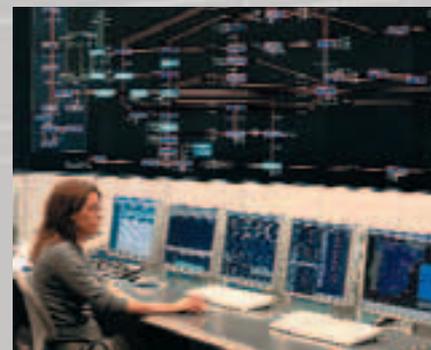


CECOEL

POWER CONTROL CENTRE



RED ELÉCTRICA DE ESPAÑA





Assured
continuity and
reliability
of electricity
supply



The reliable operation of the electricity system is an essential service that Red Eléctrica renders to society at large, as it implements two basic operations: electricity transmission and electricity system operation.

Red Eléctrica role as a key agent for the system operation is based on Law 54/1997 for the Electricity industry, dated the 27th November 1997, where the system operation, management of the transmission grid and main carrier functions of the Spanish Electricity System were assigned to the Utility.



- For implementing such functions, the transmission grid is operated by Red Eléctrica that coordinates its use with the generation facilities to ensure, at all times, the electricity supply continuity and security.

The mentioned operations are regulated to meet the efficiency and transparency criteria as well as to keep agents from being discriminated.

Red Eléctrica has the Power Control Centre (CECOEL) for the electricity transmission facilities operation.

The Spanish Electricity System

 In the Spanish Electricity System, just like in other systems, three main distinct functions can be identified: generation, that supplies the energy required to meet the demand; transmission, that transfers energy from the generation facilities to the consumers, and distribution, which supplies energy to the end client.

As electricity cannot be stored, generation must be kept constantly balanced with demand. Both demand



forecasts and a sufficient generation margin are, therefore, required to meet any possible contingencies or changes in the expected demand. Red Eléctrica, as the System Operator, through its Power Control Centre, has to analyse and implement the required actions to hold such balance.

The generation facilities that make up the Spanish Electricity System are based on different technologies and powered by a variety of primary energy sources, a situation that leads to high service quality and flexibility. The mentioned generation equipment ranges from nuclear power plants to conventional thermo power plants – burning either coal, fuel oil or gas – combined cycle, hydraulic plants, and generation units based on renewable energies, such as biomass, solar and wind energy. Actually, the headway achieved by the last mentioned is quite significant. Based on the above, an optimistic stand about the national generation contribution to the green house effect reduction seems justified.

Overhead and, at times, underground or submarine lines, at 400 kV and 220 kV, are commonly used, jointly with substations or grid nodes, for electricity



transmission from generation to distribution nodes, and make up a grid designed to provide maximum service reliability to the agents, while a power blackout, due to any possible incident in the system, is prevented.

The international connections to neighbouring countries are enclosed in the transmission grid. The men-

tioned interconnections imply a backup for the system operation, as they increase its stability and provide an additional energy source from abroad that further enhances the electricity supply security.

