# SOME FACTS ABOUT CIEMAT

**Public Research Institution (OPI) dealing with Energy and Environment pertaining to the Ministry of Science and Technology (MICYT) through the State Secretariat for Scientific and Technical Policy**

**Annual budgeted expenses** about **64 million euros**

- 65% transferred from the State
- Remaining revenues from R&D activities and technical services

**Human Resources**

1,200 workers
about half of which have university degrees
30% civil servants 70% contracted

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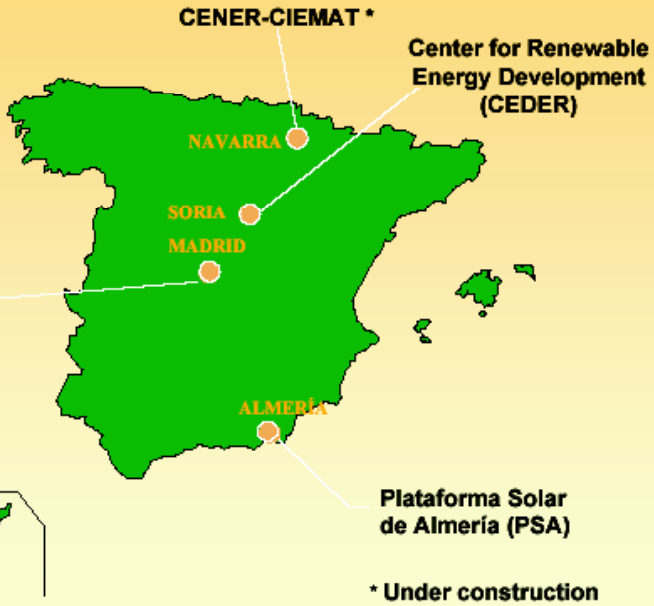
# CIEMAT RESEARCH CENTERS


* Under construction

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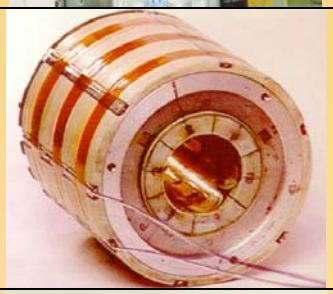
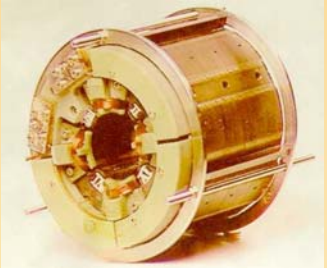
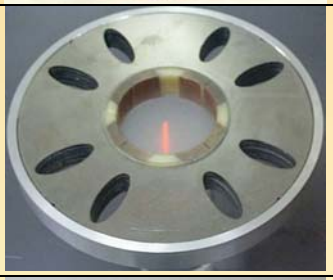
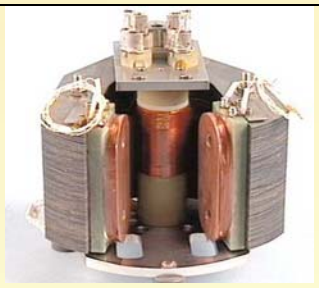
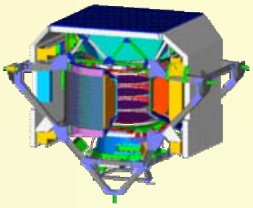
Fernando Toral
CIEMAT PRESENTATION DEC, 9, 2003

# R&D ACTIVITIES AT CIEMAT

- Renewable Energies
- Fusion by Magnetic Confinement
- Radiation Protection and Radiation Dosimetry
- Materials Behaviour in Power Plants
- Radioactive Waste Management
- Environmental Behaviour of pollutants
- Molecular and Cellular Biology
- Combustion and Gasification Technologies
- Computing and Communications Technologies
- Experimental High Energy Physics
  - ✓ International collaborations at:
    - CERN
    - DESY: Mark-J at PETRA & TESLA500
    - NASA
  - ✓ Applied Superconductivity Lab. CIEMAT-CEDEX

