizing of Network Constraints for the control of voltage profiles, the resolution of network congestion and the stability of the SEN
- Operational management of rescue procedures with other TSOs
- Implementation of national emergency procedures (e.g., PESS)
- Real-time management of emergencies and critical events of the SEN



THANK YOU!

National Control Center Room

Synoptic of Extra High Voltage Mains (400 kV)



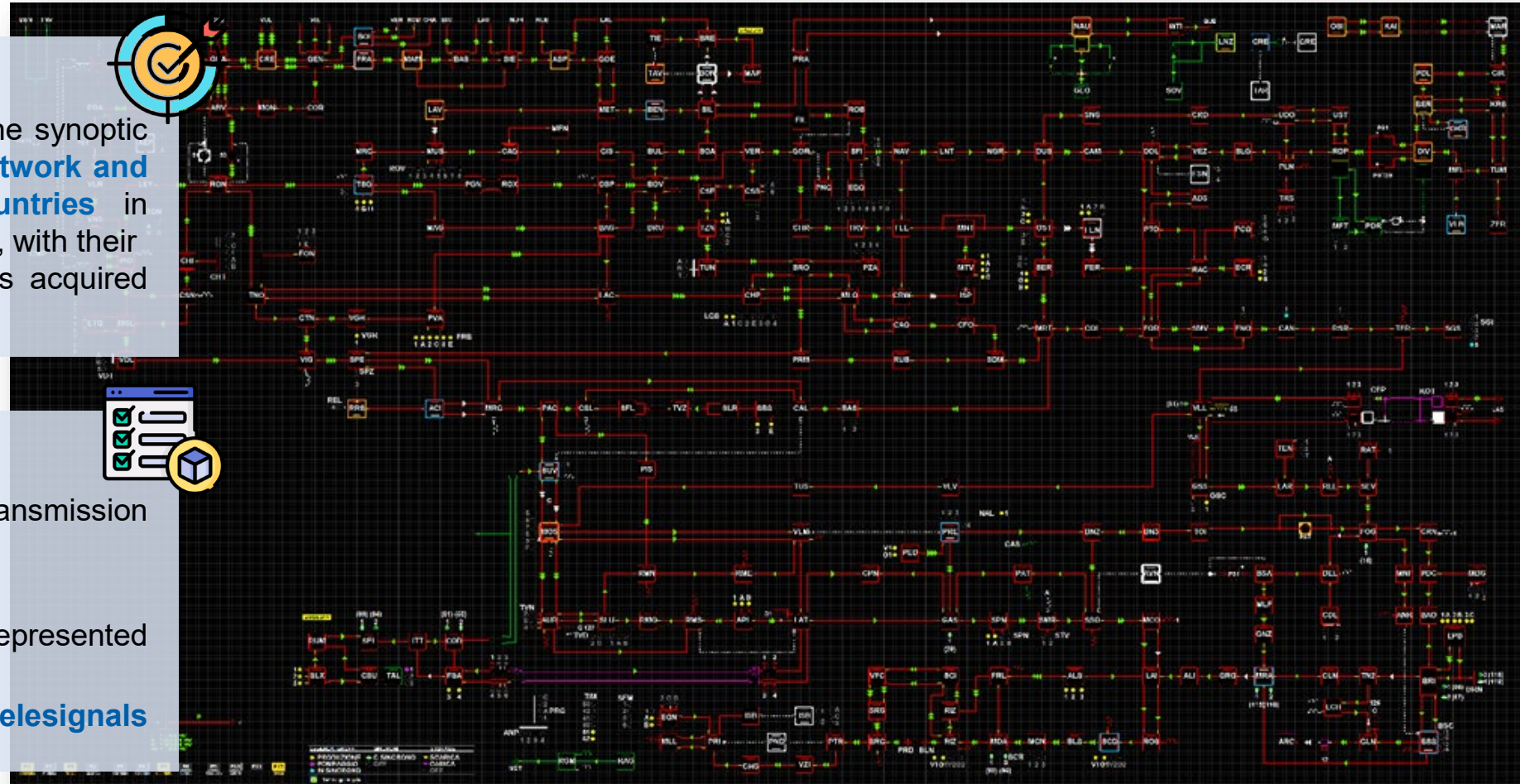
Scope

The central LED wall is dedicated to the synoptic that depicts the **extra-high voltage network and interconnections with foreign countries** in terms of electrical substations and lines, with their Remote measurements and telesignals acquired by the plants



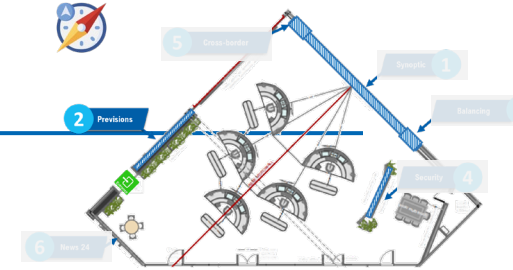
Main features

- Beyond **13.000 km** of 400 kV transmission circuits
- Beyond **170** stations 400 kV
- Over **6450** telemeasurements represented and updated
- Every **4 seconds** and **6400 telesignals** acquired