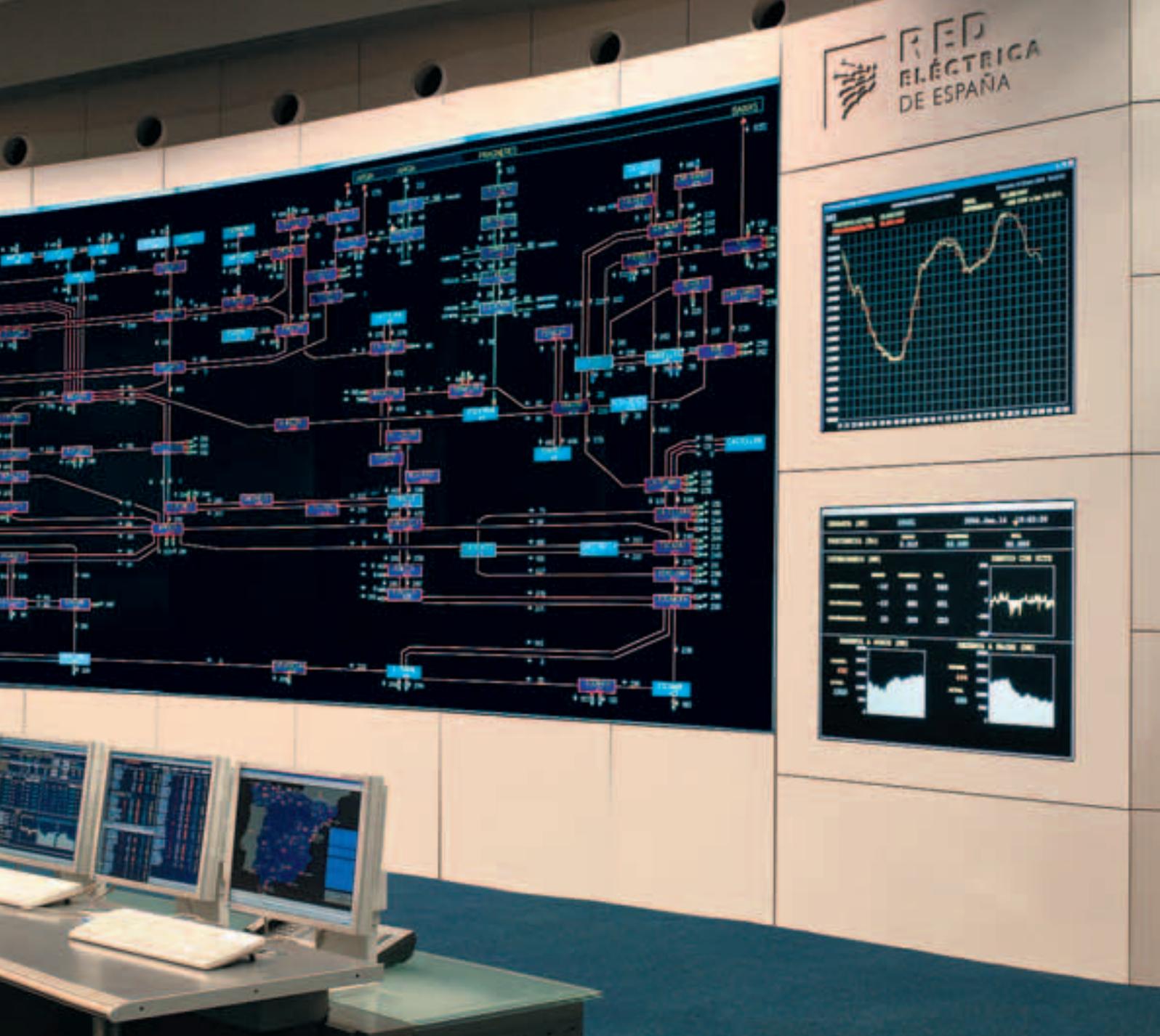
The distribution system is made up by the lines, underground cables and substations in the 132 kV or less range for energy supply to the end client.



Red Eléctrica's CECOEL



The Control Centre is responsible for the real time coordinated operation and supervision of generation and transmission facilities in the Spanish Electricity System.



Red Eléctrica has the CECOEL and the generation and distribution utilities' Dispatch Centres to coordinate and control generation and transmission operations of the Electricity System in the Peninsula.

CECOEL is made up by two control centres that operate in parallel.

CECOEL is manned by the respective Operators

teams that, led by the Shift Manager, make up the operating unit known as Operating Shift, on duty round – the clock, 24 hours a day.

Highly qualified backup technical teams are also available at each Control Centre to support the Operating Shift and carry out preparatory work for real time operation; reliability and performed tasks analysis; development of new operating methods, etc.





CECOEL and the System Operation

Different time scopes are affected by the actions associated to the System Operation. CECOEL is responsible for those related to real time operation.

 **The guidelines issued by CECOEL, for the generation and transmission system operation, are addressed to ensure both quality and security of the electricity supply. Those aims are achieved, first of all, by scheduling generation and international exchanges to meet both demand variations and the non-availability of generating units. Operating set values for the transmission grid elements must be issued, too, in order to ensure control variables remain within the Operation Procedures established range.**

Proper technical management of the system is ensured by a coherent set of technical and instruments Operation Procedures, which were approved earlier on by the Regulatory Authorities. As provided for in Royal Decree 2019/1997, the mentioned procedures have to take into account, at least, the following:

- Requirements to be met for connection to the transmission grid.
- Reliability analysis of annual coverage.
- Installation and operating requirements of measurement and control equipment.
- Analysis of short-term coverage reliability.
- Management of international interconnections.
- Demand forecasts.
- System's operations data.
- System scheduling.
- Coordination of the generation-transmission facilities maintenance.
- Exchange of information between agents.
- Operating conditions of the generation and transmission system as well as the quality, reliability and security criteria.
- Transmission losses assignment and determination.
- Management of each of the complementary-type services.
- Alarm and emergency situations.
- Criteria to determine the grid subject to technical management.

