



EMPRESARIOS AGRUPADOS

Engineers and Consultants

Company Profile and References
for
Fossil-Fired and Combined Cycle
Power Plant Engineering Services

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COMPANY PROFILE

Empresarios Agrupados (EA) is a leading architect-engineering organisation in Spain with significant international experience, providing a complete range of consulting, project management, engineering and design, procurement, construction management, plant testing, safety assessment, quality assurance, as well as plant operation and maintenance support services to the electric utility industry.

Founded in 1971, EA has a permanent multidisciplinary staff of approximately 1000, 65% of whom are university graduates, involved in engineering projects and services in the electric utility sector, and who embrace a wide range of engineering disciplines.

EA has provided engineering and consultancy services, and completed projects in Spain and some 35 other countries. The company has been ranked by the magazine *Engineering News-Record* among the Top 200 International Design Firms.

POWER GENERATION: Fossil-Fired and Combined Cycle Power Plants and Power Transmission and Distribution

Serving the electric utility industry is one of EA's primary objectives as an engineering company. In the field of power generation, EA's work includes the design, project engineering, construction management and operation support of thermal power plants (simple and combined cycles, and cogeneration), as well as hydroelectric and nuclear power plants.

EA provides its clients with the assistance required to efficiently implement optimal solutions for new power generation plant projects, as well as the safety assessment, modernisation, backfitting, repowering and life extension projects, and collaborates on the improvement of plant operation and maintenance.

The power generation services provided are as follows:

- Feasibility studies
- -Site selection and development
- Project management
- Project engineering and design
- Procurement management
- Construction management

- Plant testing and commissioning
- Plant operation and maintenance
- Quality assurance/quality control

EA has completed the engineering and construction in power plant projects totalling more than 44,000 MWe of power generating capacity.

The following is a summary of EA's capabilities, experience and references in fossil-fired and combined cycle power plant projects (ie, conventional power generation), as well as in power transmission and distribution projects (Note: EA's experience in nuclear power projects and related references are described in a separate document).

Fossil-Fired Power Plant Projects

EA has carried out many fossil-fired power generation projects covering the engineering, design, construction management, testing and commissioning for fossil-fired power plants both in Spain and abroad, burning coal, anthracite, lignite, fuel-oil, gas and biomass, and featuring a wide variety in size, capacity, and main suppliers for the boiler (Babcock & Wilcox, Balcke-Dürr, Combustion Engineering, Foster Wheeler, Stein) including supercritical boilers, and combustion technologies, as well as for the steam turbines (ABB, Alstom, General Electric, Mitsubishi, Siemens-Westinghouse).

Combined Cycles and Cogeneration

EA has carried out the complete engineering, design, procurement, construction and commissioning for a number of simple- and combined-cycle power plant and cogeneration projects using gas turbines of different technologies and from different manufacturers including General Electric, Alstom and Siemens-Westinghouse. These projects have been undertaken either as "engineering services contracts" or for EPC (Engineering, Procurement and Construction) projects awarded on a turnkey basis. Table IT1 shows our experience in this area.

New Power Generation Technologies

EA has participated in the engineering of new power generation technologies. An important project in this area has been the Elcogas project, a 335-MW plant using Integrated Coal Gasification Combined Cycle (IGCC) technology, built in Spain on the initiative of a group of European electric utilities. EA has been participating since 2004 in the engineering of the CO₂ capture and H₂ production pilot plant for this facility. Since 2010 EA is developing the engineering services for the OXY-CFB-300 (Compostilla Power Plant) project, a supercritical 350 MW coal power plant using oxy-coal combustion

technology and featuring a CO₂ capture plant, located in Cubillos de Sil (province of León, Spain).

Another project of interest in this area is a 100 kW pilot power plant that uses molten carbonate fuel cells.

Renewable Energies

In the field of renewable energies, EA has carried out projects for electric power generation using solar, wind or biomass energy. Regarding the rational use of energy, EA has acquired extensive experience in energy management and saving.

Modernisation Projects

EA also has broad experience in the provision of operation support services and in refurbishment, modernisation and modification projects for operating power plants. EA helps its clients comply with the severe environmental standards in force, enhance general power plant performance and operation, increase availability, reliability and safety, and reduce operation and maintenance costs.

Environmental Protection

EA's work covers environmental protection projects and the processing of solid, liquid and gaseous effluents associated with the construction and operation of fossil-fired power plants and nuclear power plants in which the company has participated as the main architect-engineer and as part of international consortia. These projects cover aspects such as flue gas desulphurisation, corrective actions against pollution, soil analyses, noise control studies, water quality management, safe waste storage and treatment plants, water management, industrial solid waste management, etc.

EA's extensive experience in power generation covers the following aspects:

- Energy market studies, analysis of combustion power generation technologies, techno-economic studies and site studies for power plant projects
- Preparation of specifications for invitations to tender, evaluation of tenders and contract negotiation support
- Project management and organisation of technical teams to undertake projects covering all areas of planning, management of resources, economic evaluations, project financing schemes, cost control, etc
- Preparation of project documentation such as technical design criteria, equipment specifications, evaluations and follow-up of contracts

- Basic and detail design for a large number of fossil-fired and combined-cycle power plants using all types of fuels (coal, gas, fuel-oil, etc), boilers, and gas and steam turbine-generators from different suppliers and technologies
- Complete EPC (Engineering, Procurement and Construction) projects, delivered under a turnkey contract to our clients
- Retrofitting and repowering of fossil-fired power plants through associated combined-cycle configurations - especially *boosting* and *topping* configurations - adapted so as to achieve optimal techno-economic results
- Development of in-house computer programs and of specific applications based on commercial software to perform thermodynamic analyses and simulation of modern power plants

We have completed numerous coal, fuel-oil and/or gas-fired power plant projects both under engineering services type contracts and under *EPC* contracts, maintaining stringent environmental conditions. EA's main references in this area are listed in Table IT2 .

Recent relevant projects in the thermoelectric power area include:

- Basic and detail engineering for the Altamira Fossil-Fired Power Plant Units 1 and 2, located in the industrial area of Altamira, Tampico, on the Caribbean coast of Mexico. This project, awarded as a turnkey contract by the utility *Comisión Federal de Electricidad* (CFE) to the consortium formed by ISOLUX and ALSTOM, consists in revamping the two power plant units, by replacing the existing liquid-fuel fired boilers with new circulating fluid bed (CFB) boilers firing petcoke. The converted facility will comprise 2 power generating units with a net output of 150 MW each. The project also includes revamping the steam turbine-generator and new facilities for assorted BOP services, such as a railway for unloading petcoke and limestone, a handling system, novel integrated desulphurization (NID) units, etc.
- Basic and detail engineering of the *Central Térmica Recka* project, a 185-MW open cycle power plant with dual fuel and fin fan-cooler turbine cooling. The *Sociedad Minera Cerro Verde* (SMCV) signed an electrical power supply contract with Electroperu S.A to increase cold reserve and thus supply power for the extension of the Cerro Verde production unit through the surplus power in the national network. Established under an EPC contract signed between SMCV and COBRA, the plant will be built in the district of Reque (Peru).
- Basic and detail engineering for the Yanbu Power and Desalination Project Phase III. The turnkey contract for this power plant project was awarded by the Saline Water Conversion Corporation (SWCC) to the consortium formed by Al Toukhi, Arabian

Company for Water and Power Development (ACWA) and Samsung Engineering Company Limited (SECL). The plant is located 40 km south of Yanbu Al Bahar, on the Red Sea, in the Kingdom of Saudi Arabia. The projected facility comprises 5 power generating units in a base configuration with a net output of 2,708.5 MW: 2,500 MW will be supplied to the Saudi Electricity Company (SEC) and Marafeq, while 208.5 MW will be supplied to the 550,000 m³/day desalination plant located in the same complex. Each power block comprises a dual-fuel (heavy fuel-oil and natural gas) firing supercritical steam generator and a steam turbine supplied by Alstom, as well as a seawater flue gas desulphurization (SWFGD) unit.

- Basic and detail engineering for the Ashuganj South Combined Cycle Power Plant project, a 450 MW, single-shaft unit with open circuit cooling using river water. Awarded as a turnkey contract by Ashuganj Power Station Company Limited (*APSCCL*) to the TSK-INELECTRA consortium, the plant will be built in the Ashuganj Industrial Park, in the city of Ashuganj (Bangladesh). The project uses a Siemens gas and steam turbine-generator, as well as heat recovery steam generators (HRSGs) from CMI.
- Basic and detail engineering of the add-on project aimed at converting the Ensenada de Barragán Power Plant (consisting in two Siemens gas turbines) into an 800 MW, 2x2x1 multi-shaft combined cycle power plant by including Siemens steam turbines. The plant features open circuit cooling using river water. Awarded as a turnkey contract by *Energía Argentina S.A. (ENARSA)* to the ISOLUX-IECSA joint venture, the plant is near the city of Ensenada, approximately 10 km from the city of La Plata in the province of Buenos Aires (Argentina).
- Basic and detail engineering of the add-on project aimed at converting the Brigadier López Power Plant (consisting in one Siemens gas turbine) into a 400 MW, 1x1x1 multi-shaft combined cycle power plant by including a Siemens steam turbine. The plant features open circuit cooling using river water. Awarded as a turnkey contract by *Energía Argentina S.A. (ENARSA)* to the ISOLUX-IECSA joint venture, the plant is located in the Sauce Viejo industrial park, approximately 11 km from the city of Santo Tomé in the province of Santa Fe (Argentina).
- Basic and detail engineering of the power island for the Deir Azzour Combined Cycle Power Plant project, a multi-shaft (2x2x1), 800 MW unit with Heller-type cooling tower, located near Deir Azzour (Syria), awarded as a turnkey contract by the Syrian utility *Public Establishment of Electricity for Generation and Transmission (PEEGT)* to Metal Constructions of Greece, S.A. (Metka). Gas and steam turbines with their associated generators and auxiliaries are supplied by Ansaldo.

