SPANISH CAPABILITIES TO FACE A NEW **NUCLEAR PROJECT**

CEIDEN
Plataforma Tecnológica de
Energía Nuclear de Fisión

CEIDEN - NUCLEAR FISSION R&D TECHNOLOGY PLATFORM

CEIDEN Technology Platform is a coordinating body of needs and R&D efforts in the field of nuclear fission technology in Spain. Their work allows projects raised and addressed jointly by the entities that are affected by the problems they seek to solve, and present a single national position against the proposals or the international commitments.

The overall objective of the Platform is to coordinate and develop CEIDEN R&D aimed at the safe, reliable operation of existing nuclear plants and the development of technological knowledge in new designs.

In the Platform CEIDEN are represented all sectors related to nuclear R&D in Spain and its scope includes both currently operating plants and new reactor designs.

Participating entities include all the entire nuclear sector: Administration, Regulatory Body, research centers, universities, utilities; equipment, engineering, consulting and services companies, etc.

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CREDITS

Authors:

Laura Gala Delgado
Pablo Teófilo León López
Pilar López Fernández
Pedro Ortega Prieto
Antonio Peñarrubia Ibáñez
Eduardo Serra Sintes

Design and Realization: Grupo SENDA
ISBN: 978-84-694-7100-5
Legal Deposit: M-35768-2011

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Foreword

It is with great honour and satisfaction that I present this work, the end product of the teamwork of a large group of people and institutions of the nuclear sector.

Firstly, because this study embodies to a great extent the spirit and history of the CEIDEN technology platform. From the outset it attempts to integrate all actors in this sector into a collective effort with the aim of looking for synergies and a common ground. Like CEIDEN, this project has progressed in a slow and gradual process which has not been without its ups and downs, arguments and reconsiderations. Likewise, it is based on the voluntary contribution of all the people that have taken part in it; on an overall picture of the sector, independent of the inevitable personal interests; on the responsibility of each entity; and, finally, on mutual trust.

Secondly, because of the need and the opportunity to perform an analysis to show and quantify in a sound and credible manner the capabilities of the Spanish nuclear sector to carry out a new nuclear project at the present moment. Without entering into the issue of the need for or the advisability of relaunching the nuclear program in our country, I am convinced that an essential element to guide this debate is a study as the one shown in this book.

It is evident that the Fukushima accident is a turning point in the discussion about the future of nuclear energy both worldwide and in the context of each country. The first reactions after the accident started to come in as this document was being completed, which lead to discussing whether publishing its results was advisable right now. In my opinion, it is clear that the right time to issue the study on the capabilities of the Spanish nuclear industry is now, not only because postponing its publication would entail a certain loss of validity of the collected information but, especially, because it is precisely at times like this when it is more necessary than ever to have the best information and tools at hand to underpin the debate and the decision making in a responsible manner.

Another aspect that makes me proud of this study is that it has been carried out with a methodology and a rigour that guarantee the credibility of its results. Finally, I cannot help but add that, by and large, said results are surprising and very satisfying. In the past few years I have too frequently heard gratuitous claims about the lack of standing and capacity of the industry and the service companies of the Spanish nuclear sector as a result of a supposed dismantling process due to a lack of new construction projects. I hope this paper contributes to refine or counter these pessimistic assertions, which in many cases belie ulterior motives.

In any case, the part of the process, that now comes to an end with the publication of this book, that I have found most rewarding has been the chance to work and discuss with a team of excellent professionals and human beings, which, incidentally, has been the overall trend in my tenure as CEIDEN's President.

As part of this context and to wrap things up, I would like to extend my deepest gratitude and acknowledgement to Javier Arana, the driving force behind this Association and, within it, this Project; to Pío Carmena, CEIDEN's first and current Secretary, who set this whole thing in motion; and, above all, to Pablo León – with whom I have closely and intensely worked during the past two years –, the person in charge of the second phase and the completion of the study.

I would like to bring this foreword to a close by thanking all those who day in and day out contribute with their personal effort to build up this technology platform, whose activities, results and capacity of influence are growing noticeably.

Francisco Fernández Moreno
CEIDEN President

1. Purpose of the study

The purpose of this study of the capabilities of the Spanish industry for dealing with a new nuclear project is to update the state of these capabilities 23 years after the Spanish nuclear programme for the construction of new power plants came to an end with the commissioning of Trillo NPP back in 1988.

The nuclear programme in Spain resulted in the creation a robust nuclear industry which was developed in the different stages[1] of the construction of nuclear power plants and reached an 85% share (in financial terms) for the last plant that came into operation. This entailed the creation and promotion of companies that exported technology and know-how outside Spain once the moratorium was introduced in our country.

Together with the activities to support the operation of our plants, the international endeavours of these companies have preserved nuclear know-how these 23 years during which no new nuclear power plants have been built in our country. This study aims to answer the following question: what capacity to build new nuclear power plants now has been able to maintain the Spanish industry? Moreover, should our country decide to launch a new nuclear programme, how would these and other companies be able to outfit themselves so as to carry out new activities in five years' time?

What is the reason for conducting this study at this time? After the international nuclear industry was brought to a standstill following the Chernobyl accident, in the last few years it has been undergoing a renaissance in many countries. Both developing countries, such as China and India, and industrialised nations are behind this resurgence. In Europe, new nuclear programmes involving the construction of plants have been set in motion in Finland and France. There are also plans under way in the Czech Republic, Russia, Slovakia, South Korea, the United Kingdom and the United States, among other countries. As of August 2011 there were a total of 66 reactors being built in the world. This nuclear rebirth has its origin in the intrinsic properties of nuclear energy: an energy source suitable for the massive generation of electricity without CO_2 emissions that guarantees the security of supply and the generation of electricity at competitive costs.

This is compounded by the country's economic situation. Spain is currently in the midst of a severe economic crisis that has lead to the highest unemployment levels in its history. The launch of a new nuclear programme in our country would bring about the creation of jobs with high technical acumen and the retaining of a high percentage of the economic activity derived from a new project (in the order of thousands of millions of Euros) managed by Spanish companies. Another of this study's goals is to analyse this percentage.

The Fukushima nuclear accident of 11 Mar 2011 – caused by an earthquake and subsequent tsunami – has cast a shadow over this outlook, although some countries have stated that they will continue with their nuclear programmes already under way. The lessons from this accident will be taken into account in the operation of existing plants and the

[1] *It is accepted that Spanish nuclear power plants were built in three stages, which have been referred to traditionally as generations. In order to avoid confusion with the technological generations of nuclear power plants throughout the world, the term stage has been used in this paper to refer to the three generations of nuclear power plants in Spain.*

José Cabrera Nuclear Power Plant

Trillo Nuclear Power Plant

construction of new ones. The world's economic and social development cannot do without nuclear power, so the world has no other choice but to rely on this source of energy now and in the future.

A historical review of the Spanish nuclear programme and the participation of companies in the construction of nuclear power plants in Spain has been carried out in order to ascertain the capacity of the industry in the nuclear field in our country. The activities involved in a new nuclear project for a generic Generation-III plant are analysed below. The percentage of the total monetary cost of the project has been defined for each of these activities. The breakdown level has been sufficient to include the capabilities of the sector's different entities but without going to the extent of itemising sub-activities, which would make it impossible to conduct this analysis.

Areva, General Electric-Hitachi and Westinghouse have taken part in this breakdown of activities. An average has been calculated from their Generation-III designs in the commercial phase, which has resulted in the list of activities of a generic Generation-III reactor.

After coming up with the list of activities, different companies from the Spanish nuclear sector were contacted, which filled out a questionnaire in order to detail their capabilities for each of the activities and relevant experience.

36 companies took part in this survey, which have all been included in this study. The economic percentage of a new nuclear project that can be tackled by the Spanish industry in general and the nuclear sector in particular was obtained from their answers; this percentage is detailed in the conclusions of this study.

2. Background

Construction of José Cabrera Nuclear Power Plant

2.1. The historical and institutional approach to the development of nuclear power in Spain

The Spanish nuclear programme began in **1945** as international interest in atomic energy was awakened; the Government reserved in favour of the State the exploitation of the uranium deposits, declaring them to be of national interest. Three years later, in **1948**, José María Otero Navascués, the driving force of atomic energy in Spain, set up the **Atomic Research Board (Junta de Investigaciones Atómicas)**, whose initial objectives focused on the training of staff and the study of the exploitation of uranium deposits, uranium extraction and metallurgy techniques and uranium physics.

In **1951**, the Atomic Research Board became the **Nuclear Energy Board (Junta de Energía Nuclear - JEN)**, which was created to coordinate different nuclear energy-related activities. The JEN was, among other conditions, a research centre, an advisory body to the Government, a technical body responsible for safety and protection against ionising radiations, a body in charge of prospecting and working deposits of radioactive substances, and a body for the promotion of the industrial applications of nuclear energy.

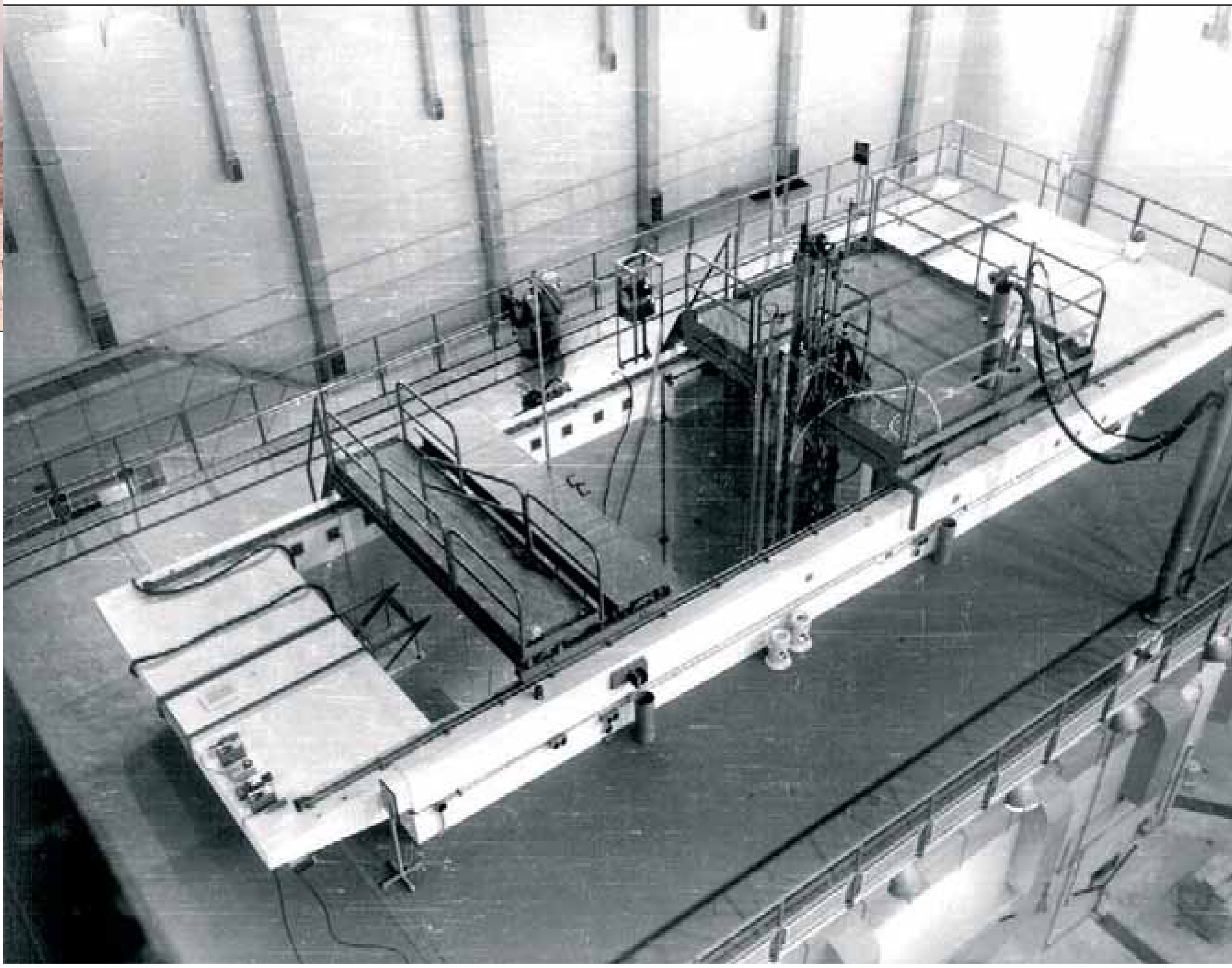
The JEN was also behind the construction of several research reactors. With respect to the activities corresponding to the fuel cycle, uranium geology and mining-related tasks were carried out by means of drilling surveys in Cordoba, Salamanca, Caceres and Jaen, where uranium concentrates were obtained; the transformation of concentrates into uranium oxides and the manufacture of fuel assemblies were subsequently developed. In addition, the JEN later set up a small pilot facility for the processing of the first spent fuel in Spain from the JEN-1 research reactor and a small amount of overseas fuel.