All the approved procedures are published in Red Eléctrica web site: www.ree.es.





Electricity demand forecasting is an essential factor, for, to reach a dynamic demand-generation balance, knowing in advance and as accurately as possible the expected electricity consumption, at a given time, is extremely significant. A computer application for demand forecasting that supplies highly accurate findings has been developed by Red Eléctrica. Based on that application, the Scheduling Department, for terms over one week, and CECOEL, for weekly, daily and hourly horizons, are updating demand forecasts.

Once CECOEL has adjusted its demand forecasts to the actual trends, those complementary services—such as secondary and tertiary regulation and deflections management—are assigned and the power output from each generating unit is scheduled based on the bids they are continuously submitting. The mentioned information, combined with the international exchange plans, is used to achieve the actual demand balance, regardless of its trend. In this way, any possible faults of the generating units are set off. This is essential to control the system's basic variables: voltages and frequency.

Still, since generation and demand cannot be dynamically and accurately matched by changes in the generation programs, an automatic regulation system is available in the Spanish Electricity System, known as the Peninsular Shared Regulation (RCP), that changes the power generated by the units, within specific limits—the secondary

regulation. For this system to be operational, a specific spinning reserve has to be kept available at the generation units. The spinning reserve is controlled and scheduled by CECOEL that automatically generates and sends to the Control Centres of generation utilities the commands to increase or reduce the generation output. Those signals are sent, in turn, by the Control Centres to the generating units, for achieving the required balance between generation and demand.

The international exchanges with other countries are carried out by authorised agents who trade actively in the daily and intraday markets. On the other hand, CECOEL has to establish, on real time, any backup exchanges that might be required, with other electricity systems, to ensure power supply to clients when market arrangements are not sufficient to achieve that target. **The trading exchange capacity** must be updated, too, on real time, at the different electricity borderline connections to ensure their value is compatible with the secure operation of the Spanish Electricity System.

The process to solve the existing technical restrictions, first of all, for matching the daily and intraday markets and, finally, those on real time, is continuously in progress to meet any incidence that might come up in the Electricity System, since it is essential for the assured system's operation.

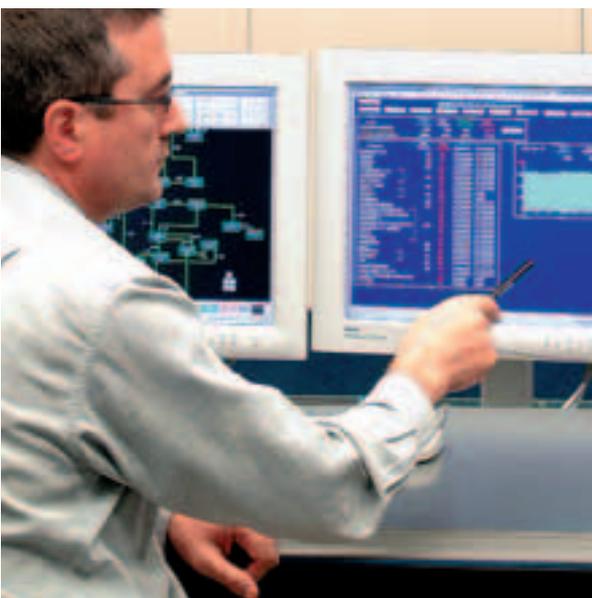
The maintenance of transmission facilities must be coordinated with those of generation, to ensure sufficient availability of the system facilities, as a whole, as well as meeting both security requirements and users demand.

The electricity system security is controlled on a continuous and preventive basis to keep the supply

continuity from being jeopardised. All the appropriate steps are applied, both as regards generation and transmission, that ensure the electricity system normal operation or as fitting to restore it after an incident.

CECOEL supervises the reliable operation of the complete Spanish Electricity System. To such purpose, the grid condition and electricity values, are continuously controlled and control variables managed to ensure the supply security and quality or reset service after an incident.

Operation of the transmission grid **facilities is carried out** by CECOEL. As concerns Red Eléctrica facilities, operations are remotely implemented from both Control Centres. As for the facilities of other transmission utilities, operation commands are issued to their Control Centres and, either by remote operation or through



the service personnel manning those facilities, the required operations are implemented.

If the system's security is at risk situations, due to some key elements failure, consumption can be reduced applying the current legislation for demand management. The action is materialized through instructions to reduce consumption sent to those clients that benefit from a tariff that allows for supply interruptions.

