THANK YOU

To all the companies that make this catalogue real.
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In Spain, nuclear energy has represented approximately 20% of the total production of electricity in recent years. On a world scale, nuclear generation represents almost 12% with nearly 448 reactors in operation in more than 30 countries and more than 60 reactors in construction in 16 countries.

These data have meant that a large number of Spanish companies have focused their activity in the nuclear sector, based on the experience of their participation in the development of the Spanish nuclear programme since its beginnings and are present in the whole chain of value.

All of this industrial structure has evolved with the circumstances of each moment, incorporating new technologies adapted to current needs and requisites and making it possible that Spanish companies are present today in nuclear projects in more than 40 countries, in four of the five continents.

Our industry also participates in international research and development projects for advanced nuclear reactors, in programmes based on nuclear fusion, such as the ITER International Project and in programmes based on high energy physics.

The companies that work in the nuclear sector are grouped in this catalogue according to the activity that they carry out.

The electrical companies focus their main activity on the production, transportation, distribution and commercialisation of electricity. However, the objective of these companies is to work permanently towards excellence in the management of nuclear power plants, with a commitment to long term production in a safe and reliable way and promoting growth in their areas of influence both from the social and environmental point of view.

Since the construction of the first nuclear power plant they have extended their actions to the study of the optimization of the performance, maintenance, management of improvements in equipment and procedures, management of the fuel cycle and the development of new reactors.

The Spanish electrical companies are capable of participating in an efficient manner in international markets undergoing a process of growing integration, globalisation and increase in competition.

The international suppliers of nuclear systems provided the first “key in hand” nuclear power plants in Spain and the steam generation systems for the nuclear power plants that were built after that. This was due to the fact that, at the beginning of the Spanish nuclear programme, the decision was made not to constitute a company of systems linked by license to a foreign supplier, which would have meant having to choose a single type of reactor.

In generating wealth and employment, the Spanish nuclear industry has leading edge capabilities and exports products, services and high technology to more than 40 countries. Recognised at an international level and with a firm commitment to human factors, as well as research and development, it intervenes in the whole chain of nuclear value. As indicated in this publication, it develops the initial studies, the conceptual design, the construction of reactors, the manufacturing of fuel, engineering for operation and maintenance, the supply of equipment and components, training, the management of waste, dismantling of installations, decontamination or provides support to production.

Its worldwide recognition and prestige is also reflected in the perfect maintenance and updating of the Spanish nuclear reactors, which operate with maximum guarantees of safety and excellent performance indicators. The capacities, experience and state of the art technology of the sector, applied to the services and products that it provides to the Spanish nuclear power plants, lead to lead factors, operation or availability of more than 90%. Year after year, this figure makes nuclear energy the source that produces the most electricity and operates the most hours.

In Spain, the nuclear power plants are leaders in production. They generate more than 21% of the electricity that we consume and help to decrease contaminating emissions to the atmosphere. Guarantee of supply and no CO2 emissions are two of the reasons why many countries seek to maintain and develop this technology and in doing this, join forces with the Spanish nuclear sector.

Nuclear energy still has a big pull worldwide with almost 550 reactors in operation and 60 units more in construction around the world, according to the United Nations’ International Atomic Energy Agency. Together with the hundreds of planned reactors these data push the companies in the Spanish nuclear sector to expand internationally and to open new markets. The Nuclear Forum is involved in this task of promoting the nuclear business and showcasing the capacities of the Spanish nuclear industry by supporting the presence of our industry on the exterior by participating in congresses, business missions, exhibitions and meetings in collaboration with Spanish and international institutions.

This publication, available in Spanish and English, and issued since 2008 in collaboration with ICEX, includes the capacities and services that the Spanish nuclear companies offer, their business objectives and activities and references. A show of how well our sector is doing at the technological forefront with an ever-growing consolidated international presence.
They currently provide support services to nuclear sites in operation and maintenance in more than 20 countries, such as for example, Germany, Belgium, Brazil, Bulgaria, China, Slovakia, Slovenia, United States, Finland, France, India, Japan, Mexico, United Kingdom, South Africa, Sweden, Taiwan, etc.

These companies work through agreements with Spanish companies with which they have developed strong technological links. This has led to as framework of mutual benefit, through which the Spanish industry has been able to participate in the development of nuclear projects all over the world.

The design, manufacture and supply of fuel to Spanish and international nuclear power plants is made by the public capital company ENUSA Industrias Avanzadas and is responsible for the supply of raw materials and their processing right through to the final elaboration of the product. It is the owner and operator of the fuel elements factory in Juzbade (Salamanca), one of the most innovative in Europe which, since the start of its operation in 1985, has manufactured more than 22,400 fuel elements for both Spanish and foreign nuclear power plants. In recent years, it had had significant international growth with more than 65% of its production going overseas.

The manufacture of capital equipment is made by Spanish companies who cover the production of main equipment to turbine alternators, valves, cranes, piping, boilers or equipment for handling the storage of fuel for both Spanish and foreign nuclear power plants, with a recognized level of quality. At present more than 80% of their annual production is exported.

At present, the whole portfolio of orders for the supply of large components as well as a high percentage of the rest of components of this group of companies is for exports.

The Spanish engineering and services companies have created an important engineering capacity for nuclear power plants, providing support in the management of the construction of new plants and in the operation and maintenance of the plants in operation, with a very diversified activity in which they export more than 60% of their annual production and in some cases up to 100%.

These companies have developed very specialised services such as the supply of simulators, training programmes for operators, in service inspection and the development of support and improvement systems in production. Their clients include all of the Spanish nuclear companies and a large number of foreign entities.

Some of these companies have laboratories for radiological analysis which offer an integral service that responds to all the needs of the sector and which are focused on the efficient and sustainable management of their activities.

Radwaste management in Spain is carried out by the National Radwaste Company, ENRESA. It is a public company and is an important international reference and example as its activities are studied and monitored by more than 15 countries around the world who have visited our site.

Very low, low and medium activity radwaste from nuclear sites, hospitals research centres and industry is managed in the Storage Centre in El Cabril, located in the province of Cordoba.

The fuel used in the nuclear power plants is kept in the onsite pools or in some cases, such as Trillo, Asco or Jose Cabrera, in the Centralised Temporary Storage Facility which is being built in the town of Villar de Cañas (Cuenca) is finished.

Among its activities it is also responsible for decommissioning nuclear and radioactive sites and was a pioneer in the decommissioning of the nuclear power plants of Vandellos I and Jose Cabrera.

Spanish Nuclear Industry Forum (Foro Nuclear) is a non-profit association which defends the purposes of nuclear energy and helps all of these companies and supports them in all the activities that they require.

Through their four phases of action, Support to the Industry, Technical Support, Communication and Education and Training it attends to the needs of the companies in the Spanish nuclear sector, at both a national and an international level.

In the area of Support to the Industry, Foro Nuclear coordinates the activities of the industry in different scenes, such as the participation in exhibitions with grouped pavilions, the organisation of business meetings among companies from different countries, the coordination of technical workshops in events of interest, etc.

For all of these activities it has the support of both national and international entities and institutions which gives it a greater diffusion and the possibility of reaching other companies that are not members of the Association.

Since 2014, Foro Nuclear and its associated companies have become part of “Brand Spain”, a recognition and prestige for the numerous companies in the nuclear sector which have extensive activities beyond our frontiers.

The figures of the activity of our nuclear industry and the degree of internationalisation of their companies are the best proof of the competitiveness of the sector and the capacity of our professionals. At present the nuclear sector is a consolidated, prestigious industry that generates wealth and employment.

The aim of the catalogue of the Spanish nuclear industry is to reflect the reality of an open and dynamic sector in a growing international market.
ELECTRICITY UTILITIES

EDP
Endesa, S.A.
Gas Natural Fenosa
Iberdrola, S.A.

The Spanish electric utilities constantly work towards excellence in the management of nuclear power plants with a strong commitment to enabling long term production in a safe way.
EDP in Spain is made up of a group of companies dedicated to the production of electricity and to the distribution and commercialization of electrical energy, natural gas and energy services.

It is part of the EDP energy group, a world leader and one of the main operators in the Iberian Peninsula, which is present in 14 countries, with a total installed capacity of 25 GW, in which 66% of the energy generated is renewable, being the fourth largest operator in the world of wind energy.

### ELECTRICITY GENERATION
In Spain EDP has a diversified generating park which stands out for its efficiency, high availability and operating flexibility sustained by a continuous effort of investment. Its participation in Trillo Nuclear Power Plant makes it possible for EDP to have first-hand nuclear experience.

### ELECTRICITY DISTRIBUTION
Once again, EDP HC ENERGÍA has obtained in 2016 the best supply quality in Spain achieving a historical low in interruption time equivalent to the installed capacity (TIEPI). As well as Asturias, which constitutes its initial distribution area although it now has consolidated electrical distribution networks in Madrid, Valencia, Alicante, Barcelona, Huesca and Zaragoza.

### COMMERCIALIZATION
EDP has a commercial portfolio of more than 2.3 million customers all over Spain, with a volume of commercialization in excess of 18,193 GWh of electricity and 19,129 GWh of natural gas, with commercial offices in all of the major cities in the country.

### SERVICES
The commercialization of electricity and gas is complemented with a wide range of services for each possible scenario. It is worth mentioning the maintenance service "Funciona" for homes as well as energy efficiency and optimization services for companies.

### RENEWABLES
EDP RENEWABLES is one of the leading world operators in wind energy with a presence in twelve countries and a head office in Spain where it has more than 2,371 MW of installed power. It is operative in 10 countries and generated 24,473 GWh of which 4,726 GWh correspond to Spain. With an average use factor of 30% it maintains its position as sector leader reflecting the quality of its wind farms.

<table>
<thead>
<tr>
<th>Data 2016</th>
<th>Production (GWh)</th>
<th>Power (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic</td>
<td>930</td>
<td>426</td>
</tr>
<tr>
<td>Classic Thermal</td>
<td>9,150</td>
<td>1,224</td>
</tr>
<tr>
<td>Combined Cycle</td>
<td>1,639</td>
<td>1,497</td>
</tr>
<tr>
<td>Nuclear</td>
<td>1,239</td>
<td>156</td>
</tr>
<tr>
<td>Special thermal regime</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>9,058</td>
<td>3,528</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Datos económicos 2016 (million €)</th>
<th>EDP in Spain</th>
<th>EDP Renewables</th>
<th>EDP Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnover</td>
<td>3,350</td>
<td>1,651</td>
<td>13,369</td>
</tr>
<tr>
<td>Gross Production Result (EBITDA)</td>
<td>510</td>
<td>1,171</td>
<td>3,753</td>
</tr>
<tr>
<td>Net Profit (BDI)</td>
<td>348</td>
<td>56</td>
<td>1,200</td>
</tr>
<tr>
<td>Number of Employees</td>
<td>1,513</td>
<td>1,083</td>
<td>11,392</td>
</tr>
</tbody>
</table>

| Points of electrical supply | 642,545 |
| Distributed electrical energy (GWh) | 9,190 |
| TIEPI (min)                  | 24      |
| Intelligent counters         | 503,772 |
Endesa, founded in 1944, is the leading company in the Spanish electricity sector and the second operator in the Portuguese electricity market, with total assets amounting to 30,764 million euros at 31 December 2016. Endesa has over 9,600 employees and provides services to 10.9 million customers.

Endesa’s core business is the generation, distribution and sale of electricity. The company is also a major operator in the natural gas sector and provides other energy-related services.

**BUSINESS OBJECTIVE**

Endesa, like all the companies forming part of the Enel Group, has always been at the forefront of developments in the energy sector, providing millions of people around the world with safe, affordable and sustainable energy.

The industry is currently experiencing a profound transformation and, aware of this, the Group is leading the way in a new, more open, participatory and digital energy era. This strategic positioning is called Open Power.

SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE

Endesa mainly operates in the electricity and gas markets in Spain, Portugal and Morocco. To a lesser degree, it sells electricity and gas in other European markets as well as value-added products and services (VAPS) related to its main business areas.

In terms of generation, Endesa has a diversified energy mix, with nuclear energy being the main technology with a production of 25,921 GWh, 37.7% of Endesa’s total production, which amounted to 68,490,645 GWh in 2016.

The installed power in Spain amounted to 23,691 MW and the total net production reached 69,831 GWh.

- **Conventional generation.** Endesa’ generation business is located in Spain, Portugal and Morocco, with an installed hydropower capacity of 4,765 MW, 8,130 MW of classic thermal power, 5,678 MW of combined cycles and 3,443 MW of nuclear power.

- **Renewable generation.** Endesa carries out its business activity in the field of emission-free energies via its division, Enel Green Power España, with a total installed capacity of 1,475 MW, 1,618 MW of wind power, 43 MW of hydroelectric power and 14 MW of other sources of renewable energy, such as biomass and solar power. The renewable plants generate around 4 TWh of emission-free energy each year.

- **Distribution.** Endesa distributes electricity in 27 Spanish provinces in 10 autonomous communities: Cataluña, Andalucía, Biscay, Canarias, Aragón, Extremadura, Castilla y León, Navarra, Comunidad Valenciana and Galicia. In 2016, the distributed energy reached 115,602 GWh, which accounts for 44% of the total demand in Spain.

- **Nuclear energy at Endesa**

Endesa, the largest nuclear energy producer in Spain, with 47% of the installed nuclear power, amounting to 3,700 MW.

Endesa has a permanent commitment to excellence in the management of its nuclear plants. The company is committed to safely and reliably operating its nuclear plants on a long-term basis, as reflected in its nuclear policy approved in February 2011 by the company’s Board of Directors. It also has a firm commitment to the surrounding areas, from a social and an environmental point of view, promoting the development of the regions in which it operates.
GAS NATURAL FENOSA

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Data 2016

- **Net turnover**: 23,184 million euros
- **Net Profit**: 1,347 million euros
- **Consolidated EBITDA**: 4,970 million euros
- **Workforce**: 19,661 employees

Gas Natural Fenosa is a multinational energy group operating in over 30 countries where it serves almost 22 million customers with a rated output of 15.4 GW. The basis of its business are in the regulated, liberalised gas and electricity markets, with an input of almost 50% from international operations.

The company is listed on the four Spanish stock exchanges via the continuous market and forms part of the select Ibex 35 index.

This Spanish multinational participates across the entire energy value chain, from generation and distribution to the commercialisation of natural gas and electricity. Its generation mix is diversified and includes combined-cycles, hydraulics, nuclear, coal and renewable sources.

In addition to Spain, Gas Natural Fenosa also has generating capacity in Mexico, Puerto Rico, Dominican Republic, Panama, Costa Rica and Kenya, and has new projects in progress in Australia, Chile and Brazil.

Gas Natural Fenosa is also the leading operator in the Atlantic and Mediterranean basins, managing an LNG supply portfolio of approximately 30 bcm.

**OUTSTANDING NATIONAL AND INTERNATIONAL ACTIVITIES**

Gas Natural Fenosa promotes best practices in energy infrastructure management, aligning its activities with its concern for the environment, the development of low-emission economies and sustainability. And as an energy operator, it seeks to achieve progress in the use of increasingly efficient and less polluting energies and is committed to attaining enhanced air quality for our urban environments.

In the electricity generation business, the group’s strategy focuses on having a balanced, competitive and environment-friendly generation mix, in keeping with the objectives and commitments of the COP 21 with regard to global warming and consolidation of its presence as one of the chief operators of the Spanish electricity sector. Gas Natural Fenosa’s electricity generation business in Spain includes generation under the ordinary and special regime using renewable technologies.

Under the ordinary regime, the company currently has almost 13 GW, chiefly in combined-cycles but also via hydraulics, nuclear and coal.

As regards renewable generation, the company’s capacity in Spain is 1,147 MW. The group’s generation business outside Spain is managed by its subsidiary Global Power Generation (GPG), which groups together all the assets and holdings in international generation with a rated output that is currently 2,100 MW and projects awarded for 543 MW.

As regards nuclear powered generation, the company has interests in the nuclear plants of Almaraz I and II and Trillo.
After the last quarter of 2016, IBERDROLA has 47,324 MW of installed capacity. Over 66% of it corresponds to greenhouse gases-free energy that is also low cost. From the whole installed capacity, nearly 33.72% corresponds to renewable energies; 29.35% to combined-cycle gas plants; 24.67% to hydro; 7.54% to Nuclear; 2.8% to cogeneration and the remaining 1.93% to coal.

the strongest commitments of IBERDROLA, establishing as environmental objective to reduce the CO2 emissions below 150 gr per kWh in 2030, that is, 50% below the specific emissions released by the company in 2007.

SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE
Main activities of IBERDROLA consist of electricity production through renewable and conventional sources, trade in electricity and gas in wholesale markets, transmission and distribution of electricity, marketing of electricity and other activities mostly connected to the energy sector.

After the last quarter of 2014, IBERDROLA has 47,324 MW of installed capacity. Over 66% of it corresponds to greenhouse gases-free energy that is also low cost.

From the whole installed capacity, nearly 33.72% corresponds to renewable energies; 29.35% to combined-cycle gas plants; 24.67% to hydro; 7.54% to Nuclear; 2.8% to cogeneration and the remaining 1.93% to coal.

IBERDROLA is making a huge investment effort between 2016 and 2020, during which 25,000 million € will be invested in energetic project and countries with an estable and predictable regulation.

In 2011, Iberdrola started a new stage of growth mainly internationally, as can be seen with the purchase of the Brazilian company Elektro and creation of the company AVANGRID in USA, as a result of merging of IBERDROLA USA with distributor of electricity company UIL.