An event took place in **1953** that completely changed the situation of nuclear energy in the world: the President of the United States of America, Dwight D. Eisenhower, gave his “Atoms for Peace” speech where he expressed his support for the development of peaceful atomic energy projects in the allied countries. Electric companies started to see nuclear energy as a source of electricity, and more so later in the 1960s and 1970s, when the consumption of electricity rose 8% per year. Thus, in **1955** Spain signed a nuclear collaboration agreement with the US which enabled the construction of the first Spanish reactor (**José Cabrera**) as well as the purchase of enriched uranium. The preliminary studies for the plant, which was owned by a private company, started in **1963**. The construction of the plant began in **1964**, which went into service in **1968**.

The creation of the Spanish civil industrial nuclear structure began in the 1960s with the decision to promote a nuclear fleet and build the Jose Cabrera, Garoña and Vandellós I NPPs with support from the Administration via the JEN.

Projects integrated in the so-called second and third stages were developed in parallel to the commercial operation of this first stage of NPPs (José Cabrera, Santa María de Garoña and Vandellòs I), in which the Spanish industry was slightly involved.

Spanish companies played a greater role during the second stage of power plant construction (Almaraz units I and II, Ascó units I and II and Cofrentes, in addition to Lemóniz units I and II, which never reached the operation phase).



JEN experimental reactor

The country's companies progressively warmed up to nuclear technologies, a process that became consolidated in the 1980s during the construction of the 3rd-stage plants (Vandellós II and Trillo), when new equipment factories and fuel plants were built and specialised services started to be provided. The Valdecaballeros I and II and Trillo II units, which never came into operation, are also part of this third stage.

At the peak of the nuclear industry's activity in Spain, it directly employed over 20,000 people, including more than 5,000 highly qualified technicians. In addition, 40,000 to 50,000 more people worked for equipment supply and service provision companies. All this activity involved a significant effort of technology assimilation and training of technicians and specialists.

The Spanish Atomic Forum (Forum Atómico Español) – currently known as **Foro de la Industria Nuclear Española (Spanish Nuclear Industry Forum)**, a non-profit organisation that brings together those Spanish companies involved in the peaceful uses of nuclear energy and whose aim is to inform, disseminate, shape and boost the public image of nuclear energy, was created in **1962**. It currently has fifty three members including electric utilities, nuclear power plants, nuclear and radioactive facility operating companies, component manufacturers and nuclear system vendors, engineering and nuclear and radiological services companies, entities for the development of nuclear technology, and civil construction and installation companies.

In **1964**, the **Law 25/1964, of 29 April, on Nuclear Energy**, was approved. This law aimed to set the bases for nuclear energy in Spain and to define the powers and dependences of the JEN.

As nuclear energy developed in the country, the powers held by the JEN were allocated to different bodies.

The **National Uranium Company (Empresa Nacional del Uranio – ENUSA)** was set up in **1972**, in which the National Industry Institute (Instituto Nacional de Industria – INI) had a 60% share and the Spanish electric utilities the remaining 40%. In 1973, the first oil crisis exposed western countries' energy dependence and vulnerability; the Spanish Government entrusted ENUSA with managing the provisioning of uranium concentrates and the uranium conversion and enrichment services in order to guarantee the supply of fuel to the plants which were in operation in Spain and those included in energy plans.

Saelices El Chico

CIEMAT

Initially, the company's exploitation activities focused on areas near the uranium deposits in the Province of Salamanca. An uranium mine in Saelices el Chico, in Salamanca, was worked from 1972 to 2001, together with a yellow cake plant. This plant was closed when its operation ceased to be profitable enough. Nowadays, enriched uranium oxide is imported for the fabrication of fuel assemblies at the Juzbado plant (Salamanca), which has been in operation since 1985.

In **1974** ENUSA drew up the National Uranium Exploration Plan (PNEU), which was updated in 1981 when the Government entrusted ENUSA with devising the National Uranium Exploration and Research Plan (PNEIU). In **1983** the JEN transferred to ENUSA the uranium deposits it owned in La Haba (Badajoz) along with a small experimental facility.

The **Spanish Nuclear Society (Sociedad Nuclear Española – SNE)**, a non-profit professional association whose main goal was to serve as a forum for discussion between its members, was founded in 1974. It currently has close to one thousand individual and group members. Among the individual members there are engineers, scientists, doctors, legal experts, economists, students, etc. from both Spain and abroad.

In March **1979** the Three Mile Island (TMI-2) accident happened in the US. This accident showed it was possible to suffer accidents involving the deterioration of the reactor core, which up until then had been discarded in the deterministic analysis. As a result of the analysis of the event, a significant number of improvements where made to the safety regulations and requirements and the oversight mechanisms of the regulatory bodies, in particular in respect of man-machine interactions. The importance of sharing operating experiences and knowledge among plant operators was also revealed. The internationally-minded Institute of Nuclear Power Operations (INPO) was born out of this, of which Spain became a sector member through UNESA.

Due to the significant increase in the number of requirements from regulators as a result of the TMI-2 accident, design modifications where implemented in all plants in operation. In projects under construction, the impact of these new requirements resulted in delays and large cost increases in the projects.

Research programmes where launched to study in greater detail the phenomenology associated with severe nuclear accidents and to learn how to mitigate their consequences. Spain took an active part in R&D projects from a sector point of view.

With the **Law 15/1980,** creating the **Nuclear Safety Council (Consejo de Seguridad Nuclear - CSN)**, the regulatory function was dissociated from the JEN.

Fuel elements production facility in Juzbado

El Cabril

The new body would be in charge of the regulatory functions as regards nuclear safety and radiation protection. New energy goals – including the study of renewable energies – were set following the approval of the National Energy Plan PEN-83. Thus, in **1983** the JEN was turned into the **Research Centre for Energy, Environment and Technology (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas - CIEMAT)**, which was assigned R&D projects in four differentiated areas: Basic Research, Nuclear Technology, Radiation and Environmental Protection, and Renewable Energies.

The JEN was in charge of the management of the country's radioactive waste during the 1975-1979 period. At the end of 1979, the Decree Regulating the Activities in the Nuclear Fuel Cycle assigned the responsibility for managing radioactive waste to the JEN and spent fuel to ENUSA. Among the decisions of the aforementioned PEN-83 was the creation of a public company for the management, transport, storage and surveillance of radioactive waste.

The **National Radioactive Waste Company (Empresa Nacional de Residuos Radiactivos - ENRESA)** was set up in **1984**; it had the obligation to draft on the first quarter of every year an Annual Report on the actions taken the previous year and a revised version of the General Radioactive Waste Plan (PGRR). The first PGRR was approved in **1987** and stated that low- and medium-level waste (LMLW) must be stored in centralized facilities owned by ENRESA and that high-level waste (HLW) must follow the interim storage policy until they are disposed of. In addition, the Plan envisaged an interim storage facility, which must be in operation by 1993. The costs for managing radioactive waste according to the useful life of power plants were also established.

The third PGRR, which was approved in **1991**, included the new option of storing fuel in the plants fuel pools and finding technical solutions should their capacity become limited, the notion of a centralised storage being temporarily abandoned. It also established the programme for decommissioning Vandellòs I NPP. The El Cabril Low and Medium Level Waste Storage Centre, located in the Province of Córdoba, came into service in **1992**. In **2003**, Trillo I NPP, whose capacity to store spent fuel in its pools was limited, began to store its waste in a temporary dry storehouse. In **2006** the Government approved by consensus of all Spanish political parties the last General Plan – PGRR VI, which is currently in force, and among other measures it announced that Spain would have a surface Temporary Centralised Storage Facility (Almacén Temporal Centralizado – ATC) for storing the spent fuel and high-level radioactive waste from all Spanish NPPs. This project is currently in the ATC siting phase.

Former entrance to JEN

In **1983**, the ambitious nuclear energy programmes were suspended, following the guidelines of the National Energy Plan PEN-83. The nuclear moratorium (moratoria) was finally approved in **1984** (therefore, two years before the Chernobyl accident). The nuclear moratorium restricted Spanish installed nuclear capacity to 7,600 MWe and opted for an open fuel management cycle. Consequently, the work on five planned reactors was stopped: the Lemóniz I and II units, which belonged to the second stage (which at the time was 85 percent complete), and the Valdecaballeros I and II units (90 percent complete) and the Trillo II unit (still in its early construction stages), from the third stage.

In **1986**, the Chernobyl disaster happened, the most severe nuclear accident in the history of nuclear energy in the world. This accident was caused by plant design errors (of soviet design; very different from the technologies used in the western world) and inappropriate human behaviour, which took the plant to situations beyond its proper operation limits. As a result of the Chernobyl accident, the concept of "safety culture" was developed, which has been widely applied since then in Spanish NPPs in operation.

The National Energy Plan 1991-2000 was approved in **1992**, which kept the moratorium in place but promoted research in this field and underscored the contribution of this type of energy to the security of the supply. In **1994**, these projects were brought to an end once and for all with the passing of the National Electric System Planning Act (LOSEN), which annulled the corresponding construction permits.

The **Spanish Electricity Industry Association (Asociación Española de la Industria Eléctrica - UNESA)** played an important role in the coordination of nuclear activities. UNESA is the electricity sector's professional organisation for the coordination, representation, management, promotion and defence of the interests of the associated electric companies. It was established back in 1944 on the initiative of 18 electric utilities under the name of Unidad Eléctrica, S.A., to face up to the difficult circumstances the Spanish electricity supply was going through in those days.

UNESA has been involved in all aspects of the electrical activity and has played an essential part in issues such as the first energy planning projects, the setting up of a national tariff system, the exchange of knowledge and experiences between companies with regard to all technical aspects of the electrical activity, the beginning of the electronuclear development, etc.

Until the approval of the Law on the Electricity Sector of 1997 and the institutional transformation of UNESA into an Association, the business organisation focused on different sector activities: studies and analyses of the different facets of the electrical activity (transmission, distribution, regulation, recommended planning), prices and tariffs, economic and financial aspects, international and institutional relations, quality of service, the environment, research, standardisation and social communication, among others.

The **Law 54/1997 on the Electricity Sector,** which brought in regulatory changes to the electricity sector, came into force on **1 Jan 1998**. In particular, it approved the deregulation of the electricity sector by increasing competition among the different electric utilities and giving consumers the chance to choose their supplier.

The institutional transformation and the significant change in the approach to UNESA's different activities can be seen as the direct consequences of the Law on the Electricity Sector insofar as it meant that the electricity sector had to meet the new requirements of the competitive and deregulatory environment contained therein.