- Complete range of basic and detail engineering services for the Khulna Peaking Power Plant project, based on a 150-MW Alstom GT13E2 (E) gas turbine, located in Goalpara (Khulna district, Bangladesh), a facility using natural gas as base fuel and fuel-oil as backup fuel, property of the North-West Power Generation Company Limited and built under a turnkey contract by ISOLUX. Alstom supplies the gas turbine, the generator and their associated auxiliaries. Plant connection to the existing Goalpara substation (132 kV) and Khulna Central substation (132 kV) through a 132 kV plant substation.
- Owner's Engineer and in-house consultant for the Eurostar Combined Cycle Power Plant project (Turkey), a GE 2x2x1 multi-shaft configuration, 850 MWe unit with air-cooled condenser, awarded under an EPC contract to the GE-GAMA consortium by the Met Group of Companies (Metcap).
- Owner's Engineer and in-house consultant for the Dervish Combined Cycle Power Plant project (Turkey), awarded under an EPC contract to the GE-GAMA consortium by the Met Group of Companies (Metcap). The single-shaft, 490 MWe plant with a new GE 9FB.05 gas turbine and an air-cooled condenser integrates a 50 MWe solar field for direct feeding and increased efficiency of the cycle, as well as a 12 MWe wind park to compensate for auxiliary plant loads.
- Front-End Engineering and Design (FEED) for the fossil-fired power plant of Compostilla (León, Spain), owned by Endesa. This pilot project consists of a coal-fired supercritical plant featuring oxy-coal combustion and CO₂ capture technologies, whose first stage aims at demonstrating project feasibility and at obtaining a suitable budget for its construction under an EPC approach.
- Complete basic and detail engineering services for the Riga II Combined Cycle Power Plant project (Riga, Latvia), a multi-shaft (1x1x1) unit providing 350-420 MWe and 270 MWt in cogeneration mode for district heating, featuring a cooling system based on cooling towers. This turnkey project was awarded by Latvenergo to GAMA. GE supplies the gas turbine (109FB) and its associated generator, while Siemens supplies the steam turbine-generator and associated auxiliaries. EA supervises and coordinates the activities of the local engineering firm in charge of permits and engineering activities related to the application of Latvian codes and standards.
- Basic and detail engineering of the Megalopolis Combined Cycle Power Plant project (Megalopolis, Greece), an 800 MW unit in multi-shaft (2x1) configuration with cooling towers, awarded as a turnkey contract by the Greek utility Public Power Corporation (PPC) to TERN. The gas and steam turbines and their associated generators and auxiliaries are supplied by GE. The facility will run on natural gas.

- Basic and detail engineering of the power island for the Deir Ali Combined Cycle Power Plant project, a multi-shaft (2x2x1), 800 MW unit with Heller-type cooling tower, located near Damascus (Syria), awarded as a turnkey contract by the Syrian utility Public Establishment of Electricity for *Generation and Transmission* (PEEGT) to Metal Constructions of Greece, S.A. (Metka). Gas and steam turbines with their associated generators and auxiliaries are supplied by Ansaldo.
- Basic and detail engineering of the power island for the Denizli Combined Cycle Power Plant, an 800 MW unit in multi-shaft (2x2x1) configuration with air-cooled condenser, located 300 km to the west of Izmir (ancient Smyrna), in Turkey. This turnkey project was awarded to Metka by the Turkish utility *RWE & Turcas Güney Elektrik Üretim A. Ş.* The gas and steam turbines with their associated generators and auxiliaries are supplied by Siemens.
- Basic and detail engineering of the Rio Turbio Thermoelectric Power Plant project (Santa Cruz, Argentina), a coal-fired power plant comprising two 125 MWe units, each equipped with a fluidised bed boiler manufactured by *Foster Wheeler North America Corp.* (FWNA) and a steam turbine from Siemens, and integrating air condenser cooling. This turnkey project was awarded by *Yacimientos Carboníferos de Río Turbio S.A.* to the joint venture established between *Isolux Ingeniería S.A.* and *Tecna Proyectos y Operaciones S.A.*
- Design and detail engineering services of the Samsun Combined Cycle Power Plant project, located at approximately 76 km from the city of the same name in Turkey. Owned by Borasco Elektrik, this power plant with a nominal rating of 886 MWe is based on GE's 109FB single-shaft "Standard Plant Block 2" design. Each of the two 109FB single-shaft units features a PG9371FB gas turbine, a three-pressure HRSG, a 109A steam turbine and a 450H-type generator, supplied by GE.
- Design and detail engineering services of the Moerdijk Combined Cycle Power Plant project (owned by Essent), located in the city of the same name, approximately 80 km north of Amsterdam (Netherlands). This plant with a nominal rating of 435 MWe is based on GE's single-shaft 109FB standard plant design, with a condenser, 9FB (PG9371FB) gas turbine, three-pressure HRSG, 109A steam turbine and 450H-type generator, all supplied by GE.
- Engineering and design of the Koudiet Combined Cycle Power Plant project, located in Koudiet Ed Draouch, Wilaya de Tarf (Algeria), awarded by Sonelgaz to Iberdrola Ingeniería y Construcción, S.A.U., with an approximate power rating of 3x400 MWe in a 3x109FB configuration, i.e. three single-shaft units, each featuring a 9FB gas turbine, a steam turbine, a generator, an HRSG and a distributed control system

(DCS), all supplied by GE. Plant design is based on GE's Standard Plant 109FB Block 2.

- Conceptual engineering services for the Volos Combined Cycle Power Plant (property of Endesa-Hetlas), awarded by the Greek utility PPC to Metka and located in the city of Volos, approximately 360 km north of Athens and 215 km south of Salonika (Greece). Nominal rating of 420 MW and configuration based on GE's standard 109FB single-shaft plant with an air-cooled condenser and a 9001FB gas turbine, one three-pressure HRSG, one steam turbine and one electric generator (GH350 common to the gas and steam turbines).
- Design and detail engineering services for the Brazi Combined Cycle Power Plant, property of the petrochemical company Petrom and located on the premises of the company's "Petrobrazi" refinery in Brazi (approximately 40 km from Bucarest), Romania. Awarded by Petronom to Metka, this 865 MW, multi-shaft (2x1) plant is based on GE's 209FB multi-shaft standard plant design, and features two (2) 9FB gas turbines, two (2) three-pressure HRSGs, one (1) D11 steam turbine and three (3) power generators (2 type 330H and 1 type 324H), supplied by GE, and a closed cooling system with cooling towers.

The plant exports steam (10 to 96 t/h at approximately 16 barg), which is recovered as condensate. The GIS substation and the power transmission line are not included in the project scope.

- Engineering for the Puerto de Barcelona Combined Cycle Power Plant project, owned by Gas Natural, S.A. and located in Barcelona (Spain). The plant consists of two (2) single-shaft, 400 MW units in a 2x109FB configuration with GE turbines. Project awarded by Gas Natural, S.A. to a consortium formed by GE and Técnicas Reunidas (TRSA).
- Complete engineering and design of the Montoir Combined Cycle Power Plant project, owned by Suez-Gaz de France (COFATHEC) and located in Montoir (France). It consists of one (1) single-shaft, 400 MW unit, using a GE 109FB turbine. Project awarded on an EPC basis to a consortium formed by GE and TRSA.
- Complete engineering and design of the Granadilla 2 Combined Cycle Power Plant, a 220 MW unit owned by Endesa, in the island of Tenerife (Canary Islands, Spain). The plant uses a 2x1 configuration (206FA) with GE 6FA gas turbines. Project awarded on an EPC turnkey basis to a consortium formed by GE and TRSA.
- Engineering services for the Besós 5 Combined Cycle Power Plant (Sant Adrià de Besós, Barcelona, Spain), a multi-shaft (2x2x1) 209FB configuration, 800 MW unit equipped with GE-supplied power train (GTs, STs and generator), HRSGs and DCS.

Project awarded under an EPC contract by the electric utility Endesa Generación, S.A. to the consortium formed by GE and TRSA.

- Engineering and project management support services contract for the Thiva Combined Cycle Power Plant (Thiva, Greece), with a generation capacity of approximately 420 MW. Project awarded by the Greek utility PPC to TERNA. The main equipment, supplied by General Electric, comprises one (1) 9FB gas turbine and one (1) steam turbine (provided with air-cooled condenser) mounted on a single shaft, and a heat recovery steam generator (HRSG).
- Engineering services of the Andina Fossil-Fired Power Plant (Mejillones coast, northern Chile), featuring two units of approximately 165 MWe each, burning coal and petcoke, equipped with a Foster Wheeler fluidised bed boiler and a Skoda turbine-generator, and cooled by seawater. Project awarded by Suez Energy Andino to Cobra Plantas Industriales, S.A. under an EPC contract.
- Basic and detail engineering services of the Lares Combined Cycle Power Plant project, located in Figueira da Foz (Lares, Portugal) and awarded by Energias de Portugal (EDP) to the consortium formed by Cobra Plantas Industriales S.A.-CME de Portugal and GE. The plant features two single-shaft units of 400 MWe each, using 9FB gas turbines and A15 steam turbines. The heat sink consists of cooling towers supplied by river water.
- Conceptual engineering services for the Shatura Combined Cycle Power Plant (Moscow region, Russia), with a power output of 400 MWe, and comprising a 109FA gas turbine, a D10 steam turbine and a generator, in a single-shaft configuration, and a heat recovery steam generator (HRSG). The plant is fuelled by natural gas and the condenser is cooled by lake water. Project awarded by the Russian electric utility OK4 to GAMA.
- Basic and detail engineering services for Phase II of the Peaker Escatrón Combined Cycle Power Plant project (Escatrón, Zaragoza, Spain) awarded by GLOBAL 3 COMBI SLU to Técnicas Reunidas, S.A. (TRSA). Development of the second phase of another live project, converting the open cycle undertaken in the first phase to a combined cycle. Main equipment: four (4) once-through HRSGs with post-combustion system and two pressure levels, supplied by *Innovative Steam Technologies* (IST), coupled to the respective outlets of GE's LM6000 gas turbines installed in the first phase, and one Siemens steam turbine and associated generator operating with two steam pressure levels to generate approximately 96 MW.
- Basic engineering services for the power island and testing and commissioning of the Agios Nikolaos IPP Combined Cycle Power Plant, located on the banks of the Gulf of Corinth, near the city of Itea (Greece). The 420 MW facility comprises one (1)