IBERDROLA SHARE IN THE SPANISH NPP’S

<table>
<thead>
<tr>
<th>NPP</th>
<th>Capacity (MWe)</th>
<th>Share IBERDROLA</th>
<th>Capacity IBERDROLA (MWe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cofrentes</td>
<td>1092</td>
<td>100%</td>
<td>1092</td>
</tr>
<tr>
<td>Almaraz I y II</td>
<td>2094</td>
<td>53%</td>
<td>1103</td>
</tr>
<tr>
<td>Torre</td>
<td>1087</td>
<td>48%</td>
<td>523</td>
</tr>
<tr>
<td>Sta. Mª de Garoña</td>
<td>446</td>
<td>50%</td>
<td>223</td>
</tr>
<tr>
<td>Vandellosa II</td>
<td>1087</td>
<td>28%</td>
<td>304</td>
</tr>
<tr>
<td>Ascó II</td>
<td>1027</td>
<td>15%</td>
<td>154</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3410</td>
</tr>
</tbody>
</table>

IBERDROLA has undergone a wide-ranging transformation over the last ten years which has enabled it to advance through the ranks to become the number one Spanish energy group, one of the Spanish main companies on the Ibex 35 by market capitalisation, the world leader in renewable energy, a pioneer in the deployment of smart grids and one of the world’s top power companies.

Nowadays, IBERDROLA is working in the construction of new wind farms and regulated generation plants, to achieve a total capacity of 5,000 MW.

In addition to consolidation in Spain, it has an international reference position, becoming one of the main operators of the United Kingdom, one of the largest producers of wind power and electricity networks in the United States, the main generator private Mexico and has strengthened its leadership as a distributor of electricity with more customers from Brazil.

Iberdrola is making a huge investment effort between 2016 and 2020, during which 25,000 million € will be invested in energetic project and countries with an estable and predictable regulation.

In 2011, Iberdrola started a new stage of growth mainly internationally, as can be seen with the purchase of the Brazilian company Elektro and creation of the company AVANGRID in USA, as a result of merging of IBERDROLA USA with distributor of electricity company UIL.

Countries where it has activity Around 60
Users More than 30 millions
Staff 28,220 employees

IBERDROLA is a private global company with experience forged over the span of more than hundred fifty years of history at the service of energy development, supply guarantee, quality and innovation.

Iberdrola owns a balanced, efficient and well diversified grid, guaranteeing its response capacity in any energy related matter.

BUSINESS OBJECTIVE
The company has taken a decisive and pioneer bet to use cleaner generation technologies, fight against climate change and respect towards the environment, becoming world wide leader in wind power.

After last quarter 2016, renewable business has got 15,256 MW of installed capacity around the world.

Fighting against climate change and in favor of sustainable development is one of the strongest commitments of IBERDROLA, establishing as environmental objective to reduce the CO2 emissions below 150 gr per kWh in 2030, that is, 50% below the specific emissions released by the company in 2007.

NUCLEAR ENERGY IN IBERDROLA

From the whole electricity generated by IBERDROLA in Spain, more than 60% comes from nuclear plants, with an installed capacity of 3,410 MW.

For IBERDROLA, the safety of its nuclear plants is the prime objective over other aspects as economics, production or compliance of schedule. Likewise, IBERDROLA is committed to generate electricity from nuclear plants in a respectful way with environment, making rational use of natural resources, maintaining the best quality standards and excellence levels, and continuously carrying out the modernization of its plants according to the state of the art in this field.
NUCLEAR SYSTEMS SUPPLIERS

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GE-Hitachi
Westinghouse Electric Spain, S.A.U.

22-25

Nuclear systems suppliers provide support and maintenance services to nuclear sites in operation across more than 20 countries.
and highly valued nuclear plant services.

GEH is a world-leading provider of advanced reactors and nuclear services. Established in June 2007, GEH is a global nuclear alliance created by GE and Hitachi to serve the global nuclear industry. The nuclear alliance executes a single, strategic vision to create a broader portfolio of solutions, expanding its capabilities for new reactor and service opportunities. The alliance offers customers around the world the technological leadership required to effectively enhance reactor performance, power output and safety.

BUSINESS OBJECTIVE

GEH offers customers innovative solutions that take nuclear energy the smart choice for a cleaner and more secure energy future. GEH is committed to serving the needs of customers, communities and the environment with a balanced portfolio of advanced technologies, trusted services and global energy experience for the world’s growing energy needs.

SERVICES, PRODUCTS AND TECHNOLOGIES AVAILABLE

The GE and Hitachi alliance is recognized as the world’s foremost developer of boiling water reactors, robust fuel cycle products and highly valued nuclear plant services.

Beginning in the 1950s, GE developed breakthrough light water technology with the Boiling Water Reactor (BWR). Since that time, GE has developed nine evolutions of BWR technology including the ABWR, the world’s first operational Generation III Class advanced light water design and, most recently, the ESBWR, our latest Generation III+ Class design that combines advanced safety features, improved economics, and new operational efficiencies. Within the segment of Modular reactors, PRISMA is a Generation IV design. Sodium-cooled, which provides a wide range of MWt offerings – 140 to 600 Mwe.

NUCLEAR PLANT PROJECTS

Advanced Boiling Water Reactor (ABWR)

The ABWR is the world’s first and only Generation III nuclear plant design in operation today, providing the benefit of a combined 25 reactor-years of operational experience. GEH’s first ABWR began commercial operation at Kashima- Karuiwa in Japan, in 1994. The ABWR is licensed in the U.S., Japan and Taiwan, and will complete the licensing process in UK in 2017. That is the reactor selected by Hitachi for the Horizon project.

Economic and Simplified Boiling Water Reactor (ESBWR)

The ESBWR is a GEH-designed Gen III+ reactor currently in the U.S. Design Certification process. This simplified design provides improved safety, excellent economics, better plant security, a broad seismic design envelope and operational flexibility that increase plant availability. ESBWR employs passive safety design features. The reactor can cool itself for more than seven days with no on-site or off-site AC power or operator action, uses approximately 25 percent fewer pumps and mechanical drives than reactors with active safety systems and offers the lowest projected operating, maintenance and staffing costs in the nuclear industry on a per-kilowatt basis.

Power Reactor Innovative Small Modular (PRISM)

PRISM is a small modular, sodium-cooled fast reactor that is designed to recycle used nuclear fuel to generate low-carbon electricity. It is an inherently safe design that could help to close the nuclear fuel cycle, decrease the amount of waste and reduce the time that waste has to be stored in a repository to a few hundred years. It is based on proven sodium reactor technology, developed and tested over 30 years in the US.

GLOBAL NUCLEAR FUEL (GNF)

GNF is a world-leading supplier of boiling water reactor fuel, including uranium dioxide and MOX fuel and fuel-related engineering services. GNF operates primarily through Global Nuclear Fuel-Americas, LLC in Wilmington, N.C., and Global Nuclear Fuel-Japan Co., Ltd. in Kurehama, Japan. GNF continues to strategically expand the nuclear fuel cycle by offering customers an extensive portfolio of dependable and innovative fuel solutions.

NUCLEAR PLANT SERVICES

As nuclear plants get older and worldwide demand for cleaner energy increases, GEH offers a wide range of valuable services that can improve performance, increase power output and extend plant life. GEH provides the technical leadership and experience for all operational and expansion requirements.

PERFORMANCE ENHANCEMENT PROGRAMS

Advanced products and services improving performance and safety, such as Plant Upgrading and Optimization Programs, Lifetime Management, New Instrumentation and Control Platforms or the new Reactor Water quality surveillance program (WaterCare™).

DECOMMISSIONING AND DISMANTLING (D&D)

On the D&D segment, GEH offers solutions in the field of emerging cutting tools, advanced imagery technologies, the latest radiation detection devices and brilliant robots to assess what is possible. Solutions that deliver significant improvement to resolve the biggest issues identified in the market: schedule uncertainty and cost risk.

ACTIVITIES AND REFERENCES

Although GEH has no production centers in Spain, GE has based its strategy on alliances with national partners with whom it has developed strong technology links. This has led to a framework of mutual benefits through which the Spanish industry has been able to participate with GEH many projects throughout the world. The alliances with the following companies are particularly noteworthy:

Empresas Agrupados has collaborated with GEH in proposals and projects for new plants in several countries, with a wide range of scopes and has been the main project engineering firm for the Cofrentes and Valdecaballeros plants. They also participated in the certification efforts for the new ABWR and ESBWR designs.

As regard nuclear fuel, links with ENUSA date back to 1974 and since that time some 10,000 GEH design fuel assemblies have been manufactured for 13 BWR reactors in Europe. Since 1994, GEH has been commercializing Fuel and associated services for Europe through the Spanish company GENUSA, held jointly by GNF and ENUSA.

In the area of Reactor Components, ENSA has supplied several different items of equipment for the Lungmen ABWR project and in the near future will supply reactor vessels and fuel racks for the new ESBWR designs. It has also manufactured replacement components for delivery to operating plants.

Since 1992, GE has had a Cooperation Agreement with Tecnatom, through which the two companies have jointly developed non-destructive testing equipment and have participated in Inspection Services in more than 25 nuclear plants worldwide and in the design of Man-Machine interfaces for certain new reactor designs.

This high degree of participation by the national nuclear industry at world level should be valued especially in view of the fact that GE has access to a wide range of partners and suppliers on the five continents. This is clear indication of the capacities and competitiveness of the sector, which will be strengthened in future projects for new reactors across the world, some already underway.
L'Hospitalet de L'Infant.
in three locations: Madrid, Vandellós and
Westinghouse has 300 employees in Spain
expanding its business in Spain. Nowadays,
acquired Initec's nuclear division, thus
power plants. In 2001, Westinghouse
in its service to the Spanish nuclear
presence has been permanent and active
Already in 1972 Westinghouse had its
company Unión Eléctrica Madrileña.
Nuclear Power Plant to the electric
a turnkey contract, of the José Cabrera
in the mid-sixties with the supply, under
Westinghouse's presence in Spain began
and Asia). This way it fulfills its vision of
Europe/Middle-East and Africa, (EMEA)
New Plants) and three regions (America,
Components, Nuclear Fuel, Field Services
(Engineering Services, Manufacturing &
TECHNOLOGY AVAILABLE
Westinghouse's product lines are as follows:
ENGINEERING SERVICES
Westinghouse provides different types
of solutions and services to practically
all reactors in operation. It offers a
promise of safe and efficient operation
of nuclear power plants throughout the
world.
Some of the services it provides are:
• Reactor-related engineering, such as
  support to systems operation, safety
  evaluations, accident analysis or power
  uprates.
• BOP engineering.
MANUFACTURING & COMPONENTS
Westinghouse’s factories and spare parts
supplies have been consolidated in a single
business unit in order to cover the following
processes:
• Design, supply and replacement of
  nuclear components.
• Supply of spare parts.
FUEL
Westinghouse provides nuclear fuel and
all the engineering services related to
operating nuclear power plants. From its
factories in the United States, Sweden,
United Kingdom and Japan, and its
agreement with ENUSA, Westinghouse is
capable of providing fuel to power plants of
all commercial technologies in any country.
Additionally, in collaboration with Toshiba it
can supply enriched uranium.
Furthermore, Westinghouse carries out all
the necessary fuel inspection and repair
services for their operation.
FIELD SERVICES & MODIFICATIONS
Regarding Outage & Maintenance services,
such as reactor services, Fuel Handling or
inspection, all of them are done locally in
Spain. For very specialized services, our
local team is supported by European or
American organizations.
Also, this business unit has been unified
with engineering support and Vessel
and Internal segmentation capabilities,
Westinghouse provides solutions for a wide
range of Decommissioning, Dismantling,
Remediation and Waste Management
projects
More than 30 years of national and
international experience endorsed the new
DDR&WM business unit being remarkable:
El Cabril and Radiana Waste Repository
Design, Zorita and Barsebäck Internal and
Vessel segmentation, as well as Vandellós
I, Oskarshamn, Chin-Shan and JEN-1
Decommissioning Plans.
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Design, Zorita and Barsebäck Internal and
Vessel segmentation, as well as Vandellós
I, Oskarshamn, Chin-Shan and JEN-1
Decommissioning Plans.
NEW PLANTS
Taking advantage of the accumulated
experience gained by Initec in building
Spanish plants, Westinghouse’s office
in Madrid actively supports the detail
engineering of the AP1000 reactor in China
USA and UK.
Westinghouse is developing new versions
of the AP1000 and has initiated several
development projects for a new small
modular reactor.

Design Modifications and its associated
engineering.
INSTRUMENTATION & CONTROL
Westinghouse owns technology and
instrumentation and control products for
both protection and plant reactor control
systems. Additionally, Westinghouse
designs, supplies and installs
instrumentation and control systems for
the rest of the plant. The effort currently
being made by plants towards digitalization
of control systems is especially significant.
In this respect, Westinghouse stands out as
a pioneer with its Ovation platform.

PHOTO: ENRESA
Spanish nuclear power plants operate in a continuous, reliable, safe and clean way, diversifying growth in their zones of influence.
**ASOCIACIÓN NUCLEAR ASCÓ-VADELLÓS II, A.I.E.**

In 1998, as a result of a merger between the companies that independently managed the Ascó and Vandellós II nuclear power plants, an economic interest group known as Asociación Nuclear Ascó-Vandellós II (ANAV) was born. The rather similar technologies of both plants, and their relatively close locations, led the owner utilities to integrate them into a common management company.

This commitment is embodied both in the Group’s investments on the Plants to guarantee their safe and long term operation, and in direct actions on the territory, with activities that promote economic, social and cultural development of the towns in the influence areas of both Plants.

The staff working at the Ascó and Vandellós II Nuclear Power Plants play a major role in the daily routine of the sites. With over 2,400 jobs shared among staff from stable cooperating companies, ANAV is a beacon of economic growth not just for the province of Tarragona but also for the whole of Catalonia.

**ASCÓ NUCLEAR POWER PLANT**

The Ascó Nuclear Power Plant is located on the right bank of the Ebro River in the district of Ribera d’Ebre, in the municipal area of Ascó in the province of Tarragona. It's construction began in 1972 and 81% of the construction and equipment assembly work was carried out by Spanish companies.

The Ascó Nuclear Power Plant has two pressurised water reactors (PWR), the cooling water for the two units being provided by the Ebro River.

Unit I of the Plant, with a thermal power of 2,940.6 MW and an electric output of 1,032.5 MW, is the property of ENDESA (85%) and IBERDROLA (15%), and it initiated its commercial operation on December 10th, 1984.

Unit II, with a thermal power of 2,940.6 MW and an electrical output of 1,027.2 MW, is jointly owned by ENDESA (85%) and IBERDROLA (15%), and it initiated its commercial operation on March 30th, 1986.

In recent years, both units at the Plant have recovered load factors over 90%, this of course depending on whether the necessary shutdowns take place during the year in order to reload fuel and carry out preventive maintenance activities.

This evolution has been accompanied by an important increase in investment to renovate and upgrade systems and plant equipment as well as continue with the "Safety Reinforcement Project".

At the end of 2016, practically all of the modifications and improvements derived from the stress tests carried out at European nuclear power plants as a result of the Fukushima accident were completed. These modifications, grouped into the "Safety Reinforcement Project" aim to guarantee the response capacity of the plants to events that could go beyond the design bases of the plants and have led to an investment of over 100 million euro.

Moreover, intense work, on from 2011 to 2014 on reinforcing structures, equipment and systems, including among others, the provision of portable cooling and electrical supply equipment, the incorporation of systems aimed at protecting the integrity of the containment buildings at the three plants such as the hydrogen passive recombiners or the vent filter system, or the construction of an Alternative Emergency Management Centre (CAGE) for each plant.

The Ascó Nuclear Power Plant has a staff of nearly 540 people, of which approximately half are university graduates. It must be added that the Plant has over 680 staff members from stable cooperating companies and that during reload periods there is the addition of between 900 and 1,200 workers.

ANAV devoted more than 16,400 hours to training staff, representing 3.6% of the hours worked in 2011, ANAV opened an Information Center at the Ascó site that it has already received more than 16,000 visitors. This project responds to ANAV’s multiple goals to promote a public approach to energy and how nuclear power plants work, generating an added value that complements the offer of Ribera d’Ebre to attract visitors to the area and attend to demand of visits to the Plant.
The Vandellós II Nuclear Power Plant is located on the Mediterranean coast in the province of Tarragona, in the municipal area of Vandellòs i l’Hospitalet de l’Infant, being the only Spanish Plant that extracts the cooling water necessary for its operation from the sea.

National participation in the construction and supply of equipment for this Plant amounted to more than 89% of the total, the highest percentage achieved in Spain for this type of project.

The Plant has a Pressurized Water Reactor (PWR) with a thermal power of 2,940.6 MWt and an electrical power of 1,087.1 MWe, and is jointly owned by ENDESA (72%) and IBERDROLA (28%). The Plant launched its commercial operation on March 8th 1988.

In recent years, the Vandellós II Nuclear Power Plant has recovered load factors over 90%, this of course depending on whether the necessary shutdowns take place during the year in order to reload fuel and carry out preventive maintenance activities. This evolution brings with it a progressive increase in investments as well as operation and maintenance costs.

Between 2014 and 2015 investments were 95 million euros, intended to renovate and upgrade equipment and plant systems, including among others, the supply equipment, the incorporation of systems aimed at protecting the integrity of the containment buildings at the three plants such as the hydrogen passive recombiners or the vent filter system; or the construction of an Alternative Emergency Management Centre (CAGE) for each plant. These centres, together with the safe warehouses for portable equipment and the aerial evacuation platforms are now ready for the emergency personnel to use in the case of a loss of the current emergency centres that the plant has. With an autonomy of 72 hours and 70 people working in the case of Vandellòs II NPP and 120 in the case of Ascó NPP, ANAV’s Alternative Emergency Management Centres are designed to maintain capacity for emergency management in the case of extreme events involving rain, wind, snow, temperature, fires or earthquakes that could go beyond the plants’ design bases.

The Vandellös II Nuclear Power Plant houses ANAV’s corporate headquarters. Between the Plant and the corporate services, the site has a workforce of more than 1,100 people, of which approximately 500 are ANAV workers and nearly 630 come from stable cooperating companies. During reload periods there is an addition of between 900 and 1,200 workers from around 65 local companies.

ANAV devotes more than 20,000 teaching hours of staff training, representing 4.2% of the hours worked, which have been given, 26% by internal staff, and 74% by external staff.

Currently, the Vandellós II Nuclear Power Plant does not have an information center on sit and all visitors are sent to the ANAV Information Center at the Ascó Nuclear Power Plant, except technical or institutional visitors to the Plant.
In November 1999, the companies that owned the Nuclear Power Plants of Almaraz and Trillo constituted the Economic Interest Group Almaraz-Trillo Nuclear Power Plants (CNAT) for the operation, management and integrated administration of the two plants, without changing their participations in the property of each one of them.