Important nuclear sector activities have been coordinated from UNESA. The sector's participation in international bodies such as INPO, WANO, EPRI, etc. has been managed through UNESA. UNESA has also coordinated R&D activities that have carried out thanks to the funds of the **Electrotechnical Research Plan (Plan de Investigación Electrotécnico - PIE)**, established in **1983**, and the **Electrical Association**

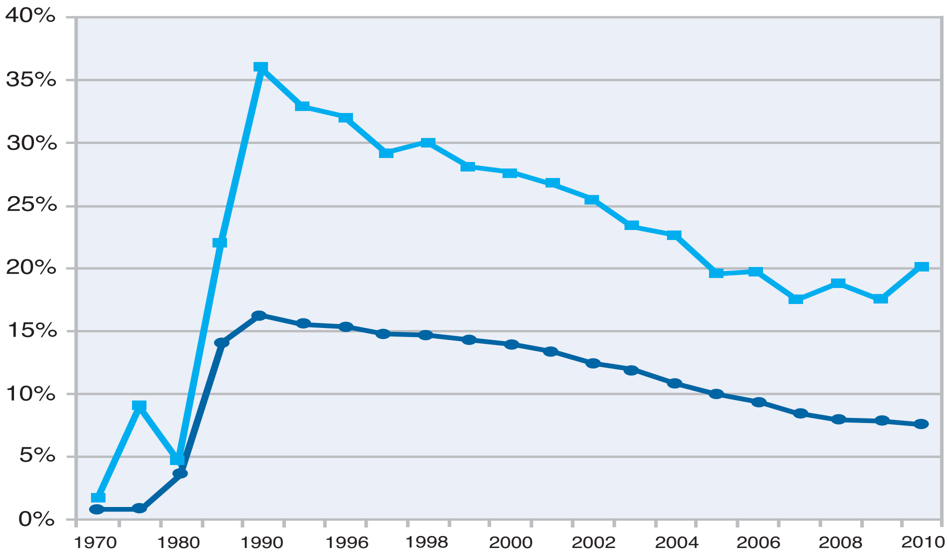
El Cabril

Transport used during the construction of José Cabrera Nuclear Power Plant

for Nuclear Technology Development (Agrupación Eléctrica para el Desarrollo Tecnológico Nuclear - DTN), set up in **1994**. The objective of the DTN was to keep the sector involved in new nuclear development programmes at the international level for as long as the nuclear moratorium lasted, by taking an active part in international forums and programs where new technologies are analysed (AP600, ABWR and so on).

The **Strategic Nuclear Research and Development Committee (Comité Estratégico de Investigación y Desarrollo Nuclear - CEIDEN)** was created in **1999** with the aim of coordinating Spanish nuclear R&D. This Committee led to the setting up in 2007 of the CEIDEN Nuclear Fission Energy R&D Technology Platform, which currently encompasses the entire nuclear sector.

The contribution of nuclear power to both electricity generation and installed capacity in Spain is shown in percentage terms in the following figure. The nuclear power's market share peaked at the beginning of the 1990s, when it accounted for more than 35% of all electricity generated in the country.



Contribution of nuclear power to electric power generation and installed power in Spain

Construction of Santa María de Garoña Nuclear Power Plant

Construction of Valdecaballeros I and II Nuclear Power Plant

2.2. The participation of Spanish companies in the construction of the existing nuclear power plants

Introduction

From the beginning of the Spanish nuclear programme, the national industry's participation in the introduction of nuclear power plants has been promoted and supported by the Government, as in other industrial sectors. The estimate of the potential degree of national participation in the construction of a nuclear power plant has been the subject of many studies from the start.

National participation is calculated on the basis of the percentage of involvement in the following headings into which the project of a nuclear power plant is typically divided:

1. Civil Engineering
2. Large components
3. Erection
4. Engineering
5. Personnel Training
6. Special Transports

Thus, real estate investment, financial costs and other types of investments are excluded.

The first stage of Spanish NPPs

When the construction of NPPs in Spain began to be planned, the Administration had the proper legislation to promote the contracting of national products and the local production of components. Since the promoters of the projects were public utility companies, they were under the legal obligation to acquire national products; if this was not feasible, the issuance of a Certificate of Exemption by the Ministry of Industry was required to formalise the corresponding import.

The degree of nationalisation of a nuclear power plant was set by means of an agreement between the promoters and the Public Administration, which set in the corresponding Construction Permits minimum objectives that the different equipment must meet in order to be compatible with the country's existing industrial structure. Coordination Committees were set up in every project so as to monitor the fulfilment of these goals.

The three NPPs from the **First Stage** (José Cabrera, Santa María de Garoña and Vandellòs I) were turnkey projects from international technology firms given the lack of experience of the Spanish industry at that time. The technology of these plants belongs to the so-called First Generation of nuclear reactors.

National participation in those projects was set to be at least 36%, although it finally came to an overall average figure in the order of **43%**: very high in Civil Engineering and Erection (70% to 80%); slightly over 60% in Engineering; rather large in Training; and below 25% in large components. The participation of the local industry in the sectors with the most advanced technology – nuclear, more specifically – was non-existent or scant. However, this relatively low participation in the supply of nuclear equipment allowed Spanish technicians to become familiarised with the nuclear industry's specifications and requirements.

Construction of Lemóniz I and II Nuclear Power Plant

The Second Stage of Spanish NPPs

At the time of tackling the projects of the next generation of NPPs there was in Spain a new legislation in force that had proven successful in the construction of several fossil-fuel thermal power plants: the Joint Equipment Manufacturing System, which provided a series of administrative advantages and tax breaks. The many joint manufacturing authorisation decrees that were granted determined the nationalisation percentages to be reached and how they would change in the future. Thus, help was given to the national industry to reorganise and become familiarised with the codes and standards used in the nuclear world and to acquire a new mindset on the quality requirements that are required of the nuclear industry.

The collaboration of Spanish technology firms was also important. Local engineering companies entered into agreements with foreign counterparts directed at gradually achieving self-sufficiency. As a result of all the above, it was possible to build a peripheral, national auxiliary industry infrastructure and, consequently, to increase the degree of participation in projects.

The first National Energy Plan was published in 1975, whose long-term planning provided sufficient and reliable knowledge of the view and perspectives if the local energy market. This schedule made by the Administration enabled the Spanish industry to become prepared sufficiently in advance to take part in NPP projects. The important market created in Spain in the 1970s allowed the national nuclear manufacturing industry to develop by leaps and bounds.

Degrees of national participation were set in the respective Preliminary Authorisations and Construction Permits for the plants of the **Second Stage** (Almaraz I and II, Lemóniz I and II, Ascó I and II and Cofrentes) that were greater than those of the previous Stage. Thus, for example, Almaraz NPP's Preliminary Authorisation set this percentage at a minimum of 50%, in accordance with the guidelines of the 1969 National Electricity Plan, whereas its Construction

Almaraz I and II Nuclear Power Plant

Components manufactured by ENSA

Construction of Ascó I and II Nuclear Power Plant

Permit raised it to at least 60%, following the guidelines laid down by the first version of the 1972 National Electricity Plan.

This group of plants – belonging to the so-called Generation II of nuclear reactors – was contracted in large packages such that the electric companies took on the direct responsibility for the projects, although they were assisted by Spanish engineering firms. This contracting scheme, along with the experience gained by many local companies and the application of the joint manufacturing authorisation system pushed by the Administration, made it possible to substantially increase national participation.

The main packages that were contracted were the Nuclear Steam Supply System (NSSS) and the Turbo-generator. The rest of the plant – or BOP (Balance of Plant), was divided in turn into systems and subsystems, which were contracted with different vendors.

Given the contractual approach of these projects, engineering firms played an increasingly greater role – except in the design of the nuclear island – and their performance had a multiplier effect that contributed to an increase in Spanish participation in the rest of headings that make up the final cost of a plant, particularly large components.

In a typical NPP belonging to the Second Stage, the highest degree of national participation was achieved in the Civil Engineering, Erection and Training headings, almost hitting 100% mark. The lowest national participation was in large components – hovering around the 50% mark, even though a considerable technological leap had taken place with regard to that of the preceding Stage. On the whole, national participation in Engineering stood at approximately 85%. The overall degree of national participation in this NPP Stage ranged **between 65% and 70%**. The range between these two fig-

Construction of Vandellós II Nuclear Power Plant with Vandellós I in the background

ures is due to variations according to the project at hand and the source consulted.

At the beginning of the 1970s it was understood that in order to significantly increase the degree of national participation in the subsequent Stages (with the ultimate goal of reaching 80%) it was essential to increase participation in the large components heading and more specifically in the area of Nuclear Steam Generation Equipment. Consequently, the Administration promoted the constitution of the company Equipos Nucleares, S.A., (ENSA) in 1973. Among the conditions that were placed on the public bidding process announced to this end was that of tackling at least the manufacture of the vessels with its internal components, steam generators, pressurizer and primary-circuit piping. Its manufacturing facilities were initially designed to produce at least three Nuclear Steam Generation Systems per year.

The Third Stage of Spanish NPPs

The Preliminary Authorisations of **Third-Stage** NPPs (Sayago, Trillo I and II, Valdecaballeros I and II, and Vandellòs II and III) set minimum national participation percentages at 65%. As in the previous Stage, the technology used during this Stage belonged to the so-called Generation II of nuclear reactors.

This time national participation was widespread for the first time in the main components of the primary circuit and also the fuel cycle thanks to the involvement of the aforementioned ENSA entity and the National Uranium Company (ENUSA) respectively. In the case of the heavy components of the primary circuit of Second-Stage plants, the percentage of national participation stood just at 8%, whereas that for Third-Stage plants it was expected to reach 50% in pressurised water systems and exceed 70% in boiling water reactors.

Vandellós I Nuclear Power Plant

Trillo I Nuclear Power Plant

The estimated degree of national participation for NPPs belonging to this Stage ranged **from 80% to 86%** according to the specific project and the source of the information. In the Civil Engineering and Erection headings, participation was virtually 100%. In Engineering it ranged between 85% and 95%, and in Other Services it was above 95%. Spanish participation in large components ranged from 70% to 78%.

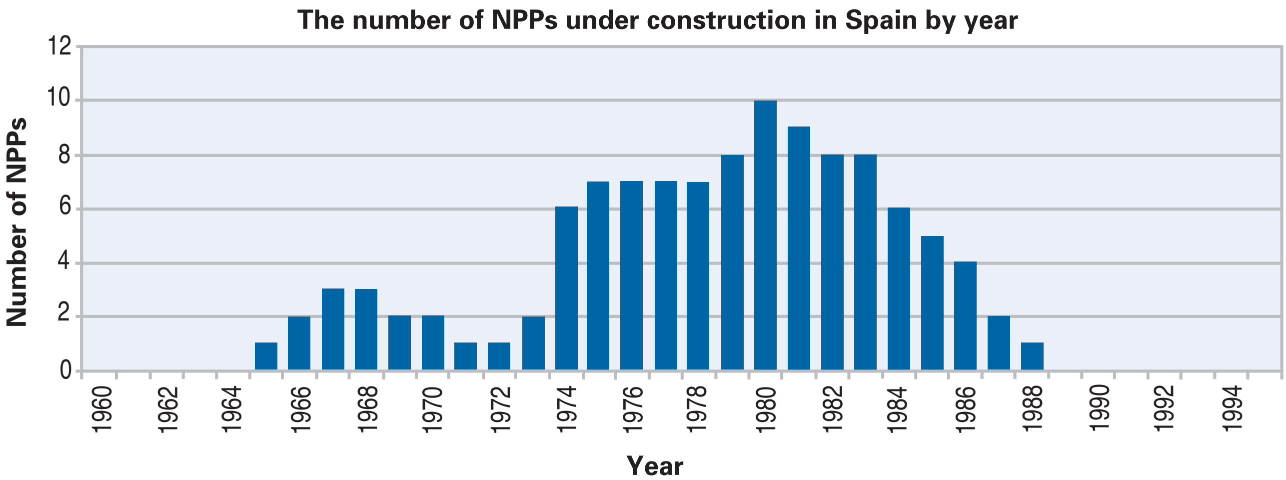
The infrastructure of the national nuclear industry reached its maturity during the introduction of this last group of plants, it being rounded off with the construction of primary-circuit component and fuel plants and the creation of specialised-services companies. The degree of national participation reached its practical maximum in the large components heading, it being hard to surpass since it was greatly influenced by the need to obtain in the Spanish market intermediate semi-finished goods whose manufacture was not justified for scale reasons. The local production of items for which there was not a sufficiently large market or of highly specialised equipment was not envisaged.

Some plants that did not manage to obtain the Construction Permit but for which equipment was built and civil engineering work was carried out have not been included in the posterior Table (Sayago, Cabo Cope or Regodola).

