



## Red Eléctrica line and substation maintenance works



**RED ELÉCTRICA**  
DE ESPAÑA

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Red Eléctrica de España annually carries out a maintenance plan for all its installations of the transmission grid, in compliance with the current legislation and the company's defined criteria. The execution of the plan makes it possible to maintain the reliability of the lines and substations, and therefore guarantee the proper functioning of the transmission grid, avoiding and reducing the unavailability of the installations.

As part of the maintenance works, periodic inspections of lines and substations are programmed, with the objective of inspecting the condition of the installations and plan the actions that may be derived from the inspections.

Operators on a tower carrying out maintenance works.



## Annual maintenance plan

Before the start of each year, Red Eléctrica prepares an annual maintenance plan for its lines and substations which includes the activities to be carried out on the installations during the period to ensure they are kept in perfect working conditions.

Some of the measures included in the plan are:

### Lines

#### • Anti-corrosion treatment

Paint is applied to the metallic structures of the lines to prevent corrosion, especially in the installations near to coastal areas where high levels of contamination exist (pollution, salt...).

#### • Washing of insulators

The cleaning of the electric glass insulators is carried out to eliminate surface dirt deposits from them and thus prevent a high number of disconnections.

Washing electric glass insulators by helicopter.



The state of the structure before and after anti-corrosion treatment works.





Washing electric glass insulators using trucks.

As with the anti-corrosion treatment, these works are intensified in coastal areas where salt contamination adds to the normal pollution which accumulates on electric glass insulators.

Red Eléctrica always performs these works with the line still in service and employing either special trucks for washing or helicopters.

#### • **Thermographic revision**

During the year, Red Eléctrica verifies the temperature of the cable conductors, terminals and connections of their overhead and underground lines as a safety measure. In some cases, the thermography is performed twice a year as an additional measure.

#### • **Tree felling and cutting back vegetation**

The tree felling and pruning works are carried out to avoid the growth of flora underneath the installations which could give rise to disconnection of the lines, be it from a tree falling down or from vegetation growing into the proximity of the conductors. Also, in the case of zones where the growth of a particular type of tree is out of the ordinary, a specific treatment is carried out.



State of a line after the felling and pruning process.

- **Live working-overhead lines**

Red Eléctrica is the only company in Spain which performs this type of works using a helicopter with an attached platform on which an operator sits with a specialised tool to carry out the work.

This method allows the company to carry out maintenance works without the need to disconnect any line, and therefore not put the security of supply at risk. Amongst the more significant works which can be carried out on live installations are: washing electric glass insulators, replacing different line elements and earth cables, installing bird flight diverters and marker balls or repairing cable conductors.



Helicopters used for maintenance works.

## Substations

- **Thermographic inspections**

Thermographic revisions consist of using a thermovision camera to measure from a distance the temperature radiated from different points on a surface, principally produced by the heating of electrical contact pieces. The periodicity of these inspections is annually and on some equipment six-monthly.



Live working for substation cleaning.

Inspection works on a switch.



Cleaning the contacts of a switch.

### • Installation inspections

In order to monitor the state of the equipment and the systems on an ongoing basis, each month Red Eléctrica carries out inspections and collects data on the functioning parameters of their installations. These actions also facilitate the strategy and planning of subsequent maintenance works on substations. Also, through the use of their own telecommunications network, 'remote' revisions (telesupervisions) are performed to instantly check the working condition of an installation's equipment.

### • Telecontrol and protection systems

Depending on the different protection schemes and the telecontrol equipment available in the substations, Red Eléctrica performs different types of maintenance works to ensure the correct functioning of the

Inspection of a voltage transformer in a substation.



installation and therefore achieve the maximum reliability and availability possible of the transmission grid.

- **Direct current and alternating current auxiliary service**

Red Eléctrica also performs maintenance works on the elements, which constitute the auxiliary services of the substations, and which allow the electricity supply in those installations: control panels and distribution boxes, batteries, rectifiers, mid-voltage systems and electricity generators. The periodicity of the revisions is in accordance with the functioning characteristic of this equipment.

- **Power transformers and reactors**

Amongst the maintenance activities of the power transformers and reactors are included the ordinary works, the revision of the step voltage regulators, the measurements of the functioning parameters and oil analysis.

- **High voltage equipment**

In the case of the switches, breakers, instrument transformers, insulators, lightning conductors and other high voltage equipment in the substations, Red Eléctrica defines maintenance actions in accordance with the manufacturing characteristics, model and location in the grid.

The maintenance for some of this equipment is:

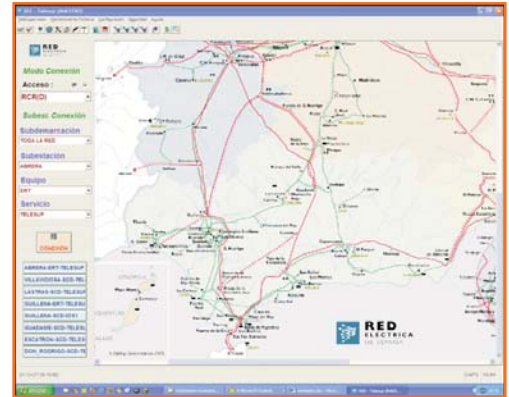
- Switches

Depending on the type of switch (Sulphur Hexafluoride, oil or air), the type of control (pneumatic, spring or hydraulic) and its function (position of the transformer, reactor, in-line, amongst others), technicians perform different maintenance activities adapted to each one of them. In addition, measurements of their functioning parameters are made periodically.