- 9FB gas turbine, one (1) power generator and one (1) steam turbine supplied by GE in a single-shaft configuration, and a heat recovery steam generator (HRSG), uses seawater cooling through cooling towers for the condenser. Project awarded by Mytilineos Power Generation and Supply S.A. (MPGS) to METKA.
- Complete basic and detail engineering services for the Mesaieed Combined Cycle Power Plant (Qatar), awarded under an EPC contract by the PCO company (created by Marubeni, Qatar Petroleum and Qatar Water and Electricity Company) to Iberinco. The plant has an output of 2,000 MWe and comprises three (3) multi-shaft (2x1) combined cycle units, each with two (2) GE 9FA-type gas turbines, one (1) steam turbine, two (2) heat recovery steam generators (HRSGs) with bypass stacks and selective catalytic reduction (SCR), as well as two (2) GE 6B-type gas turbines for plant black start.
 - Basic engineering services and supervision of the detail engineering of the 123 MWe Gas Turbine Simple Cycle Power Plant project in Saih Rawl (Oman), owned by Petroleum Development Oman (PDO) and comprising one GE Frame 9E (123 MWe) gas turbine and one generator, a new 132 kV air-insulated switchgear (AIS) substation for power transmission to the Oman grid, a new gas-insulated switchgear (GIS) substation, and HV lines for distribution to the PDO grid and interconnection to the Oman grid.
 - *Multidisciplinary engineering and design for the licensing and permitting process of the multi-shaft (2x2x1), 800 MW Algeciras Combined Cycle Power Plant, located in the area of the existing Bahía de Algeciras power plant in San Roque (province of Cadiz, Spain), and including support to ENEL in construction supervision and in the supervision and performance of plant testing and commissioning.* In this project, the old fossil-fired power plant of Algeciras is converted into a combined cycle power plant by installing two (2) 250 MW gas turbines supplied by Ansaldo and two (2) HRSGs, and by adapting the existing steam turbine (300 MW) to its new service in the combined cycle.
 - Engineering and design services of the power island of a single-shaft, 3 x 400 MW combined cycle power plant in a GE 3 x 109FB configuration located in Hadjret en Nouss (Algeria). Project awarded by the Canadian company SNC-Lavalin Constructors.
 - Engineering and design services contract for a Simple Cycle Power Plant located near Marib (Yemen), and awarded by the Public Electricity Company of Yemen to the Siemens/Bemco International consortium. This simple cycle comprises 3 x 100 MW Siemens V92-2 gas turbines.

- Engineering and project management support services for a cogeneration combined cycle power plant featuring gas turbines for Aluminium de Grèce (AdG), in a multi-shaft (2x2x1, GE 2 x PG9171E) configuration with a generation capacity of 316 MWe and 332 t/h of steam, built by METKA, S.A. in St. Nicholas, Beotie (Greece).
- Complete basic and detail engineering services for La Plana del Vent Combined Cycle Power Plant project (Tarragona, Spain), owned by Gas Natural, S.A., and consisting of two (2) single-shaft, 400 MW units (2 x 400 MW), using a 2x109FA configuration with GE turbines. Project awarded by Gas Natural to a consortium formed by GE, Técnicas Reunidas (TRSA) and Ferrovial.
- Engineering services for the As Pontes Combined Cycle Power Plant, a multi-shaft, 800 MW unit in a 2x2x1 209FB configuration equipped with a GE-supplied power train (GTs, STs and generator) and located in As Pontes de García Rodríguez (province of La Coruña, Spain). Project awarded under an EPC contract by the electric utility Endesa Generación, S.A. to the consortium formed by GE and Duro Felguera (DF).
- Engineering services and project management support for the Lavrion V Combined Cycle Power Plant, a single-shaft, 109FA configuration, 400 MW unit built in Lavrio (Attica), near Athens (Greece) by METKA, S.A. under an EPC contract from Public Power Corporation (PPC). This unit is equipped with a power train (GT, ST and generator) supplied by General Electric.
- Engineering and design services for the Aceca Combined Cycle Power Plant, a 400 MW, 109FA single-shaft unit using a power train (GT, ST, generator, HRSG and DCS) supplied by General Electric and built by Iberdrola near Toledo (Spain).
- Engineering activities for the Arcos de la Frontera Combined Cycle Power Plant project (Cadiz, Spain), owned by Iberdrola and featuring two (2) 400-MW, single-shaft units equipped with GE turbines in a 2x109FA configuration. This project resumed Enron's original project for a 3x400 MW power plant on the same site, for which EA had also been hired to provide the engineering services, and which was acquired by Iberdrola who continued with the two-unit power plant project.
- Complete engineering and design of the Granadilla 1 Combined Cycle Power Plant, a 220 MW unit owned by Endesa, in the island of Tenerife (Canary Islands, Spain). The plant uses a 2x1 configuration (206FA) with GE 6FA gas turbines. The project was awarded by Endesa-Generación on an EPC turnkey basis to a consortium formed by GE and TRSA; the latter subcontracted the complete scope of project engineering and design services to EA.

- Complete engineering and design services, and project management, construction supervision, procurement and commissioning of the Santurtzi Unit IV Combined Cycle Power Plant, a GE 109FA, single-shaft, 400 MW plant project owned by Iberdrola. Project awarded on an EPC turnkey basis to a consortium formed by GE, ACS, GHESA and GAMESA.
- Complete engineering and design services, and testing and commissioning support for the Tarragona I Combined Cycle Power Plant, a GE 109FA, single-shaft, 400 MW combined cycle project owned by Endesa Generación and awarded on an EPC turnkey basis to a GE-TRSA consortium.
- Basic engineering of the facility and detail engineering of the mechanical, electrical and I&C systems of the power island, as well as procurement of an equipment package for the power island for the Termopernambuco Combined Cycle Power Plant (Recife, Brazil), owned by Termopernambuco, S.A. Project awarded to the Odebrech-Promon consortium (main EPC contractor). This project, of a power output of 550 MW and owned by Termopernambuco S.A., uses GE gas and steam turbines in a 2 x 2 x 1 multi-shaft configuration.
- Complete engineering and design services, and project management, construction supervision, procurement and commissioning of the Castejón Combined Cycle Power Plant (Spain), a GE 109FA, single-shaft, 400 MW plant project owned by Iberdrola. Turnkey project awarded to a consortium formed by GE, ACS, GHESA and GAMESA.
- Civil engineering and project design for the Besós Combined Cycle Power Plant (Spain), an ABB (Alstom), 2 x KA26, single-shaft, 800 MW plant owned by Endesa S.A. - Gas Natural S.A.
- Civil engineering and design of San Roque Combined Cycle Power Plant (Spain), an ABB (Alstom), 2 x KA26, single-shaft, 800 MW plant owned by Gas Natural S.A. - Endesa S.A.
- Complete engineering services for the El Grao-Castellón Combined Cycle Power Plant (Spain), a GE 209FA multi-shaft, 800 MW plant project, owned by Iberdrola and awarded as a turnkey contract to a consortium led by GE.
- Contract from Hitachi for the preparation of the Operation, Maintenance and Training Manuals of the ILO 2 Fossil-Fired Power Plant, Peru (Hitachi, coal-fired, 135 MW). The contract with Hitachi also included imparting two training courses, one off-site and the other on-site (the latter for a duration of four months) for operators and maintenance personnel, and the updating of the manuals following completion of the commissioning period.

- Engineering and commissioning services for the Elcogas IGCC project, a 335-MW integrated coal gasification combined cycle plant in Puertollano (Spain), owned by a consortium of European utilities and built with European Union financing. The combined-cycle portion of the plant, featuring gas and steam turbines manufactured by Siemens, burns natural gas as well as gas from the coal gasification facility.
- Piping design, analysis and support engineering for the combined cycle plant at Montazer Ghaem (300 MW) in Iran, owned by TAVANIR Iran Power Generation and Transmission Co.
- Management, engineering and design of the project of conversion from fuel-oil to both fuel-oil and natural gas for three power plants in Spain owned by *Compañía Sevillana de Electricidad*, so that they could burn gas piped from Algeria under the Straits of Gibraltar to Spain. The units are Bahía Algeciras TPP Unit 1 (220 MW) and Unit 2 (550 MW), and Cristóbal Colón TPP Unit 2 (150 MW). This included an integral retrofitting project for these plants, including the total replacement of all I&C systems.
- Design as architect-engineer of Patache Fossil-Fired Power Plant, a 150 MW coal-fired plant operated in Chile by *CELTA* and built by a consortium formed by Foster Wheeler, Mecánica de la Peña and General Electric under an EPC scheme.
- Project of Carbón II Fossil-Fired Power Plant, a 2 x 350 MW coal-fired power plant in Mexico, for the national electric utility Comisión Federal de Electricidad (CFE).
- Project in Ukraine, within the framework of the Tacis Programme (funded by the European Commission), examining the alternatives for the retrofitting of Burshtyn Power Station (12 x 200 MW) with the purpose of increasing the availability, operational reliability and ecological performance of the station.
- Project *Transfer of Know-How in Economic Analysis of Modern Combustion Technologies* within the framework of the EU-financed Tacis Programme for technical assistance to CIS (former USSR) countries, in collaboration with Unión Fenosa. The purpose of this project was to provide training in the technical, economic and financial aspects of modern combustion technologies to the administrative and managerial staff of the Ministry of Energy of Ukraine.
- Collaboration with EPDC International Ltd in Japan to provide consultancy and engineering services for Pha Lai No. 2 TPP, a 2 x 300 MW anthracite-fired power plant in Vietnam.
- Participation in the construction, testing and commissioning management of a 2 x 30 MW low-speed diesel power plant in Jamaica, in operation since October

1996. These services were carried out for the consortium responsible for the plant's EPC contract.

- Various coal-fired power plant projects using low-grade Spanish coals (eg, the 550-MW lignite-fired Meirama Power Plant or the 350-MW anthracite-fired Narcea 3 Power Plant), to achieve compliance with stringent environmental conditions.
- Engineering, design, construction management and commissioning of a simple-cycle, gas-turbine installation in the Petromed Oil Refinery in Castellón (Spain), for the cogeneration of electric power and process steam for the oil refinery.
- Vetejar 12.4 MW power plant project in Southern Spain, featuring a fluidised-bed combustion boiler and using biomass to generate electric power and steam for industrial purposes.
- Feasibility study, design of the project economic and financing scheme, basic engineering and preparation of main equipment specifications for a 70-MW cogeneration plant (process steam and power production) at the Algeciras Oil Refinery in Spain. The plant uses a gas turbine combined cycle burning refinery torch residual gases.
- Feasibility study, economic evaluation and conceptual design, for the Spanish electric utility FECSA, of a 100 MW cogeneration plant to produce both power and process steam for various industrial factories in the area of Tarragona (Spain).