NPP projects in Spain

Name	Type	Power	Prev.	Const.	Oper.	State
1st Stage						
José Cabrera	W-PWR-1L	160	1963	1964	1968	Dismant.
Santa Mª de Garoña	GE-BWR/4	460/466	1963	1966	1971	Operation
Vandellós I	F-GCR	500	1967	1968	1972	Dismant.
2nd Stage						
Almaraz I	W-PWR-3L	930/1035	1971	1973	1982	Operation
Almaraz II	W-PWR-3L	930/1045	1971	1973	1984	Operation
Lemóniz I	W-PWR-3L	930	1972	1974	-	Cancelado
Lemóniz II	W-PWR-3L	930	1972	1974	-	Cancellled
Ascó I	W-PWR-3L	930/1032,5	1972	1975	1985	Operation
Ascó II	W-PWR-3L	930/1027,2	1972	1975	1986	Operation
Cofrentes	GE-BWR/6	975/1092	1972	1975	1985	Operation
3rd Stage						
Valdecaballeros I	GE-BWR/6	975	1975	1979	-	Cancellled
Valdecaballeros II	GE-BWR/6	975	1975	1979	-	Cancellled
Vandellós II	W-PWR-3L	930/1087	1976	1980	1988	Operation
Trillo I	KWU-PWR-3L	1030/1066	1975	1979	1988	Operation
Trillo II	KWU-PWR-3L	1030	1975	1979	-	Cancellled

Vessel of Cofrentes Nuclear Power Plant



Evolution by heading

A heading-by-heading analysis of the degree of national participation in Spanish NPP projects reveals the following:

- The **Civil Engineering** heading always had very high percentages – close to 100% – of Spanish involvement.
- Participation in **Large Components** in the Second Stage doubled that of the First Stage, a significant technological leap having been made by taking part in the supply of high quality components with a large technical content. The practical maximum degree of Spanish participation was reached during the Third Stage.
  - In **Nuclear Equipment**, national participation was at first practically zero, but it experienced spectacular growth until managing to supply primary-circuit and fuel components during the last Stage.
  - The supply of **Mechanical Equipment** by the national industry was scarce at the beginning but it increased with time.
  - The supply of **Electrical Equipment** was comparatively greater at the start and achieved a very high degree of national production.
  - As far as **Instrumentation & Control** is concerned, however, the national contribution was rather low.

At the end of the 1970s, a study ascertained that 90% of the materials used in the construction of a nuclear power plant were Spanish as well as 80% of the machinery.

- Spanish participation in **Erections** (mechanical, electrical and I&C) was initially somewhat lower than in Civil Engineering – although very high too, increasing with time.
- In **Engineering**, the contribution in the first projects was not great, it being limited to a collaborative role with foreign companies. From the Second Stage on, national companies played an increasingly greater role, participation being very high in the last projects.
- Spanish contribution was always fairly large in the **Training** department.
- National participation in **Quality Assurance** was significant from the outset and increased as time went by.

Cofrentes Nuclear Power Plant

3. Activities of a new Generation III Nuclear Project

This Study analyses the Spanish industry's capacity to tackle the project for the construction of a new nuclear power plant in Spain. To this end, the base case of the construction of a generic nuclear reactor of an advanced design – Generation III – is taken as a starting point and a set of basic activities associated with the project is defined such that the consulted companies may identify those activities for which they have capabilities.

The construction of an NPP is a complex process that involves many activities ranging from the first feasibility and siting studies to the commissioning and subsequent operation, by way of the entire process of engineering development, licensing and obtaining of administrative permits, equipment manufacturing, and construction and erection proper.

The activities that make up a NPP construction project can be grouped in many ways, which in turn can be detailed down to the level of sub-activities or tasks, which may exceed the 100,000 mark.

For the purposes of this Study, it has been deemed appropriate to class the activities into a small group of large activities. The final list of activities of a nuclear project has been prepared in several phases. An initial list that was drawn up based on international references and the Spanish nuclear industry's own experience was used as a starting point, which was distributed to a series of companies as a questionnaire to ascertain its potential and identify possible areas for improvement.

This process has resulted in a classification of the activities into 14 large groups and a breakdown thereof into three levels at the most.

The 14 groups of activities into which the different activities that are needed to carry out a nuclear project have been divided are the following:

1. Preliminary and feasibility studies: it includes the activities for developing the business plan for the new project as well as the configuration of the team required to manage it, with the support of whatever education and training are necessary.
2. Siting studies: it encompasses the activities needed to select and license the site, including the necessary specific surveys and investigations (geological, geotechnical, weather, etc.).
3. Selection of technology: this phase includes the activities required to select and contract the plant's main contractor (drafting of the bid invitation specification, the technical and economical evaluation of the tenders received, the financial evaluation, and the negotiation of the contract).
4. Support to licensing and permits from public administrations: this phase relates to the drafting of documentation and the application for the necessary permits for the licensing of the project from both the nuclear and the environmental and administrative points of view.

   In the part that is strictly nuclear, it encompasses the execution of the Safety Study, including the necessary deterministic and probabilistic nuclear safety analysis, and the drafting of the technical specifications and other authorisation and permit documentation, as well as the support required during the licensing process with the CSN.

   In the non-nuclear part, it includes the Environmental Impact Assessment and the process for obtaining the Environmental Impact Statement (EIS), as well as obtaining the corresponding regional and municipal permits.
5. Project management: it refers to the technical management of the plant's construction project. This activity can be divided into two basic sub-ac-

Olkiluoto NPP, Finland

tivities: the nuclear island, and the turbine island and BOP.

6. Engineering and design: it covers two large blocks, the basic and detailed engineering of the project, including the civil engineering, mechanical, electrical and I&C areas; and the human factors engineering, which includes the design and supply of the control room.
7. Procurement and suppliers inspection: it includes the purchasing and suppliers monitoring process, the manufacturing and approval inspections and audits, and the transport of special equipment.
8. Construction and erection: it comprises the preparation of the site, the supervision of the construction and the construction proper, including civil works, the mechanical, electrical and I&C erections and the hiring out of cranes for construction.
9. Drawing up quality assurance programmes and procedures for appropriately controlling the construction process.
10. Education and training: of operators, for them to obtain their operator licences, and of the rest of personnel needed to operate the plant.
11. Large-component manufacturing: it is subdivided into two main sub-activities, the manufacture of components belonging to the Nuclear Steam Supply System (NSSS) and the manufacture of the rest of equipment.

    The reactor vessel and its internals, the steam generators and the pressurizer, the primary-circuit piping and the primary and recirculation pumps are included in the part corresponding to the nuclear island (NSSS).

    The remaining equipment includes the turbo-generator, the containment vessel, piping, pumps, valves, the condenser, heat exchangers, fuel storage racks in pools, large modules, handling cranes, the waste treatment system, and transformers.
12. Fuel procurement and fabrication: it encompasses the licensing of the fuel, the refuelling scheme, the procurement of enriched uranium and the fabrication of fuel.
13. The commissioning prior to operation, including the drafting of procedures for commissioning and in-service pre-inspection.
14. Operation support: radiation protection, operating procedures and in-service inspection at the start of operation are included in this activity.

In order to perform a study of the capabilities of the Spanish nuclear industry, it is necessary to appraise the monetary value of the different activities of the base case. Given that the base case is a generic, GIII or GIII+ advanced-design nuclear reactor, it is just unfeasible to talk about absolute economic values, although the approximate estimated cost of one of these reactors would be in the order of thousands of millions of Euros. This is why we have opted for assigning a percentage-wise economic weight to each of the activities of the project over the total value thereof. On the other hand, the activities may have different weights depending on the design. Therefore, it has been necessary to resort to the technology firms present in Spain and carry out an iterative process to obtain weights that may represent the possible different designs. Additionally, said weights have been contrasted with the information on Spanish construction experience of the last reactors built in the 1980s available at the different electric utilities.

	ACTIVITY	ECONOMIC WEIGHT
1	Preliminary and feasibility studies	0,2%
2	Siting studies	1%
3	Selection of technology	0,3%
4	Support to licensing and permits from public administrations	7,5%
5	Project management	5%
6	Engineering and design	15%
7	Procurement and suppliers inspection	3%
8	Construction and erection	25%
9	Quality assurance programmes and procedures	2%
10	Education and training	1%
11	Components manufacturing	30%
12	Fuel procurement and fabrication	5%
13	Commissioning	4%
14	Operation support	1%
TOTAL		**100%**

The economic weights shown in the preceding table are the final result of the estimation process that has been followed.

As has been previously mentioned, in order to perform the analysis of the Spanish industry's capacity, a first detailed list to be sent to the companies was prepared based on the identified activities.

The definition of the final list of activities of the nuclear project has been made in several phases. During the Initial Phase of the Study, a first list was agreed with the companies belonging to the CEIDEN's Advanced Reactors Group (Grupo de Reactores Avanzados – GRA) which included the 14 defined fields of activity broken down into 54 activities arranged in rows so as to make it easier for the study participants to select those activities in which they were experienced.

Four columns to be filled in were included in every activity:

- The company's experience in past or current projects in said field of activity.
- Interest. It corresponds to those fields of activity where the company, regardless of whether it has experience in them or not, wants to work in hypothetical construction projects for new NPPs in Spain.
- References. It identifies the projects in which the company has taken part and has indicated in the field "Experience".
- Additional comments about any of the activities.

This initial table was filled out by most of the participants of the GRA. Likewise, other companies from the sector were invited to participate in the study, most of which were willing to do so.

The participants in this Initial Phase were: Acciona, Coapsa, Empresarios Agrupados, Ensa, Enviros (now, Amphos 21), Idom, Initec, Medidas Ambientales, Sener, Socoin, Tecnatom, and Vector Valves.

As a result of the participant's involvement, a first picture of the potentiality of the questionnaire and areas for improvement were obtained for tackling the following phase of the Study, with wider participation of the Spanish nuclear business sector.

Jules Horowitz reactor

Among the areas for improvement was the need to modify the list, further breaking down some of the activities and increasing the level of proof of experience in the different fields.

The Second Phase of the Study was coordinated by the electric companies ENDESA, GAS NATURAL FENOSA and IBERDROLA, with support from the Spanish Nuclear Industry Forum (FORO NUCLEAR) and the collaboration of the main technology firms (Areva, GE-Hitachi and Westinghouse).

The resulting list of activities of the preceding phase was jointly reviewed and completed by these companies.

With the new list, meetings were held from November 2009 onwards with some of the companies that are representative of the different areas of the sector so as to finish shaping the questionnaire: Acciona, Dragados, Ensa, Enusa, and Tecnatom.

After these consultations, the final version of the questionnaire was prepared, which is the one that has been used for the campaign.

The final list breaks down the 14 large areas of activity into 92 activities. The full list of activities of the questionnaire is shown next:

1. PRELIMINARY AND FEASIBILITY STUDIES

- **1.1.** Feasibility studies
- **1.2.** Project management personnel training (utility)
- **1.3.** Plant construction personnel training (utility)
- **1.4.** Other (specify)

2. SITING STUDIES

- **2.1.** Site selection
- **2.2.** Technical site studies
  - 2.2.1. Geotechnical investigations
  - 2.2.2. Other studies related to the safety of the site
- **2.3.** Support to the licensing of the site

3. SELECTION OF TECHNOLOGY

- **3.1.** Drafting of the bid invitation specifications for the main contractor
- **3.2.** Technical and economic evaluation of tenders from the main contractor
- **3.3.** Negotiation and financial evaluation of tenders from the main contractor

4. SUPPORT TO LICENSING AND PERMITS FROM PUBLIC ADMINISTRATIONS

- **4.1.** Nuclear licence documentation drafting
- **4.2.** Safety Studies
  - 4.2.1. Deterministic approach: Accident Analysis and radiological estimate:
    - *4.2.1.1 Transient analysis*
    - *4.2.1.2 LOCA analysis*
  - 4.2.2. Probabilistic Safety Analysis
- **4.3.** Technical Specifications
- **4.4.** Environment Impact Assessment
- **4.5.** Other aspects related to the licensing of Nuclear or Radioactive Facilities
- **4.6.** Other administrative permits

Lungmen Nuclear Power Plant

Flamanville Nuclear Power Plant

5. PROJECT MANAGEMENT

- **5.1.** Nuclear Island
- **5.2.** Turbine Island-BOP
- **5.3.** Other (specify)