National Control Center Room

Final balance of electricity demand, RES and energy mix



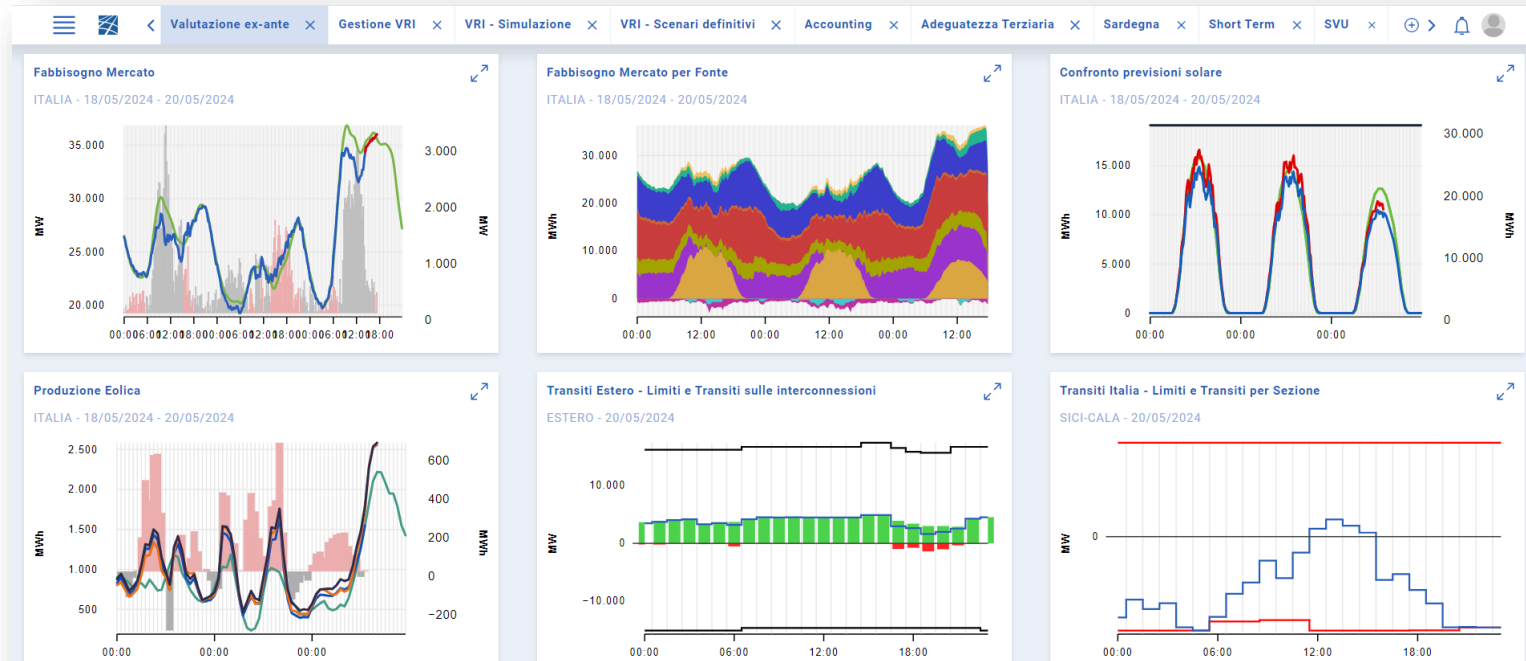
Scope

Section dedicated to the final balance of **renewable sources** and the **functional needs** for the advance management of the National Electricity System



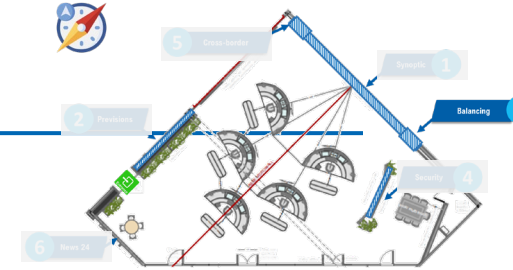
Main features

- **15-minute** resolution
- Over **1200** relevant UPs monitored in real time
- **Business analytics** tools for comparison between final balance and forecast
- Monitoring trades **on all market sections**



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Balancing the SEN



Scope

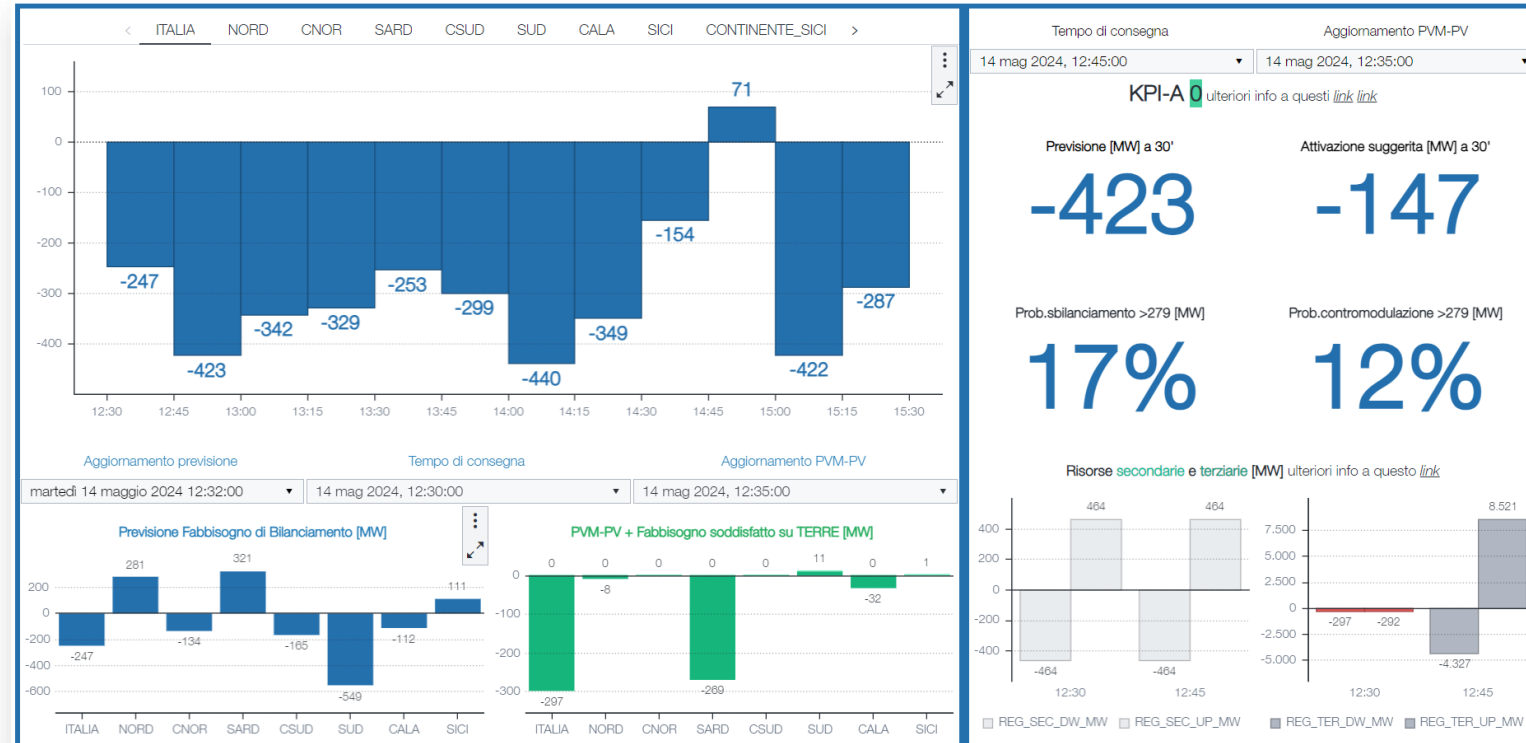


The balance of Italy's needs is closely related to the variability of renewable sources and the habits of Italians. The **balancing forecast** suggests an increase or decrease necessary to balance production and load safely and economically in the next 15 minutes by **sending balancing orders** to the production units located throughout the country.