It should be mentioned that, as an independent consulting and engineering organisation, the engineering services EA provides are not dependent upon any specific supplier or equipment vendor. Therefore, the management decisions and technical solutions it recommends are optimal and based on the best technology available in the industry, without being tied to any specific product and/or design.

EA's main references relevant to projects in the Conventional Power Generation sector are summarised in the attached tables.

POWER TRANSMISSION AND DISTRIBUTION

In the transmission and distribution field, EA provides a wide range of services. Working together with electric utilities on the development of modern transmission and distribution systems, we have devised innovating engineering solutions for substations, transmission systems, protection systems, energy management systems, and supervisory control and data acquisition (SCADA).

For more than 30 years EA has been taking part in the development of the Spanish power transmission grid through the implementation of projects involving the supply, construction and erection, testing and commissioning of many of the installations which make up the grid: transmission and distribution substations, distribution centres, design of protection systems for power lines and substations, training courses for personnel, new management systems, new technologies, grid audits, improvement of energy use, improvement of communications systems, analyses and behavioural studies of the grid including simulation, stability, reliability, interconnection with other national grids, evaluation and reduction of energy losses, operation and control, analyses of generator failures, techno-economic studies, etc.

We have advanced computer programs which are capable of producing electrical system studies and projects, such as the following:

- Planning of transmission and distribution systems
- Load forecasting
- Switching analyses
- Transfer studies
- Short-circuit studies
- Dynamic simulation
- User models for speed regulators and excitation systems
- Grid reliability
- Transient stability of transmission grid interconnections
- Stability in generation plants
- Small signal stability
- Evaluation and reduction of electrical losses
- Power system protection studies
- Operation and control of systems
- Contingency analysis
- Quality of service of the electrical system
- Overvoltage control and reactive power compensation
- Coordination of insulations
- Ferroresonance study

- Electromagnetic frequency (EMF) caused by power transmission lines
- Electromagnetic compatibility
- Protection from atmospheric phenomena (lightning)
- Overvoltage induced by switching impulses and lightning pulses
- Dynamic oscillations in the transmission grid
- Energy optimisation of water reserves

EA's most recent work in this field includes the following:

- Implementation of complete projects for new substations (physical layout, civil works, control, protection and measurement) as well as extensions and improvements to more than 75 existing high-voltage substations (between 400 and 30 kV) for several utilities in Spain, and more recently abroad
- Stability studies for the interconnected high-voltage grids between Spain and Morocco through the new link in the Strait of Gibraltar, for *Red Eléctrica de España S.A.*
- Stability studies for the interconnected high-voltage grids between Spain and France, for *Red Eléctrica de España S.A.*
- Planning studies for the high-voltage grids in northern and central Spain with reference to horizon years 2005 and 2010, for *Unión Fenosa S.A.*
- Planning studies for the high-voltage grids in northern Spain with reference to horizon year 2000, for *Hidroeléctrica del Cantábrico S.A.*
- Studies on connection to the grid of wind parks in Gran Canaria, for *UNELCO S.A.*
- Optimisation of the insulation of electrical equipment in the 400 and 220 kV grids, for *Red Eléctrica de España S.A.*
- Development of the integrated control and protection system (SICPRO project), by substituting conventional equipment with digital technology equipment, in high-voltage installations, for *Red Eléctrica de España S.A.*
- Development of a project for the implementation of remote control systems (TEYDE project) in distribution substations, for *Iberdrola S.A.*
- Creation of the databases required for running Iberdrola installations (generation plants, power transmission lines, substations, distribution centres, etc), providing integrated maintenance management, support to systems operation and operation management (BADEX Project)

- Planning studies for the distribution grids in the central and western regions of Spain for *Electra de Viesgo S.A.*
- Stability study for a cogeneration process and its connection to the transmission and distribution grid, for *Petromed S.A.*

Tables IE1 and IE2 summarise the engineering carried out by EA in electrical substations and in power transmission and distribution projects.

EMPRESARIOS AGRUPADOS' REFERENCE TABLES

The scope of work in the areas of project management, engineering, design, procurement, construction, commissioning activities, as well as support to plant operations, performed by Empresarios Agrupados for fossil-fired, simple and combined-cycle, and electrical power transmission and distribution projects is summarised in the attached tables, as follows:

Summary of EA Main Power Plant Projects

EA's overall experience in power plant projects

Fossil-Fired Power Plants

- IT1 EA References in Simple and Combined Cycle Plants and Cogeneration Projects
- IT2 EA Main References in Fossil-Fired (burning coal, fuel-oil, gas or biomass) Power Plant Projects
- IT3 EA References in Bidding Process Activities for Fossil-Fired Power Plants

Electrical Substations and Transmission and Distribution

- IE1 EA References in Electrical Substations
- IE2 EA References in Power Transmission and Distribution

**SUMMARY OF EA MAIN POWER PLANT PROJECT EXPERIENCE
AS A FULL-SCOPE ARCHITECT-ENGINEERING COMPANY**

EA's SCOPE OF SUPPLY:

**Engineering and Design (all) + Procurement (some) +
Construction Management (some) +
+ Preoperational Testing & Commissioning (some)
+ EPC Turnkey Contract (some)**

• Combined Cycle Power Plants:	58 units	-	24,218 MWe
• Coal and/or Oil-Fired Power Plants:	34 units	-	11,300 MWe
• Nuclear Power Plants:	8 units	-	8,717 MWe
• Hydroelectric Power Plants:	2 units	-	250 MWe
	102 Units	Total	44,485 MWe

Table IT1 (1/6)
Empresarios Agrupados' References in Simple and Combined Cycle Plants and Cogeneration Projects

Owner	Location	Type of Industry	MW	Type of Plant	Scope of Work
Sociedad Minera Cerro Verde (SMCV)	Reque (Peru)	Power Generation Plant	185	Open Cycle (GE7FA 03)	Complete basic and detail engineering services
Ashuganj Power Station Company Limited (APSCL)	Ashuganj South (Bangladesh)	Power Generation Plant	450	Combined Cycle (Siemens' STG5-4000F GT and SST5-3000 ST)	Complete basic and detail engineering services
Energía Argentina S.A. (ENARSA)	Ensenada de Barragán (Argentina)	Power Generation Plant	800	Add-on to Combined Cycle (Siemens' SCC5-4000F GTs and SST5-5000 ST)	Complete basic and detail engineering services for the add-on project
Energía Argentina S.A. (ENARSA)	Brigadier López (Argentina)	Power Generation Plant	400	Add-on to Combined Cycle (Siemens' SCC5-4000F GT and SST 700 HP ST, plus SST-900 MP and LP ST)	Complete basic and detail engineering services for the add-on project
Public Establishment of Electricity for Generation and Transmission (PEEGT)	Deir Azzour (Syria)	Power Generation Plant	800 (2x2x1, multi-shaft)	Combined Cycle (Ansaldo's GTs and ST with Heller tower)	Power island basic and detail engineering services
North-West Power Generation Company Limited	Khulna, Goalpara (Bangladesh)	Power Generation Plant	150	Simple Cycle (Alstom's GT GT13E2 (E))	Complete basic and detail engineering services
Met Group of Companies	Eurostar, Thrace (Turkey)	Power Generation Plant	850 (2x2x1 multi-shaft)	Combined Cycle (GE 209FB, air-cooled condenser)	Owner's Engineer and In-house Consultant
Met Group of Companies	Dervish, Karaman (Turkey)	Power Generation Plant	490	Combined Cycle (GE 109FB.05, air-cooled condenser, 50-MW solar field and 12-MW wind park)	Owner's Engineer and In-house Consultant
Latvenergo	Riga (Latvia)	Power Generation Plant	420 (1 x1x1, multi-shaft)	Combined Cycle (GE's GT and Siemens ST with district heating)	Combined cycle basic and detail engineering services
Public Power Corporation (PPC)	Megalopolis (Greece)	Power Generation Plant	800 (2 x2x1, multi-shaft)	Combined Cycle (GE's GTs and ST with cooling towers)	Combined cycle basic and detail engineering services
RWE & Turcas Güney Elektrik Üretim A. Ş	Denizli (Turkey)	Power Generation Plant	800 (2 x2x1, multi-shaft)	Combined Cycle (Siemens' GTs and ST with air-cooled condenser)	Power island basic and detail engineering services, and testing and commissioning services for the facility
Public Establishment of Electricity for Generation and Transmission (PEEGT)	Dier Ali (Syria)	Power Generation Plant	800 (2 x2x1, multi-shaft)	Combined Cycle (Ansaldo's GTs and ST with Heller tower)	Power island basic and detail engineering services, and testing and commissioning services for the facility
BORASCO ELEKTRIK	Samsun (Turkey)	Power Generation Plant	886 (2x443, single-shaft)	Combined Cycle (GE 2x109FB, Standard Plant Block 2)	Basic and detail engineering services
ESSENT	Moerdijk (Netherlands)	Power Generation Plant	435 (single-shaft)	Combined Cycle (GE STAG109FB)	Complete basic and detail engineering services
SONELGAZ	Koudiet ed Draouch, Wilaya de Tarf (Algeria)	Power Generation Plant	1,200 (3x400, single-shaft)	Combined Cycle (GE 3x109FB, 9FB gas turbines)	Complete basic and detail engineering services
Mytileos Power Generation and Supply S.A. (MPGS)	Volos (Greece)	Power Generation Plant	420	Combined Cycle (GE 9FB gas turbine with air condenser)	Engineering services and plant testing and commissioning services