With this decision, the owner companies (Iberdrola Generacion Nuclear, Endesa Generacion, Gas Natural Fenosa Generacion, (Berenergia and Nuclenor) reinforced their commitment to the safe and reliable operation of the two plants and their confidence in nuclear energy, in a diversified and environmentally free sector.

The Group has a staff of 839 employees, 87 employees and Trillo with 333 employees.

The Almaraz nuclear power plant has two pressurised light water reactors (PWR) with a thermal power of 2,947 MWt each, and an electrical power of 1,049.43 MWe in Unit I and 1,044.45 MWe in Unit II.

Each reactor has a cooling circuit comprising three loops. Each loop in turn has a cooling pump and a steam generator. Both cooling circuits are contained in their respective containment areas in each reactor building.

The steam from the generators is taken to the turbine buildings which houses the two turbogroups, in the same room, but separated. The cooling system (common for the two sites) is an open circuit from the cold spot which is the Arrocampo dam, constructed for this purpose.

Unit I started its commercial service on 1st September 1983 and Unit II did so on 1st July 1984. It is conceived to operate as a base plant, that is, with uninterrupted operation, and it is capable of guaranteeing an average annual supply of 16,000 million kWh.

The Almaraz Nuclear Power Plant provides around 9% of the national production of electrical energy. During its years of operation, the two plant units have obtained excellent results in their performance with load factor, operation and availability of more than 90% and have accumulated until December 2016 a production of 495,367,3 GWh. These results put the Almaraz Nuclear Power Plant among the best in the world park of nuclear power plants.

The Almaraz Nuclear Power Plant has a staff of 419 people, of which 46% have a university degree, plus the collaboration of highly qualified personnel from contracting companies. Training is a key factor for the constant improvement of safety, quality, efficiency and competitiveness.

In order to let the public know about the reality of its activity, it has an Information Centre which started to receive visits in February 1977, years before the plant started its operation, allowing visitors to have a more direct knowledge of what a nuclear power plant is and how it works.

Since its opening the Information Centre has received more than 659,748 visitors. Most of them are students from institutes, schools and universities and mainly from the community of Extremadura.
The Trillo Nuclear Power Plant is located in the village of Trillo (province of Guadalajara). The land on which the plant is built occupies a surface of 545 hectares. It is the property of the following Spanish electrical companies: Iberdrola Generación Nuclear with a participation of 48%; Gas Natural Fenosa Generación, 34.5%; Iberenergía 15.5% and Nuclenor, 2%. Construction started in 1979 and 85% of the investment made is from Spanish origin. National engineering and equipment exceeded 80% and such important areas as civil engineering and assembly were all national.

The Trillo Nuclear Power Plant has a pressurised light water reactor (PWR) with a thermal power of 3,010 MWt and an electrical power of 1,066 MWe with a cooling circuit with three loops. Each loop in turn houses a cooling pump and a steam generator. This circuit is contained in the containment area of the reactor building. The steam from the generators is taken to the turbine building. The cooling system is a closed circuit with two natural draught towers.

It started its commercial operation on 6th August 1988. It is conceived to operate as a base plant, with uninterrupted operation and guarantees an average annual supply of 8,000 million kWh and is the most modern plant in the Spanish nuclear park.

The Trillo Nuclear Power Plant has a temporary dry warehouse which stores part of the spent fuel inside metal containers which are totally hermetic and shielded. With a surface of 2,280 square meters, this warehouse is designed to house 80 containers.

During its years of operation, the plant has obtained excellent results in its operation, with load factors, operation and availability of more than 90%. It is worth mentioning that in 2003 the plant reached 9,304,908 MWh (maximum production in a cycle).

The Trillo Nuclear Power Plant has a staff of 333 people, of which 42% have a university degree, plus the collaboration of highly qualified personnel from contracting companies.

Training is a key factor for the constant improvement of the levels of safety, quality, efficiency and competitiveness.

The Trillo Nuclear Power Plant has an Information Centre which started to receive visits in November 1981, years before the plant started to operate, allowing the visitors to have a more direct knowledge of what a nuclear power plant is and how it works.

Since it was opened the Information Centre has received 354,033 people. Most of them are students from institutes, colleges and universities, mainly from the Autonomous Communities of Madrid and Castilla La Mancha.
The Cofrentes nuclear power plant is the property of the electricity company Iberdrola Nuclear Generation, S.A.U.

Cofrentes nuclear power plant is located in the town of Cofrentes (province of Valencia) at the end of the old Embarcaderos dam, on the right bank of the river Jucar.

It operates using a nuclear system producing steam formed by a light boiling water BWR/6 supplied by the American company General Electric Company with a thermal power of 3,237 MW and 1,092 MW of electrical power. The plant is cooled using a closed circuit with two natural draught towers.

An operation scheme is shown below:

The authorisation for construction was granted in 1975 and it started commercial operation in March 1985. 2015 is the 32nd year of operation and since its origin up to 31st December 2016 it has generated more than 255,172 million kWh.

Cofrentes nuclear power plant is currently one of the main electricity production centres at a national level, with a contribution in 2016 of 3.6% within the ordinary regime. Within the community of Valencia where it is located it satisfies about one third of the total demand for electricity.

As well as its activity as one of the most important electricity producers in the country, the Cofrentes nuclear power plant carried out an intense and important relationship with its social surroundings, where the visits to the Information Centre for learning centres and different associations stand out, with an average of 5,000 visitors per year.

As an environmental contribution, the uninterrupted operation of Cofrentes throughout a year avoids approximately the importation of 14 million barrels of petrol and the emission to the atmosphere of about 7 million Tm CO₂.

Throughout 2016 the operation of Cofrentes nuclear power plant was normal, without incidents worthy of mention. The events reported to the regulatory body were all insignificant for safety.

In 2016 the Cofrentes nuclear power plant generated a total of 9,540.71 GWh, maintaining the generator coupled to the electrical grid for 8,784 hours in the year, considering that 2016 was a leap year and it was not shut down for any outage or for any other reason.

The production obtained in 2016 was the second best in the plant’s history.

Worthy of mention is the fact the plant has not had a scram for more than 7 years which makes Cofrentes one of the most reliable plants in operation.

The Plant has a Management Plan, which has been revised with a horizon in 2020, in order to guarantee an orderly action in the most important areas for the correct operation of the plant.

This Plan currently includes 69 projects grouped into the areas of Excellence and Operational Safety; Technological Update and Reliability; Radiological Protection; Management of Large Emergencies; the Safe Seismic Storage Area; Passive Autocatalytic Recombiners were installed in containment and the dry well and the construction of the building that houses the new seismic fire protection system was completed. It has the capacity to supply water to the fire areas which contain equipment required for the safe shutdown of the plant and also to inject water into the reactor vessel, containment and spent fuel pools in the absence of electrical power.

An operation scheme is shown below:

The Alternative Emergency Management Plan was implemented as was the case in 2016.

In short, all of the actions derived from the Management Plan will continue the search for efficiency and effectiveness, guaranteeing safety as a priority element in all of the activities of the company, in order to guarantee the protection of people and of the environment.

The key elements that make up the Management Plan are the People, the Organisation and the Site. Their permanent interaction is essential in achieving the objectives established.

In 2016 the projects carried out as requisites of the past Fukushima action plan were completed. These include the implementation of new infrastructures and installations with significant organisational improvements made in emergency response.

The Alternative Emergency Management Centre (CAGE) was implemented as was
In February 2014, a series of regulatory changes were published that allowed the nuclear power plants that had ceased their activity due to reasons other than safety – for example – economical – to be able to apply for a renewal of their operating licence.

The Santa María de Garoña nuclear power plant is located in the province of Burgos, in the meander of the river Ebro near the town with the same name in the Valley of Tobalina, and close to the Sobron reservoir. It belongs to NUCLENOR SA (50% Iberdrola and 50% Endesa). It started its commercial activity in 1957 and was a pioneer in Spain in the use of nuclear energy for the generation of electricity.

In February 2014, a series of regulatory changes were published that allowed the nuclear power plants that had ceased their activity due to reasons other than safety – for example – economical – to be able to apply for a renewal of their operating licence.

The plant has not produced electricity since 16th December 2012 although its technical and organisational capacities have been kept intact. From an administrative point of view Santa María de Garoña is in cessation of production due to economic reasons and not due to safety or technical matters.

In this new context, on 27th May 2014, Nuclener presented the Ministry of Industry, Energy and Tourism (MINETUR) with an application to renew the operating licence of Garoña until 2031, considering that this time frame would provide the stability and certainty required to undertake the investments for the safe and reliable operation of the plant.

On 1st August 2014, the Spanish Regulator (CSN) published a Complementary Technical Instruction (ITC 14-01) indicating the twenty-two requisites for the renewal of the operating licence at the Garoña plant. These requisites included the examination of aspects related with the condition of site components, and the training and qualification of personnel as well as the implementation of improvements.

During the second semester of 2014 and throughout 2015 Nuclener made a huge effort to respond to the CSN’s requisites for renewal and to implement the improvements required in the aforementioned ITC 14-01.

2016 was a year of waiting for the results of the evaluation. On 3rd February, Nuclener and the CSN held a meeting on the conclusions of the technical evaluation followed by several requests for and delivery of additional information. On 19th October, the CSN issued a communication on the status of the evaluation process, which was practically complete at the time.

During 2016, activities and tests associated with the site preservation programme continued. These were given a satisfactory evaluation by the CSN. The results confirmed the adequate availability of the equipment and systems for the restart of plant operation.

In 2016 work started on the construction work of the Temporary Individualised Storage Facility (ATI) which in the future will house spent fuel. As a prior step to it transfer to the ATC. The activities on the processing of the operational waste and the fuel pool reconfiguration project were also started. The objective of the latter is to adapt the systems to the new situation of less residual heat in the pool and has progressed well throughout the year.

AENOR renewed Garoña’s environmental certificate (UNE-EN-15-14901-2004) highlighting the high level of implementation of the environment management system, even in the plant’s current situation.

For all of these activities, at the end of 2016, NUCLENOR had a workforce of 244 people of whom almost 50% are university graduates and service managers and 20% technicians and administrative workers. Apart from its own employees, NUCLENOR also has the support of around 180 people from collaboration companies.
A Spanish company is responsible for all stages of the nuclear fuel production process, from the delivery of raw materials, through to their processing and manufacturing.
ENUSA INDUSTRIAS AVANZADAS S.A.

ENUSA Industrias Avanzadas, S.A., S.M.E. (ENUSA) was founded in 1972 as the National Uranium Company. It was part of an initiative that intended to strengthen the importance of the nuclear component in Spain’s energy development. Today ENUSA is a public Enterprise 60% owned by the Sociedad Estatal de Participaciones Industriales (SEPI), and the remaining 40% by the Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT). ENUSA is a public Enterprise 60% owned by the Sociedad Estatal de Participaciones Industriales (SEPI), and the remaining 40% by the Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT). ENUSA is the parent company of the ENUSA Group, jointly with Express Truck, S.A., S.A.U. (ETSA) and Residuos Industriales S.A., S.M.E., M.P. (Empisa), focuses its activities in the nuclear fuel cycle and develops environmental services.

BUSINESS OBJECTIVE

ENUSA business goal is to endeavor to improve its competitiveness, maintain the safety and quality of current production as well as the received recognition from regulators, institutions and clients, and contribute to the socioeconomic development of the communities where it operates.

ACTIVITIES AND REFERENCES

The nuclear business focuses on activities of the nuclear fuel cycle that are marketed both nationally and internationally and which services consists of:

- Management of the enriched uranium supply to the Spanish nuclear power plants under the criteria of security and flexibility.
- Engineering in all technical aspects of the lifetime of the nuclear fuel, from design and operation in the nuclear power plant up to its tenures as irradiated fuel for transport and dry storage.

- Manufacturing and fuel assemblies to national and foreign nuclear power plants for:
  - Pressurized water reactors (PWR), under Westinghouse license.
  - Boiling water reactors (BWR) under General Electric license.
- Pressurized water reactors (PWR), in collaboration with Westinghouse.
- Coordination the handling, inspection and repair campaigns that take place during the refueling programs, providing fresh fuel reception and irradiated fuel handling services and supervising the process during the reload (inspection, repair, characterization and cleaning)
- Transport of nuclear and radioactive materials through the subsidiary ETSA.

- Waste treat and management all kinds of waste:
  - Hazardous and non-hazardous industrial waste. Collection, transport and management of hazardous and nonhazardous industrial waste, prioritizing waste reuse and recovery.
  - Municipal Solid Waste. Design, construction and operation of MSW recovery facilities with biodyrning and accelerated oxidation technology using airflow. Odour free system and no contact with the waste.
  - Agricultural, Livestock and Agro-industrial Waste. Plants design for agronomic valorization of digestates and energy (biogas).
  - Characterization and treatment of contaminated soils and groundwater.
- Performance of all kinds of environmental site assessment on soil and groundwater contamination.
- Radiological studies
- Engineering and environmental consultancy.

As a complement to these activities, the environmental area supervises the reclamation of former uranium mining facilities in Saelices el Chico and La Habia, the purpose of which is to try to restore the affected natural space to its original state, with environmental and radiological conditions as similar as possible to those existing before the mining operations.

Currently ENUSA has three work centers. Two of them are industrial sites: a fuel assembly factory in Juzbado, and a center in Saélices el Chico (Ciudad Rodrigo). Both of these are in the province of Salamanca. The corporate headquarters are in Madrid. ENUSA also manages a biogas plant in Juzbado and a solid urban waste plant in Cervera del Maestre (Castellón). Since 1985, the Juzbado factory manufactures uranium pellets, assembles fuel elements and develops equipment for the manufacture and inspection of elements for PWR and BWR.

- In 2016, ENUSA supplied a total of 153 tonnes of uranium (TU) at different enrichment levels to the Spanish nuclear power plants Almaraz 1 & 2, Ascó 1, Trillo and Vandellós 2, which is equivalent to 1,378 tonnes of uranium concentrates (U3O8), 1,163 tonnes of natural uranium as U6, and 983 thousand TSU (technical separation units).
- The fuel assembly factory manufactured 291 TU, of which 188 TU – or 65% of the total – were exported to plants in France, Germany and Belgium.
- In all, 603 fuel assemblies were assembled, 513 for Pressurized Water Reactors (PWR) and 90 for Boiling Water Reactors (BWR).

Juzbado Fuel Assembly Factory
Road Salamanca-Ledesma, km 26 37115 Juzbado (Salamanca)

Saelices el Chico Center
Ctra. Ciudad Rodrigo a Lumbrales, km 7 37592 Saelices el Chico (Salamanca)

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Headquarters

Turnover
% from fuel sales that go to R&D projects
Staff number average

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Manufacturing cumulative form 1985 to 2016

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EQUIPMENT GOODS

- Equipos Nucleares, S.A., S.M.E. (Ensa)
- Ringo Válvulas, S.L.

46-49

Equipment goods manufacturing companies export more than 80% of their output.
In 1980, after the creation of the Business Development & Field Services department, Ensa started performing works at the nuclear power plants such as installation, commissioning, fuel management, plant maintenance, decontamination and dismantling. Since 1986, Ensa has a majority ownership of ENWESA, a company mainly dedicated to provide services at nuclear power plants.

Ensa’s headquarters are located in Madrid and its operations center is located in Maliaño (Cantabria). It belongs to SEPI Group, a holding company that owns directly or in majority a total of 15 public companies, holding company that owns directly or in majority of nine other companies, and indirect participation in more than 100 companies.

Known in the nuclear industry as a preferred manufacturer for the high quality of its products and the high technology of its manufacturing processes, Ensa fabrication specializes in components such as reactor vessels including internals, supports and cover heads, steam generators, primary circuit pippings, pressurizers, heat exchangers, fuel elements bundle heads, used fuel casks for storage and transport and fuel racks for both new and used fuel.

Ensa has provided, following recognized international standards and meeting the most demanding quality requirements, equipment operating with the required security in nuclear plants of multiple and varied designs located throughout the world. This has made Ensa a distinguished multisystem capable manufacturer, able to successfully provide the most demanding nuclear components based on continuous research and development of new and competitive manufacturing technologies for each of the different nuclear designs in the market.

Ensa’s headquarters are located in Madrid and its operations center is located in Maliaño. It belongs to SEPI Group, a holding company that owns directly or in majority a total of 15 public companies, holding company that owns directly or in majority of nine other companies, and indirect participation in more than 100 companies.

ENSA’S INTERNATIONALIZATION

With the technology and quality as the main pillars of the company, the successful orientation to the international market started in the late eighties and now accounts for over 90% of the manufacturing equipment and over 50% of the service provided to plants. Ensa is involved in demanding markets such as French, U.S., Belgium, Japan, Chinese, Taiwan, Slovakia, English, etc. Currently, all major equipment portfolio and equipment being manufactured in Ensa have a destination for the international market.

Focusing only on the NSSS (Nuclear Steam Supply System) components, only three of the thirty-seven major components manufactured by Ensa until 1986 were made for the international market, a percentage lower than 10%. However, this situation changed significantly in the late eighties beginning a rapid increase in exports. Twenty-six large equipment were exported between 1988 and 1995. Although the Spanish market demand, a priority for Ensa, restarted in the mid-nineties due to the need of replacement of components in power plants in operation, only three components of a total of eighty-eight have been provided to this market since 1997. This means that the internationalization has represented about 94% of the portfolio of Ensa since 1997.


Another important market line is the dismantling of national and international nuclear power plants. It’s important to highlight the works carried out at José Cabrera (Guadalajara), Kisloduy (Bulgaria) and Trino (Italy) plants.

Throughout its history, the nuclear activity in Ensa has also been reconciled with the manufacture of components for research institutes (CERN, UKAEA, EPRI, Max Plank etc.) and institutions (ITER, NASA, EURATOM) and the manufacture of offshore oil platforms, support services to other firms and the manufacture of pressure components for the chemical and petrochemical industry.

Within the line of Fuel Management, Ensa has also provided transport and storage casks for fresh and used fuel to countries like China, Bulgaria, France and Finland.