Main features

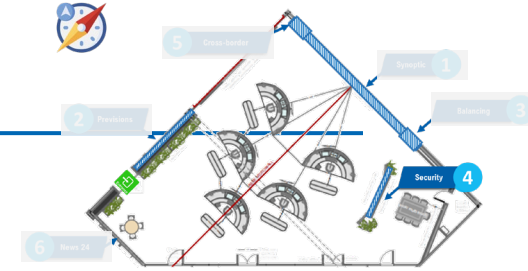


- Forecast **between the next 15' and 180'**
- Over **600 balancing orders** sent daily
- Continuous improvement of performance ratios**



National Control Center Room

Wide Area Monitoring System



Scope



Through the **Wide Area Monitoring System (WAMS)**, Terna monitors the behaviour of the European interconnected system by sampling "high frequency" electrical quantities and enabling advanced logics for the defence of the SEN.

Main features

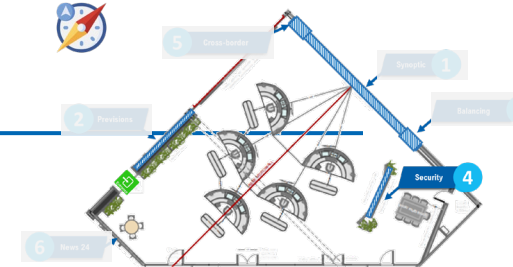


- Acquisition and processing of measurements sampled at **20 ms**
- Over **300 PMUs installed**
- Over **50 GB** of data generated every day



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Dynamic Thermal Rating



Scope



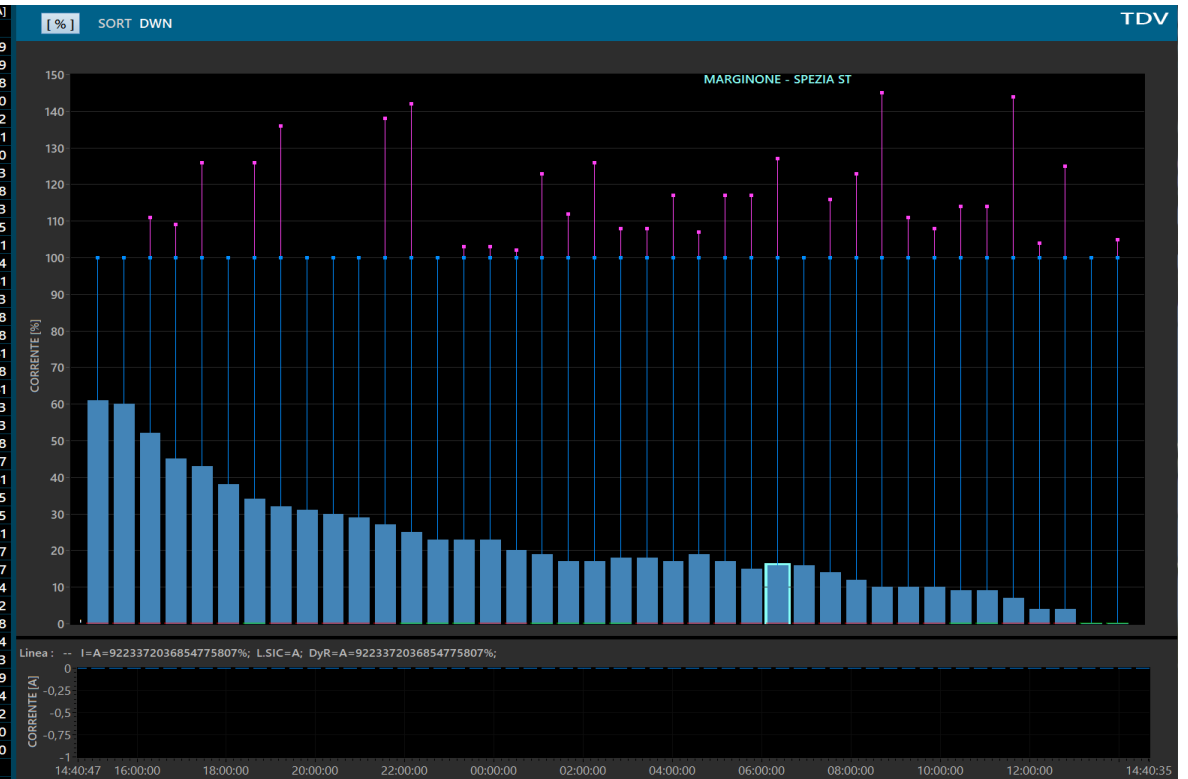
Dynamic Thermal Rating (DTR) improves grid efficiency by **dynamically assessing** the **real current-carrying capacity of transmission lines** using real-time environmental data like temperature, wind, and solar radiation. This estimate uses both data provided by meteorological services and sensors installed on the lines, enabling continuous monitoring and safer, more flexible network operation.

Main features



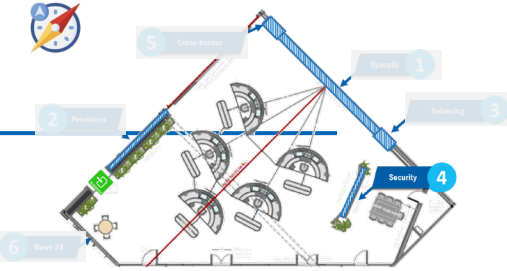
- **88 lines** equipped with DTR (of which **37** 400 kV lines)
- **15 new installations** planned in **2025**, of which 8 have already been completed