Table IT1 (2/6)
Empresarios Agrupados' References in Simple and Combined Cycle Plants and Cogeneration Projects

Owner	Location	Type of Industry	MW	Type of Plant	Scope of Work
PETROM	Brazi (Romania)	Power Generation Plant for a Petrochemical Facility	800 (2x1, multi-shaft)	Combined Cycle with Steam Export	Basic and detail engineering services, except for the electrical area where only basic engineering services are provided
Gas Natural, S.A.	Puerto de Barcelona (Barcelona, Spain)	Power Generation Plant	800 (2x400, single-shaft)	Combined Cycle (GE 2 x 109FB)	Engineering and design services, and engineering support to the EPC contractor for procurement, construction, testing and commissioning
Suez-Gaz de France (COFATHEC)	Montoir (France)	Power Generation Plant	400 (1 x 400; single-shaft)	Combined Cycle (GE 109FB)	Engineering and design services, and engineering support to the EPC contractor for procurement, construction, testing and commissioning
Endesa Generación	Granadilla 2 (Tenerife, Spain)	Power Generation Plant	220 (2 x2x1, multi-shaft) (Unit 2)	Combined Cycle (GE 206FA)	Engineering and design services for the EPC contractor
Endesa Generación	Besós 5 (Sant Adrià de Besós, Barcelona, Spain)	Power Generation Plant	800 (2 x2x1, multi-shaft)	Combined Cycle (GE 209FB)	Engineering and design services, and engineering support to the EPC contractor for project management, construction supervision and commissioning management
Heron Thermolectric/TERNA	Thiva (Greece)	Power Generation Plant with steam cogeneration	420 (1x1x1, single-shaft)	Combined Cycle (GE 109FB)	Engineering and design services, and engineering support to the EPC contractor
Energias de Portugal (EDP)	Figueira da Foz Lares (Portugal)	Power Generation Plant	800 (2 x 400, single-shaft)	Combined Cycle (GE 9FB gas turbine)	Complete basic and detail engineering services
OGK4	Shatura (Russia)	Power Generation Plant	400	Combined Cycle (GE 109FA gas turbine)	Conceptual engineering of the power plant, and review of detail engineering and design performed by others
Mytilineos Power Generation and Supply S.A. (MPGS)	Nikolaos, Itea (Greece)	Power Generation Plant	420	Combined Cycle (GE 9FB gas turbine)	Engineering services and plant testing and commissioning services
Global 3 COMBI SLU	Escatrón (Zaragoza, Spain)	Power Generation Plant	96	Peaker Combined Cycle (GE LM6000 gas turbine)	Basic and detail engineering services
Marubeni, Qatar Petroleum and Qatar Water and Electricity Company (PCO)	Mesaieed (Qatar)	Power Generation Plant	2000 (2x1)	Combined Cycle (GE 9FA gas turbines)	Complete basic and detail engineering services
Petroleum Development Oman (PDO)	Saih Rawl (Oman)	Power Generation Plant	123	Simple Cycle (GE Frame 9E gas turbines)	Basic engineering services and supervision of the detail engineering, and design of two substations and of HV lines for connection to the power grid of the Emirate
Shariket Kahraba Hadjret En Nouss, SpA (EPC Contractor: SNC-Lavalin, Canada)	Hadjret en Nouss (Algeria)	Power Generation Plant	1200 (3 x 400; single-shaft)	Combined Cycle (GE 3 x 109FB)	Engineering and design services for the power island
Viesgo-Enel Group Company	Bahía de Algeciras (San Roque-Cádiz, Spain)	Power Generation Plant	800 (2x2x1, multi-shaft)	Combined Cycle	Assistance to permitting process, engineering and design services, and engineering support to ENEL in construction supervision, and testing and commissioning management
Public Electricity Company (PEC)	Marib (Yemen)	Power Generation Plant	300 (3 x 100)	Simple Cycle (Siemens)	Engineering and design services

Table IT1 (3/6)
Empresarios Agrupados' References in Simple and Combined Cycle Plants and Cogeneration Projects

Owner	Location	Type of Industry	MW	Type of Plant	Scope of Work
Aluminium de Grèce/ METKA	St Nicholas Beotie (Greece)	Power Generation Plant with steam cogeneration	316 MWe + 332 t/h of steam (2x2x1, multi-shaft)	Combined Cycle Gas Turbine: GE 2 x PG9171E Steam Turbine: Siemens	Engineering and design services, and engineering support to the EPC contractor (METKA, S.A.) in project management, construction supervision and commissioning management.
Gas Natural, S.A.	La Plana del Vent (Tarragona, Spain)	Power Generation Plant	800 (2x400, single-shaft)	Combined Cycle (GE 2 x 109FB)	Engineering and design services, and engineering support to the EPC contractor for procurement, construction, testing and commissioning
Endesa Generación	As Pontes (A Coruña, Spain)	Power Generation Plant	800 (2 x2x1, multi-shaft)	Combined Cycle (GE 209FB)	Engineering and design services, and engineering support to the EPC contractor for project management, construction supervision and commissioning management
Public Power Corporation (PPC)	Lavrio (Attica) (Greece)	Power Generation Plant	400 1 x 400, single-shaft	Combined Cycle (GE 109FA)	Engineering and design services, and engineering support to the EPC contractor (METKA, S.A.) in project management, construction supervision and commissioning management.
Iberdrola	Aceca (Spain)	Power Generation Plant	400 (1 x 400, single-shaft)	Combined Cycle (GE 109FA)	Engineering and design services
Iberdrola	Arcos de la Frontera (Spain) (Arcos 1&2)	Power Generation Plant	800 (2x400, single-shaft)	Combined Cycle (GE 2 x 109FA)	Engineering and design services
Endesa Generación	Granadilla 1 (Tenerife, Spain)	Power Generation Plant	220 (2 x2x1, multi-shaft) (Unit 1)	Combined Cycle (GE 206FA)	Engineering and design services, and engineering support to the EPC contractor for procurement, construction, testing and commissioning
Iberdrola	Santurzi (Spain)	Power Generation Plant	400 (1 x 400, single-shaft)	Combined Cycle (GE 109FA)	Engineering and design services, and engineering support to the EPC contractor for procurement, construction, testing and commissioning
Endesa Generación	Tarragona I (Spain)	Power Generation Plant with steam cogeneration	400 (1x400, single-shaft)	Combined Cycle (GE 109FA)	Engineering and design services, and engineering support to the EPC contractor for procurement, construction, testing and commissioning
Termopernambuco SA	Termopernambuco, Recife (Brazil)	Power Generation Plant	550 (2 x2x1, multi-shaft)	Combined Cycle (GE 207FA)	Plant basic engineering; detail engineering for the power island system and supply of an equipment package for the power island
Iberdrola	Castejón (Spain)	Power Generation Plant	400 (1x400, single-shaft)	Combined Cycle (GE 109FA)	Engineering and design services, and engineering support to the EPC contractor for procurement, construction, testing and commissioning
Enron Power	Arcos de la Frontera (Spain)	Power Generation Plant	1200 (3x400, single-shaft)	Combined Cycle (GE 3 x 109FA)	Engineering and design services, and engineering support to Enron Engineering & Services Company (the EPC contractor) for procurement, construction, testing and commissioning

Table IT1 (4/6)
Empresarios Agrupados' References in Simple and Combined Cycle Plants and Cogeneration Projects