Finally, if a serious incident takes place in the system, the Plans Service Resetting have to be activated and the Transmission Grid operations and those to start and load generation plants have to be coordinated for resetting electricity supply the soonest possible.

On the other hand, external support is rendered to the Control Centres by other areas in Red Eléctrica, such as Scheduling, Markets, Energy Control Systems, Operation Tools, Substations, Lines and Telecommunications Maintenance, besides Grid and Systems Engineering.





The Energy Control System

Due to the complex nature of the managed processes, the availability of high capacity telecommunications and computerised systems is essential for operation on real time. Control Centres in Red Eléctrica are backed up by a state-of-the-art control system, based on open systems running on RISC technology work stations and advanced performance UNIX software, while encloses object-oriented relational databases, and supports, besides other, ICCP, BCN and MBCN communications protocols, for remote access to information and full graphics display.

 **The control system is intended to manage all the information received on real time from power plants and the grid facilities. Operators will be shown this information through easy to understand graphics for studies aimed to ensure the Electricity System's security.**

Supervision and control of the transmission grid is implemented by the control system, that processes on 4, 8 and 12 seconds cycles, over 21,000 signals, which represent analog variables (active and reactive power



in the grid and generation nodes, as well as consumption, voltage values, etc.). The system processes, also, 25,000 digital variables (circuit breakers and isolator switches position, etc.) and issues the respective remote control instructions for 4,500 variables.

Information interchange is implemented either directly from to the own facilities or, through communication links, it uses the control computers of Electric Utilities and other System Operators. The control system has to manage all the mentioned information and supervise, too, any change experienced by the grid layout, update the required alarms, estimate the system condition, analyse its security, act as the System Master Regulator, send information to a block diagram panel, etc.

The help that the control system renders to the operator to take decisions during operations is priceless. Help rendered through simulation programmes,



implemented on real time, that can process any electricity system contingencies which are enclosed in the Operating Procedures. The grid studies are carried out in the control system work stations where estimate grid conditions and loads sharing, evaluate the Electricity System reliability, compute the active and reactive energy balances, transmission losses, etc.

A large-sized block diagram panel is built-in the control system to display the digital images generated by liquid crystal matrixes. The images show the transmission grid and generation units schematic diagrams, besides their availability and loads on real time. The system is rather useful for operation, specially during alarm, emergency and resetting situations.

But the control system most innovative feature is the ability to provide symmetric backup between the Control Centres, where subsystems and telecommunications are completely redundant, based on the so-called multisite functionality. Red Eléctrica is the pioneer at world level for its implementation in two control centres which are simultaneously active.

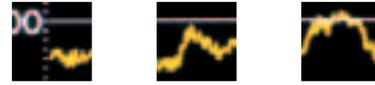
To such purpose, both Control Centres are connected to each other and the grid facilities through a powerful communications system, which owns currently, besides other facilities, over 13,000 km of fibre optic cable.

Apart from the mentioned computerised applications and equipment, found commonly in a control system, the operators have also available, as a help for operating decisions, several expert systems developed by Red Eléctrica to meet its own needs, that the operators can use to prevent and solve any anomalies that might momentarily come up in the electricity system, such as:

- Daily and hourly Demand Forecasting System.
- Expert System for Contingencies Analysis (SEACON).
- Expert System for Assistance to Service Resetting (SAR).

In addition to the real time functions, an OTS (Operator Training Simulator) is available in the system. The simulator is extremely helpful not only for training operators and carrying out service resetting simulations but for implementing also different training tasks. This functionality is especially significant since actual disturbances of the Spanish Electricity Transmission System in the Peninsula are quite uncommon locally and the operators find it difficult to build up the necessary experience for handling this type of situations that might come up during the normal system operation.

Service Quality



The services rendered by Red Eléctrica to the Electricity System and society at large have earned outstanding quality ratings for their continuity of supply and grid availability, facts that set Red Eléctrica in the forefront of comparable European utilities.

The measured values indicative of the transmission service quality and its reference limit values are determined by Royal Decree 1955/2000, as follows:

- Non-supplied energy (ENS).
- Mean interruption time (TIM).
- Grid availability ratio.

Due to these ratios significance, they are not only specifically controlled and tracked, but benchmarked, also, to other international utilities. The ratios trends and international benchmarking findings are shown in the "Spanish Electricity System" report that Red Eléctrica publishes yearly.





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