KVL	Impianto From	Impianto To	I [A]
380	TURANO ST	S.ROCCO PO	1599
380	CHIARI ST	GORLAGO	1529
380	MALEO	CREMONA	978
380	GISSI	LARINO	1200
380	AVELLINO NO	BISACCIA 380	1132
380	BAGGIO	PIEVE ALB.	981
220	BORGOVALSU	LAVIS	180
380	M/CORVINO	S.SOFIA NUO'	703
380	CHIVASSO S.	RONDISSONE	508
380	CASANOVA	PIOSSASCO	553
380	TURANO ST	TAVAZZANO	765
380	VILLANOVA	GISSI	611
220	VILLAVALLE	PIETRAFITTA	214
220	SORGENTE	MRBIANCO 2	181
220	SORGENTE	MRBIANCO 1	183
380	LEJNI	RONDISSONE	528
380	CASTELN.AL	VIGNOLE B.	418
220	MONTORIO SI	ROSARA AL	241
220	MONTORIO	VILLANOVA	248
220	CARACOLI	SORGENTE	141
220	CORRIOLO RI	CARACOLI	143
380	MELFI 380	BISACCIA 380	423
380	LARINO	ROTELLO380	468
380	CANDIA	FANO E.T.	417
380	ROTELLO380	S.SEVERO 380	461
380	CASTELN.AL	TRINO	405
380	MARGINONE	SPEZIA ST	315
380	MELFI 380	GENZANO 38	381
380	GENZANO 380	MATERA	367
380	VOGHERA ST	CASTELN.AL	317
380	VOGHERA ST	PIEVE ALB.	244
380	ACCIAIOLO	SPEZIA ST	202
380	S.MART. XX	FANO E.T.	198
220	CHIARAMONTI	FAVARA 1	84
220	CHIARAMONTI	FAVARA 2	83
380	P.SPERANZA	ROMA NORD	149
380	FOGGIA	S.SEVERO 380	94
380	LATINA NUC	APRILIA380	72
220	S.COLOM.GE 2	VIGNOLE B.	0
220	M/CORVINO	TUSCIANO	0



National Control Center Room

Dynamic Security Assessment



Scope



On the **ledwall** dedicated to **security**, the results of the **Dynamic Security Assessment** (DSA) analyses can be displayed, which allows you to monitor the **dynamic behavior of the SEN** by simulating the loss of one or more network elements

Main features



- **Dynamics** simulations with a **frequency** of **5** minutes
- Over **400 simulations** of possible contingencies
- Around **600 cores** work in parallel

Terna DSA NAZIONALE

STANDARD

14-05-2024 12:05

NAZ

Telescati (Sintesi)

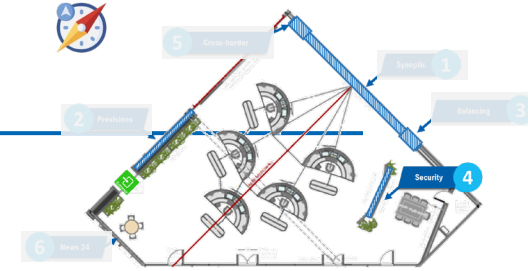
SINTESI

Visualizzazione espansa

Sistema di Telescatto	Contingenza	Verifica statica finale con telescatto	Verifica dinamica finale senza telescatto	Verifica dinamica finale con telescatto	
> CALA	ALTOMONTE-FEROLETO (361 - 400kV)	<div></div>	<div></div>	<div></div>	i <div></div> <div></div>
> CALA	ALTOMONTE-FEROLETO (361 - 400kV)	<div></div>	<div></div>	<div></div>	i <div></div> <div></div>
> MCOSSO	M/CORVINO-S.SOFIA (315 - 400kV)	<div></div>	<div></div>	<div></div>	i <div></div> <div></div>
> NCNS	ACCIAIOLO-MARGINONE (327 - 400kV)	<div></div>	<div></div>	<div></div>	i <div></div> <div></div>
> NOOV	BAGGIO-PIEVE ALBI (383 - 400kV)	<div></div>	<div></div>	<div></div>	i <div></div> <div></div>
> NORDOVESTEST	BAGGIO-LACCHIAREL (373 - 400kV)	<div></div>	<div></div>	<div></div>	i <div></div> <div></div>
> PUMA	ALIANO-LAINO (374 - 400kV)	<div></div>	<div></div>	<div></div>	i <div></div> <div></div>

National Control Center Room

Operational Security Insight



Scope

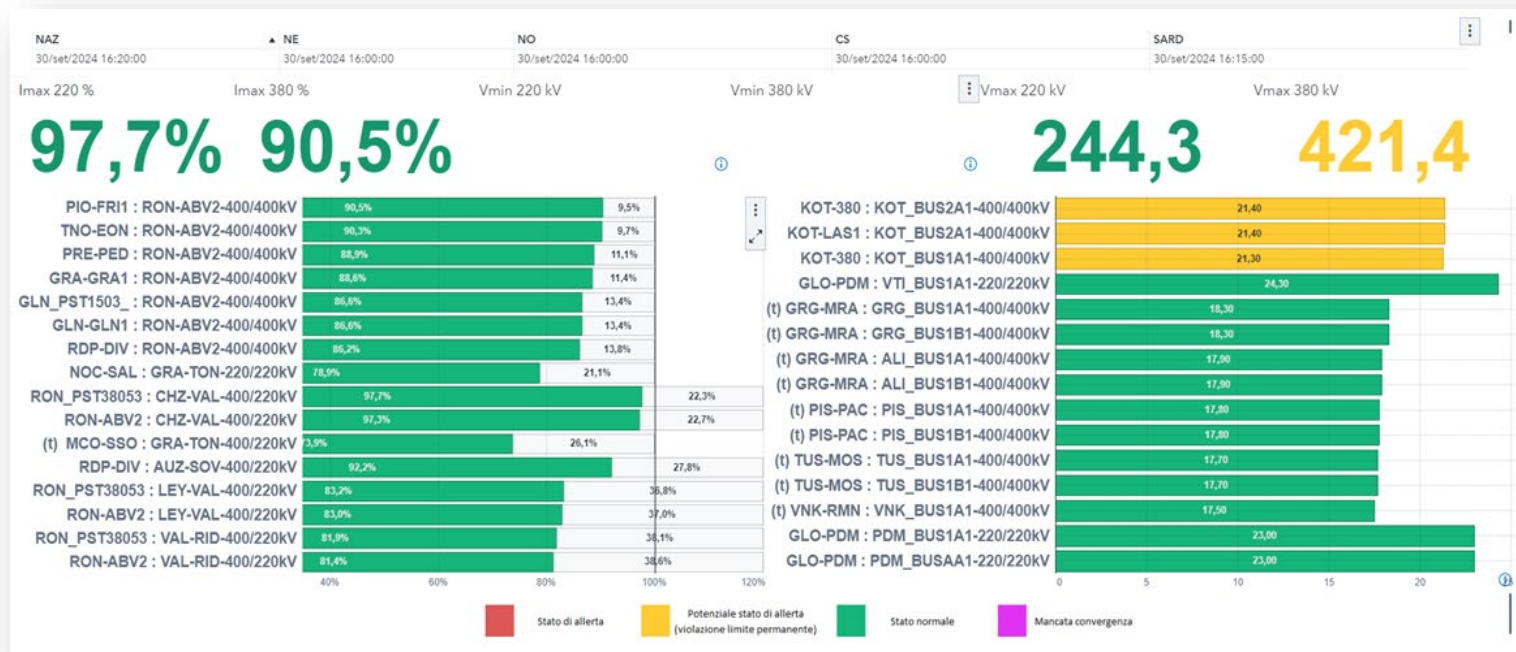


The **OpSight (Operational Security Insight)** allows you to monitor the behavior of the network downstream of the loss of any element.