Owner	Location	Type of Industry	MW	Type of Plant	Scope of Work
Iberdrola	Castellón (Spain)	Power Generation Plant	800 (2x2x1, multi-shaft)	Combined Cycle (GE 209FA)	Engineering and design services, and engineering support to the EPC contractor for procurement, construction, testing and commissioning
Endesa-Gas Natural	Besós-Barcelona (Spain)	Power Generation Plant	800 (2x400, single-shaft)	Combined Cycle (ABB 2 x KA26)	Civil engineering and design package
Gas Natural-Endesa	San Roque-Cádiz (Spain)	Power Generation Plant	800 (2x400, single-shaft)	Combined Cycle (ABB 2 x KA26)	Civil engineering and design package
Elcogas S.A (Consortium of European Electric Utilities)	Puertollano (Spain)	Power Generation Plant	335	IGCC (Integrated Coal Gasification with Combined Cycle) (Combined Cycle: Siemens)	Engineering and design, construction supervision and commissioning
SOGAMA (Sociedade Galega do Mediambiente)	Cerceda, La Coruña (Spain)	Solid Waste Treatment	49	Cogeneration Plant	EPC Contractor, Project Management Oversight and Construction Management Support
PIESA/Repsol Petróleo	La Coruña (Spain)	Refinery	57	Combined Cycle Cogeneration Plant	Lump Sum Turnkey
GE Plastics	Cartagena (Spain)	Plastics Manufacturing	80	Cogeneration Plant	Basic design, equipment specifications and RFP documentation
TAVANIR (Iran Power Generation and Transmission Co)	Montazer Ghaem (Iran)	Power Generation Plant	300	Combined Cycle Cogeneration Plant	Piping design, analysis and support engineering
Cía. Sevillana de Electricidad	Huelva (Spain)	Power Generation Plant	100	Integrated Solar and Combined Cycle Plant (Colón-Solar Project)	Engineering and design
Cía. Sevillana de Electricidad and CEPSA (GEGSA)	Algeciras (Spain)	Oil Refinery	70	Combined Cycle Cogeneration Plant	Feasibility study, conceptual engineering and main equipment specifications (HRSG, gas and steam turbines)
Cía. Sevillana de Electricidad	Huelva (Spain)	Power Generation Plant	--	Conversion to Combined Cycle of existing Cristóbal Colón 1, 2 & 3 fuel fired units adding gas turbines	Feasibility study, conceptual engineering and main equipment specifications
FECSA	Tarragona (Spain)	Various process Industries	100	Centralised cogeneration Plant	Feasibility study and conceptual engineering
Repsol	Puertollano (Spain)	Oil Refinery	70	Combined Cycle Cogeneration Plant	Basic engineering and EPC contract follow-up for the Client
Repsol	Tarragona (Spain)	Oil Refinery	40	Combined Cycle Cogeneration Plant	Basic engineering and EPC contract follow-up for the Client
Petromed	Castellón (Spain)	Oil Refinery	6	Power Generation Simple Cycle Plant	Engineering, procurement and construction (EPC) supply
Colortex	Alicante (Spain)	Textile	13	Combined Cycle, Cogeneration Plant	Engineering, procurement and construction (EPC) supply
Iberdrola	Various sites in Spain	Power Generation Plants	Castellón TPP 2 x 550 Escombreras TPP 2 x 330 + 1 x 120 Santurce TPP 2 x 550 Aceca TPP 2 x 313	Conversion to Combined Cycle of nine Fuel-oil fired Power Plants	Feasibility studies
Unión-Fenosa	Various sites in Spain	Power Generation Plants	Meirama TPP 1 x 550 Narcea TPP 1 x 350 La Robla TPP 1 x 220 + 1 x 350 Sabon TPP 1 x 120 + 1 x 360	Conversion to combined cycle of 4 coal fired and 2 fuel-oil fired power plants	Feasibility studies

Table IT1 (5/6)
Empresarios Agrupados' References in Simple and Combined Cycle Plants and Cogeneration Projects

Owner	Location	Type of Industry	MW	Type of Plant	Scope of Work
Fecsa	Various sites in Spain	Power Generation Plants	Sant Adriá TPP 3 x 350	Conversion to combined cycle of 3 fuel-oil fired units	Feasibility study
Endesa (Eneco)	Córdoba (Spain)	Power Generation Plant	Puentenuevo TPP 1 x 350	Conversion to combined cycle of 1 coal-fired unit	Feasibility study
Hidrocantábrico	Asturias (Spain)	Power Generation Plant	150	Combined cycle using blast furnace gas	Feasibility study and conceptual design
Prat Carton	Prat de Llobregat (Spain)	Cardboard	4	Cogeneration Plant	Basic engineering and design
LPE	Rentería (Spain)	Pulp and Paper	--	Cogeneration Plant	Feasibility study
Río Rodano, S.A.	Huelva (Spain)	Sodium Tripolyphosphate	--	Cogeneration Plant	Feasibility study
Safen Michelin	Vitoria (Spain)	Tyres	--	Cogeneration Plant	Feasibility study
P.T. Aribhawana	Indonesia	Fatty Alcohol	2.2	Cogeneration Plant	Basic and detail engineering and design
Aiscondel	Tarragona (Spain)	PVC Plant	4.5	Cogeneration Plant	Basic and detail engineering
Renfe	Madrid (Spain)	Spanish National Railways	--	Combined cycle Cogeneration Plant	Feasibility study of energy recovery for steam production and calciners
Tioxide	Huelva (Spain)	Titanium Dioxide	7	Cogeneration Plant	Feasibility study
ERT	Castellón (Spain)	Nitric Acid	--	Cogeneration Plant	Feasibility study
Repsol Petróleo	La Coruña (Spain)	Refinery	36.4	Cogeneration Plant	Basic engineering and design
Sarrio	Allo (Spain)	Paper Plant	5.6	Cogeneration Plant	Feasibility study of a steam production and flue gas heat for drying
Leche Pascual	Aranda de Duero (Spain)	Milk Bottling Plant	3.4	Cogeneration Plant	Feasibility study
Tioxide	Huelva (Spain)	Titanium Dioxide	9.1	Cogeneration Plant	Basic and detail engineering, construction supervision and start-up
Río Tinto Minera	Huelva (Spain)	Mine	--	Cogeneration Plant	Feasibility study
Tarradellas	Vic (Spain)	Food Industry	--	Cogeneration Plant	Feasibility study
Leche Pascual	Aranda de Duero (Spain)	Milk Bottling Plant	2 x 3.5	Cogeneration Plant	Basic and detail engineering, procurement, construction supervision, and start-up
Foarsa	Reinosa (Spain)	Steel Plant	12	Cogeneration Plant	Feasibility study
General Motors	Figueroles (Spain)	Car Production	20	Cogeneration Plant	Basic and detail engineering, procurement, construction supervision, and start-up
Pyccsa	Alcolea del Cinca (Spain)	Paper Plant	30	Cogeneration Plant	Feasibility study
Papelera de Castilla	Dueñas (Spain)	Paper Plant	14	Cogeneration Plant	Feasibility study
ACG Saginaw	Cádiz (Spain)	Spare Parts	15	Cogeneration Plant	Feasibility study
Papelera del Angel	Gallur (Spain)	Paper Plant	15	Cogeneration Plant	Feasibility study
Iberia	Barajas (Spain)	Airline	10	Cogeneration Plant	Feasibility study
Jomar	Oporto (Portugal)		5.8	Cogeneration Plant	Basic and detail engineering
CLH	Somorostro (Spain)	Hydrocarbons Distribution	6.7	Cogeneration Plant	Feasibility study
General Motors	Cádiz (Spain)	Car Factory	20	Cogeneration Plant	Feasibility study
Piensos Pascual	Aranda de Duero (Spain)	Food Industry	1.1	Cogeneration Plant	Feasibility study

Table IT1 (6/6)
**Empresarios Agrupados' References in Simple and Combined Cycle Plants
and Cogeneration Projects**

Owner	Location	Type of Industry	MW	Type of Plant	Scope of Work
Papelera de Castilla	Dueñas (Spain)	Paper Plant	12.3	Cogeneration Plant	Basic and detail engineering, procurement, construction supervision and start-up
Pyccsa	Alcolea (Spain)	Paper Plant	3.5	Cogeneration Plant	Basic and detail engineering
Ford España	Almusafes (Spain)	Car Factory	18	Cogeneration Plant	Basic and detail engineering
Citroën Hispania	Vigo (Spain)	Car Factory	17	Cogeneration Plant	Feasibility study
Hospital de Tarrasa	Tarrasa (Spain)	Hospital	1	Cogeneration Plant	Feasibility study
L'Air Liquide	Huelva (Spain)	Chemical	9 to 13	Cogeneration Plant	Feasibility study
Cepsa	Huelva (Spain)	Petrochemical	13 to 30	Cogeneration Plant	Feasibility study
Minera de Santa Marta	Belorado (Spain)	Mining	19	Cogeneration Plant	Basic and detail engineering, procurement, construction supervision and start-up
Proquimed	Castellón (Spain)	Petrochemical	9 to 20	Cogeneration Plant	Feasibility study
Repsol Química	Tarragona (Spain)	Petrochemical	65	Cogeneration Plant	Overall project management
Eissa	Tarrasa (Spain)	Hospital	1	Cogeneration Plant	Basic and detail engineering, procurement, construction supervision and start-up
Leche Pascual	Otero del Rey (Spain)	Milk Bottling	5.2	Cogeneration Plant	Basic and detail engineering procurement, inspection and expediting

Table IT2 - Empresarios Agrupados' Main References in Fossil-Fired (burning coal, fuel-oil, gas or biomass) Power Plant Projects
(Simple and combined cycle plants and cogeneration projects are listed separately)