Ensa’s competitiveness is based on its highly qualified and competent staff and their culture and passion for improvement, safety, quality, innovation and research and technological development.

The current order includes the supply of equipment and services to countries like France, USA, Finland, Italy, Bulgaria, China, South Korea and Spain.
Ringo Válvulas, S.L. (RV) was founded in 2000 with the aim of manufacturing high performance valves of all types along with operational spares for use in the nuclear industry. Thanks to a team of persons with over 35 years of experience in valve manufacturing for the nuclear industry, RV currently has over 90% market share for the Spanish nuclear power plants, along with numerous contracts to supply to more than 30 plants in more than 15 countries: Spain, Sweden, Finland, Switzerland, Belgium, United Kingdom, Russia, Bulgaria, Slovakia, Slovenia, Rumania, South Africa, China, India, Mexico and Argentina. The company was incorporated into the German group, Samson AG, in 2013, enhancing the future business opportunities, opening up new markets using the extensive commercial network with over 40 sales offices worldwide.

BUSINESS OBJECTIVE

The business objective of RV has, and continues to be, to cover the demand of the Spanish nuclear industry for valves and spares, guaranteeing equipment supply and providing high levels of quality and reliability. RV is equipped with modern facilities adapted to the manufacturing needs of the Spanish nuclear market, and is capable offering a rapid and satisfactory response to its clients’ demands. Thanks to good supply experience and excellent technical references, RV has been able to access the nuclear valve export market, this having increased its backing and commitment to the nuclear sector and leading the company to consolidate a professional team with wide experience on the nuclear market.

The RV plant is a modern facility with the latest technology available for all manufacturing activities. The plant is located in the Empresarium industrial estate in Zaragoza’s most modern and logistically best located industrial zone. The production facility has a production area of 12,000 m² and office space of 2,500 m².

SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE

RV manufactures all types of valves for the nuclear industry, both nuclear and non-nuclear class. Applicable design codes are ASME III, NB, NC and ND, AD-Merkblatter and RCC-M.

Ringo portfolio includes:

- Gate valves: both manual, motor-operated and pneumatic.
- Globe valves for on/off services and regulation.
- Control valves.
- Check valves, including testable and assisted valves.
- Butterfly valves for applications such as containment and control room isolation.
- Diaphragm valves.
- Bellow seal type zero leakage valves.
- Ball valves, including top entry and in-line removable types.

RV also supplies operational spares for maintenance activities during refueling outages. One of the company’s most significant services offered to the NPPs is the performance of special calculations and tests for the qualification of designs, in collaboration with TECNATOM, S.A., and the dedication of conventional valves for use at nuclear power plants.

RV has a Quality system in accordance with ISO 9001:2008 and it is homologated in accordance with the European Pressure Vessels Directive 97/23/CEA for the manufacturing of valves and related spares. On the other hand, RV is a company qualified as ASME III N & NPT stamps holder, that allows RV to supply nuclear valves for the plants in USA as well as certified according to RCC-M, to produce valves according to the French nuclear code.

Besides the main target of assuring the quality of its products, RV is fully committed to the environment, safety and corporate responsibility so, in order to fulfill all these aims, RV has an environmental program certified according to ISO 14001, a safety system qualified to the DSHAS 18001 and a corporate responsibility program certified as per SA8000.

RV has the most advanced design software in both 2D and 3D, allowing calculation in all areas, mechanical, fluid and dynamic noise, ensuring the adequacy of the valves. This is very important, especially in control valve applications for critical services.

ACTIVITIES AND REFERENCES

As in previous years, RV has been very active supporting all the Spanish NPPs in all operational upgrades, maintenance work and safety upgrades, especially those required for Fukushima upgrades: it is important to remark for instance the supply of butterfly and globe valves for the Contention Filtered Vent system of Trillo and Almaraz as well as manufacturing of gate, globe, check and ball valves for the Alternative Emergency Management System (CADE) of Ascó-Vandellós.

As a consequence of the good performance in the Spanish nuclear market, other European utilities have also relied heavily on the expertise of RV for this type of work. Business has been considerably increased in Russia, where RV has been successful in obtaining orders for construction of new WPR plants such as Beloyarskaya, Leningrad, Novovoronzh, Baltic, Kalinin ska, Kolos and Kursk and also for plants exported to third countries like Tianwan NPP in China, Belarus NPP in Belarus or Kozloduy NPP in Bulgaria.

In addition to the strengthening in the nuclear markets where RV has already an install base, RV has been able to penetrate into new areas where it had no presence in the past. A good example of this expansion process is the contract finalized for Hitachi Europe for the supply of valves for the HCU (Hydraulic Control Unit) of the new ABWR of Wylla NPP in United Kingdom.

Finally, after having got the N & NPT stamp qualification according to ASME III in year 2013, RV is actively working in the nuclear market of North America where it has already participated in some conferences about Motor and Pneumatic operated valves in USA and has already met some of the potential customers in that market. Currently RV is already participating in some bids related to valves for plants in USA and Canada. Riope is currently manufacturing N-stamped valves for several projects for the Krsko NPP (Slovenia) and Angra 1 NPP (Brazil).

<table>
<thead>
<tr>
<th>Turnover (average last 5 years)</th>
<th>51 million €</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of sales related to nuclear products</td>
<td>28%</td>
</tr>
<tr>
<td>% of sales related to nuclear products in the Spanish market</td>
<td>10%</td>
</tr>
<tr>
<td>Staff</td>
<td>105 employees</td>
</tr>
<tr>
<td>Graduates and highly qualified technical staff</td>
<td>10%</td>
</tr>
<tr>
<td>Specialised operators</td>
<td>25%</td>
</tr>
<tr>
<td>Administrative personnel</td>
<td>15%</td>
</tr>
</tbody>
</table>

50720 Zaragoza Polígono Industrial Empresarium C/ Romero, 6
Tel.: +34 976 454 940 Fax.: +34 976 454 840
E-mail: ringo@ringospain.com
Web: www.ringospain.com
The Spanish engineering and services companies have and continue to be engaged in nuclear projects across more than 40 countries.
**AMPHOS 21**

Amphos 21 Consulting S.L.
Paseo de la Castellana, 40, 8º
28046 Madrid
Tel.: +34 620 634 729

Amphos 21 is a group offering an environmental consulting scientific, technical and strategic consulting services in 5 main activity areas:

- Nuclear
- Mining
- Water
- Sustainability
- Oil and Gas

We develop nuclear activities since our inception in 1976. Our team is recognised at an international level in radioactive waste management. From our headquarters, we work for clients in the entire world, mainly for agencies implementers and regulators of radioactive waste issues, the European Commission, as well as for private clients needing assessment on issues related with the uranium cycle, such as legacy wastes and soils affected by the presence of radioactive materials.

Our activities are organized around three main axis:
- Consulting
- R+D+i and
- Advanced modelling solutions

Which we apply to provide the best solutions to the following issues:
- High, Intermediate and Low level radioactive wastes.
- Radioactive waste repository performance assessment and siting.
- Environmental and radiological impact of radioactive waste storage and disposal facilities.
- Water, sites and soils affected by the presence of radioactivity.

Our distinctive trends as organization are based on:
- A highly qualified team, used to face complex technical and scientific challenges to help our clients find the best solutions.
- Highly skilled in-house conceptual and numerical capabilities.
- Innovative solutions, which we present in international conferences and publish in international scientific and technical journals.
- Our imbrication with Universities and Research Institutions Worldwide, which puts us in a unique position to find and develop the best solutions for every case. There is a constant pool of Ph.D students and engineers advised by our senior staff.
- Our international character. Most of our activities in Nuclear are developed outside the Spanish borders (a 95% in 2016).

CERTIFICATIONS:
- Amphos 21 is certified according on international standards ISO9001 and ISO14001 and European Regulation EMAS.
- Amphos 21 is a company certified by the French Ministry of Education and Research (MENESR) as R+D developer (CIR).
- Amphos 21 is the 1st COMSOL certified consulting in geosciences.

DEVELOPMENTS 2016

In 2016, we have developed projects in the nuclear sector for clients in Sweden, France, Finland, Belgium, Spain, Germany, United Kingdom and Japan. We have long-term relationships with our clients, what provides us with a deep understanding of their strategy so that we can accompany them in important decision taking processes.

Some especially relevant project examples of last year 2016 are summarised below. They are selected because of both, innovation and relevance for our clients.

Development for a French client of a tool to support decision-taking process on waste management of special type of wastes presenting low and very low activity. This tool considers parameters such as activity and chemotoxicity, chemical behaviour of the wastes, waste volume, physical state, different treatment for stabilisation and conditioning, type of facility for waste disposal, and very importantly, considers the associated costs of the treatment and management of the wastes. The tool is tailored to the French regulation in terms of toxic and radioactive wastes. The name of the client cannot be disclosed.

Along 2016, we have also developed numerical simulation tools to model hydro-chemo-mechanical coupled processes. These tools have been applied to make quantitative predictions of the expected durability of cement and concrete barriers used in the low and intermediate waste repositories in Sweden and in Japan. The results obtained have fed the probabilistic models of the long-term safety assessment of these waste disposal facilities. Clients: SKB (Sweden) and NUMO (Japan).

2016 was especially relevant for the advance of a research project developed for the Belgian waste management agency (ONDRAF). The project tackles the problem of the degradation of the superplasticisers used to increase the workability of concrete. These additives are organic compounds that may suffer degradation under the temperature and radiation conditions developed in the repositories, and may then increase the leachability of active elements through chemical interaction with them. This would represent an increase in the calculated long-term doses. Our research has provided important hints on the fact that the dosages of the superplasticisers usually applied in the preparation of these concretes are not very likely to produce radionuclide remobilisation, thus no expected increase in leachability, even after irradiation of the material with the aim of increasing its degradation. The project will continue over 2017, to ascertain to which extent degradation of these materials may still constitute an issue to contemplate in safety assessments.

2017 presents important challenges for us. We may mention, among others, the organisation of the international Migration 2017 conference (www.migration2017.org). This is a conference of reference for the presentation of scientific advances related with the migration of actinides and fission products in the media. It usually counts with a large audience of participants from over the world. This edition (2017) is a milestone of 30 years of this conference series, and it is the first time that it is organised by a private company. We are extremely proud of having been honoured with the organisation, as it is a clear recognition of the scientific and technical excellence of our team and our work. We are confident that the conference will be a success and invite all those interested to come to Barcelona in September 2017 and discuss on such important issues for future generations and the sustainability of nuclear energy, as is the development of knowledge on the behaviour of high, intermediate, low and very low radioactive wastes. The conference will start with a panel discussion on the role of research in radioactive waste management and will count with expert panelists from ONDRAF (Belgium), ENRESA (Spain), SKB (Sweden), ANDRA (France) y RWMM (United Kingdom).

**ENGINEERING AND SERVICES**

<table>
<thead>
<tr>
<th>Founded in</th>
<th>1976</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual turnover</td>
<td>8 million €</td>
</tr>
<tr>
<td>% of international activity</td>
<td>50% global, 75% nuclear</td>
</tr>
<tr>
<td>% of offices in 4 countries</td>
<td>Spain (1994); Chile (2001); Peru and France (2012)</td>
</tr>
<tr>
<td>Total staff</td>
<td>100 employees</td>
</tr>
<tr>
<td>% unionised degree</td>
<td>95%</td>
</tr>
<tr>
<td>% PhD in science or engineering</td>
<td>30%</td>
</tr>
</tbody>
</table>
BUSINESS OBJECTIVE

CEN Solutions develops its activity in the Energy, Oil & Gas, Industry and Transport sectors, in which it provides solutions in the field of equipment manufacturing and expert maintenance.

In 2016, CEN Solutions undertakes the purchase of the Abengoa Production Center in Seville, with the subrogation of all its personnel and purchase of the designs, references and certifications.

The manufacture of safety equipment is a key activity within the strategic development of the company, with capacity for the supply of control panels and consoles, auxiliary panels for reactor protection systems, sampling equipment, power centers and distribution switchboards, motor control centers, medium voltage switchgear, isolated phase bus ducts, dry transformers, and power electronics.

The design and manufacture of the equipment is carried out at the company’s premises in the free zone of Seville, with a total area of 60,000 m².

SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE

To ensure good performance in terms of quality, environment and safety, CEN Solutions has management systems in accordance with the requirements of ISO 9001, ISO 14001, PECAL 2120, NQA-1: 1994, 10CRF50 Appendix B, UNE 73401: 1995, ANSI Standards and ASME Codes, which are periodically audited allowing the homologation and accreditation as a supplier of Nuclear Safety equipment (Class 1E) at national and international level.

The use of the most advanced manufacturing processes and technology, including qualification tests in accordance with the applicable regulations in each case (IEC, IEEE, NEMA, UDE, KTA, MIL, etc.) and the subjection of manufactured products to the strictest requirements of control and quality assurance, allow us to offer the most appropriate equipment and assemblies that, in compliance with current standards, satisfy the needs of the customer.

We also have our own capacities for commercial dedication of electrical components, performed for the components of the products we manufacture or spare parts required by the different NPPs.

CEN Solutions maintains a highly specialized technical team and the homologations necessary for the sector, which have allowed it to continue offering uninterrupted global solutions for the supply of safety and commercial equipment from the beginning of the industry.

This continuous contact with the most specialized companies in the nuclear field, makes CEN Solutions aware of the new technological advances and can be present in the nuclear power plants in Spain and abroad.

NATIONAL AND INTERNATIONAL OUTSTANDING ACTIVITIES

Among the most recent references for the nuclear sector are the following work and supplies:

NATIONAL NUCLEAR POWER PLANTS

- Supply of spare parts (CCM and SD carts, relays, cable, thermocouples, contactors, earth clamps, etc.) (Trillo NPP, Ascó NPP and Vandellós II NPP).
- Supply of 6.3 kV switchgear, transformation centers and MCC, train A, B and N for EJ project (Vandellós II NPP).
- Provision of labor for main sites and control room works (Almaraz NPP).
- Supply of power centers and MCC for power increase (Almaraz NPP).
- Design, manufacture and assembly of modular electric room for TC cooling towers system (Almaraz NPP).
- Design, manufacture and assembly of modular electric room for water treatment (Almaraz NPP).

INTERNATIONAL NUCLEAR POWER PLANTS

ABWR by GE Hitachi

- Main Control Room Panels and Remote Shutdown Panels (Simulator, units 1 and 2).
- FMCRD relay logic panels and self-firing solenoid fuse panels (units 1 and 2).
- HCU self-test panels (units 1 and 2).
- Systems of sampling and analysis of liquids of secondary systems.
- Meteorological control panels.
- NUMAC panels: NMS panels, optical fiber panels, ATIP & MRBM panels, PRM panels, RTIP panels (units 1 and 2).
- Provision of labor for review in plant and control room.

China Nuclear Power Engineering & China Techenergy Co. LTD.

- Main Control Room Panels and Remote Shutdown Panels for Fuqing NPP (Simulator, units 1 and 2).
- Main Control Room Panels and Remote Shutdown Panels for Fangjiashan NPP (Simulator, units 1 and 2).
- Main Control Room Panels and Remote Shutdown Panels for Hainan NPP (Simulator, units 1 and 2).
- Provision of labor for supervision and mod f cations in the Fuqing and Fangjiashan NPPs.
- Instrumentation for the main control rooms for Hongsan NPP 5 & 6.

Nuclear Fusion Technology

- Support activities for the design and manufacturing processes of the Safety Control System - Nuclear (SCS-N).

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The Technological Centre of Components is a private foundation which is recognized as a Technology Center by the Ministry of Economy and Competitiveness.

Its main objective is to bring value to companies through research, development and innovation projects, contributing to the enhancement of their competitiveness and sustainability, and becoming their technology partner, by being the meeting point between their needs and research activities.

Within the various fields of knowledge, the CTC is positioned in Experimental Sciences and Engineering, driving their activity of R&D&I to the following technology solutions:

- Advanced engineering.
- Advanced materials and nanomaterials.
- Predictive maintenance.
- Robotic systems and unmanned vehicles.
- Navigation systems.
- Intelligent offshore structures.
- Industry 4.0.


The CTC was recognized in 2004, by the Interministerial Commission for Science and Technology (CICYT), as “Research Results Transfer Office” (GTR), Registration No.193.

The Technological Centre of Components has cooperation agreements with various institutions and companies. The purpose of these agreements is to establish the basis for joint and coordinated development of R&D&I in different fields of activity and thereby promote the culture of innovation and the enhancement of the technological collaboration.

CTC is active partner of various platforms and associations. Among these associations’ highlights:

- Clúster de la Industria Nuclear de Cantabria. The objectives of the cluster are to strengthen the field of nuclear energy in Cantabria and act as a reference for all players in the sector and thus represent the same interests as partners in the nuclear industry to the government or other decision-making bodies; to increase competitiveness and business opportunities of the companies or entities in the field of nuclear industry market, combining synergies that allow access to major projects both national and international.
- CEIDEN. It was formed in 2007 and its aim is to coordinate the different national plans and programs of innovation in the field of nuclear fission technology, as well as participate in international programs, ensuring consistently guide the efforts of the entities involved.

SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE

CTC specializes in structural integrity analysis of last generation nuclear reactors under ASME design codes and design of components and tools for nuclear power stations according to ASME, RCC-M, Eurocode and FEM. Analyses consist of material resistance calculations and heat transfer calculations which require engineering expertise and strict compliance with the codes. Analyses have allowed the detailed design and the manufacturing on components for generation III+ and IV reactors and spare components for generation II reactors.

CTC performs the design of manipulation and test tools. The design consists of analysis, manufacturing drawings and specifications.

The specialization lines and technologies are:

- Simulation of welding processes.
- Decontamination of water by graphene.
- Thermal and structural simulations (ANSYS).
- Thermo-hydraulic analysis of pipes of a BWR reactor.
- Mechanical and structural design.

Ongoing projects:

- Analysis of pressure vessels and test procedures for joint and coordinated development of R&D&I under ASME design codes (ANSYS).
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- Collaborative research projects:
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To achieve the growth that they have reached, they have based their work on three key principles:

- Offering quality and good service in every work we do.
- Counting on a professional and highly trained human team capable of offering quick solutions to any possible problems that may appear on the development of each project.
- Adapting to the new technologies that appear on the market, integrating them on the equipments supplied to our customers.