Main features

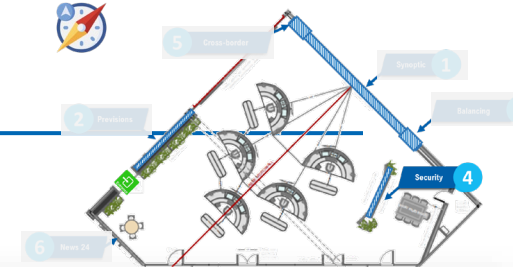


- Simulations with a **frequency of 5 minutes**
- Real-time** information from the Control System
- Current** trend in the previous **30 minutes**
- Real-time** updated **limits** with **DTR**
- Network model with **irrelevant network portions**



National Control Center Room

Robustness of the SEN



Scope

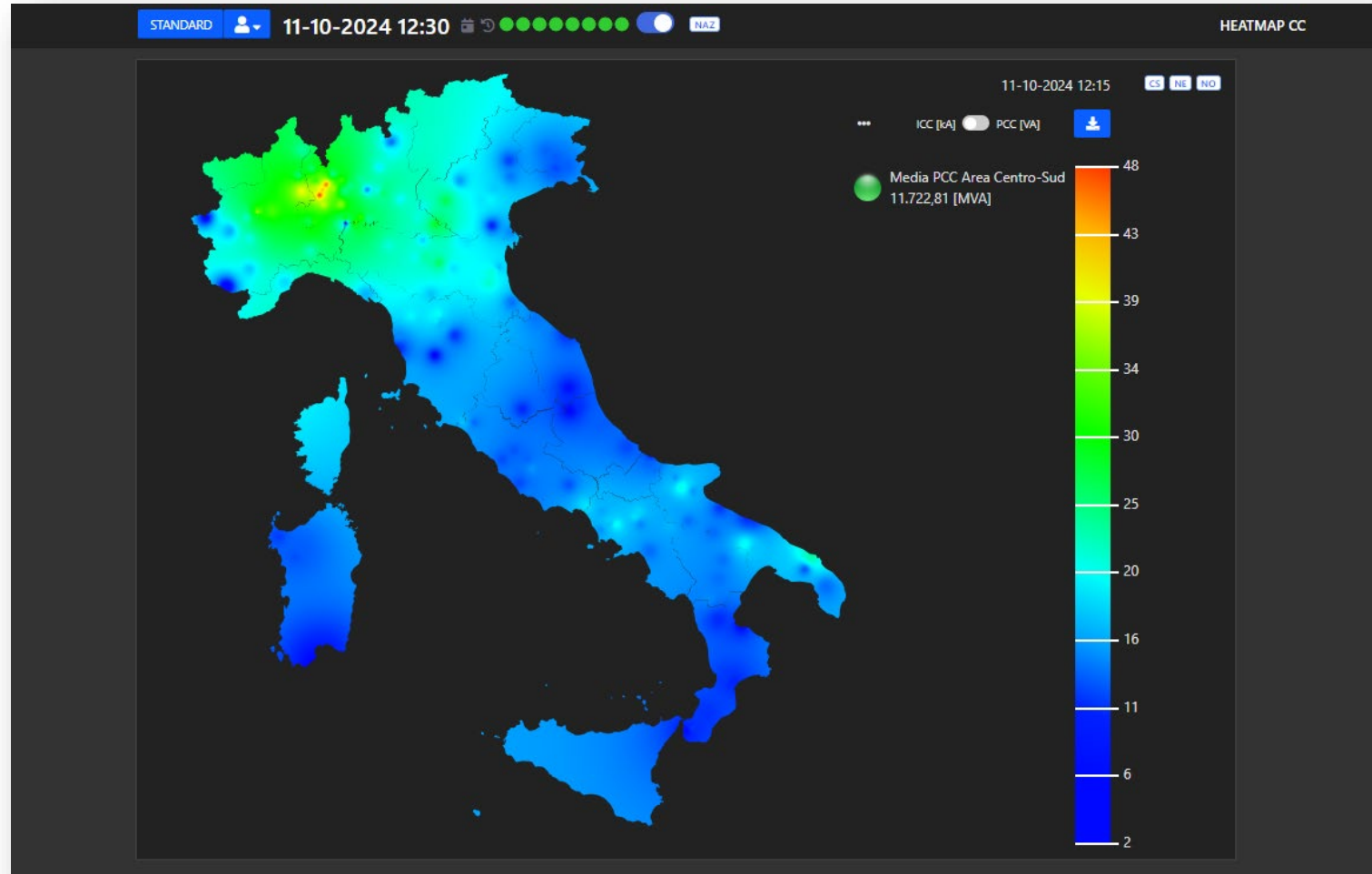


The observation of the behavior of the short-circuit current over time can give information about the **robustness** of the grid in a system increasingly characterized by the presence of renewable sources. DSA – Short Circuit Power allows you to monitor the short-circuit power of the national transmission grid.

Main features

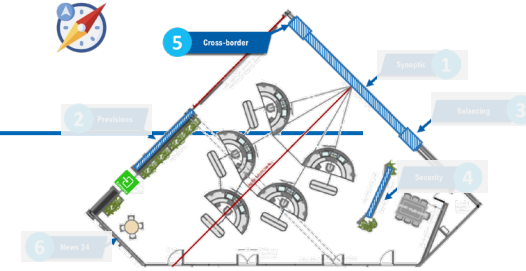


- Update **every 5 minutes**
- View on **Heatmap**
- Construction of a '**national**' indicator