6. ENGINEERING AND DESIGN

- **6.1.** Development of drawings, specifications, calculations, reports, etc.
  - 6.1.1. Mechanical engineering
  - 6.1.2. Electrical engineering
  - 6.1.3. I&C
  - 6.1.4. Civil engineering
- **6.2.** Human factors engineering. Man-machine interface
  - 6.2.1. Design and supply of the Control Room and the man-machine interface
  - 6.2.2. Procurement of the simulator
  - 6.2.3. Supply of operation support systems
  - 6.2.4. Design of screens and displays
  - 6.2.5. Other (specify)

7. PROCUREMENT AND SUPPLIERS INSPECTION

- **7.1.** Tenders evaluation, procurement and activation
- **7.2.** Suppliers inspection and quality control and assurance supervision
- **7.3.** Transport of special equipment

8. CONSTRUCTION AND ERECTION

- **8.1.** Site Preparation
- **8.2.** Construction and erection
  - 8.2.1. Civil works
  - 8.2.2. Electrical erection
  - 8.2.3. Mechanical erection
  - 8.2.4. I&C
  - 8.2.5. Cranes for construction
  - 8.2.6. Other (specify)
- **8.3.** Construction and erection supervision

9. QUALITY ASSURANCE PROGRAMMES AND PROCEDURES

10. EDUCATION AND TRAINING

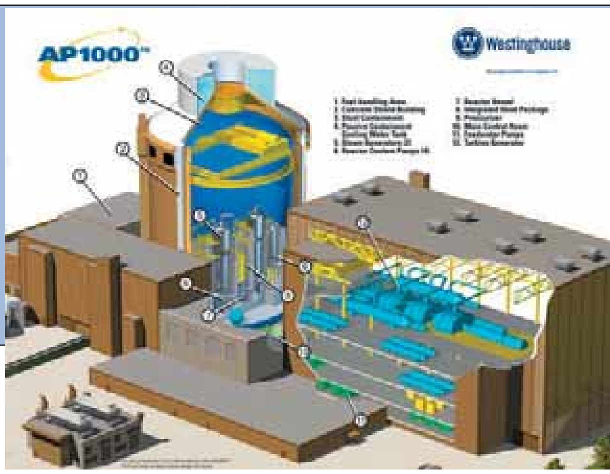
- **10.1.** Operators training (licencing)
- **10.2.** Plant personnel training
- **10.3.** Managers and construction personnel training (project)

11. COMPONENTS MANUFACTURING

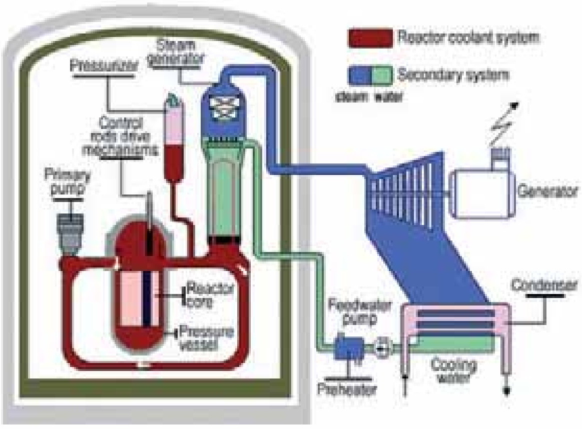
- **11.1.** NSSS components manufacturing
  - 11.1.1. Reactor vessel
  - 11.1.2. Reactor internals
  - 11.1.3. Steam Generators (PWR)
  - 11.1.4. Pressurizer (PWR)
  - 11.1.5. Primary-circuit piping
  - 11.1.6. Primary-circuit and recirculation pumps
- **11.2.** Manufacturing the rest of the equipment
  - 11.2.1. Turbo-generator
  - 11.2.2. Valves
  - 11.2.3. Containment vessel
  - 11.2.4. Condenser
  - 11.2.5. PRHR heat exchanger
  - 11.2.6. Heat exchangers
  - 11.2.7. Fuel storage racks
  - 11.2.8. Large modules
  - 11.2.9. Other components and modules
  - 11.2.10. Cranes for plant operation
  - 11.2.11. Waste treatment systems
  - 11.2.12. Transformers

12. FUEL PROCUREMENT AND FABRICATION

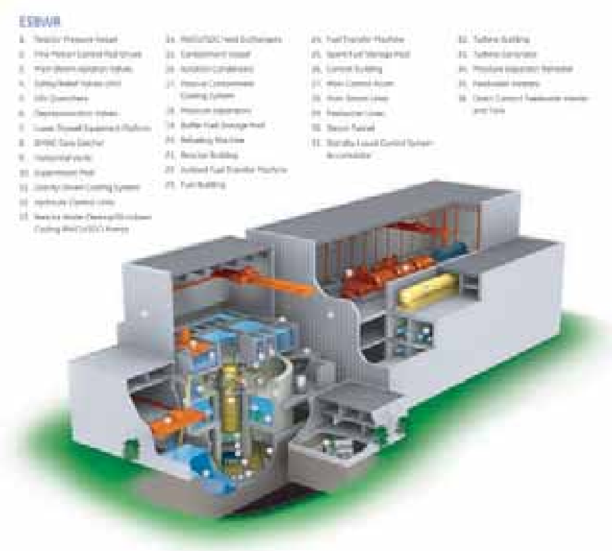
- **12.1.** Fuel licensing
- **12.2.** Refuelling scheme
- **12.3.** Procurement of enriched uranium



AP1000, Westinghouse



EPR, Areva



ESBWR, General Electric

- 12.3.1. Procurement of concentrates
- 12.3.2. Procurement of conversion services
- 12.3.3. Procurement of enrichment services
- **12.4.** Fuel fabrication

13. COMMISSIONING

- **13.1.** Commissioning procedures drafting
- **13.2.** Commissioning support
- **13.3.** In-Service Inspection
  - 13.3.1. In-Service Inspection Programme
  - 13.3.2. Accessibility study
  - 13.3.3. Execution of the pre-ISI

14. OPERATION SUPPORT

- **14.1.** Radiation Protection
  - 14.1.1. Dose calculation codes
  - 14.1.2. Procedures
- **14.2.** Operating procedures
- **14.3.** Design modifications
- **14.4.** Codes and standards applicable to the ISI
- **14.5.** Execution of the ISI

The purpose of the analysis is to evaluate two time horizons. The first one, by analysing the company's current situation. The second, by analysing the situation in the event the company had a 5-year horizon to prepare itself for the new project. This last case would correspond to that situation when there is a political commitment to launch the new project, but 5 years would be required from this commitment to the start of construction (application for permits, licensing, etc.).

Allowing for all of this, the questionnaire includes three columns to be filled in for each activity:

- **The current situation:** the activities in which the entity has capabilities and experience at present must be indicated.
- **The situation after 5 years:** the activities in which the company would be interested in becoming proficient – in the event it had 5 years to prepare itself – must be indicated.
- **Proof of experience:** the entity's experience – by means of the name of the project and a brief description thereof – must be entered in this column for the activities in which the company has stated having capabilities.

This questionnaire was sent to the companies during the second half of 2010 as an Excel spreadsheet so as to facilitate its completion (see Annex I).

4. List of nuclear sector companies

In order to conduct an analysis of the Spanish capabilities to embark on a new nuclear project it was necessary to find out which companies were capable of carrying out parts of the project. Taking this parameter into account, companies that carry out all or part of their activities in the nuclear sector have been selected. In order to do so, the list of companies that have shown interest in the nuclear sector provided by the Spanish Nuclear Industry Forum was taken as a starting point.

181 companies, associations, technology centres and professional associations (a representative sample) were selected out of the almost 1,000 entities that have been found that might perform activities in a standard NPP. Of this list, 36 companies responded.

The classification of these companies by sector is the following:

CATEGORY		COMPANIES
1. Engineering and Consultancy		Abengoa, Acciona, Amphos 21, Cespa Conten, CT3 Ingenieria, CTC, Empresarios Agrupados, Iberdrola Ingeniería y Construcción, Idom, Ingeciber, Proinsa, Sener, Siemsa, Socoin, Thunder España Simulación
2. Inspection and Services		Coapsa, Cobra, Iberdrola Ingeniería y Construcción, Medidas Ambientales, PGS Enrique Mª Hierro, Siemsa, Tecnalia, Tecnatom
3. Construction		Acciona, Dragados
4. Erection		Abengoa, Acciona, Dragados, Duro Felguera, Tamoin
5. Electrical and I&C Equipment	Vendors and Manufacturers	Abengoa, Amara, Cantarey Reinosa, Dragados, Electromediciones Kainos, PGS Enrique Mª Hierro
6. Mechanical Equipment		Alfa Laval, Dragados, Duro Felguera, Ensa, Mecanol, Navantia, PGS Enrique Mª Hierro, Ringo Válvulas, Tubacex, Vector & Wellheads
7. Insulation and Paint		Revanti
8. Fuel Cycle		Enusa
9. Test Laboratories		Ensa, Medidas Ambientales, Navantia


DRAGADOS
Y CONSTRUCCIONES, S.A.

5. Results of the analysis

The answers of the different companies that have taken part in the study have been shown in table form, including the sub-activities in which each company has stated having experience (currently or five years from the launch of a new nuclear programme in our country), a summary of the experience provided by the companies as proof of their capabilities and the contact information thereof. The different tables may be looked up in Annex 2.

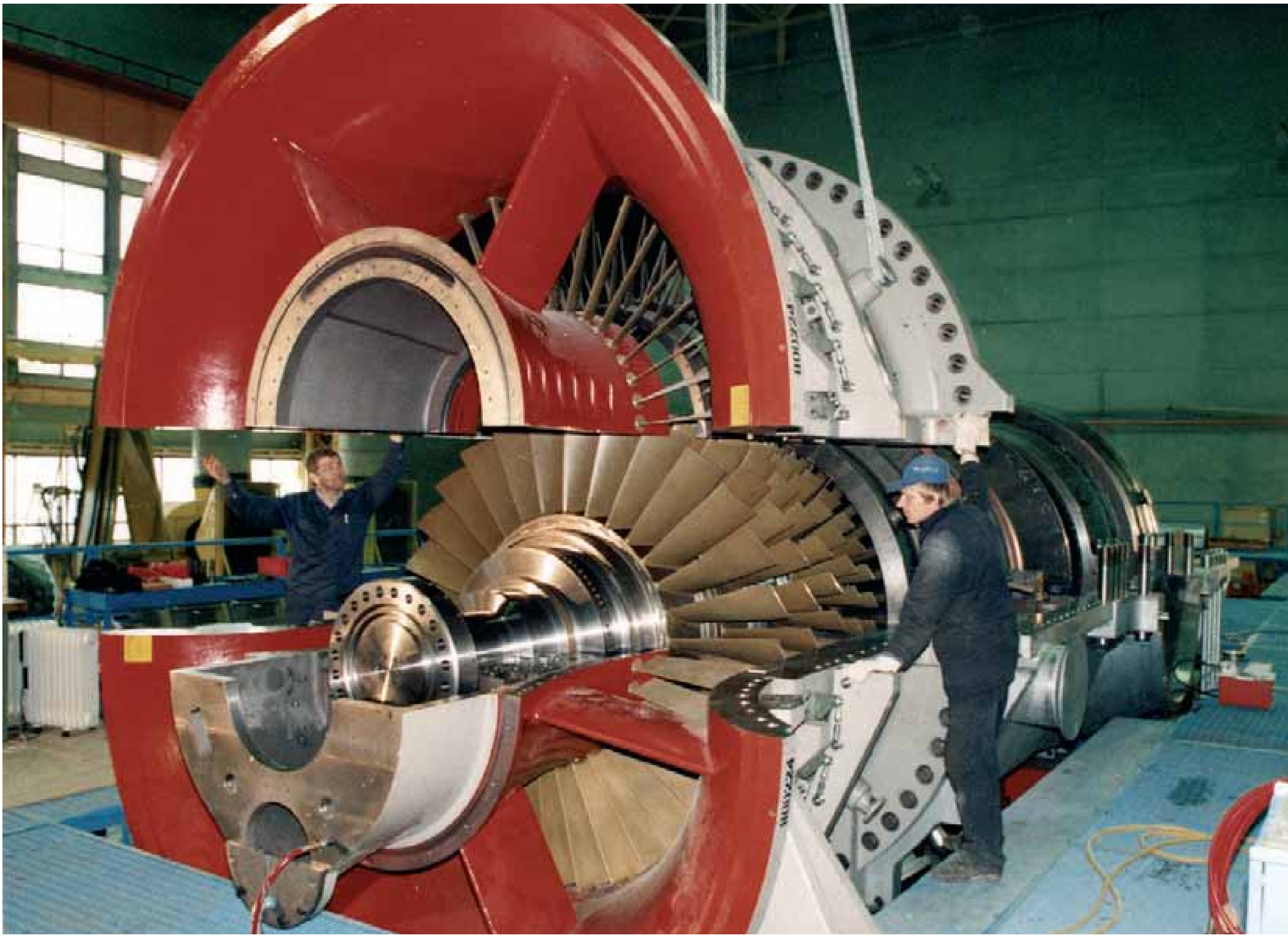
The following results were obtained after analysing all the answers:

1. All activities and their corresponding sub-activities have been covered by Spanish companies at present, showing their experience in all fields.
2. A greater level of detail in sub-activities has not been attained in the drafting of this report so as to render the study manageable. However, the team that has conducted this study is aware that, in some particular cases, even though the capacity to perform the corresponding sub-activity has been ticked and proof of the related experience has been provided, this experience does not cover the entire sub-activity but only part of it. This is why the final result does not entail 100% of the project carried out by Spanish companies but a somewhat lower value.
3. Bearing the previous comment in mind, the result of the analysis is that:

- the Spanish nuclear sector has the capacity to handle **77 per cent of a new nuclear project at present,** with proven experience,
- which would jump to **82 per cent five years after the launch** of a new nuclear programme in our country.