**BUSINESS OBJECTIVE**

Since our very beginning Coapsa has had the ability to carry out the design, assembly, installation and start-up, in addition to the compliance with all the applicable quality assurance requirements as regards the control and automation of industrial processes and systems.

From the very beginning, the orientation within the sector has traditionally been towards control systems for lifting and handling equipment of heavy and special loads, among others, high precision heavy duty gantry cranes: polar and turbine cranes... and for nuclear fuel handling systems: refueling machines, manipulators, gantry cranes for the handling of spent fuel casks, etc.

At present we have experience in the qualification of the Single Fault Criterion applied to gantry cranes (Nureg-0554 and Nureg-0612) and in the design, manufacturing and assembly of equipment with environmental seismic qualification 1E.

In addition, we have consolidated experience on the port and harbor machinery markets, for the handling of containers and merchandise, as well as on the equipment for other industrial processes in general: MDD’s Low Voltage Distribution Centers, control systems and monitoring of industrial processes, remote control systems for the handling of devices on underground rail networks, etc.

Coapsa’s objective is to extend and improve the services we offer on our consolidated market, for which we are improving and extending all our human and material resources in order to bring them into line at all times with the quality and service required by the type of work we perform.

**SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE**

**ENGINEERING**

We offer a complete integrated service adjusted to the client needs, supported by our highly qualified personnel and our experience.

- Wide experience in the design of conceptual, basic and in detail engineering.
- The use of the principal technologies makes us to be able to give the best solution and assure the total integration of our client’s facilities.
- Economical and technical viability studies.
- Planning and monitoring.
- Comprehensive automation projects of industrial processes.
- Automation and improvement of existing processes.
- Migration of control systems, PLC’s and industrial communication from the main manufacturers.
- SCADA systems programming including prescriptions, reports, control charts, etc.
- Electronic design using the most avant-grade tools from the market (E-plan, Autocad, etc.).

**MANUFACTURING**

We are manufacturers of electrical equipment, low voltage distribution equipment, regulation equipment, Motor Control Centers, etc. applying the latest technologies existing on the market.

- Distribution and Power equipment.
- Automation and Control equipment.
- Motor Control Center with fixed and removable execution.
- Intelligent Motor Control Center. We offer solutions to any kind of industrial installation, adapting to any requirement of the sector and client.
- Supervision and Control Systems (SCADA) and Distributed Control Systems (DCS).
- Desks, consoles and conventional control ergo seat and by radio-control.
- Supply and installation of weighing systems for cranes.
- HVAC systems.

**SERVICES ON PLANT**

Our highly qualified technical team offers corrective maintenance service, preventive maintenance, repairs, start-up in the client facilities, adapting us to the client’s needs and requirements.

We offer our clients all kind of services in plant:

- Supervision of the assembly in plant.
- Execution of SAT tests and put into service.
- Preventive, predictive and corrective maintenance works in equipments.
- Diagnosis and solution to breakdowns.
- Modification on existing equipments.
- Modernization of equipments (Retooling).
- Training for the maintenance personnel.
- Post sales service.

**ACTIVITIES AND REFERENCES**

Coapsa has become an essential reference in the nuclear field, that is why most of Spain’s power plants and their service companies trust Coapsa as a provider of goods and services.

**Works on nuclear field**

- Trillo NPP: Completely remodelling the 404TN gantry crane in the turbine hall and undertaking a series of improvements to the polar crane. There is constant support work throughout the year, especially during recharge times.
- José Cabrera NPP: Complete reformation of the Omegas gantry crane in the containment building in order to meet the requirements established for the handling of the spent fuel casks.
- Vandellós NPP: Manufacturing of the local command cabinets for the new essential services water cold source. Continuous maintenance and enhancement work on the plant gantry and fuel handling cranes at the plant.
- Ascó NPP: Installation of two new 115TN carriages and integral reformation of the bridge cranes at the fuel buildings in order to reach compliance to the Nureg-0554 regulation for spent fuel cask handling.

Installation of a radio control system for polar crane handling. Continuous maintenance and support work.

- Almaraz NPP: Collaboration in changing equipment on the refuelling machines, fuel transfer channels and polar cranes in both groups.
- Cofrentes NPP: Adaptation of the 15TN gantry crane in the fuel building to the Single Fault criterion.
EFECTIS is a fire science company and covers all fire safety expertise in testing, modeling and risk analysis, certification and inspection around the world. To always offer safer life environments, the EFECTIS teams expand their skills to other safety domains such as structures integrity, pathologies assessments of materials, components and systems, life prediction and durability for new and ancient buildings, monuments and infrastructures.

NUCLEAR CONTEXT

After a low in the 1990s, recent years have seen the worldwide nuclear industry regain momentum and experience important growth. However, the accident at Fukushima damaged public opinion of nuclear energy. For all countries that produce or use nuclear energy, it prompted a review of safety policy, particularly risk management frameworks, and created new rules or regulations. Countries have reinforced their regulatory bodies, and new international nuclear organizations have been created.

WHY WORKING WITH EFECTIS?

EFECTIS is a reference expert in the nuclear field, regarding fire testing, fire safety engineering, and fire behaviour of construction products. EFECTIS France has more than 20 years experience in the nuclear field, and has worked extensively on fire safety in nuclear plants, becoming a major partner of nuclear operators for all fire safety related issues.

OUR SERVICES

In the nuclear field, EFECTIS includes the activities of accredited fire laboratory and fire safety engineering:
- Qualification of fire products (doors, penetration seals, dampers, etc.) according to the combination of actions (water tightness, airtightness, earthquake, displacements, fire resistance, durability, interoperability of fire protection products for maintenance).
- Establishment of performance diagram of fire products, according to the EPRESSI method, which is today accepted by the Nuclear Authority and applied in EPR NPP. Its aim is to cover the fire resistance performance of products under real fire conditions in order to justify its effectiveness in relation to the degree of fire risk in NPP.
- On-site diagnoses to attest the fire resistance performance of fire protection systems and products.
- Maintenance of products (assessment of aging conditions, fire resistance degree and determination of action plan to maintain the fire resistance performance).
- Fire risk analysis and fire modelling studies (assessment of nuclear safety degree in case of fire and appropriate fire protection solutions).
- Fire behaviour and stability studies of structural elements of nuclear facilities based on: - Standard ISO-fire curve analysis - Fire design curve analysis - Fire safety design of nuclear facilities and assistance to design of fire protection systems (active and passive).
- Training of nuclear fire safety standards (NFPA, AFCEN, etc.).

OUTSTANDING ACTIVITIES - INTERNATIONAL

THE SAFETY CONFINEMENT ARCH OF CHERNOBYL NPP

The project consists in the construction of a steel arch covering the Chernobyl NPP unit 4 to contain the radioactive elements and to protect against weather aggression during the dismantling of the unit.

EFECTIS carried out a fire engineering study on the steel arch structure of the NSC Arch in case of a real fire, that is a fire of the bituminous part of the roof over the existing building (Turbine Hall and De-aerator Stack). This mission involved the fire engineering services of Efected France (modelling - numerical approach) as well as the laboratory (fire tests – experimental approach).

A benchmark between EFECTIS France and the IETP (Institute of Engineering Thermo Physics of the National Academy of Science of Ukraine) was organized to perform a comparative analysis of the fire development and thermal calculation methodologies and software: results and conclusions were very similar. The same approach was performed with success for mechanical calculations with the Ukrainian institute URDISC.

Through different steps of validation by the Ukrainian authorities, EFECTIS was able to prove its scientific capabilities and know-how in a specific and complex context.

CIGEO PROJECT

EFECTIS is involved since 2012 in the Cigéo project: deep geological disposal of spent fuel and high-level (HL) and intermediate level long-lived (IL-LL) waste. Fire safety is indeed a major challenge for Cigéo, both in terms of nuclear safety and safety of personnel and firemen, in operational areas as well as in areas under construction.

The contribution of EFECTIS in this project mobilizes a wide range of skills such as fire risk analysis, smoke extraction and ventilation in case of fire, fire development modelling, fire behaviour of structures and performances of fire safety equipment, but also including the fire behaviour in tunnel, mines, nuclear installation. Efected was also selected to perform the first fire resistance test of the concrete protective packaging of radioactive waste in order to justify the fire resistance efficiency in case of fire.

Companies dedicated to fire science including

- Emergency management
- Fire safety
- Fire tests
- Safety engineering

Employees in 14 sites, including 4 laboratories

For more than 33 years

Recognised as an official testing institute

Tests carried out in 2016 (reaction to fire and fire resistance tests)

Over 2,500

Turnover [2016]

€ Over 20 million

Accreditations

More than 800

Building reactor vulnerability study: fire scenario models to determine the thermal stress (temperature and heat flux) on 250 strategic targets inside the reactor building.

EFECTIS GROUP

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Espace Technologique – BSI Apollo
Route de l’Orme des Merisiers
91193 Saint Aubin, France
Web: www.efectis.com

Office in Spain:
Apto. Postal 200301
28080 Madrid, España

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EFECTIS has participated in the project through:
- Qualification of all fire products
- Fire & waterproof-seismic tests to assess the fire resistance of penetration seal systems after seismic loading. A testing program is to make comparative analysis and to determine the influence of seismic loading on fire resistance.

More than 1000 on-site diagnosis per year.

More recently, we have performed 20 on-site assessments of special configurations for EPR NPP construction, in order to attest the fire resistance performance to the Nuclear Safety Authority.

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Empresarios Agrupados (EA) is a leading international engineering and construction management company with headquarters in Madrid (Spain). Founded in 1971, EA has a permanent multidisciplinary staff of over 1,000 persons, 75% of whom are university graduates.

EA’s main focus as an engineering company is to provide the full range of engineering services for nuclear, conventional and renewable energy power plant projects.

In the Nuclear field, EA areas of activity are:
- New build nuclear power plant projects.
- Engineering support services to nuclear plants in operation.
- Decommissioning and radioactive waste management projects, including design of low and intermediate level waste and spent fuel storage facilities.
- Research reactors and GEN IV projects.
- Fusion technology (ITER project).

EA has carried out the engineering for electric power generating plants with a combined installed power of more than 50,000 MW, with projects in Spain and in over 40 other countries. EA is ranked among the Top 225 International Design Firms by the US magazine “Engineering News Record” (ENR).

EA is an independent engineering company, with quality services recognised by the market. Our clients include electric utilities, IPPs, reactor vendors, government agencies, EP-C contractors, main equipment suppliers and numerous international organisations such as INEA, EBRD, European Commission, ITER Organization, F4E, etc.


OUTSTANDING ACTIVITIES-NATIONAL

The main references and experience developed in Spain in the nuclear field are summarized below:

- Power Up-rating Engineering for Almaraz NPP (Units 1 and 2, PWR, Westinghouse, 2 x 1000 MW).
- Engineering for the replacement of the Pressure and Criteria Computers of Trillo NPP (PWR, AREVA, 1664 MW).
- Engineering services for the temporary spent fuel storage facilities (ATI) at plant site for the Trillos NPP (PWR, AREVA, 1664 MW) and Ascó 1 & 2 NPPs (PWR, Westinghouse, 2 x 1000 MW).
- Probabilistic Safety Analysis (PSA) for majority of the Spanish nuclear power plants.
- Collaboration with the Spanish Nuclear Safety Council (CSN) in the optimization of fire modeling methodologies in NPPs.

OUTSTANDING ACTIVITIES-INTERNATIONAL

New Build Nuclear Power Plant Projects:

- Over the year EA has taken part in a number of international projects aimed at developing and implementing Generation III and III+ of advanced nuclear reactors. This includes an active participation in projects using different technologies such as Westinghouse PWRs (SPWR, AP-600, EPR and AP-1000), GE-Hitachi BWRs (ABWR, SBWR and ESBWR), Areva PWRs (EPR), Rosatom VVERs (VVER-440, VVER-1000, VVER-1200), Mitsubishi PWRs (AP600), Korean PWRs (AP1000), etc.
- EA has been providing consulting and Owner Engineering services for plant preconstruction activities, preliminary engineering design of new NPPs.
- Engineering and design of the Centralized Intermediate Storage Facility (“Almacen Temporal Centralizado”, ATC) for the spent fuel produced at all the nuclear plants operating in Spain (Client: ENRESA).
- Engineering for the replacement of the Pressure and Criteria Computers of Trillo NPP (PWR, AREVA, 1664 MW).
- Engineering services for the temporary spent fuel storage facilities (ATI) at plant site for the Trillos NPP (PWR, AREVA, 1664 MW) and Ascó 1 & 2 NPPs (PWR, Westinghouse, 2 x 1000 MW).
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- Also as a Subcontractor to GE-Hitachi, EA has provided engineering support services for the design development and Design Certification by the US NRC of the ESBWR.
- For the Mochovice Units 3 & 4 NPP (VVER, 2 x 440 MW), under construction in Slovakia (Client: SE/ELNE), EA has carried out the high energy pipe break analysis and protection against the consequences of pipe break in the Nuclear Island of both Units.
- Consultancy services to support the Jordanian Energy and Minerals Regulatory Commission (ERMC) in the evaluation of the Site Permit Application for the 1st NPP in Jordan.
- Engineering Support to Plants in Operation:
- Design and engineering for the Upgrade of the Emergency Power Supply at Burkered Building 1 (BB1) in Kritia NPP (370MW), Westinghouse, PWR, in Slovakia.
- Buildings and Civil Structures Monitoring Plan and Methodology for VVER NPPs in Ukraine (EU Project).

Over the last 25 years, EA has been providing engineering and consultancy services for the implementation of plant upgrades and the safety improvement of Russian design WER-440 and WER-1000 plants in Russia, Ukraine, Czech Republic, Slovakia and Armenia.

Research and GEN IV Reactor Projects:
- EA forms part of a Consortium with AREVA-IA and Ansaldo Nucleare that is performing the Front End Engineering and Design (FEED) for the Myrrha research reactor complex at SCK CEN in Belgium (Client: SCK-CEN), an experimental accelerator driven reactor system.
- JHR (Julius Horowitz Reactor) experimental reactor, for materials research: design of the primary circuit heat exchangers.
- PBMR ( Pebble Bed Modular Reactor) high temperature gas reactor project in South Africa: complete structural/mechanical engineering and design of the primary pressure boundary system and components.

Decommissioning and Waste Management Projects:
- Project management services for the decommissioning of Kozloduy Units 1 to 4 NPP (WER 440) and for the construction of the National Disposal Facility for Low and Intermediate Radioactive Waste in Bulgaria (EBRD funding, Client: SERAW).
- Project management services for the decommissioning of the WER 440 Bohumin NPP Units 1 and 2 in Slovakia (Client: JAYWS and EBRD funding).
- Radioactive Waste Management Project at the Vektor Industrial Complex in Chernobyl (Ukraine) – EU Project.

Nuclear Fusion Technology Projects:
- 20 years involvement in Fusion technology (ITER, IFMIF, DEMO, etc).
- Architect-Engineer and Construction Management for all buildings and auxiliary systems of ITER Project (as part of Engage consortium) (Client: F4E).
- Nuclear Safety Control (SCS-N) System for ITER IOD: design, manufacture, qualification and installation (in consortium with Inabensa).
- ITER Project Final Design of the Connection Pipes for the Tokamak Blanket System (TBS) (Client: IO).
- ITER Project, Thermo-Hydraulic Analyses for Process and System Engineering of the TCWS (Client: IO).

COUNTRIES IN WHICH THERE IS NUCLEAR ACTIVITY

EA has carried out nuclear projects in: Spain, United States, Belgium, Bulgaria, Czech Republic, Canada, Slovakia, Italy, Turkey, Finland, France, United Kingdom, Russia, Japan, Mexico, Argentina, Brazil, Taiwan and Jordan.
ENWESA OPERACIONES, S.A.

ENWESA is a global supplier of maintenance, manufacturing and construction services to the power generation industry.

The company’s core business is Nuclear Services, with ample experience in PWR and BWR technologies and a high degree of specialization in the maintenance tasks throughout the operation cycle and during refueling outages as well.

Committed to a high added-value portfolio of activities with a significant technological content that cover all stages of the plant life, from construction to decommissioning.

SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE

ENWESA’s scope of activity is very diverse, thus suitable for a turnkey approach to many projects. The company occasionally collaborates with other, either shareholders (ENSA, WTS), other state owned entities (ENUSA), or partners from the industry. The main product lines are:

- Maintenance services of nuclear power plants: reactor, fuel, steam generators, reactor coolant pumps.
- Valve maintenance.
- Mechanical maintenance of turbines, pumps and motors.
- Electrical maintenance (including HVAC systems).
- Automation & controls, industrial robotics.
- Mechanical construction (gas and steam turbines, heat exchangers, condensers, pumps, motors, auxiliary equipment, ducts and piping).
- Manufacturing of mechanical components.

OUTSTANDING ACTIVITIES - NATIONAL

The Spanish PWR industry (Almaraz, Ascó, Trillo and Vandellós III) is ENWESA’s main business area, with scopes that cover most of the following activities:

- Maintenance of nuclear power plants: reactor, fuel, steam generators, reactor coolant pumps.
- Valve maintenance.
- Mechanical maintenance of turbines, pumps and motors.
- Electrical maintenance (including HVAC systems).
- Automation & controls, industrial robotics.
- Mechanical construction (gas and steam turbines, heat exchangers, condensers, pumps, motors, auxiliary equipment, ducts and piping).
- Manufacturing of mechanical components.

OUTSTANDING ACTIVITIES - INTERNATIONAL

ENWESA has grown into other countries, mainly in Europe, and specifically in France. Recent international activities are:

- Maintenance at Plana del Vent CCGT in Tarragona.
- Manufacturing and assembly projects for the shipbuilding industry.
- Process automation and robotics at Nissan and Renault manufacturing facilities.

COUNTRIES IN WHICH THERE IS NUCLEAR ACTIVITY

The main international business area for ENWESA is France, with a branch office in Manosque. Current nuclear activity in that country is focused in several EDF PWR plants and at ITER.