Project	Owner	MW/Fuel	Type of Work Performed												
			1	2	3	4	5	6	7	8	9	10	11	12	13
Altamira 1 & 2 (Mexico)	CFE	2 x 150 / Petcoke			◆	◆	◆	◆		◆		◆			
Yanbu Power and Desalination Project Phase III (Saudi Arabia)	SWCC	5x540 / heavy fueloil and natural gas			◆	◆		◆							
Andina 1 & 2 (Chile)	Suez Energy Andino	2 x 165 / coal & petcoke		◆	◆										
Rio Turbio (Argentina)	YRCT	2 x 125 / coal		◆	◆	◆	◆								
Ilo 2 (Peru)	ENERSUR (Hitachi)	135 / coal			◆									◆	
Patache (Chile)	CELTA	150 / coal	◆	◆	◆	◆	◆	◆				◆	◆		◆
Carbón II/U 3 & 4 (Mexico)	CFE	2x350 / coal		◆	◆	◆	◆	◆	◆			◆	◆		◆
Pha Lai No 2 (Vietnam)	EVN	2 x 300 / anthracite	◆		◆										
Yahekou (China)	HPEPB	2 x 350 / coal			◆								◆		
Valdemingómez (Spain)	TIRMADRID	29 / SWT				◆									
Burshtyn (Ukraine)	LVE	12 x 200 / coal			◆			◆	◆	◆	◆				
Pego 2 (Portugal)	E/NP	307 / coal						◆							
Central Diesel (Jamaica)	JPPC	2 x 30 / diesel						◆							
New Power Generation Technologies	Various	Various projects	◆		◆						◆				◆
Plant Repowering and Modernisation	Various	Various projects	◆		◆						◆				◆
Vetejar (Spain)	Vetejar	12.4 / biomass	◆	◆	◆			◆							◆
Teruel (Spain)	E	3 x 350 / lignite			◆		◆	◆					◆		
Aboño 1 & 2 (Spain)	HC	360-543 / fuel-oil, gas, coal	◆		◆		◆	◆	◆			◆		◆	◆
Aceca 1 & 2 (Spain)	ID/UF	2x310 / fuel-oil	◆	◆	◆	◆	◆	◆	◆			◆		◆	◆
Algeciras 1 (Spain)	CSE	220 / fuel-oil, natural gas					◆						◆	◆	◆
Algeciras 2 (Spain)	CSE	550 / fuel-oil, natural gas	◆	◆	◆	◆	◆		◆			◆	◆	◆	◆
Anllares (Spain)	E/UF	350 / coal	◆	◆	◆	◆	◆								
Castellón 1 & 2 (Spain)	ID	2 x 550 / fuel-oil	◆	◆	◆	◆		◆	◆			◆			◆
Cristóbal Colón 1 & 2 (Spain)	CSE	68 - 150 / fuel-oil			◆	◆	◆					◆	◆	◆	◆
Cristóbal Colón 3 (Spain)	CSE	160 / fuel-oil		◆	◆	◆	◆	◆	◆			◆	◆	◆	◆
Elcogas IGCC (Spain)	Elcogas	335 / coal gasification / NG			◆		◆								
Escombreras 4 & 5 (Spain)	ID	2 x 290 / fuel-oil	◆	◆	◆	◆		◆	◆			◆	◆	◆	◆
Foix 1 (Spain)	TB	550 / gas, fuel-oil	◆	◆	◆	◆								◆	
Jiener (Spain)	Jiener	25 / biomass	◆												◆
Lada 2 & 3 (Spain)	ID	50-155 / coal		◆						◆	◆		◆		◆
Lada 4 (Spain)	ID	350 Supercritical / coal	◆	◆	◆	◆	◆	◆	◆			◆	◆	◆	◆
La Robla 1 (Spain)	UF	270 / coal, anthracite		◆						◆			◆	◆	◆
La Robla 2 (Spain)	UF	350 / coal, anthracite		◆	◆	◆	◆	◆	◆	◆			◆	◆	◆
Los Barrios (Spain)	CSE	550 / coal	◆	◆	◆	◆		◆	◆			◆	◆	◆	◆
Meirama (Spain)	UF	550 / lignite	◆	◆	◆	◆	◆	◆	◆	◆			◆		◆
Narcea 2 (Spain)	UF	155 / anthracite							◆	◆			◆		
Narcea 3 (Spain)	UF	350 / anthracite	◆	◆	◆	◆	◆	◆	◆	◆			◆	◆	
OXY-CFB-300 (Spain)	E	350 Supercritical coal / CO ₂ Capture	◆	◆	◆										
Puertollano 1 (Spain)	CSE	220 / coal		◆				◆	◆			◆	◆	◆	
Puente Nuevo (Spain)	E	330 / anthracite						◆	◆						◆
Sabón 1 & 2 (Spain)	UF	120 - 350 / fuel-oil							◆	◆			◆		◆
Sant Adrià (Spain)	FECSA	3 x 350 / gas, fuel-oil													◆
Santurce 1 & 2 (Spain)	ID	2 x 550 / fuel-oil										◆			◆
Soto de Ribera 1 (Spain)	HC/ID	60 / coal						◆	◆			◆			◆
Soto de Ribera 2 (Spain)	HC/ID	230 / coal						◆	◆	◆		◆			◆
Soto de Ribera 3 (Spain)	HC/ID	350 / coal	◆	◆	◆	◆	◆	◆	◆	◆		◆			
Surigao (Philippines)	MMIC	fuel-oil-to-coal conversion		◆	◆	◆	◆					◆			



Key to Type of Work Performed

1. Feasibility Studies / Siting
2. Project Management
3. Project Engineering and Design
4. Procurement and Suppliers' QA/QC Supervision
5. Construction and Erection Management, and Plant Commissioning
6. Desulphurisation, Systems and Programmes for Environmental Control and Impact Evaluation
7. Plant Availability and Efficiency Improvement Programmes
8. Plant Life Extension Projects
9. Plant Modification and Backfitting Implementation
10. Modernisation of Control and Supervision Systems
11. Plant Operation and Maintenance Support
12. Quality Assurance Programmes and Procedures
13. Studies for Conversion to Combined Cycles and Cogeneration

Key to Owners

CDE	Corporación Dominicana de Electricidad (Dominican Rep)
CFE	Comisión Federal de Electricidad (Mexico)
CSE	Compañía Sevillana de Electricidad (Spain)
E	Endesa (Spain)
EVN	General Company of Electricity of Vietnam
FECSA	Fuerzas Eléctricas de Cataluña (Spain)
HC	Hidroeléctrica del Cantábrico (Spain)
HPEPB	Hunan Province Electric Power Board (China)
ID	Iberdrola (Spain)
JPPC	Jamaica Private Power Corporation
LVE	Lvov Energo (Ukraine)
ME	Ministry of Energy (Ukraine)
MMIC	Marinduque Mining and Industrial Corporation (Philippines)
NP	National Power (UK)
SWCC	Saline Water Conversion Corporation (Saudi Arabia)
TB	Térmicas del Besós (Spain)
UF	Unión Fenosa (Spain)
YRCT	Yacimientos Carboníferos Río Turbio (Argentina)

Table IT3
Empresarios Agrupados' References in Bidding Process Activities for Fossil-Fired Power Plants

Project	Capacity (MW) Fuel	Client	Bidders Selected	Commercial Operation Start	Type of Activity					
					1	2	3	4	5	6
Combined cycles/ cogeneration	Various projects	--	--	--	◆	◆	◆	◆	◆	
Plant Modernisation & Repowering	Various projects	--	--	--	◆	◆	◆	◆	◆	
Aceca 1 & 2 (Spain)	2 x 310 / Fuel-oil	Iberdrola & Unión Fenosa	Combustion Engineering Westinghouse	1969, 1971	◆				◆	
Algeciras 2 (Spain)	550 / Fuel-oil, natural gas	Sevillana de Electricidad	Babcock-Wilcox Westinghouse	1975	◆				◆	
Anllares (Spain)	350 / Coal	Unión Fenosa	Foster Wheeler Mitsubishi	1982	◆				◆	
Castellón 1 & 2 (Spain)	2 x 550 / Fuel-oil	Iberdrola	Babcock-Wilcox General Electric	1972, 1973	◆				◆	
Cristóbal Colón 3 (Spain)	160 / Fuel-oil	Sevillana de Electricidad	Combustion Engineering General Electric	1968		◆	◆	◆	◆	
Foix 1 (Spain)	550 / Fuel-oil & gas	Térmicas del Besós	Foster Wheeler Brown Boveri	1979	◆	◆	◆	◆	◆	
Lada 3 (Spain)	155 / Coal	Iberdrola	Babcock-Wilcox Westinghouse	1967		◆	◆	◆	◆	
Lada 4 (Spain)	350 / Coal Anthracite	Unión Fenosa	Babcock-Wilcox Westinghouse	1986		◆	◆	◆	◆	
La Robla 2 (Spain)	350 / Coal Anthracite	Unión Fenosa	Balcke-Dürr Siemens (KWU)	1985		◆	◆	◆	◆	
Los Barrios 1 (Spain)	550 / Coal	Sevillana de Electricidad	Combustion Engineering General Electric	1985		◆	◆	◆	◆	
Meirama 1 (Spain)	550 / Coal	Unión Fenosa	Balcke-Dürr Brown Boveri	1980	◆	◆	◆	◆	◆	
Narcea 3 (Spain)	350 / Anthracite	Unión Fenosa	Balcke-Dürr Brown Boveri	1985		◆	◆	◆	◆	
Soto de Ribera 3 (Spain)	350 / Coal	Soto de Ribera	Combustion Engineering Westinghouse	1984		◆	◆	◆	◆	
Pha Lai (Vietnam)	2x300 / Anthracite	EPDCI	--	--	◆	◆	◆			
Burshtyn (Ukraine)	12x200 / Coal	EC-Tacis	--	--						◆
Transfer of Know-How Tacis (Ukraine)	Tacis Programme	EC-Minenergo	--	--						◆

Key to Type of Activity Performed

- Feasibility Studies
- Preparation of Bid Invitation Specification (BIS)
- Technical evaluation of bids
- Economic and financial evaluation of bids
- Support to utility during bid evaluation
- Training in bidding process activities