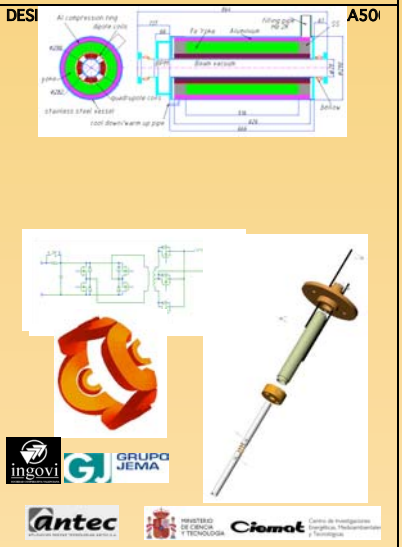
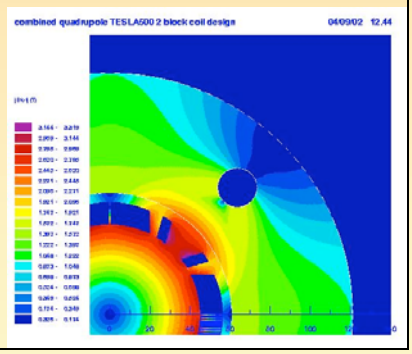
# BACKGROUND IN ACCELERATORS & DETECTORS

| PROJECT & PARTICIPATION | CHARACTERISTICS | |
|---|---|---|
| **Tuning Quadrupole for the LHC (1989-1992)**<br>*Design, Manufacturing Follow-up* | Type of Magnet: Cos 2θ<br>Nominal Gradient: 120Tm$^{-1}$<br>Nominal Current: 1600 A<br>Maximum Field: 3.8T<br>Magnetic Length: 720 mm<br>Inner Bore: 56.3 mm |  |
| **Sextupole for the LHC (1992-1995)**<br>*Design, Manufacturing Follow-up & Testing* | Type of Magnet: Cos 3θ<br>Nominal Strength: 1600Tm$^{-2}$<br>Maximum Current: 390 A<br>Maximum Field: 2.23T<br>Magnetic Length: 180 mm<br>Inner Bore: 56.0 mm |  |
| **Octupole for the LHC (1993-1994)**<br>*Design, Manufacturing Follow-up & Testing* | Type of Magnet: Superferric<br>Nominal Strength: 48000Tm$^{-3}$<br>Nominal Current: 230 A<br>Maximum Field: 1.37T<br>Magnetic Length: 150 mm<br>Inner Bore: 56.0 mm |  |
| **Trim Quadrupole for the LHC (1997-2000)**<br>*Design & Fabrication* | Type of Magnet: Double Pancake<br>Nominal Gradient: 110Tm$^{-1}$<br>Nominal Current: 550 A<br>Maximum Field: 3.7T<br>Magnetic Length: 1190 mm<br>Inner Bore: 56.0 mm<br>Nº of units: 2 |  |
| **Current Leads for LHC Correctors (1998-2000)**<br>*Design, Fabrication & Testing* | Type of Leads: Gas Cooled+HTS<br>Nominal Current: 600 A<br>Maximum Losses to LHe: 60mW<br>Type of HTS: BSCCO 2212<br>Nº of units: 4 |  |
| **Magnet Testing (1994-2000)**<br>*Test Specifications & Execution* | Type of Tests:<br>Training<br>Quench Propagation<br>Optimum Precompression<br>Gas-Cooled Current Leads<br>Maximum Mag. Length: 300 mm<br>Maximum Mag. Current: 1800 A<br>Approx. Nº of Mag. Tested: 20 |  |
| **AMS II Detector (2000-2004)**<br>*Design & Manufacturing Follow-up of a Power Supply* | Type: Switch Mode<br>Load: a 52H Superconducting Magnet<br>Current: 450 A<br>Voltage: 0 to 5 V<br>Weight < 15 kg |  |