ENWESA also works in Finland (Olkiluoto), Belgium (Doel) and Brasil (Angra).
GAS NATURAL FENOSA Engineering, S.L.U.

Gas Natural Fenosa Engineering, S.L.U. (previously named SOCONI; Soluziona; UFISA) is the energy engineering company of the GAS NATURAL FENOSA Group (GNF), in the areas of nuclear generation, solar and biomass generation, transmission and distribution of electricity and gas, and energy efficiency and environment.

GNFE started operations in 1989 as the engineering subsidiary of the Unión Fenosa (previously named SOCOIN; Soluziona; UFISA) is the energy engineering company (previously named SOCOIN; Soluziona; UFISA) is the energy engineering company, specializing in the energy sector. Our main asset is our extensive experience gained from providing Gas Natural Fenosa and overseas, we harness the experience of the Union Fenosa Engineering company (now Gas Natural Fenosa), engineering subsidiary of the Unión Fenosa (previously named SOCOIN; Soluziona; UFISA) is the energy engineering company.

Our customer portfolio includes leading power companies in their markets as well as the Ministries of Energy, Water and Mining of a large number of countries and most of the International Financial Institutions (World Bank, Inter American Development Bank, etc.).

GNFE is currently expanding rapidly at an international level. Our main office is in Spain, and we have subsidiaries in Mexico, Panama, Puerto Rico, Colombia and Brazil. In recent years we have also worked on projects in France, Italy, Ireland, Czech Republic, Serbia, Ukraine, Bulgaria, Romania, Slovakia, Bolivia, Chile, Ecuador, Peru, Paraguay, Uruguay, Venezuela, Guatemala, Nicaragua, Costa Rica, Cuba, El Salvador, Honduras, Puerto Rico, Dominican Republic, Morocco, Algeria, Egypt, Ethiopia, Equatorial Guinea, Kenya, South Africa, Turkey, Syria, Jordan, Iran, Iraq, Kazakhstan, Uzbekistan, Pakistan, Kuwait, Qatar, Filipinas, Australia and Indonesia.

Our most outstanding clients and projects in the nuclear field in Spain are:

- **UNION FENOSA GENERACION**
  - Nuclear Generation Technologies.

- **ENRESA**
  - Decommissioning of José Cabrera NPP: Basic and Detailed Engineering, Project Management.

- **CSN**
  - Support to RP and calculation of shielding.
  - OCDE - FIRE project.

- **UNESA**
  - Support in sector groups (Waste, ENDI).

- **CSN - UNESA - ENUSA - ENRESA**
  - Research Project; Elaboration of Waste and Spent Fuel Management.

- **BOHUNICE NPP (Slovakia)**
  - Decommissioning projects.

- **KOZLODUY NPP (Bulgaria)**
  - Mobile unit for the radiological control of personnel in controlled zone.

- **PETTEN HFR (Netherlands)**
  - Decommissioning Plan and cost estimation of High Flux Reactor at Petten.

- **CEA**
  - Simulation project for the Jules Horowitz experimental reactor.

- **FUSION FOR ENERGY (F4E)**
  - Technical assistance framework project.

- **EPRI**
  - ZIRP PROJECT - extraction of the reactor internals to study its behaviour after plant operation, currently being decommissioned.

- **ZIRP PROJECT**
  - Decommissioning projects.

- **SOUTH UKRAINE NPP (Ukraine)**
  - Spent fuel storage support engineering.

- **RUSSIAN NPP (Russia)**
  - Decommissioning projects.

- **ZIRK NPP (Czech Republic)**
  - Decommissioning projects.

- **SOUTH UKRAINE NPP (Ukraine)**
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GD Energy Services (GDES) is a Spanish-based business group with over 80 years of experience providing industrial services for a wide range of customer profiles: industrial maintenance, surface treatment, decommissioning of nuclear installations, logistics, power grid maintenance, renewable energy, and emergency services.

Our broad diversification makes our group one of the most predominant and visible in the energy sector, giving the company a strong market presence. GDES currently employs a staff of over 2,300 professionals actively working in 9 countries. An eminently qualified team, fully oriented toward our customers, providing high added-value solutions adapted to the specific requirements of each project.

BUSINESS OBJECTIVE
In recent years, the new challenges of an increasingly globalized industry and the high-growth strategy of the company have acted to greatly increase its international presence in global markets, with overseas business making up an increasingly important part of GDES’ business activity and revenue. Currently, the Group is active in Spain, France, the United Kingdom, Italy, Mexico, Panama, Brazil, and the United States, with projects in those and other potential markets gaining in importance.

SERVICES

INDUSTRIAL MAINTENANCE
• Decontamination and industrial and nuclear maintenance.
• Support for refueling services.
• Decommissioning of nuclear facilities.
• Radiological emergencies.
• Radiation protection.
• Passive protection.
• Reflective insulation.
• Sealing of leakage.
• Assembly of access points and scaffolding.

• Industrial cleaning.
• Preoperational tests.
• Sludge and effluent treatment.
• Chemical cleanup.
• Critical component lifecycle management.

SURFACE TREATMENT
• Application of special coatings.
• Metallization.
• Passive protection.
• Structural reinforcement and repair of concrete.
• Surface preparation.
• Application of industrial paints.
• Surface treatment with abrasive sponges.
• Resin and mortar pavements.

LOGISTICS

Warehouse Management
• Reception and forwarding.
• Loading docks.
• Picking, labeling, handling.
• Internal transport.

Integrated “In-House” Logistics Management
• Handling of internal flows.
• Provisioning.
• Internal distribution.
• Manual finishing and packaging.
• Packing.
• Equipment optimization.

RENEWABLES

Wind
• Maintenance (preventive and corrective) in factory and field.
• Retrofitting.
• Technical assessment.
• Periodic inspection (thermography and ultrasound).
• Technical consultancy.
• Rotor balancing and vibration dampening.
• Lifecycle management.

Thermosolar
• CCP mirror cleaning.
• HTF oil treatment.
• Consulting.

MAINTENANCE OF POWER GRIDS
• Construction and maintenance of high-voltage electrical substations.
• Construction and maintenance of high, medium and low-voltage electrical lines.
• Jobs involving voltages up to 66 kV.
• Servicing orders and measuring equipment.

EMERGENCY RESPONSE
• Professional fire brigades.
• Training of fire and emergency personnel.
• Maintenance of fire suppression systems.
• Consulting.
• Emergency response plans and self-protection manuals.
• Patient transportation (urgent or scheduled).

ENGINEERING
• Development of equipment and systems.
• Process design.
• Support structure and scaffolding estimates.
• Software and hardware for critical component material fatigue.

DECOMMISSIONING
• Andujar Uranium Factory (FUAI).
• Ciemat facilities (PIMIC).
• Vandellós I Nuclear Power Plant.
• Arbi Experimental Reactor.
• Jose Cabrera Nuclear Power Plant.
• Galileo Galilei Reactor (CISAM Pisa, Italy).
• Trino Nuclear Power Plant (Italy).
• Dounreay, Winfrith and Springfields NPPs (UK).

Support for Radiological Protection at the JRC in Ispra (Italy).

Chemical Cleaning: Secondary side of Steam Generators for EDF in Dampierre 1 and Dampierre 2 NPPs (France).

Treatment of effluents from chemical cleaning of Dampierre 1 (France).

Application of special coating (EXTRADOS) in Cattenom 3 and Falmanville 2 NPPs (France).

Cross Under Metalization for the Laguna Verde NPP (Mexico).

Revenues (FY 2016 consolidated)

94 million

Workforce

2,300 staff and employees

Support for Radiological Protection at the JRC in Ispra (Italy).
GEOTECNIA Y CIMENTOS, S.A.

GEOCISA is a highly skilled company with expertise across a range of technical projects: Geology and Geotechnics, Instrumentation and Monitoring, Soil Investigation and Ground Treatments, Deep Foundations, Laboratories, Infrastructure Management and Highway Maintenance, Restoration and Rehabilitation of Monuments, Bridges and Singular Buildings and Environmental Protection. GEOCISA is a sister Company of DRAGADOS, an international contractor established in 1961 that specializes in major infrastructure projects worldwide. DRAGADOS is the construction arm of ACS Group, which is one of the leading infrastructure developers in the world with a presence in more than 40 countries.

In the nuclear field and involved in the conservation and protection of our environment, GEOCISA founded over 35 years ago, Environmental Testing Laboratory as a demonstration of environmental commitment, performing both chemical and radiochemical measurements in different matrices. The experience gained over the years attached to both human and technological multidisciplinary team makes GEOCISA part, from the beginning, in the first decommissioning of a Spanish nuclear power plant, Vandellós I.

Characterized by the constant pursuit of innovation and effort in research and development it means that, with the arrival of new phases in the life cycles of facilities, new challenges are taken: new matrices and RPTU are:

- Site Release Programs: composed of measures in land surface by applying MARSSIM methodology, measuring equipment prototypes developed by GEOCISA and radiochemical samples for laboratory analysis.
- Bioanalysis: Dosimetry by bioelimination

In 2007, the process of tuning up Bioanalysis Laboratory, specializing in measurement of body radioactivity in urina and feces lab starts. In 2010 the Nuclear Safety Council issued the authorization of Internal Personal Dosimetry Service Tecnatom, being GEOCISA laboratory responsible for carrying out the measures of body radioactivity bioelimination.

The determinations made in this laboratory are:
- Determination of americium, uranium isotope, curium and plutonium in urine samples.
- Determination of strontium and tritium in urine samples.
- Determination of creatinine in urine samples.
- Determination of americium isotopes of uranium, plutonium in faecal samples.

NORM Studies

Since the publication of Royal Decree 1439/2010, the Regulation on Health Protection against Ionizing Radiation and the 11.2 Safety Guide on “Control of exposure to natural sources of radiation” of Nuclear Safety Council which recommended that these studies are conducted by the Radiological Protection Technical Units or laboratories with expertise in radiation protection as natural radioactivity, the Radiochemistry laboratory and RPTU of GEOCISA and incorporating such studies in its activities.

Determination and chemical tests

Taking as guarantee various accreditations, GEOCISA performs chemical analysis of multiple parameters in a variety of matrices by highly sensitive equipment and techniques (I.S / GC / MS, GC / FID, ICP - AES, ICP - MS). His fields of activity are:
- Quality control and inland water consumption.
- Characterization of industrial wastes.
- Environmental monitoring programs.
- Characterization of waste landfill.
- Chemical characterization of soils and building materials.

OUTSTANDING ACTIVITIES - NATIONAL

- Environmental Radiation Surveillance Programs (ERSPI), pre-Operational Stage at the Centralised Storage Facility (“ATC” in Spanish) as principal laboratory.
- Environmental Radiation Surveillance Programs (José Cabrera, Asco, Vandellós I and II and El Cabril).
- Internal Personal Dosimetry Service by bioelimination for the dismantling of the NPP José Cabrera.
- Radiological Protection Service for the proposed decommissioning and dismantling of the NPP Jose Cabrera.
- Radiological analysis of samples related to the CRI-9.
- Instrumentation and radiological measures PIMIC-CIEMAT project. 
- Exploration of the laboratory of Central Radioactive Waste Storage Medium and Low Activity El Cabril.
- Site release in the NPP Vandellós I.
- Characterization of land and buildings screebs NPPJose Cabrera.
- Monitoring of groundwater and contaminated land area SRA.
- Emergency Analysis Laboratory and radiological analysis of samples RPTU.
- Quality Control Process declassification of materials Montecillo (PIMIC Phase III).
- Analysis of samples of production process control, mining water, drinking water and disposal of sewage water (Justesa, Geodeser, Berlimed, Gate Gourmet, Sepiolis, Toyotal).
- Waste characterization tests (Divicente, Terragua engineers).

OUTSTANDING ACTIVITIES - INTERNATIONAL

Project technical advice and training of NPP Kozloduy (Bulgaria) for physico-chemical solid and liquid samples within the Project Decommissioning of the facility characterization.

ENGINEERING AND SERVICES

Founded in 1968
Turnover (annual) 3 million €
Total workforce (Nuclear Division) 43 employees
% of university graduates 23%
With its range of specialist companies, Grupo EULEN offers the following services to the Nuclear sector:

- Specialist technical cleaning
- Decontamination
- Security (EULEN SEGURIDAD)
- Radiation protection (PROINSA)
- Declassification of material
- Radioactive waste management
- Maintenance
- Environment and Gardening
- Radiation and environmental measures (ENVIRONMENTAL MEASURES)
- Conventional cleaning

The company has certificates that guarantee the quality of the services we undertake:

- ISO 9001:2008 quality standard
- UNE 73401:1995 quality standard
- ISO 14001:2004 environmental management standard
- OSHAS 18001:2007 risk prevention

SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE

Grupo EULEN has extensive presence and experience in providing all kinds of services to nuclear power stations and radioactive facilities:

- Technical cleaning and radioactive decontamination services
- Cleaning and decontamination of buildings, facilities and equipment in controlled areas
- Cleaning and decontamination of parts, tools, equipment, etc.
- Cleaning of vessel studs and nuts for the Rx and SGD
- Decontamination of material and scrap metal
- Classification and management of contaminated material
- Waste conditioning and containment
- Support (staff and equipment) during refueling and outages
- Installation and conditioning of SAS
- Filtration of refueling cavity water
- Establishing and logistics of transit ponds
- Hydrodynamic cleaning with pressure washing
- Cryogenic cleaning with CO₂
- Cleaning of heat exchangers, condensers, water boxes, pumps, tanks, intakes and supplies, pools, cooling towers, etc.
- Scaffolding, logistics and industrial support
- Decontamination interventions in incidents with radioactive sources (recovery units, steel plants)
- Fire fighting services

ACTIVITIES AND REFERENCES

Grupo EULEN has been involved in the nuclear industry for more than 35 years, working for the following Nuclear Power Plants:

- Santa María de Garoña
- Ascó I & II
- Vandellós
- Almaraz
- Trillo
- José Cabrera
- Cofrentes

At some of these facilities, Grupo EULEN has worked on the construction stage, as well as on operations and refueling.

Grupo EULEN has also undertaken activities relating to the nuclear sector at the following facilities:

- Enresa
- Enisa
- Radioactive decontamination work in the Scrap Metal Recovery sector and at Steel Plants, in collaboration with PROINSA (radioactivity monitoring).
The professional services offered by IDOM Consulting, Engineering, Architecture, S.A.U. (IDOM) cover most of the industrial and technological activities carried out in a nuclear installation, both in the fields of fission and fusion. The organizational structure of the company allows us to offer a wide range of technical solutions, assistance and management services.

IDOM distinguishes itself as a company that has the capacity to integrate the expertise and experience of the nuclear division and draw on the support of all the professionals of the Group, responding efficiently and effectively to the requirements of each project and the needs of each client.

The integrated approach of IDOM involves multidisciplinary teams with expertise from the different technical areas of the Group: Consulting and Systems, Industry and Energy, Architecture and Building, Infrastructure, Seridom (Integrated Turnkey Services) and Nuclear Services. All these disciplines are coordinated using project management practices that guarantee the correct technical and economic outcomes of the projects.

Specifically in the field of Nuclear Services (NS), IDOM is an approved supplier of the quality assurance group of Spanish NPPs, ENRESA, UNESA, AREVA, Nuclear Electricidad Argentina S.A., Rolls Royce and FaE (ITER) and possesses certifications from ROSATOM’s contractors (TITAN2).

In addition, IDOM has in place, a nuclear quality assurance system audited according to the standards NQA-1, ISO-9001, UNE-73401 and KTA 1401. Moreover, IDOM has successfully implemented the OHSAS 18001 Certification requirements (Health and Safety on working sites) as well as the Environmental Management System of UNE-EN-ISO 14001

**SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE**

**“TURNKEY PROJECT” SERVICES**

Integral Solutions for the components, structures and systems implemented in a Nuclear Facility. Covering all areas of Engineering, leading projects, supply management, works supervision, commissioning and start-up and operational support. Turnkey delivery means that the global responsibility for the project is assumed exclusively by IDOM and aligned to the needs of the client.

**ENGINEERING**

Taking into consideration the unique requirements of each project, applicable regulations and the requirements of the Nuclear Regulator of each country, IDOM performs Engineering Projects in the fields of:

- Systems Conceptual, Basic and Detailed Design Engineering.
- Specifications and Design Modifications.
- Components, Structures and Systems (SSC) Analysis and Seismic Qualification.
- Projects related to Radioactive Waste Management.
- Radiological Protection and Shielding.
- Support Engineering and Maintenance (Plant Engineering).
- Owner’s Engineering.
- Project Management.

IDOM carries out all the above activities in National and International Projects and in different nuclear technology applications such as power generation, medicine and research.

In addition to the traditional services of Design Engineering and Construction, IDOM NS has developed a multitude of special products related to safety and licensing:

- Ionizing Radiation Technology.
- Safety and Licensing.

**SPECIALIZED CONSULTANCY**

To develop the special analyses that are required for NPPs or nuclear fusion plants, IDOM offers the following activities:

- Fire simulations with FDS.
- Design Analysis of Nuclear Class SSCs and non-linear calculations.
- Gas Performance, mechanical and fluid dynamics simulations, CFD calculations.
- Thermo-hydraulic Analyses (MAAP, RELAP, MELCOR, GOTHIC).
- Software development (manipulation of radiation maps, scripts for the mapping of neutronic deposition, code coupling, mesh manipulation scripts).
- Support to the client in front of the regulator.
- Back-end engineering (spent fuel storage, radioactive waste management, decommissioning).
- Asset management.
- Analysis and evaluation of the Spanish Nuclear Regulator ITC’s impact.

**OUSTANDING ACTIVITIES - NATIONAL**

- Lifetime Management in Almaraz I-II and Tornillo NPPs.
- Lifetime Management in Ascos I-II and Vandellós II NPPs.
- Individual Spent Fuel Storage Installation (ISFSI) at Santa Mª de Garoña NPP.
- Diagnostic Ports and Remote Handling in ITER, France.
- Decommissioning-related activities in Sellafield NPP, UK.
- Design of a collimator and a robotic arm for the Jules Horowitz Reactor, France.
- Risk-based surveillance in the nuclear fusion field for JET, UK.
- Emergency Control Room at Krsko NPP, Slovenia, in consortium with Tecatom.
- Improvement of national personnel training system in the field of radioactive wastes, decommissioning and remediation in Ukraine for the European Commission.