- Insulators

The correct functioning of this equipment is conditioned by the environmental contamination in the area that, in the case of being high, can cause electrical insulation problems.

To avoid these inconveniences, the maintenance works carried out annually by Red Eléctrica are the measures to determine the level of contamination deposited on the insulators, their cleaning through live working and their surface recoating.



Application used by REE used to revise its installations remotely.

Power transformer refrigeration system.



## Renovation and improvement plan works

Throughout the year, Red Eléctrica also carries out its renovation and improvement plan, with the objective of maintaining a sufficient standard of quality of its installations to ensure the correct functioning of the system.

These works —replacement of electric glass insulators for another type of compound, of conductors and of towers (in the case of lines), and renovation of protections, transformers, switches, telecontrol systems and auxiliary services (in the case of substations)— follow certain criteria related to ageing, technology becoming obsolete, new components, etc.

## Summer focused activities

During the summer season, in addition to its activities regarding the Renovation and Improvement Plan, Red Eléctrica continues with its annual maintenance plan of its installations, which in September 2008 achieved 75 % of its target.

Nevertheless, as a consequence of the strong increase in energy demand during the summer period, Red Eléctrica intensifies the works carried out on lines and substations to ensure the correct functioning of its installations which being in the open, are more vulnerable to the heat.

By doing this, and as a compliment to the annual maintenance plan, they define special action plans to carry out exceptional works in installations considered critical, with the objective of achieving the highest possible rate of availability of Red Eléctrica de España assets (in 2007 this was 98.06 %).

Some of the works which are a result of these special pre-summer plans are:

- Inspections of all the electricity lines considered sensitive in the summer to verify their good condition before the summer period.
- Intensification of the insulator cleaning works in the areas with higher levels of contamination.
- Special campaign of felling and pruning back vegetation with the objective of preventing wooded areas from provoking disconnections.

Workers carrying out maintenance.

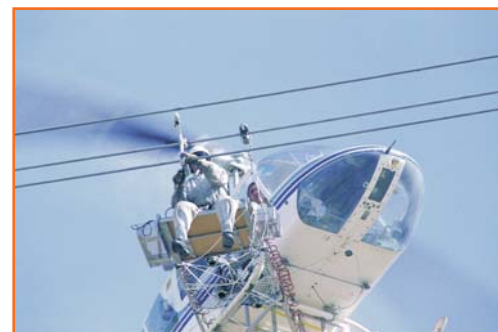




- Verification of all the fire detection systems and transformer protections, fire stops, cable rooms, and control and voltage rooms.
- Detailed inspections of the refrigeration systems for power transformers. Verification of the temperature alarm and trigger settings in order to adjust them so that they activate based on the performance conditions of the equipment.
- Exhaustive analysis of the state of the protection systems in order to resolve the anomalies as quickly as possible before the start of the summer period.
- Stocking of spare parts which are highly critical for the protection, operation and power systems. Emergency kits are distributed to the most sensitive installations with the objective of minimising the response time in case of hypothetical breakdowns, reducing the non-availability of the systems.
- Constant monitoring of the condition of the equipment via remote control systems.



Close up of some insulators.



Replacement of cable separators using a platform attached to a helicopter.

## Red Eléctrica Maintenance School

As of January 2008, Red Eléctrica's Maintenance School gives courses to its transmission grid maintenance technicians, guaranteeing them fully up-to-date professional training and qualifications which ensures their installations are maintained to the highest possible standard and therefore avoiding possible non-availabilities of their installations.

These courses are designed not only for teaching new employees but also for the on-going and recycling training of the rest of their technicians. It contemplates not only technical training but also work-related risk prevention, environmental protection and quality.

In addition, the Maintenance School also provides training and certifies personnel from other companies who work on the installations of Red Eléctrica. With this initiative, Red Eléctrica has achieved a reduction in work-related risks associated with this type of work, and has increased the quality and efficiency of the maintenance of its lines and substations.

The School has specialised teachers, specific equipment for training and testing and also employs technologically advanced systems. It's worth

Simulator used in the Maintenance School.



highlighting that, in addition to a virtual training platform, a simulator is used to train students in the art of how to execute manoeuvres, operations and emergency plans in a substation so as to afterwards be able to apply this knowledge in a real installation.

In January 2009, the School, in collaboration with the Industrial Engineering School at the Universidad Pontificia de Comillas in Madrid (ICAI), is going to start a post-graduate training programme in design, construction and maintenance of high voltage electricity installations. The programme will consist of two courses, each with a duration of 250 hours, and constitutes a university Master's Degree in High Voltage Installations from said university.

An operator on a tower carrying out maintenance works.





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