Control room

Turbine



6. The regulatory body's approach

In order to assess the feasibility of new nuclear power plant projects, it is unavoidable to analyse the essential aspects of the licensing process from the point of view of both the licensee and regulatory system. In this context, this Section purports to provide some general considerations of a qualitative nature allowing to assess the impact of the licensing process from the perspective of the regulatory body: the CSN.

Overall, it can be stated that the licensing of a new nuclear power plant in Spain would constitute a very important challenge for the CSN, which would entail the need to greatly strengthen the body's resources and capabilities. Nevertheless, the execution of this licensing is considered feasible in view of current resources, experience and capabilities, provided it is possible for the body to take the necessary steps to afford itself of the necessary additional infrastructure in a scheduled manner.

The issues associated with the licensing of a new NPP and the means and resources currently available or attainable in the medium term to face up to said issues are analysed below on a general basis. From this, it can be concluded that the CSN would be in position to tackle such licensing process with a guarantee of success.

First of all, it is worth mentioning that the CSN's current organisational structure and resources are designed and dimensioned to deal with the activities for licensing and overseeing the existing nuclear fleet. The licensing of new NPPs would inevitably require a major restructuring of the body and a marked increase of its resources.

On the other hand, the long time passed since the last generation of Spanish NPPs (Cofrentes, Trillo and Vandellòs II) was licensed must be taken into account. In this 25-year period the technological evolution has been significant, not only in respect of the conceptual design of reactors and associated systems but also with regard to the auxiliary components, circuits and systems (particularly digital I&C systems and modern man-machine interfaces, which are radically different from those currently installed in our plants).

From these considerations, it can be derived that the CSN would have to deal in this regard with a dual challenge. On the one hand, the lack of experience of most of the body's technical staff in the licensing of new NPPs, given that most of them joined the CSN after the mid-1980s. On the other, the need to acquire or increase the degree of knowledge and experience in certain technologies that might apply to a new project.

Nevertheless, it is believed that these challenges can be dealt with successfully provided there is an appropriate period of adaptation. Throughout its more than 30 years of history, the CSN has been capable of acquiring infrastructures and capabilities to develop all the new activities it has had to undertake, some of which far-reaching and complex.

As far as the increase in resources needed to deal with licensing is concerned, the CSN has the independence and appropriate tools to bring in new personnel and have external support, should the possibility of building new plants be assumed at the political level.

The natural way of taking on new staff is the recruitment of technicians by competitive examination, filling positions from public job vacancies. Evidently, it must be borne in mind that newly hired personnel will not be ready to carry out new-NPP licensing tasks after a minimum education and training period has elapsed, which can be around three years; moreover, the resolution of the competitive examination is 18 to 24 months after the announcement of new positions, that must be added to this period. Thus, it is essential that the decision making regarding new nuclear projects to take place such that it is possible to carry out this process in a scheduled manner.

An additional resource available to the CSN is the hiring of external support for assessment tasks. There is plenty of experience with regard to the licensing processes of the most modern plants. This resource, however, has limitations and poses difficulties when it comes to having companies with the required capabilities and experience that may be deemed completely independent from licensees. On this subject, the CSN's constant effort to keep highly qualified and

Consejo de Seguridad Nuclear headquarters

Emergencies room (SALEM) operating room

specialised technical staff in public bodies through R&D programmes and other tools has to be underscored. Owing to all of the above, this hiring would in any case be complementary to the recruitment of new personnel of its own.

As for the CSN's technical capacity and know-how, some considerations must be set forth. Even though it is true that due to the 25-year lapse without performing activities to license new plants the CSN has not acquired deep knowledge about new technologies applicable to new-generation plants, it has followed to a certain extent the evolution of said technologies and their licensing implications. For example, the CSN has actively participated in monographic technical seminars on new technologies organised by CEIDEN in Spain as well as in different international courses and meetings about issues related to the new designs. On the other hand, the activity displayed for many years by the electrical systems and I&C area in the field of digital technology applications for Spanish plants in operation in collaboration with UNESA has also been noteworthy; there is already some accumulated experience in the licensing of this type of systems.

In this sense, the CSN's monitoring of aspects related to the licensing of new plants via its participation in a specific initiative on the subject as part of UNESA's licensing subgroup is worth stressing. By taking part in this group, the CSN is systematically keeping abreast of all international programmes related to the subject (basically, within the OECD/NEA and IAEA) and, above all, has the chance to put forward and discuss with the sector the big issues that would arise in the event of the construction of new plants, such as the characteristics of the licensing process to be applied and the estimated time for granting an authorisation. Likewise, the CSN is participating in a OECD/NEA programme on new-generation reactors. In relation to all of this, the crucial role that international cooperation would play in preparing the CSN to approach the licensing of a new plant at both the level of multinational organisations (OECD/NEA, IAEA, WENRA, etc.) and a bilateral level with the support from the regulators of the countries of origin of the technology or countries with previous experience in these processes (NRC, ASN, STUK, etc.) must be highlighted.

Finally, an important aspect to keep in mind is the technical preparation and experience of the CSN's current staff to embark on the evaluation and inspection activities associated with the licensing of a new plant. On this subject it is worth mentioning that the CSN maintains a core of experts in different disci-

CSN emergencies room (SALEM) management room

IAEA headquarters in Vienna, Austria

plines who have remained in the body almost from the start (many of them, in addition, come from the old Nuclear Energy Board – JEN, the CIEMAT's forerunner, and, therefore, have previous experience in these issues) and who, therefore, are experienced in the licensing and commissioning of NPPs and have a general view of the process and a long professional career in licensing and inspection issues; even though some of these experts are not longer part of the body for one reason or another, the CSN can avail itself of a minimum number of experts of these characteristics in the medium term. In any case, it must be taken into account that the people from the first classes of CSN technicians will begin to retire in the next few years and measures will have to be put in place to replace them and retain their experience, a process that could overlap with the process for recruiting personnel for new projects. The actions taken or envisaged by the CSN related with knowledge management (even though a knowledge management system as such has not been introduced yet) will help to preserve this know-how in the best possible way.

In addition to the above, the current technical department, which is made up by about 220 experts (of which approximately half are devoted to nuclear safety and around 50 to radiation protection activities related to nuclear power plants, although the latter not usually full time), has kept acquiring knowledge about and experience in technical areas and analysis and supervision methodologies, which guarantees the presence of a foundation of technical proficiency for tackling the licensing of new plants. The CSN's technical capacity undergoes a process of constant improvement and has been revised and proven e.g. during the IAEA's 2008 IRRS mission (to be followed up in 2011).

7. Conclusions

The following conclusions can be drawn from the analysis of the Spanish nuclear industry's capabilities for dealing with a new nuclear project in our country:

1. Even though 23 years have gone by since the last NPP was commissioned in Spain, the value obtained for the Spanish industry's capacity to carry out a new nuclear project in our country **–77 per cent of the economic activity of the new project**– is very high. It is clear that the internationalisation of our companies due to their competitiveness in the international market and the support given to the operation of Spanish NPPs have allowed to maintain the knowledge base during these years.

2. Secondly, it must be emphasised that the launch of a new nuclear programme in our country would mean increasing the value of the Spanish industry's participation to **82 per cent of the economic activity of the new project in a period of five years**. Evidently, this means that Spanish companies are willing to strengthen their nuclear departments in order to participate in a new project, which would contribute to the creation of highly qualified technical jobs.

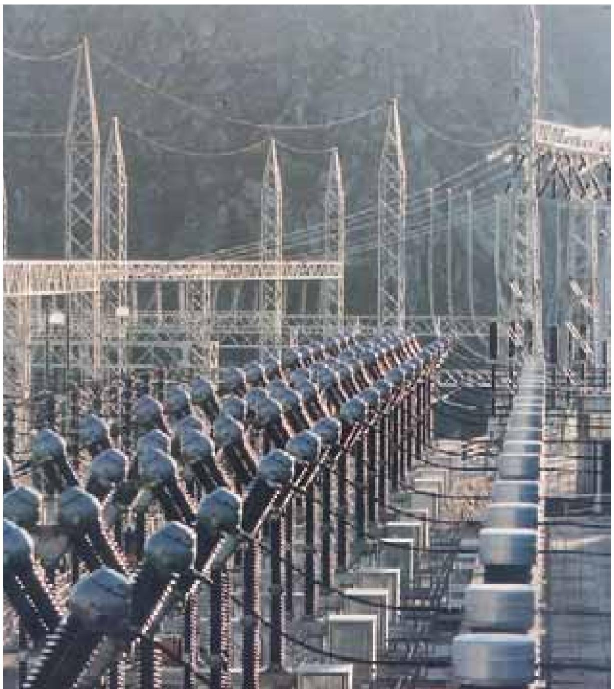
3. Since the total cost of a new nuclear project is in the order of **thousands of millions of Euros**, its economic repercussion in the country would be huge owing to both the creation of highly qualified technical jobs mentioned in the preceding paragraph and the boost of the nuclear sector as a driver of the country's economy thanks to the indirect and induced effects. These aspects are very interesting and must be taken into consideration by our leaders, particularly in view of Spain's current economic situation.

4. Should the development of a new Nuclear Programme be contemplated instead of a single nuclear project, a significant job creation and economic development impact would be felt in our country.

5. This study has been very favourably received by the contacted companies. In general, the responses thereto have been very positive, which is proof of the sector's interest in new nuclear projects.

Two aspects of this study which are very interesting and complementary but which fall outside its scope are, on the one hand, the assessment of the economic impact and, on the other, the creation of jobs associated with a nuclear project. From CEIDEN we encourage other institutions to analyse them in greater depth.

Switchyard of a Nuclear Power Plant



Turbine Building of a Nuclear Power Plant

8. Acronyms

ABWR	Advanced Boiling Water Reactor.
ANSI	American National Standards Institute.
ASME	American Society of Mechanical Engineers.
ASN	Autorité de Sûreté Nucléaire. The French Nuclear Safety Authority.
ATC	Almacén Temporal Centralizado (Temporary Centralised Storage Facility).
BOP	Balance of Plant.
BWR	Boiling Water Reactor.
CEIDEN	Comité Estratégico de Investigación y Desarrollo Nuclear, also known as the Nuclear Fission R&D Technological Platform.
CIEMAT	Centro de Investigaciones Energéticas, Medio Ambientales y Tecnológicas (Research Centre for Energy, Environment and Technology).
CSN	Consejo de Seguridad Nuclear (Nuclear Safety Council).
CTC	Centro Tecnológico de Componentes. (Components Technology Centre).
EIS	Environment Impact Assessment.
ENRESA	Empresa Nacional de Residuos Radiactivos (National Radioactive Waste Company).
ENSA	Equipos Nucleares S.A.
ENUSA	Empresa Nacional del Uranio (National Uranium Company).
EPRI	Electric Power Research Institute.
GENE	General Electric Nuclear Energy.
GIII	Generation-III reactor design.
GRA	Grupo de Reactores Avanzados (Advanced Reactor Group).
I&C	Instrumentation & Control.
R&D	Research & Development.
IAEA	International Atomic Energy Agency.
INI	Instituto Nacional de Industria (National Industry Institute).
INPO	Institute of Nuclear Power Operations.
IRRS	Integrated Regulatory Review Service.
ISI	In-Service Inspection.