**OUSTANDING ACTIVITIES - INTERNATIONAL**

- Design and Analysis of main equipment for Hinkley Point C NPP, UK.
- Dynamic Analyses (Framework contract) in ITER, France.
- Advanced Mechanical Analyses (Test Blanket Module) in ITER, France.
- Neutronics Analysis, thermo-hydraulic and fluid dynamics (Framework contract) analyses in ITER, France.
- Diagnostic Ports and Remote Handling in ITER, France.
- Lifetime Management Missions, Laguna Verde NPP, Mexico.
- Decommissioning-related activities in Sellafield NPP, UK.
- Design of a collimator and a robotic arm for the Jules Horowitz Reactor, France.
- Risk-based surveillance in the nuclear fusion field for JET, UK.
- Emergency Control Room at Krsko NPP, Slovenia, in consortium with Tecatom.

**ENGINEERING AND SERVICES**

- 40 offices
- 6,000 employees
- 90%
Medidas Ambientales was created in 1996 as a radiological laboratory. Since then, it has diversified its activity to offer an integral and high-quality service, both to the nuclear and to the environmental Spanish industry.

The company belongs to Nuclenor (Santa María de Garoña MPP operator) and Grupo Eulen, a multinational corporation in general business services (www.eulen.com).

Its broad experience and the trust of its clients have placed Medidas Ambientales as a leading company in radiological analyses.

- Groundwater Surveillance Programs: Sampling and physical-chemical analysis of groundwater around nuclear power plants.
- Analysis of radioactive waste from nuclear installations undergoing decommissioning process and other facilities.
- Radiological analysis on drinking water according to what is established on Spanish legislation.
- Control of import/export food, testing radioactive contamination of the products.
- Training courses and technical advice for companies who need to acquire or expand their knowledge in sampling and analysis procedures for measuring environmental radioactivity.
- Environmental dosimetry. Thermoluminescent dosimeters are provided for their exposure and subsequent measure.
- Natural radiation. The presence of radon in the air is measured, so as to comply with Nuclear Safety Council Instruction IS-33, of 21 November 2010, on the radiological criteria for the protection against exposure to natural radiation. Radioactivity measurements on Naturally Occurring Radioactive Materials (NORM).

**ENVIRONMENTAL SERVICES**

- Physical-chemical and microbiological analyses from a variety of samples: analytic control of wastewater and drinking water, Legionella, swimming pool water, food, etc.
- Detection of the population of zebra mussels at their different developmental stages, in order to evaluate the proliferation of this invasive species on aquatic ecosystems.
- Strategic Environmental Assessment (SEA). A decision-making tool that makes it possible to identify the effects of regional development initiatives on the environment.
- Eco-Labelling and Carbon Footprint Calculation.
- Indoor Air Quality Studies in office buildings and industrial facilities, according to international standards and Spanish regulation RITE (Regulations for Thermal Installations in Buildings).
- Communication and Training. Courses and training focused on environmental communication and management, preparation of Informatives Guides, corporate environmental training, etc.

**QUALITY COMMITMENT**

Medidas Ambientales’ commitment to quality encourages continuous improvement and the use of the best available technology in our daily work.

The laboratory has a certified Quality Management System according to UNE-EN-ISO 17705 regulation, in compliance with nuclear standards established on Regulations UNE 73401, UNE 73404 and UNE 73405. Technical competence is certified by ENAC according to UNE-EN-ISO/IEC 17025 standard, and regularly participates in intercomparison analysis programs between national and international laboratories.

Medidas Ambientales is also an official cooperator of the Hydraulics Spanish Administration (ECAM) for testing freshwater and wastewater samples.

**OUSTANDING ACTIVITIES - NATIONAL**

Medidas Ambientales is currently providing radiological services to all operating nuclear power reactors in Spain, as well as to other plants undergoing a decommissioning process and at El Cabril storage facility for low and intermediate level radioactive waste materials (Enresa).

- Implementation of a new laboratory module, techniques and equipment for analysing radioactive waste.
- Carbon Footprint estimation, in collaboration with Grupo Eulen, at the 42nd Annual Meeting of the Spanish Nuclear Society held in Santander in September 2016.
- Reference and emergency laboratory for Environmental Radiological Surveillance Programs at Ascó I and II, Vandellós II, Santa María de Garoña, Cofrentes, Trillo I and Almaraz nuclear power plants.
- Environmental dosimetry laboratory.
- Analytical Quality Control Program for Environmental Radiological Surveillance at José Cabrera, Vandellós I, El Cabril, as well as at an Old Uranium Factory in Andújar.
- Analytical Quality Control Program for Environmental Radiological Surveillance in Pre-operational phase at Centralized Temporary Storage Facility for spent fuel and high-level radioactive waste (currently under construction).
- Setting up programs for hydrogeological sampling and analysis for groundwater surveillance at Santa María de Garoña, Cofrentes and José Cabrera nuclear power plants.
- Determination of the presence of zebra mussels in aquatic ecosystems around Santa María de Garoña and Almaraz nuclear power plants.
- Indoor Air Quality Testing and Endurance of Hygienic Quality at different sites: hospitals (Quirón, Red Cross), shopping centers (IKEA, Thader), offices buildings (Castilla and Leon Court Authority, El Entreso) and industries facilities (Cerem-Novafrijas).
- Wastewater analytics (Solán de Cabras, Bodegas Alión and Vega Sicilia).

**OUTSTANDING ACTIVITIES - INTERNATIONAL**

Internationally, Medidas Ambientales regularly participates in intercomparisons programs between laboratories, organized by the International Atomic Energy Agency (IAEA), the Nuclear Spanish Security Council (CSN) or the Center for Energy, Environmental and Technological Research (CIEMAT).

**SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE**

**RADIOACTIVITY ANALYSIS**

- Environmental Radiological Surveillance Programs and Analytical Quality Control Programs. Their goal is to detect possible increases in background radiation levels and measure the presence of artificial radionuclides in the environment.
- Environmental Radiological Surveillance on Emergency. Laboratory Emergency Response in case of emergency situation at any nuclear site.
In the Microwave Drying Facility, Cofrentes NPP certification ENRESA. UNE 73401:95, ISO 9001:2008, 14001:2004, according to the requirements of the industries. These divisions provide high quality Maintenance Areas.

NUSIM, S.A., was founded in 1980 to provide technological solutions for different application fields, such as Nuclear, Health Care, Research, Construction and Prevention. Nowadays, NUSIM, S.A. consists of four divisions: Radioactive Waste Treatment, Radiation Protection, Health and Safety Instrumentation, and Automation, all supported by their corresponding Radiation Protection, Health and Safety divisions: Radioactive Waste Treatment, Health Care, Research, Construction and Automation.

NUSIM has developed a significant number of equipment that are being used today in all the Spanish Nuclear Power Plants in operation or decommissioning and in the Official Spanish Agencies and disposal, like ENRESA (El Cabril) or research centers like CIEMAT.

NUSIM is also internationally present with equipment in main nuclear sites like Laguna Verde NPP (Mexico), Kozloduy NPP (Bulgaria), Karachi NPP (Pakistan), Chernobyl NPP (Ukraine), Atucha NPP (Argentina) or the NORM waste treatment plant Abu Dhabi.

All the equipment developed by the Division are manufactured on the basis of own technology. The proposed solutions have been developed to meet the most demanding requirements, giving reliability and robustness, which is highly valued within the Nuclear Sector.

The products range covers the hole cycle of the Radwaste from cradle to grave. Equipment catalogue features: Handling Devices of Drums, HICs, Containers and special Handling with filling, capping, or nesting process.

For the detection and measurements of the ionizing Radiation from the main Companies: Mirin – Canberra and ORTEC among others.

This Division is not only in charge of distribution, but also of assembly and onsite commissioning to products for Nuclear Power Plants, Research Centers, Universities, etc. undertaking the subsequent maintenance to ensure proper functioning.

In Drum Microwave Drying Facility, Cofrentes NPP.

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SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE

RADIWASTE TREATMENT DIVISION

The Radioactive Waste Division, with over 35 years of experience working with all the Nuclear Power Plants in Spain, carrying out the Engineering, Manufacturing, Commissioning, Operation and Maintenance of equipment for treatment, handling and transport of Radioactive Waste.

NUSIM has developed a significant number of equipment that are being used today in all the Spanish Nuclear Power Plants in operation or decommissioning and in the Official Spanish Agencies and disposal, like ENRESA (El Cabril) or research centers like CIEMAT.

NUSIM is also internationally present with equipment in main nuclear sites like Laguna Verde NPP (Mexico), Kozloduy NPP (Bulgaria), Karachi NPP (Pakistan), Chernobyl NPP (Ukraine), Atucha NPP (Argentina) or the NORM waste treatment plant Abu Dhabi.

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Inspection Equipment
- X-Ray Drums Inspection.
- Sampling systems.
- Latency reactor Inspection equipment.
Radiological Characterization for radwaste packages (drums or containers) with accessories for capping, surface contamination test etc.

Processing Equipment for recovery and reconditioning Plant for Historical Wastes.

Volume Reduction Equipment
- Drying systems for sludge or miscellaneous waste by microwave or resistances.
- Pre-compacting equipment.
- HEPA filters Compactors.

Grounding and cementation systems
- In situ Mixing System or premixed systems.
- Modular Blocking System, skid or ISO container mounted systems.
- Continuous or batching Mixers with cleaning system.
- Secondary waste recovery systems.

Cleaning and Decontamination Equipment for drums or containers in fully enclosed cabinet, on conveying line or in glove box.


Decommissioning equipment and Systems.
Cutting, confining, handling, water treatment, processing.

NORM radwaste facilities with integral solution for processing, drum filling, capping, nesting, cementation and grouting.

RADIOLOGICAL PROTECTION DIVISION

Since its creation, NUSIM is the exclusively distributor in Spain of equipment for contamination measuring, spectrometry systems, dosimetry systems and equipment, and electronic components for the detection and measurements of the ionizing Radiation from the main Companies: Mirin – Canberra and ORTEC among others.

This Division is not only in charge of distribution, but also of assembly and onsite commissioning to products for Nuclear Power Plants, Research Centers, Universities, etc. undertaking the subsequent maintenance to ensure proper functioning.

The catalogue features the following equipment:
- Radiation Dosimeters.
- Spectrometry Alpha and Gamma.
- Contamination Monitors equipment/clothing.
- Personal Contamination Monitors.
- Radiometer/ Radiation Meters.

AUTOMATION DIVISION

Carries out the study, the planning and the integrated global solutions for the automation systems covering the design, development, assembly and commissioning in all type of industry installations.

NUSIM carries out the PLC’s and SCADAS programming of the main manufacturers in the market. NUSIM is recognized integrator of Rockwell Automation even though also have tools and knowledge of the software of the main brand in remaining market shares such as Siemens, Schneider, Omron, ABB, etc.

NUSIM integrates complete automatic systems, both hardware and/or software from different manufacturers, interconnected business systems (ERP’s, Information Servers, etc.) with the manufacturing (Solutions MES).

OUTSTANDING NATIONAL AND INTERNATIONAL ACTIVITIES

RADIWASTE TREATMENT DIVISION

Between main references, the major projects are the following:

- Container handling, nesting and capping equipment for the New Safe Confinement in the Chernobyl NPP, Ukraine (TAIM WEISER).
- Stabilization and Solidification plant for NORM ashes. ADNOC Abu Dhabi National Oil Company (TAKREER).
- ISO container SAS confinement with control room for the José Cabrera NPP reactor vessel lid cutting.
- Drums and HIC handling and compaction equipment for Laguna Verde NPP (Mexicali).
- Reprocessing Plant for Historical Waste, for the Santa María de Garoña NPP.
- In drum Microwave Drying Facility, for Ascó and Cofrentes NPP.
- Equipment for Casting Collection and Cooling for a Plasma Oven Facility for Kozloduy NPP (Bulgaria).
- In addition, drum and container handling devices, waste solidification plants, package radiological characterization systems, compactors, etc. are in operation in all the Spanish nuclear emplacements.

RADIOLOGICAL PROTECTION DIVISION

Main supplies during recent years:

- Contamination portal monitors: RADDOS with proportional and scintillation detectors for Trillo, Almaraz, Ascó, Vandellós II and Santa María de Garoña NPP and for tools for Vandellés II NPP.
- TLD RADDOS dosimetry systems for Almaraz and Trillo NPP and Dosimetry center.
- Gamma Spectrometry Systems ORTEC with germanium detectors and Alpha Spectrometry Systems ORTEC for the Universities, Polytechnic of Valencia, Cáceres, Basque country, Polytechnic of Barcelona, Catalan Government, DIEMAT and CSIC.
- Portable Gamma Spectrometry Equipment ORTEC for ENRESA, Customs Alguciras and Catalan Government.
- BRα y Na Detectors for environmental network of the Catalan Government.
- Integral radiological protection equipment for the NORM waste treatment plant. Takreer, Abu Dhabi.
- Laundry RADDOS monitor for Ascó, Almaraz, Vandellés II and Santa María de Garoña NPP and for tools for Vandellés II NPP.
- Alpha RADDOS monitor for El Cabril.
- Radiotherapy portal monitors for El Cabril.
- Baking Equipment for Drums, El Cabril (ENRESA)
- Seenal equipment for Drums, El Cabril (ENRESA)

NUSIM, S.A.

Founded in 1980
International activity 60%
Sales that come from the nuclear and radwaste sector 90%
Master Degree Engineers 80%
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SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE

PROINSA is authorised by the Spanish Nuclear Safety Council as a Radiological Protection Technical Unit against ionising radiation.

This permit has allowed it over the years to become specialised in offering radiological protection and environmental services, which can be classified as follows:

Radiological protection in nuclear power plants.
- Services in normal production.
- Services in refuelling outages.
- Services during decommissioning.

Control and radiological protection of radioactive sites.
- Radiological control.
- Elaboration and processing of documentation.
- Advice and management with respect to public entities.
- Training in radiological protection.
- Supervisors and operators of radioactive installations.
- Directing and operating medical and/or dental radiodiagnosis.
- Other specific radiological protection courses.

Nuclear and radiological emergencies.

Environmental radiological surveillance services.

Environmental studies and projects.

Protocol and collaboration on the monitoring of metallic materials.

Firefighting squads and services.

Legionellosis prevention and control services.

Industrial waste management.

Turnover: 6.1 million €
Volume of sales that comes from the nuclear sector: 87.6%
Investment in R+D+i: Integrated in the Eulen Group
Staff: 127 employees
Managers: 4
Senior Engineers: 25
Engineers: 8
Technicians and administrative workers: 95

PROINSA has also delivered courses related with radiological protection, including, official courses for personnel in radioactive installations, as well as other specific courses for nuclear power plants and courses on radiological protection for different official institutions.

PROINSA has also collaborated with all the Spanish nuclear power plants in matters relating to environmental radiological surveillance plans and with Trillo nuclear power plant as well in monitoring the ecosystems surrounding it.

Since 2002 it has carried out activities related with the control and prevention of legionellosis at risk sites and has delivered training courses.

PROINSA is enrolled in the official registry of Pesticide Establishments and Services of the different autonomous communities and is authorised to give training courses to personnel to carry out hygiene-health maintenance operations in sites with a risk of legionellosis.


ACTIVITIES AND REFERENCES

Throughout its course, PROINSA has provided permanent support to the radiological protection services of the nuclear power plants of Asco I and II, Vandellós II and Santa María de Garoña, during their normal operation (closed radiological protection shifts, instrumentation, etc.) as well as support in radiological protection during refuelling outages in the same plants and in the nuclear power plants of Jose Cabrera, Cofrentes and Trillo.

It also provides several specific radiological protection services for other clients such as ENRESA and CIEMAT.

Since it was founded PROINSA has also provided services to both medical and non medical radioactive installations, offering the maximum scope and guidance in radiological protection. Clients include Ibermutuamur, Siemens, Smurfit, Unión Española de Explosivos, etc.
At TAIM WESER we have more than 100 years experience in the supply of EOT and gantry cranes for the main industrial sectors, paying close attention to the specific requirements requested by our customers and always based on the principles of safety, high performance, precision of movements, low maintenance and operation costs and maximum availability of our products.

In the nuclear industry we are a national and international leading supplier of special EOT and gantry cranes for the handling of low and intermediate active nuclear waste and nuclear fuel.

In addition, we have also supplied high precision cranes to the most prestigious research experiments in the world, CERN and CELLS studying the relation between mass and energy.

We are qualified supplier of ENRESA, IHI, ELECTRABEL and SELLAFIELD among others and we are certified ISO 9001, ISO 14001 y OHSAS 18001.

SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE

Turnkey supply of cranes

We specialize in the supply of tailor made EOT and gantry cranes to meet the special requirements of the nuclear industry. For this purpose we have the most suitable resources and the most advanced techniques. Our scope of supply includes the whole project cycle, design, manufacturing, assembly and test at our facilities, final assembly at site and commissioning of the equipment.

All essential processes of design and fabrication are carried out and supervised in our installations and additionally all the cranes are assembled and tested in our factory, generally without load, or with load if so specified by the client. This process leads us to the achievement of a final product of high quality and an absolute assurance that no major unforeseen problems occur during installation on site.

After sales and spare parts

TAIM WESER After Sales Service gives support to the Cranes business unit of the company and offers its extensive experience and know-how in maintenance, improvement and re-bumping of equipment and industrial installations, specially focused on the following areas:

• Specialized maintenance works.
• Supervising equipments.
• NDT: Non Destructive Tests.
• Reverse engineering.
• Structural analysis.
• Customised solutions.
• Spare parts and integration of new supplies.
• Re-vamping and small facilities.
• Training.
• Equipment adaptation to EU Directives.

Maintenance services and technical assistance

More than a service, we offer security, reliability and protection to our customer’s assets, through a well-managed, planned and executed maintenance, which is essential to optimize resources:

• Increasing of working life of the equipments.
• Decreasing of stop-times and their associated costs due to the non-production.
• Decreasing of maintenance costs.
• Increasing of performance equipments.
• Compliance with the target set in the production and maintenance plan.