National Control Center Room

European Awareness System



Scope

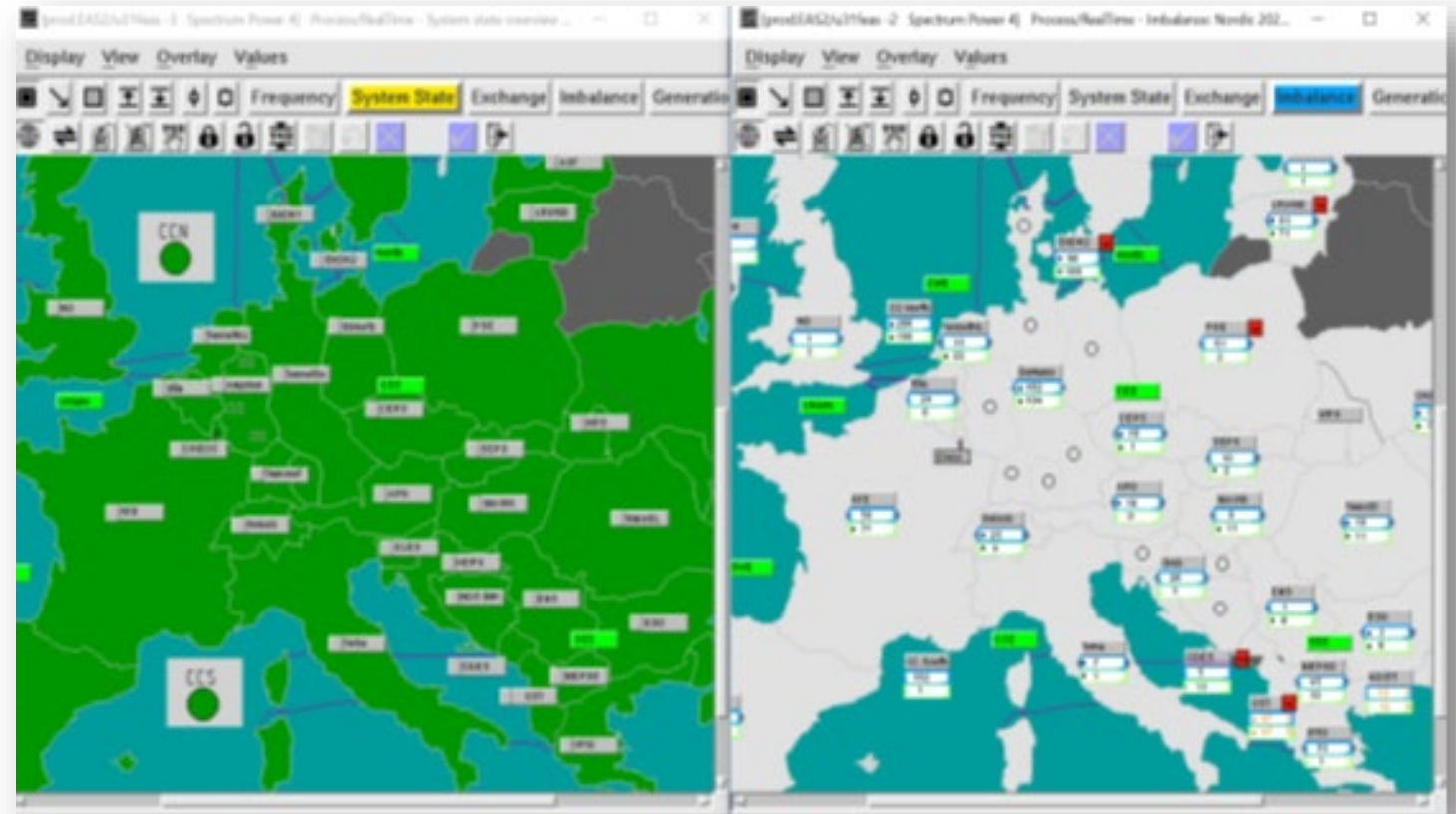


With all European TSOs, security on the European interconnected grid is constantly monitored and controlled in order to **keep the frequency around 50 Hz**. This activity is supported by a system in use in all Control Rooms in Europe, called the **European Awareness System (EAS)**.

Main features

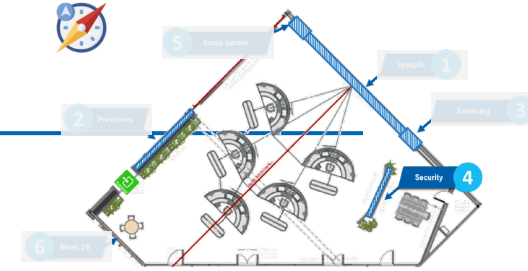


- **All European TSOs** connected in real time
- **Continuous data exchange** fed by the control systems of each TSO
- **Real-time alerting system** to support Emergency Management & Common Awareness