ISO	International Organization for Standardization.
JEN	Junta de Energía Nuclear (Nuclear Energy Board).
LMLW	Low-and Medium-Level Waste.
LOCA	Loss-Of-Coolant Accident.
LOSEN	Ley de Ordenación del Sistema Eléctrico Nacional (National Electric System Planning Act).
NPP	Nuclear Power Plant.
NPPs	Nuclear Power Plants.
NQA	Nuclear Quality Assurance.
NRC	Nuclear Regulatory Commission. The US regulatory body.
NSSS	Nuclear Steam Supply System.
NTD	Nuclear Technology Development.
OECD/NEA	Organisation for Economic Cooperation and Development's Nuclear Energy Agency.
PEN	Plan Energético Nacional (National Energy Plan).
PGRR	Plan General de Residuos Radiactivos (General Radioactive Waste Plan).
PIE	Plan de Investigación Electrotécnico (Electrotechnical Research Plan).
PNEU	Plan Nacional de Explotación del Uranio (National Uranium Exploration Plan).
PNEIU	Plan Nacional de Explotación e Investigación del Uranio (National Uranium Exploration and Research Plan).
PRHR	Passive Residual Heat Removal.
PWR	Pressurized Water Reactor.
RP	Radiation Protection.
SNE	Sociedad Nuclear Española (Spanish Nuclear Society).
STUK	Säteilyturvakeskus. The Finnish nuclear and radioactive safety authority.
TMI	Three Mile Island.
UNESA	Asociación Española de la Industria Eléctrica (Spanish Electricity Industry Association).
WANO	World Association of Nuclear Operators.
WENRA	Western European Nuclear Regulator's Association.

9. Acknowledgements

The CEIDEN platform, which has promoted this study through its Steering Committee, would like to thank all those entities and people that have taken part in it.

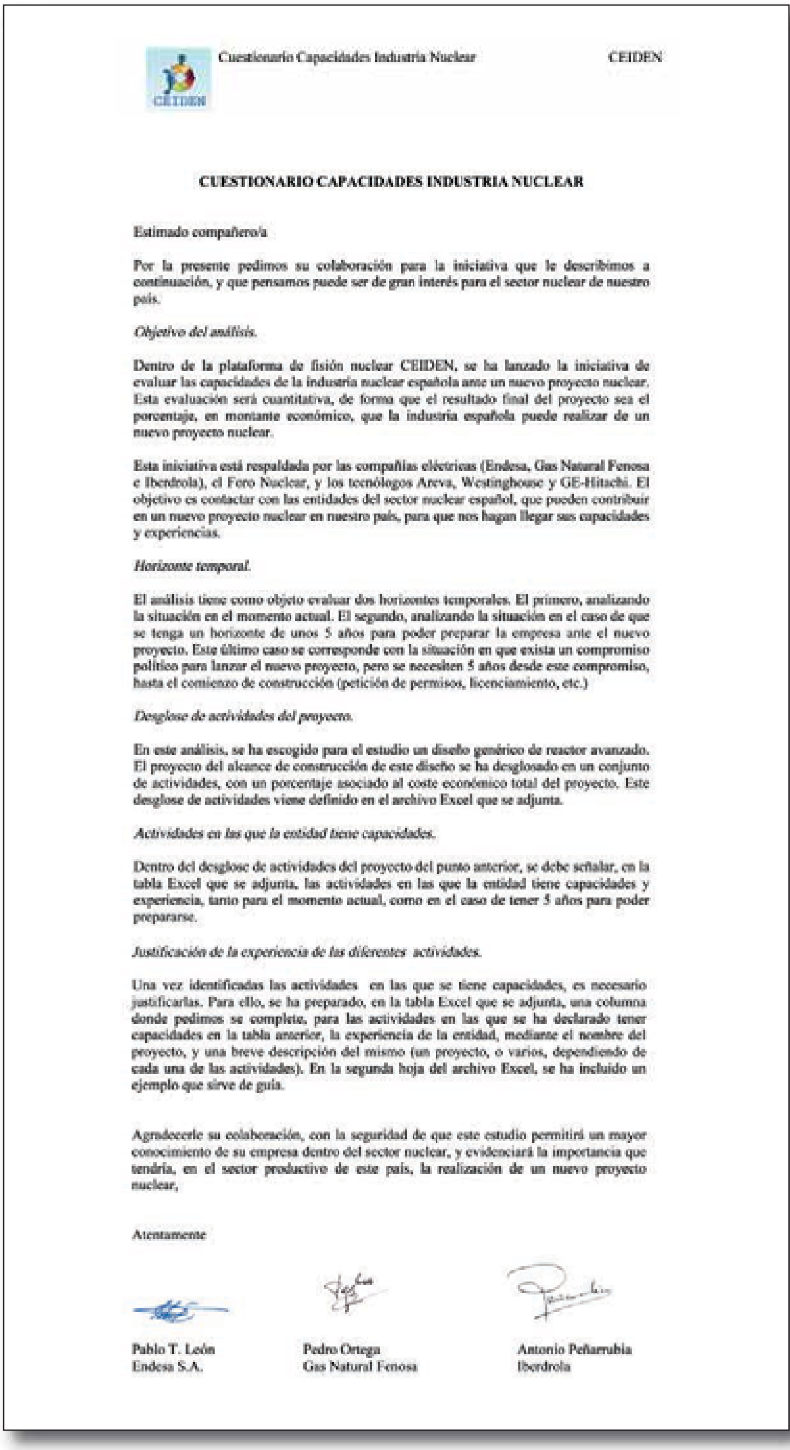
First of all, the authors of this report, who with their effort and dedication have managed to complete and eventually publish it. The companies Endesa, Gas Natural Fenosa and Iberdrola, which have facilitated the participation of said authors and given them whatever support was necessary. Along these lines, the work of the Spanish Nuclear Industry Forum's staff, which has collected the information on the Spanish nuclear industry and has actively participated in the coordination and drafting thereof, is worth highlighting.

Likewise, we would like to thank the technology firms Areva, General Electric-Hitachi and Westinghouse for their invaluable help in approaching the study and defining the activities of a nuclear project and their relative magnitude in detail.

Lastly, we would like to thank all those companies that have answered the capabilities questionnaire and, particularly, those that have collaborated in the detailed design thereof, without whose participation and involvement it would have been impossible to conduct this study.

Spent fuel pool of a Nuclear Power Plant

Annex I. Nuclear Industry capabilities questionnaire



Cuestionario Capacidades Industria Nuclear — CEIDEN

CUESTIONARIO CAPACIDADES INDUSTRIA NUCLEAR

Estimado compañero/a

Por la presente pedimos su colaboración para la iniciativa que le describimos a continuación, y que pensamos puede ser de gran interés para el sector nuclear de nuestro país.

Objetivo del análisis.

Dentro de la plataforma de fisión nuclear CEIDEN, se ha lanzado la iniciativa de evaluar las capacidades de la industria nuclear española ante un nuevo proyecto nuclear. Esta evaluación será cuantitativa, de forma que el resultado final del proyecto sea el porcentaje, en montante económico, que la industria española puede realizar de un nuevo proyecto nuclear.

Esta iniciativa está respaldada por las compañías eléctricas (Endesa, Gas Natural Fenosa e Iberdrola), el Foro Nuclear, y los tecnólogos Areva, Westinghouse y GE-Hitachi. El objetivo es contactar con las entidades del sector nuclear español, que pueden contribuir en un nuevo proyecto nuclear en nuestro país, para que nos hagan llegar sus capacidades y experiencias.

Horizonte temporal.

El análisis tiene como objeto evaluar dos horizontes temporales. El primero, analizando la situación en el momento actual. El segundo, analizando la situación en el caso de que se tenga un horizonte de unos 5 años para poder preparar la empresa ante el nuevo proyecto. Este último caso se corresponde con la situación en que exista un compromiso político para lanzar el nuevo proyecto, pero se necesiten 5 años desde este compromiso, hasta el comienzo de construcción (petición de permisos, licenciamiento, etc.)

Desglose de actividades del proyecto.

En este análisis, se ha escogido para el estudio un diseño genérico de reactor avanzado. El proyecto del alcance de construcción de este diseño se ha desglosado en un conjunto de actividades, con un porcentaje asociado al coste económico total del proyecto. Este desglose de actividades viene definido en el archivo Excel que se adjunta.

Actividades en las que la entidad tiene capacidades.

Dentro del desglose de actividades del proyecto del punto anterior, se debe señalar, en la tabla Excel que se adjunta, las actividades en las que la entidad tiene capacidades y experiencia, tanto para el momento actual, como en el caso de tener 5 años para poder prepararse.

Justificación de la experiencia de las diferentes actividades.

Una vez identificadas las actividades en las que se tiene capacidades, es necesario justificarlas. Para ello, se ha preparado, en la tabla Excel que se adjunta, una columna donde pedimos se complete, para las actividades en las que se ha declarado tener capacidades en la tabla anterior, la experiencia de la entidad, mediante el nombre del proyecto, y una breve descripción del mismo (un proyecto, o varios, dependiendo de cada una de las actividades). En la segunda hoja del archivo Excel, se ha incluido un ejemplo que sirve de guía.

Agradecerle su colaboración, con la seguridad de que este estudio permitirá un mayor conocimiento de su empresa dentro del sector nuclear, y evidenciará la importancia que tendría, en el sector productivo de este país, la realización de un nuevo proyecto nuclear,

Atentamente

Pablo T. León Endesa S.A.	Pedro Ortega Gas Natural Fenosa	Antonio Peñarrubia Iberdrola

Letter and questionnaire sent to the companies participating in the study

Dear friend,

The purpose of this letter is to ask for your collaboration for the initiative that we describe below, which, we think, could be of great interest for our Country.

Purpose of the analysis.

Within the CEIDEN nuclear fission platform, the initiative of assessing the capacities of the Spanish nuclear industry to face a new nuclear project has been launched. This assessment will be of a quantitative nature so that the end result will the percentage, cost wise, that the Spanish industry may achieve in a new nuclear project.

This initiative is backed up by the electrical utilities (Endesa, Gas Natural Fenosa and Iberdrola), the Nuclear Forum and the technological companies Areva, Westinghouse and GE-Hitachi. The objective is to get in contact with the entities of the Spanish nuclear sector that may contribute to a new nuclear project in our Country, to let us know about their capacities and experience.

Time horizon.

The purpose of the analysis is two assess two time horizons: the first one, analyzing the present time; the second one, analyzing the situation assuming that the entity has a time horizon of about five years to be ready for the new project. This last case assumes that there is a political commitment to launch the new project, being five years the time required from the commitment to the start of the construction (license submittals, licensing, etc.).

Break down of Project activities.

A generic design of an advanced reactor has been selected for this analysis. The anticipated construction scope of this design has been broken down in a set of activities with a percentage related to the economic cost of the project. This activity break down is shown in the attached Excel file.

Activities for which the entity has capacities.

Within the above project activity break down, it must be written down, in the attached Excel table, the capacities and experience of the entity both for the present time and also for the case that five years are allowed to be prepared.

Justification of the experience for the different activities.

Once the activities have been identified, it is necessary to justify those for which you have experience. For that purpose, a column has been provided in the attached Excel table in which you should include, for the activities you have declared to have capacity in the previous table, the experience of the entity, including the name and a brief description of the project (one or several projects depending on each of the activities). In the second sheet of the Excel file, an example has been included for guidance.

We wish to thank you for your collaboration, being aware that this study will result in a better knowledge of your company within the nuclear sector and will show the importance that the launching of a new nuclear Project would have for the production sector of our Country.