OUTSTANDING ACTIVITIES - NATIONAL

• Supply of EOT crane to the first Nuclear Power Plant installed in Spain, the N.P.P. José Cabrera.
• Supply of EOT and gantry cranes to the N.P.P. Vandellós I.
• Supply of EOT and gantry cranes to the N.P.P. Vandellos II.
• Supply of EOT and gantry cranes to the N.P.P. Ascó I.
• Supply of EOT crane to the N.P.P. Atucha, Argentina.
• Supply of EOT crane to the HABOG-repository for high-level nuclear fuel disposal, located in the Netherlands.
• Supply of EOT and gantry cranes for the assembly and descent of the CERN’s LHC particle accelerator in Switzerland.
• Supply of EOT crane to the N.P.P. Berkeley, UK.

OUTSTANDING ACTIVITIES - INTERNATIONAL

• Supply of EOT crane to the N.P.P. Dounreay, UK.
• Supply of EOT crane to the N.P.P. Plymouth, UK.
• Supply of EOT crane to the N.P.P. Sellafield, UK.
• Supply of EOT crane to the N.P.P. Rekkashe Aomori, Japan.
• Supply of a SFFP (Single Failure Proof) trolley to the N.P.P. Tihange 2, Belgium.
• Contract awarding for the supply of up to 24 out cell high integrity cranes along 10 years for Sellafield Ltd.
• Currently supplying a bridge crane for handle structure elements and move RAW containers in the Technological Building [TEC] of the Chernobyl New Safe Confinement Project.

COUNTRIES IN WHICH THERE IS NUCLEAR ACTIVITY

Technical assistance contracts in several countries in Europe and Asia and commercial activity in Europe, America and Asia.

OTHER DATA OF INTEREST

In addition to the cranes business unit, where TAIM WESER supply equipment to the main industries: nuclear, steel industry, petrochemical, ports, mining, etc. the company is focussed in the following business areas:

• Bulk materials handling – we supply installations and equipment for the conveying and handling of bulk materials.
• Waste Treatment - we supply mechanical biological treatment plants (MBT) for municipal solid waste (MSW).
• Renewable Energy – our activity focuses in the wind energy and the biomass.
TECNATOM, S.A.

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With more than 60 years of know-how, Tecnatom has made quality one of the main principles of its activity, competing with its experience and contributing with innovative solutions to the global nuclear challenge.

BUSINESS OBJECTIVE

Tecnatom was created in 1957 as a Spanish engineering company specialised in guaranteeing the operation and maintenance of nuclear power plants with the highest levels of security.

The main activities are focused on services to inspect components and structural integrity, the training of personnel in advanced training environments and support engineering to the operation of plants. Today it is a business group with subsidiaries in France, Brazil, China, United States of America, Mexico and United Arab Emirates, which carries out activities in several sectors, among them energy, petrochemicals, rail transport and aerospace.

The company offers services and develops products with a high technological content and its own technology, adapted to the needs and requirements of the different clients and markets and possessing mechanical, electronic and data-processing resources in the state of the art of technological development.

Tecnatom develops projects in 40 countries worldwide and its methodology and equipment have been validated by clients and regulatory authorities at an international level.

The company is also deeply involved in future developments, consolidating its participation in advanced projects for nuclear energy plants, such as the construction of the new AP1000, ESBWR, ABWR, APR-1400 or PHWR plants around the world.

Tecnatom participates actively in fusion reactors and research reactors such as the great international ITER project in France, the International Facility of Material Irradiation (IFMIF) in Japan and the Jules Horowitz Research reactor (JHR) in France.

Tecnatom has provided advanced and sophisticated technology for the nuclear sector for almost six decades. Its role within the international nuclear projects in this period has allowed the company to adapt its technological capacities to a very demanding environment, providing innovative solutions to the global nuclear and technological challenge.

SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE

Tecnatom provides services and products with their own design and manufacture in order to continuously adapt to the needs and requisites of the different clients and markets, among which the following stand out:

INSPECTION AND TESTING

A relevant part of Tecnatom’s activity is devoted to the evaluation of the structural integrity of the main components of nuclear power plants and other industrial facilities. Tecnatom has achieved huge international experience and references. Its inspection and testing services have been approved and certified by many organisations and international clients. Its basic capacities include:

- Inspection services: complete capacities to perform an automated inspection using NDT of all the areas of the reactor pressure vessel, fuel assemblies, steam generators, heat exchangers and other relevant components such as piping and turbines.
- Testing services: a wide range of advanced tests for the evaluation of the status of the different components of the site.
- Engineering services: in the areas of life management, codes and standards, implementation of inspection programmes, maintenance and reliability of equipment, management of parts and components with special emphasis on the support of plant asset management and the long term operating programmes.

SAFETY, OPERATION AND TRAINING

Using the technological development and the application of its services, Tecnatom contributes to improving the training and efficiency of the personnel of the plants, as well as implementing the best resources to facilitate the operation of the sites, thus guaranteeing improvements in safety, availability and economic efficiency.

- Nuclear Training: with more than 35 year of experience in the application of the most advanced training methodologies, Tecnatom has more than 160 specialised professional instructors in the different technologies of generation II, III and IV, which makes us the leader in training services for the Spanish nuclear industry sector and provides us with an important presence in countries with nuclear projects.
- Emergencies and Operational Support: operating procedures and severe accident procedures assistance in the field of nuclear emergencies, specialised services to support start up, operational experience, radiological protection and dosimetry.
- Control Rooms and Simulation: using in-house technology, Tecnatom provides the best solutions in the areas of training and engineering assisted by simulation in the design and supply of new control rooms, as well as their modernisation.
- Safety Management: providing high added value services that reinforce the management of the sites and the development of additional competences in matters of safety culture and leadership.

DEVELOPMENT OF NDT PRODUCTS

Tecnatom has developed its own technology of automated inspection systems and, as a result, has become a provider of high level technological services and products, with the support of the companies in the Tecnatom group to guarantee global and reliable solutions for any need.

- NDT Equipment: Tecnatom offers data acquisition and analysis systems, developing also software for a wide spectrum of non destructive test applications.
- Design and Development of Products: both standard and adapted to the needs of the client, including the operational procedures and the services of technological engineering.

COUNTRIES IN WHICH THERE IS NUCLEAR ACTIVITY

Argentina, Brazil, Mexico, The United States of America, United Kindom, Finland, Belgium, France, Switzerland, Slovenia, Romania, Russia, United Arab Emirates, China, Taiwan and South Korea.

Turnover [2016]: 125.3 million €
Volume of sales that comes from the nuclear sector: 87%
Invested in R&D: 11.7 million €
SAP: 1,412 employees
Management: 21
Senior Engineers: 615
Engineers: 195
Technicians and admin. workers: 207
Rest of personnel: 114
TÉCNICAS REUNIDAS, S.A

Since 1959 Técnicas Reunidas (TR) has designed and built over 1,100 industrial facilities in more than 50 countries. For the last 30 years, over 70% of the TR revenues correspond to international activity, reaching nearly 100% in recent years and 75% corresponding to large turnkey EPC projects.

BUSINESS OBJECTIVE
TR is an international general contractor for engineering and construction of power stations (nuclear, conventional thermal power from coal, fuel oil and gas, combined cycles, renewables and cogeneration), oil and gas facilities and infrastructures.
TR is one of the founding partners of Empresarios Agrupados, in which it has a 43% shareholding.
TR is independent of any technology, industrial or utility group.
TR is a listed company in the Madrid Stock Exchange Market and is included in the selected IBEX-35.
TR headquarters are in Madrid and the company has permanent offices in, Algeria, Argentina, Australia, Bolivia, Canada, Chile, China, Dominican Republic, Egypt, France, India, Kuwait, Mexico, Oman, Peru, Poland, Russia, Saudi Arabia, Turkey, United Arab Emirates, UK and USA.

SERVICES, PRODUCTS AND TECHNOLOGY AVAILABLE
TR is one of Europe’s leaders in the design and construction of oil and gas facilities and electricity generating plants, and one of the world leaders in the refining sector.
TR has been heavily involved in electricity generating plant design and construction for over 55 years, particularly in nuclear power plants since the beginning of the 2nd phase of the Spanish Nuclear Programme in the early 70’s.
TR offers a complete range of technical and management services in the areas of industrial and electricity generating plants engineering and construction. The services may be rendered as refundable or turnkey projects or by any other formulae demanded by the client.
TR’s experience in the integration of its services guarantees project performance on time, on cost and with the highest levels of quality and safety.

In the nuclear generation sector, TR has participated in the engineering, supply and construction of six 1,000 MW nuclear groups in Spain, using GE BWR and Westinghouse and Areva (Siemens-KWU) PWR technologies.
TR has provided engineering and operating support services for the aforementioned plants and for all the other nuclear groups operating in Spain.
TR has provided engineering services, equipment supply and operating support services for numerous nuclear power plants and projects in Mexico, Argentina, Brazil, USA, Italy, Finland, Turkey, the former Republic of Yugoslavia and Taiwan, as well as for the VVER and RBMK plants in Czech Republic, Slovakia, Bulgaria, Ukraine, Armenia, Lithuania and Russia.
TR also participates in the engineering and licensing process of certain advanced reactor developments (Generation III and III+).
TR has experience in the management of radioactive waste, spent fuel storage facilities and plant dismantling projects and services.
Moreover, TR has expertise in the design, engineering and construction of facilities for the management and treatment of NORMS, effectively combining all its knowledge and experience in both the oil&gas and nuclear sectors.

TR is fully ready to undertake, mainly on a turnkey basis or as market may demand, the nuclear new build projects to come worldwide, executing the turbine island, the full Balance Of Plant (BOP), as well as deliverable turnkey packages potentially separable within the nuclear island (like radwaste treatment building, emergency diesel generators, etc.), modules EPC supply, heat transfer equipment EPC supply, engineering packages, etc.
TR has extensive experience of electricity generation in all types of power plants:
• Nuclear power plants.
• Conventional thermal power plants (coal, fuel and gas).
• Combined cycle plants.
• Hydroelectric stations.
• Cogeneration plants.
• Thermal and photovoltaic solar plants.
• Biomass plants.
• Fuel cells.

OUTSTANDING NATIONAL AND INTERNATIONAL ACTIVITIES

In the area of conventional thermal generation, TR has carried out numerous projects for new thermal power plants in Spain and overseas, fired by regular hard coal, anthracite, lignite, fuel, gas and biomass, and covering a wide range of boiler types, combustion technologies, as well as the main suppliers of boilers and gas and steam turbines.
TR also participates in the development of new technologies for electricity generation, such as coal or oil residue gasification integrated with combined cycles, advance nuclear reactors, fusion facilities and molten carbonate fuel cells.
An Urbar Ingenieros Group Company
Poliégon Industrial Asteasu. Zona B, Nº 44
20159 Asteasu (Guipúzcoa, España)
Tel.: +34 63 611 500
E-mail: laboratorio@virlab.es
Web: www.virlab.es

VIRLAB, Expertise in Vibrations and shocks. Testing Laboratory

Created in 1976, within URBAR Ingenieros, group of companies specialized in the industrial applications of vibration, VIRLAB develops its activity in the field of tests of vibration of all types of equipment, which is required to fulfill the purposes for which they are designed, in the case that they will be subjected to earthquakes or other types of vibrations.

VIRLAB has its own testing procedures, established in accordance with the requirements applicable to each case, international standards and depending on the customers’ particular requirements.

VIRLAB gives a comprehensive and tailored service to the needs of its customers, without them having to worry about anything more than to get their equipment to its facilities and collect them after testing. More than 2,600 tests have been conducted at its facilities located in Asteasu (Guipúzcoa), between San Sebastián and Tolosa and just over one hour from Bilbao airport.

FACILITIES

• A shop of 1141m² that includes a Control room, of 4.3 x 8, 4m.
• A bridge crane of 10m, with two hooks 10 and 3 tons load and maximum elevation 6 m.
• A hydraulic central driven 40 CV engines 2 and 4 engines 50 CV, capable of providing up to 250 bar (210 bar, nominal pressure) and flow rate up to 640 l/min.
• An auxiliary assembly room of about 1000 m² with 2 bridges crane 16 and 20 T.
• A complete set of electrical, pneumatic, hydraulic facilities and power supplies that make that equipment can be tested under real conditions of operation.
• Equipment testing and data collection and monitoring instruments as indicated below.

TEST PLATFORMS

Biaxial electrodynamic, LDS 824 LS
• 750x750mm.
• 2x100kN.
• ±125mm.
• ±100mm/s.
• ±10g.
• ±1 x 150Hz.

Biaxial oil hydraulic EDB 120
• 1200x1200mm.
• 2x100 kN.
• ±125 mm.
• ±1,000 mm/s.
• ±10g.
• ±0.1 x 150Hz.

Monoaxial electrodynamic, LDS 824 LS
• 750x750mm.
• 27kN.
• ±19mm.
• ±1,79mm/s.
• ±40g.
• ±1 x 3220Hz.

Monoaxial electrodynamic, LDS 824 LS
• 2.2 kN.
• ±12,7mm.
• ±1,54mm/s.
• ±100g.
• ±1 x 5000Hz.

INSTRUMENTATION

VIRLAB systems data and measure elements allow us to analyze all kinds of variables: accelerations, displacements, deformations, strains, etc. Then, the instruments available to the laboratory.

Vibration Controllers
• Sine, random and shock controller:
  • Eight input channels and one output channel (3).
  • Random, shock and SRS controller:
  • Four input channels and two output channels (1). Sixteen input channels and two output (1).

Sensors of vibration
• 32 piezoelectric accelerometers.
• 6 four channel amplifiers.
• 8 single channel amplifiers.
• 2 laser sensors ± 1 and ± 50 mm.

Signal monitoring
• Discontinuity Detectors, 12 channels, (0.5-20 m/s), (1).
• A data acquisition and processing system, 31 channels, 200 kHz (1).
• A data acquisition and processing system, 24 channels, 1 MHz (2).

Signal analyzers
• 16 channels.
• 8 channels.
• 4 channels.

Signal recorders
• 24 input channels and 24 output channels (1).
• 24 input channels and 12 output channels (1).
Radioactive waste management and decommissioning of nuclear installations in Spain has acquired international prestige.
ENRESA

ENRESA is also in charge of dismantling the nuclear power plants whose activity has come to an end and of the environmental restoration of mines and uranium related installations, when so required by the authorities.

At present, ENRESA has a definitive radioactive waste storage site for very low, low and average activity, in El Cabril located in the town of Hornachuelos in Cordoba. ENRESA is also in the process of licensing a Centralised Temporary Storage Site for the management of spent fuel and other high activity waste which will be located in Villar de Cañas (Cuenca).

With respect to the dismantling projects, ENRESA manages the Mestral Technological Centre, located in the old nuclear power plant of Vandellós I (Tarragona) currently in the latent period having completed its dismantling process to level 2. ENRESA is also the licensee of the Jose Cabrera nuclear power plant in Guadalajara, during its dismantling process, which will be completed in 2018.

The National Radwaste Company, ENRESA, is a public Company, created by Parliament in 1984 with state capital. ENRESA offers an essential public service. Its mission is to collect, condition and store all the radwaste that is produced in Spain.

ENRESA Headquarters
C/ Emilio Vargas, 7
28055, Madrid
Tel.: +34 915 668 100
E-mail: registro@enresa.es
Web: www.enresa.es

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EL CABRIL STORAGE CENTRE

Ctra. A-447 Km 17,8 [dirección Fuenterrebajona-Cazalla de la Sierra] 14740 Hornachuelos (Córdoba)
Tel.: +34 957 575 100 Fax.: +34 957 575 130

CENTRALISED TEMPORARY STORAGE SITE

16433 Villar de Cañas (Cuenca)
Tel.: +34 969 194 061

DISMANTLING

Nuclear Power Plant José Cabrera
19118 Almenacid de Zorita (Guadalajara)
Tel.: +34 625 661 452
E-mail: cevisic@enresa.es

Mestral Technological Centre
Ctra. N-340, Km 1123,7
43890 L’Hospitalet de L’Infant (Tarragona)
Tel.: +34 977 818 500 Fax.: +34 977 818 527
E-mail: cevisva@enresa.es

Type of reactor and power MWe
Vandellós I
José Cabrera

Cessation of activity
1989
2006

Years of operation
17
38

Total materials managed
96,894 Tn
84,894 Tn

Conventional materials
12,512 tons
6,001 tons

Declassified materials
1,315 tons
5,136 tons

Recovery
9,973 Tn
300-500 employees*

Dismantling period
1998-2003
323 employees

Current dismantling status
323 employees

Average workforce during dismantling*
300 employees*

ENRESA workforce 31/12/16
6,700 tons
6 employees

* Direct and indirect employment

2016 data

Total waste managed
1,098.72 m³

Low and medium activity waste:
671.65 m³

From hospitals, research centres and industry
31.50 m³

From nuclear sites
1,079.22 m³

Number of expeditions
147

ENRESA staff
123 employees 31/12/16

Number of expeditions

ENRESA staff

123 employees 31/12/16
ASSOCIATIONS

- Unesa, Spanish Association for the Electrical Industry

96-97

Sectorial associations represent the interests of their members by means of offering support and promoting new business opportunities.
In order to meet its associative objectives, UNESA carries out the following specific services and functions:

- Representing, promoting and defending the interests of its members with the Administration, jurisdictional bodies, Parliament, political parties, trade union organisations and in those public and private entities as considered necessary.

- Collaborating with the Public Administrations in representation of the Electrical Sector.

- Monitoring or participating in the elaboration of regulatory proposals or in the modification, development, study and analysis, both in specific electrical specification and in any other directly or indirectly related with it.

- Carrying out all kinds of legal and judicial actions, as well as all different types of consultations and letters to the Public Administrations and jurisdictional bodies in representation of its members.

- Elaborating studies and reports on any matter related with its objectives.

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With respect to the international organisations that deal with nuclear energy the following must be mentioned: the Nuclear Energy Institute (NEI), the Electric Power Research Institute (EPRI), the Nuclear Energy Agency (NEA) of the OECD and the International Atomic Energy Agency (IAEA).