National Control Center Room

Dispatching Platform



Scope

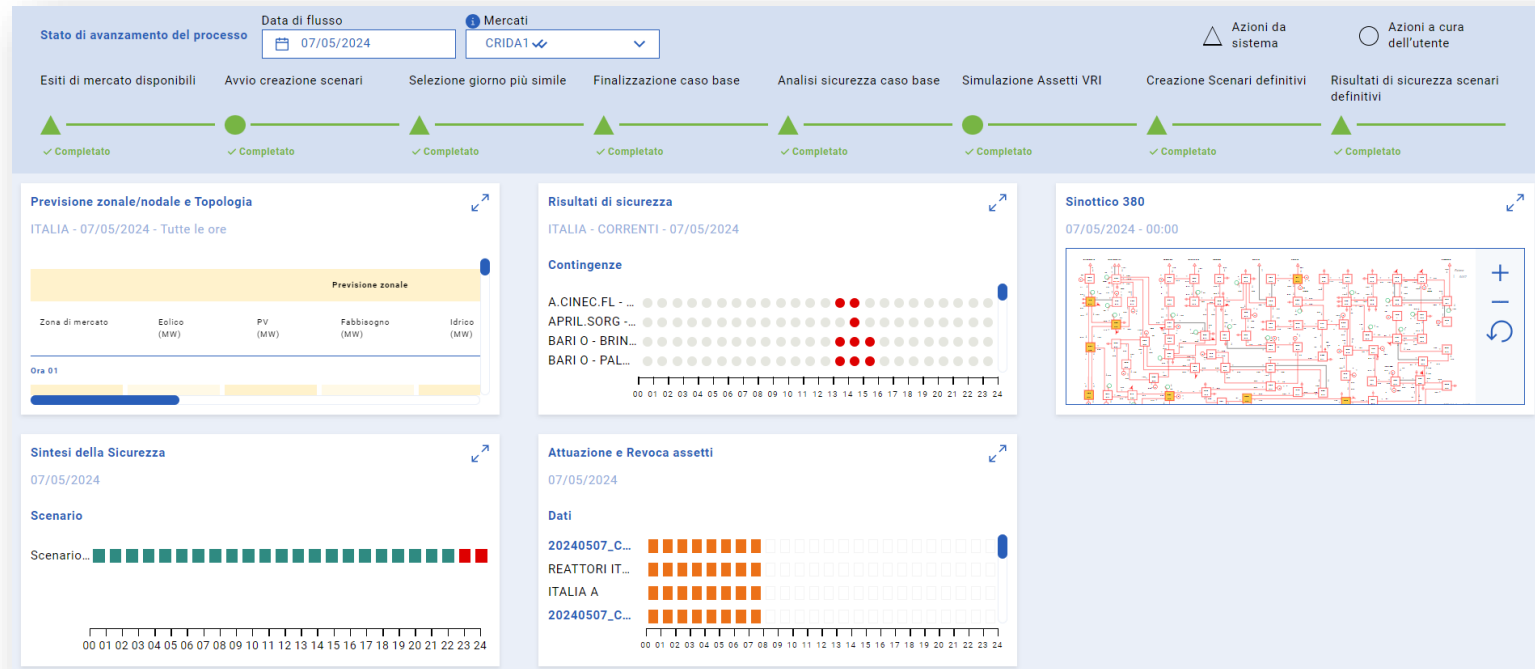


The **Dispatching Platform**, a tool integrated with the operational processes relating to the assessment of economy and safety in dispatching activities, plays a crucial role in the **sizing of security constraints** for the operation of the National Electricity System.

Main features

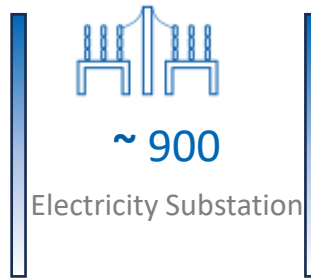
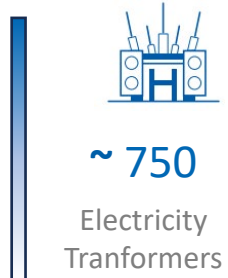
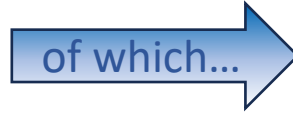
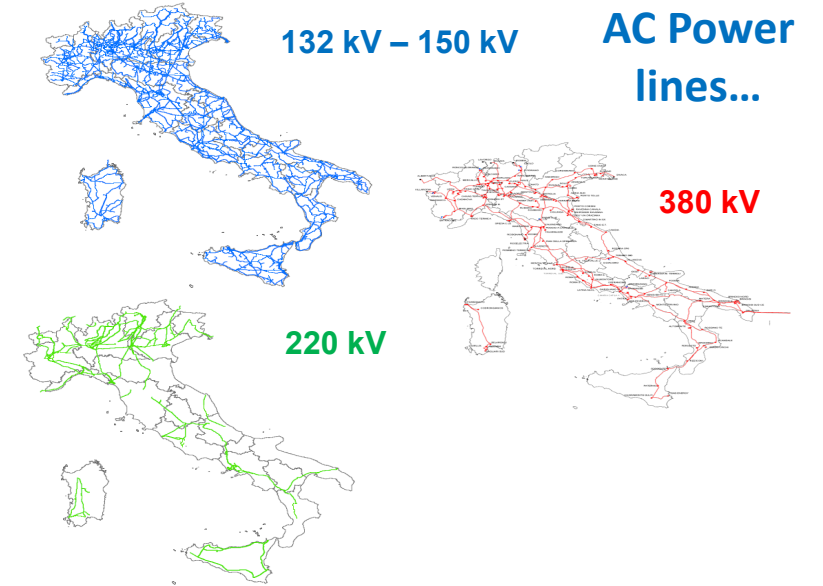
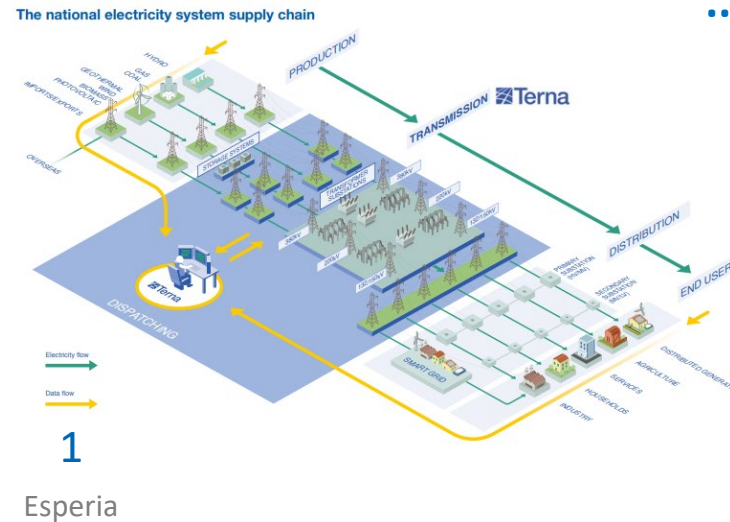


- Integrated system for safety forecasting analysis
- Over **200 topological grid assets** available in the Platform **Library**, constantly updated and integrated according to the changing operating needs of the National Electricity System.