Table IE1 (1/2)
Empresarios Agrupados' References in Electrical Substations

Facility	Year	Client	Voltage (kV)	Type of Work Performed			
				CW/SS	EE	PL	C
Patache TPP (Chile)	1996	ENDESA	220	◆	◆	◆	◆
Trillo NPP (Expansion)	1995	CNT	400/132			◆	◆
Elcogas IGCC	1995	ELCOGAS	220			◆	◆
Valdecaballeros NPP (Expansion)	1994	REE	400	◆	◆	◆	◆
Escombreras TPP (Expansion)	1994	ID	400/220/132/66			◆	◆
Carbón II TPP	1994	CFE	400	◆	◆	◆	◆
Torrelavega	1994	SOLVAY	220/55/11			◆	◆
La Eliana (Expansion)	1993	ID	400/220/132			◆	◆
Miranda	1993	GENFIBRE	50/20/11			◆	◆
Lorca (Expansion)	1992	HE	132/66/20			◆	◆
El Palmar (Expansion)	1992	HE	220/132/20			◆	◆
Muskiz	1991	PETRONOR	30/11/6.3			◆	◆
Paterna (Expansion)	1991	HE	132/66/20	◆	◆	◆	◆
Vinalesa	1990	HE	132/66/20	◆	◆	◆	◆
Beniferri	1990	HE	132/20	◆	◆	◆	◆
S1 (Expo 92)	1990	CSE	132/66/20	◆	◆	◆	◆
Fuente San Luis	1990	HE	220/132/20	◆	◆	◆	◆
Puertollano	1990	REPSOL	132/11	◆	◆	◆	◆
S3 (Expo 92)	1990	CSE	50/20	◆	◆	◆	◆
Madrid Distribution Grid	1990	HE	132			◆	◆
El Saller	1989	HE	66/20	◆	◆	◆	◆
Rocamora	1989	HE	132/66/22	◆	◆	◆	◆
Pozohondo Norte	1989	HE	132/66	◆	◆	◆	◆
Lada TPP (Expansion)	1988	HE	400	◆	◆	◆	◆
Vitoria	1988	ID	400	◆	◆	◆	◆
Saucelle-Huebra	1988	ID	400		◆	◆	◆
Villaviciosa	1988	UF	400	◆	◆	◆	◆
Almaraz NPP (Expansion)	1987	CNA	400	◆	◆	◆	◆
Cofrentes NPP (Expansion)	1987	HE	400			◆	◆
La Eliana (Expansion)	1987	HE	132	◆	◆	◆	◆
Valdecaballeros NPP	1987	HE	400/132/22	◆	◆	◆	◆
Trillo NPP	1985	UF-ID	400/132	◆	◆	◆	◆
Valdepeñas (Expansion)	1984	UF	132/45	◆	◆	◆	◆
Abenojar	1984	UF	132/45/15	◆	◆	◆	◆
Soto de Ribera TPP	1984	EV-HC-CEL	400/220/33	◆	◆	◆	◆
La Robla TPP (Expansion)	1983	UF	15/380	◆	◆	◆	◆
Astorga (Expansion)	1983	UF	132/45	◆	◆	◆	◆
Guijo de Granadilla	1983	HE	220/15/6.6			◆	◆
Castelo Ingelio (Expansion)	1983	HE	66/11	◆	◆	◆	◆
La Robla TPP (Expansion)	1982	UF	400	◆	◆	◆	◆
Santiago de Compostela	1982	UF	200/66/20	◆	◆	◆	◆
Carucedo (Expansion)	1982	UF	132/45/15	◆	◆	◆	◆
Narcea TPP	1982	UF	400/132	◆	◆	◆	◆
San Fernando	1982	UF	220/45	◆	◆	◆	◆
Madridejos (Expansion)	1981	UF	220/132/15	◆	◆	◆	◆

Table IE1 (2/2)
Empresarios Agrupados' References in Electrical Substations

Facility	Year	Client	Voltage (kV)	Type of Work Performed			
				CW/SS	EE	PL	C
Tajo de la Encantada	1981	CSE	400/200			◆	◆
Vallecas (Expansion)	1980	UF	220/46	◆	◆	◆	◆
Aranjuez (Expansion)	1980	UF	132/45/15	◆	◆	◆	◆
Burgos	1978	UBISA	44/6			◆	◆
Guadalquivir Medio	1977	CSE	400/230/33			◆	◆
Paterna	1976	HE	132/66/22	◆	◆	◆	◆
Aceca	1976	HE-UF	220/132/15	◆	◆	◆	◆
Guillena	1976	CSE	400/220/33	◆	◆	◆	◆
Huelva	1976	Rio Tinto Patiño	50/6	◆	◆	◆	◆
Cofrentes NPP	1976	HE	400/132	◆	◆	◆	◆
Villaviciosa (Expansion)	1975	UF	380/220/33	◆	◆	◆	◆
Algeciras	1974	CRINAVES	66/20	◆	◆	◆	◆
Santander	1974	ENSA	55/12	◆	◆	◆	◆
Almaraz NPP	1974	HE-CSE-UF	400/220/33	◆	◆	◆	◆
Alcobendas	1972	HE	132/22	◆	◆	◆	◆
Galapagar	1971	HE	132/66/20	◆	◆	◆	◆
La Plana	1971	HE	400/220/138/33/20	◆	◆	◆	◆
Lada TPP	1969	CE Langreo	400		◆	◆	◆
Antonio Leyva (Madrid)	1969	HE	138/20	◆	◆	◆	◆
Azutan	1969	HE	220	◆	◆	◆	◆
José Cabrera NPP	1968	UF	15/220	◆	◆	◆	◆

Key to Type of Work Performed

CW/SS Civil Works/Steel Structures
 EE Electrical Equipment Engineering
 PL Physical Layout
 C Control and Protection

Key to Client Names

CNT	Trillo NPP	EV	Electra de Viesgo SA
CFE	Comisión Federal de Electricidad, Mexico	HC	Hidroeléctrica del Cantábrico
CSE	Compañía Sevillana de Electricidad	HE	Hidroeléctrica Española SA (now Iberdrola SA)
CEL	Compañía Eléctrica de Langreo SA (now Iberdrola SA)	ID	Iberduero SA (now Iberdrola SA)
CNA	Almaraz NPP	REE	Red Eléctrica de España SA
ENDESA	Empresa Nacional de Electricidad, Chile	UF	Unión Fenosa SA

Table IE2 (1/2)
Empresarios Agrupados' References in Power Transmission and Distribution

Project	Client	Type of Work Performed															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Grid stability with connection of wind turbine generators in Gran Canaria	Des. Eolicos-ITC	◆					◆					◆	◆	◆	◆		
Transmission of wind energy to 132 kV network in Lugo (Begasa)	Electra de Viesgo				◆	◆									◆	◆	
Planning of power distribution network - Begasa Area	Electra de Viesgo				◆	◆									◆	◆	
Planning of power distribution network - Belu Area	Electra de Viesgo				◆	◆										◆	
Planning of Northern Spanish grid (Horizon 2000)	HCSA				◆											◆	
Stability of local Saucelle Huebra Hydroelectric Plant network. Network model	Iberdrola	◆		◆										◆			
Stability of the power recovery plant unit	Irsusa SA	◆							◆					◆	◆		
Stability of a cogeneration unit	Petromed	◆							◆						◆		
Analysis of power generating units connected to the Spanish Grid	REE			◆					◆								
Modelling and analysis of the stability of the Moroccan Grid	REE	◆		◆										◆			
Stability of Spanish Grid	REE	◆												◆			◆
Stability of the grid in relation to the interconnection between Spain and France	REE	◆		◆										◆			
French grid: Modelling of speed regulators and excitation systems	REE			◆													◆
Optimisation of HV grid insulation	REE									◆	◆						◆
Plan for renovating the protections of the Spanish grid	REE								◆								
Dynamic simulations of incidents in the interconnection between Spain and Morocco	REE	◆		◆										◆			
Dynamic simulation of the interconnection between Spain and France (user models)	REE	◆		◆													
Dynamic simulation of Spanish national grid	REE	◆		◆										◆			
Integrated control/protections system for the Spanish national grid	REE								◆								
Evaluation of losses in UF network	UF					◆							◆				
Rural electrification plan for Galicia. Study of alternatives	UF				◆												◆
Planning of the grid in the Vigo area	UF				◆	◆											
Stability of Trillo NPP distribution network	UF/IBSA/HCSA	◆		◆										◆			
Planning of Vigo HV grid	UF				◆	◆											◆
Underfrequency analysis of Gran Canaria grid	UNELCO								◆								
Underfrequency analysis of Tenerife grid	UNELCO								◆								
Stability of Gran Canaria and Tenerife grids	UNELCO	◆	◆	◆								◆		◆	◆		
Evaluation of losses in the Gran Canaria and Tenerife grids	UNELCO					◆											
Various cogeneration units	--	◆	◆														
Saucelle Huebra Hydroelectric Power Plant	Iberdrola									◆				◆			
TEYDE project	Iberdrola												◆				

Table IE2 (2/2)
Empresarios Agrupados' References in Power Transmission and Distribution

Project	Client	Type of Work Performed															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Almaraz NPP	CNA	◆							◆	◆	◆						◆
Cofrentes NPP	Iberdrola	◆							◆	◆	◆						
Trillo NPP	CNT 1	◆							◆	◆	◆						◆
Valdecaballeros NPP	CNV	◆							◆	◆	◆						
José Cabrera NPP	UF	◆							◆	◆	◆		◆	◆			
Lada 4 TPP	CEL								◆					◆			
Meirama TPP	UEF								◆								
Narcea 3 TPP	UEF								◆	◆							◆
Soto de Ribera 3 TPP	CT Soto de Ribera								◆								
Carbón II TPP, Units 3 & 4 (Mexico)	CFE								◆	◆							◆
Patache TPP (Chile)	CELTA								◆								

Key to Type of Work Performed

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Transient stability:
Power generation units
Interconnection of HV systems 2. Small signal stability analysis 3. Units speed regulators and excitation systems
Modelling and analysis of parameters 4. Electrical planning
Transmission and distribution networks 5. Evaluation of electric power losses
Sensitivity studies
Reactive power optimisation 6. Isolated power systems
Load supply
Stability and load shedding 7. Underfrequency in isolated power systems
Analysis of possible underfrequency systems
Criteria for load and power-frequency control
Adjustment of frequency relays
Available spinning reserve criteria | <ol style="list-style-type: none"> 8. Protections for generator units, grid and transmission lines
Engineering of protections and servocontrols
Plans for renovating protections
Assessment of the quality of a protection system and proposed improvements 9. Insulation coordination
Deterministic and probabilistic analyses
Insulation optimisation 10. Overvoltage simulation
Switching impulse
Lightning impulse
Temporary overvoltage 11. Power-frequency control 12. Voltage control and reactive compensation 13. Short-circuits in electrical systems 14. New power generation technologies
Stability of cogeneration units
Wind turbine-generators 15. Techno-economic studies 16. Training |
|---|---|

NPP: Nuclear Power Plant

TPP: Thermal Power Plant

**PHOTOGRAPHS OF RECENT
EMPRESARIOS AGRUPADOS
COMBINED CYCLE POWER PLANT PROJECTS**