# BACKGROUND IN ENERGY MANAGEMENT

| PROJECT & PARTICIPATION | CHARACTERISTICS | |
|---|---|---|
| **1 MJ Superconducting Magnetic Energy Storage SMES (1995-1996)**<br><br>*Design of the magnet and the power converter and Manufacturing Follow-up* | Stored Energy: 1 MJ<br>Power: 500 MVA<br>Current: 1000 A<br>Type of magnet: Double Pancake Solenoid |  |
| **Fault Current Limiter (1998-2001)**<br><br>*Design & Partial Tests* | Type: Inductive with Hybrid Secondary<br>Superconductor: YBCO 123<br>Rated Voltage: 380 V<br>Limiting Current: 1000 A |  |
| **Flywheel Energy Storage for a Wind-Generator (1997-2002)**<br><br>*Design & Fabrication of the electrical machine and power electronics* | High speed Flywheel for a Stand-alone Wind Generator<br>Maximum Speed: 30,000 rpm<br>Energy: 4 MJ<br>Power: 50 kW<br>Drive: Switched Reluctance Machine<br>Type of Flywheel: Carbon Fiber + Glass Fiber |  |
| **Flywheel Energy Storage for Railway Substations (2002-2006)**<br><br>*Design & Fabrication of the electrical machine and power electronics* | Low speed Flywheel for Power Levelling at Railway Substations<br><br>Maximum Speed: 6,000 rpm<br>Energy: 600 MJ<br>Power: 5 MVA<br>Drive: Switched Reluctance Machine |  |

# CIEMAT COLLABORATIONS WITH TESLA500

| PROJECT & PARTICIPATION | CHARACTERISTICS | |
|---|---|---|
| **Design and Fabrication Study on the TESLA500 Superconducting Magnet Package (2000)**<br><br>*Feasibility Study for the TESLA500 Technical Design Report* | The TESLA500 Superconducting Magnet Package consists of:<br>- Combined Magnet with a Quadrupole and two Dipoles<br>- HTS Current Leads<br>- BPM<br>- Helium Vessel<br>- Power Supply<br><br>Study content:<br>- Draft design<br>- Fabrication procedures<br>- Price estimate<br><br>Spanish Contribution: 35,000 € |  |
| **Fabrication of HTS Current Lead Prototypes for TESLA (2002-2003)**<br><br>*Design, Fabrication & Partial Tests* | Type of Leads: Normal Conducting + HTS<br>Nominal Current: 100 A<br>Maximum Losses to LHe: 25mW<br>Type of HTc : BSCCO 2212<br>Nº of units: 2<br>Spanish Contribution: 36,000 € |  |
| **Fabrication of Two Combined Magnet Prototypes (2002-2005)**<br><br>*Design & Fabrication of the Magnet and the Ribbon Machine* | **One quadrupole:**<br>Nominal Current: 100 A<br>Nominal Gradient: 60 T/m<br>**Two dipoles:**<br>Nominal current: 40 A<br>Nominal field: 0.074 T<br><br>Total Length: 626 mm<br>Bore diameter: 90 mm<br>Nº of units: 2<br>Spanish Contribution: 200,000 € |  |

# Project Resources

## FACILITIES

**CIEMAT** ⇨ **Winding workshop**

- ⇨ A winding table for coils up to 2m long, using double-pancake technique
- ⇨ Vacuum impregnation facility
- ⇨ Curing furnace
- ⇨ Soon: A ribbon machine

**CEDEX** ⇨ **Test Laboratory**

- ⇨ Three cryostats
- ⇨ One 1700A power supply
- ⇨ Several power supplies up to 125A
- ⇨ Data acquisition systems
- ⇨ Instrumentation for magnets tests

## Personnel ⇨

| | |
|---|---|
| **Doctor Engineer** | **2** |
| **Engineer** | **1** |
| **Physicist** | **1** |
| **Technical Engineer** | **1** |
| **External collaborations** | |

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