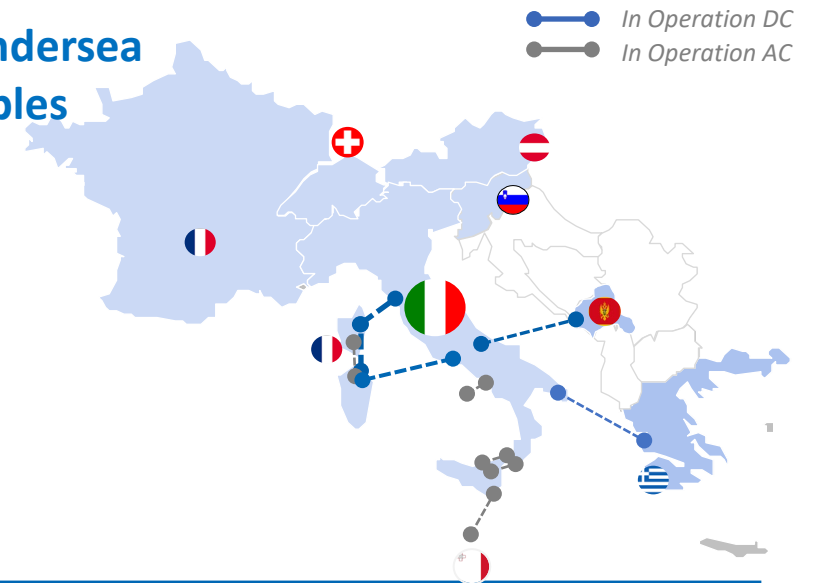


Terna is one of the largest European TSO

Terna asset



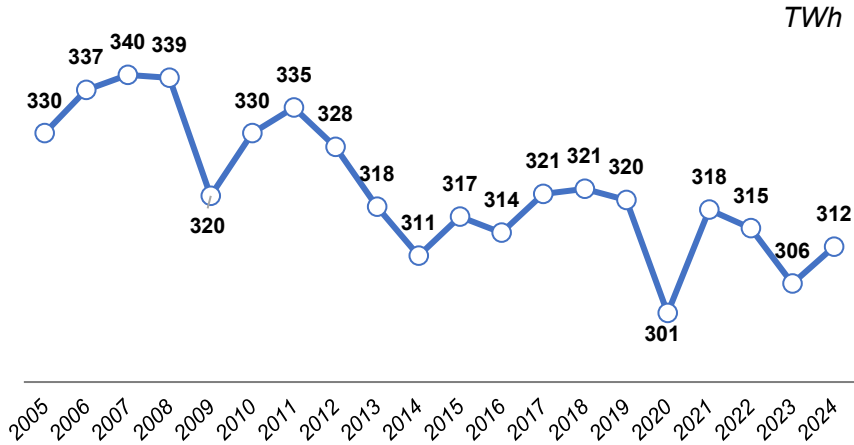
... + Undersea cables



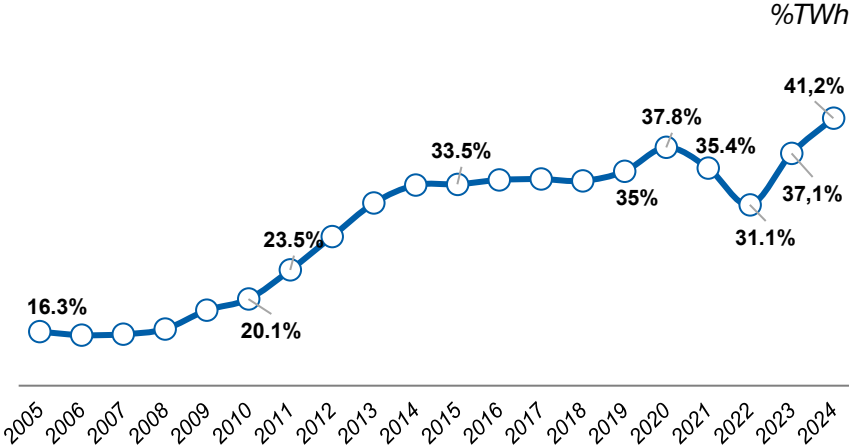
Energy Mix

Demand, installed capacity and production

Electricity demand (historical series)

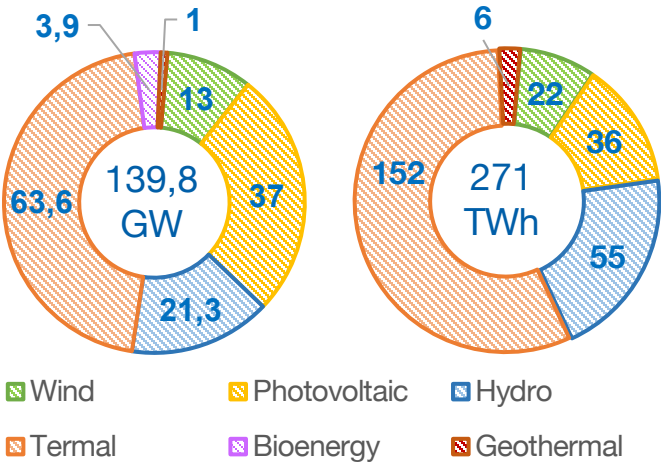


Renewable coverage (historical series)

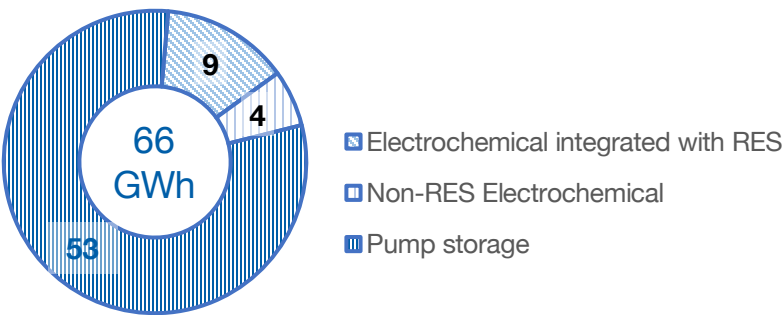


Between 2005 and 2024, an increasingly large share of electricity demand is met by renewable sources. This steady rise reflects the expansion of renewable generation capacity, strengthened climate and energy policies, and the progressive integration of technologies such as wind and solar into the power system.

2024 Installed generation capacity and production



2024 Storage capacity



The rapid acceleration in the development of renewable energy, with an increase in installed capacity, entails significant impacts on the TSO's grid management activities, especially in terms of real-time balancing of electricity production and demand.

In this context, the development of new storage systems represents, together with transmission grid development, one of the key tools to enable the energy transition.

In May 2025, renewable generation was responsible for 56% of electricity demand, setting a new record. Furthermore, in several hours of the same month, renewable sources covered 100% of demand.

Future Challenges and Network Resilience

Main challenges in managing future power systems

Ensuring the monitoring, control, operation, and management of the Electric System under safe conditions, guaranteeing the quality and continuity of the electrical service at the lowest system cost.



SECURITY

The electric system's ability to operate within proper component functionality limits even after a fault or disturbance. A system is secure if it demonstrates stability (maintaining grid parameters within acceptable limits despite disturbances) and robustness (ensuring limited voltage deviations despite disruptions). Guarantee monitoring, control, operation, and management of the Electric System under secure conditions, ensuring quality and service continuity at the lowest system cost.



ADEQUACY

The Electric System is considered adequate if it has sufficient production resources, storage, demand control, and transport capacity to meet anticipated demand with an adequacy margin in each period.



SERVICE QUALITY

Ability to ensure continuity of service (no interruptions in electricity supply) and quality of supply (waveform integrity of grid parameters).



ECONOMY

Meeting demand and procuring network services for secure management of the National Electric System must always occur at the lowest cost for the community's benefit.