Signed

Pablo T. León	*Pedro Ortega*	*Antonio Peñarrubia*
Endesa S.A.	**Gas Natural Fenosa**	**Iberdrola**

NEW NUCLEAR PROJECT ACTIVITIES LIST	ENTITY	Include name of entity	
	Current situation	Situation after 5 years	Justification of the experience
1. PRELIMINARY AND FEASIBILITY STUDIES			
1.1. Feasibility studies			
1.2. Project management personnel training (utility)			
1.3. Plant construction personnel training (utility)			
1.4. Other (specify)			
2. SITING STUDIES			
2.1. Site selection			
2.2. Technical site studies			
2.2.1. Geotechnical investigations			
2.2.2. Other studies related to the safety of the site			
2.3. Support to the licensing of the site			
3. SELECTION OF TECHNOLOGY			
3.1. Drafting of bid invitation specifications for the main contractor			
3.2. Technical and economic evaluation of tenders from the main contractor			
3.3. Negotiation and financial evaluation of tenders from the main contractor			
4. SUPPORT TO LICENSING AND PERMITS FROM PUBLIC ADMINISTRATIONS			
4.1. Nuclear licence documentation drafting			
4.2. Safety Studies			
4.2.1. Deterministic approach: Accident Analysis and radiological			
estimate:			
4.2.1.1. Transient analysis			
4.2.1.2. LOCA analysis			
4.2.2. Probabilistic Safety Analysis			
4.3. Technical Specifications			
4.4. Environment Impact Assessment			
4.5. Other aspects related to the licensing of Nuclear or Radioactive Facilities			
4.6. Other administrative permits			
5. PROJECT MANAGEMENT			
5.1. Nuclear Island			
5.2. Turbine Island-BOP			
5.3. Other (specify)			
6. ENGINEERING AND DESIGN			
6.1. Development of drawings, specifications, calculations, reports, etc.			
6.1.1. Mechanical engineering			
6.1.2. Electrical engineering			
6.1.3. I&C			
6.1.4. Civil engineering			
6.2. Human factors engineering. Man-machine interface			
6.2.1. Design and supply of the Control Room and the man-machine interface			
6.2.2. Procurement of the simulator			
6.2.3. Supply of operation support systems			
6.2.4. Design of screens and displays			
6.2.5. Other (specify)			
7. PROCUREMENT AND SUPPLIERS INSPECTION			
7.1. Tenders evaluation, procurement and activation			
7.2. Suppliers inspection and quality control and assurance supervision			
7.3. Transport of special equipment			
8. CONSTRUCTION AND ERECTION			
8.1. Site preparation			
8.2. Construction and erection			
8.2.1. Civil works			

NEW NUCLEAR PROJECT ACTIVITIES LIST | ENTITY | Include name of entity

	Current situation	Situation after 5 years	Justification of the experience
8.2.2. Electrical erection			
8.2.3. Mechanical erection			
8.2.4. I&C			
8.2.5. Cranes for construction			
8.2.6. Other (specify))			
8.3. Construction and erection supervision			
9. QUALITY ASSURANCE PROGRAMMES AND PROCEDURES			
10. EDUCATION AND TRAINING			
10.1. Operators training (licensing)			
10.2. Plant personnel training			
10.3. Managers and construction personnel training (project)			
11. COMPONENTS MANUFACTURING			
11.1. NSSS components manufacturing			
11.1.1. Reactor vessel			
11.1.2. Reactor internals			
11.1.3. Steam Generators (PWR)			
11.1.4. Pressurizer (PWR)			
11.1.5. Primary-circuit piping			
11.1.6. Primary-circuit and recirculation pumps			
11.2. Manufacturing the rest of the equipment			
11.2.1. Turbo-generator			
11.2.2. Valves			
11.2.3. Containment vessel			
11.2.4. Condenser			
11.2.5. PRHR heat exchanger			
11.2.6. Heat exchangers			
11.2.7. Fuel storage racks			
11.2.8. Large modules			
11.2.9. Other components and modules			
11.2.10. Cranes for plant operation			
11.2.11. Waste treatment systems			
11.2.12. Transformers			
12. FUEL PROCUREMENT AND FABRICATION			
12.1. Fuel licensing			
12.2. Refuelling scheme			
12.3. Procurement of enriched uranium			
12.3.1. Procurement of concentrates			
12.3.2. Procurement of conversion services			
12.3.3. Procurement of enrichment services			
12.4. Fuel fabrication			
13. COMMISSIONING			
13.1. Commissioning procedures drafting			
13.2. Commissioning support			
13.3. In-Service Inspection			
13.3.1. In-Service Inspection Programme			
13.3.2. Accessibility study			
13.3.3. Execution of the pre-ISI			
14. OPERATION SUPPORT			
14.1. Radiation Protection			
14.1.1. Dose calculation codes			
14.1.2. Procedures			
14.2. Operating procedures			
14.3. Design modifications			
14.4. Codes and standards applicable to the ISI			
14.5. Execution of the ISI			

Annex II. Answers to the questionnaire

ABENGOA

ABENGOA

Activities

1	Preliminary and feasibility studies	1.1
2	Siting studies	2.2.1, 2.2.2
3	Selection of technology	3
4	Support to licensing and permits	
5	Project management	5.2
6	Engineering and design	6
7	Procurement and suppliers inspection	
8	Construction and erection	8
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	11.1.5, 11.1.6, 11.2.2, 11.2.8, 11.2.9, 11.2.12
12	Fuel procurement and fabrication	
13	Commissioning	13.3.1, 13.3.2
14	Operation support	14.4, 14.5

Experience

Certifications. A Quality Assurance system according to standards NQA-1:1994 (Nuclear Quality Assurance) and UNE 73401:1995, ANSI standards and ASME codes, which is audited on a periodic basis, was introduced allowing the company to be approved and recognised as a supplier of both safety (Class 1E) and commercial Nuclear-Guarantee equipment before GENE (General Electric Nuclear Energy) and the Group of Owners of Spanish NPPs.

Auxiliary manufacturing capabilities (Manufacturing). The Manufacturing Division has the necessary staff and means to carry out the activities for designing, building and testing its products. To this end, it has three Plants located in Seville (12,000-m^2 covered area, 42,000-m^2 lot), Alcalá de Henares, Madrid (25,000-m^2 lot, 4,000-m^2 built area) and Tianjin, China (5,200-m^2 built surface). The company has great experience at Almaraz, Trillo, Vandellòs and Lugmen NPPs.

Maintenance capabilities (MeI). Abengoa has experience and qualified staff to carry out maintenance work in NPPs, it having done these tasks at Almaraz, Trillo, Cofrentes and Santa María de Garoña NPPs.

Supply management. Specific contracts at Ascó NPP.

CONTACT	www.abeinsa.es / abeinsa@abengoa.com

"Listed below are individual records of the companies participating in the study, with their replies to the questionnaire.

The first section of each record includes the activities and sub-activities, numbered according to the list in the questionnaire, for which the company says it has capabilities and experience in the present, and those for which the company would have capabilities in case there was a 5 years term to get ready (the latter are in brackets).

The second section includes a summary of the references submitted by the company in order to check the answers included in the previous section. Given the extent of the references submitted by companies in general, only a summary of these has been included"

ACCIONA

Activities

1	Preliminary and feasibility studies	1.1, 1.3, 1.4
2	Siting studies	2.1, 2.2
3	Selection of technology	3.2, (3.3)
4	Support to licensing and permits	(4)
5	Project management	(5.1), 5.2, 5.3
6	Engineering and design	(6.1.1, 6.1.2, 6.1.3), 6.1.4
7	Procurement and suppliers inspection	7
8	Construction and erection	8
9	Quality assurance programmes and procedures	9
10	Education and training	10.3
11	Components manufacturing	(11.2.8, 11.2.9)
12	Fuel procurement and fabrication	
13	Commissioning	(13.1, 13.2)
14	Operation support	14.3

Experience

Acciona has participated in different activities related to the following projects or NPPs:

- Santa María de Garoña NPP (1969)
- Vandellòs NPP - Water Intake (1971)
- Sayago NPP (1976)
- Lemóniz NPP (1980)
- Almaraz NPP (1981)
- Cofrentes NPP (1985)
- Large Electron Positron Collider - Geneva (1985)
- Valdecaballeros NPP (1986)
- Trillo NPP (1988)
- Almaraz NPP - SGS (1997)
- Angra I NPP, Brazil - SGS (2009)
- Vandellòs NPP - EJ System (2009)

Additionally, it has taken part in hydraulic and thermal power plant projects and has wide experience in civil engineering projects and concessions.

CONTACT

www.acciona-infraestructuras.es / **miguel.diazllanos.ros@acciona.es**
(+34) 91 663 30 22
Centro Negocios Albatros, Calle Anabel Segura, 11 - 28108 Alcobendas, Madrid

ALFA LAVAL

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	
8	Construction and erection	
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	11.2.6
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

Supply of heat exchangers for different systems of NPPs in several European, Asian and American countries.

The company has been granted certificates ISO 9001 for its offices and workshops in Spain and certificates ASME N, ISO 9001 and ISO 14001 for its manufacturing plants in Sweden.

CONTACT

www.alfalaval.es / **info.spain@alfalaval.es**
(+34) 913 790 600
C/ San Rafael 1, 1º - Edif. Europa III - 28108 Alcobendas, Madrid

AMARA

amarA
Una compañía Iberdrola

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	7
8	Construction and erection	8.2.6
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

More than 30 years supplying equipment, spares and services to all Spanish NPPs. It supplies mechanical and electrical spares, nuclear cables and RP material under its quality assurance programme PCA-02. It is a certified supplier of nuclear-class equipment.

It has collaborated with the Owners' Group by representing the organisation before NUPIC and carrying out inspections with its specialised staff.

It has a logistics department specialised in the transport of special equipment and customs clearance.

It has experience in the warehouse and worksite storehouse management. It currently manages warehouses for Cofrentes NPP, Elcogas, Repsol Química, Aceca TPP, Red Eléctrica and Iberdrola Distribución and takes part in the worksite storehouses during the construction of the cogeneration power plants awarded to Iberdrola Ingeniería.

CONTACT

www.amara.com / **atorralba@amara.es**
(+34) 91 722 40 00 – (+34) 628 12 68 36
Trespaderne 29, 2ª Planta - 28042 Madrid

AMPHOS 21

Activities

1	Preliminary and feasibility studies	
2	Siting studies	2.1, 2.2.2, 2.3
3	Selection of technology	
4	Support to licensing and permits	4.2.1, (4.2.2), 4.4
5	Project management	
6	Engineering and design	(6.1.4)
7	Procurement and suppliers inspection	
8	Construction and erection	
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	12.4
13	Commissioning	
14	Operation support	

Experience

Studies (hydrological, geological, geochemical and sociological) and projects for the selection of sites for low-, medium- and high-level waste disposal facilities carried out for European and American waste management agencies (ENRESA, Andra, Posiva, SKB, NWMO, NUMO, etc.).

Safety studies and revisions for ENRESA (at the El Cabril storage facility) and Andra (at the TFA storage facility). The company has participated in safety studies and evaluations of the behaviour of low-, medium- and high-level waste disposal facilities (SKB, Posiva, Andra, ENRESA, EC).

Safety studies and analyses for facilities for the treatment of the uranium ore prior to the fabrication of fuel (Areva).

Probabilistic event risk assessment analyses.

Environmental impact assessments of fuel cycle-related facilities prior to their construction and studies of possible releases of radionuclides to the biosphere.

Hydro-geological impact of buildings in inactive facilities.

Radiological and environmental impact assessments of fuel fabrication-related processes. Study of the behaviour of fuel after refuelling. Projects for ENRESA and Areva.

CONTACT

www.amphos21.com / **amphos@amphos21.com**
(+34) 935 830 500
Passeig de Garcia i Faria, 49-51, 1-1 - 08019 Barcelona

CANTAREY REINOSA (GAMESA)

Activities

1	Preliminary and feasibility studies	1.2
2	Siting studies	
3	Selection of technology	3
4	Support to licensing and permits	4.2.1.2
5	Project management	
6	Engineering and design	6.1.1, 6.1.2, 6.1.3
7	Procurement and suppliers inspection	7
8	Construction and erection	8.2.2, 8.2.3, 8.2.4, 8.3
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	11.1.6, 11.2.9
12	Fuel procurement and fabrication	
13	Commissioning	13.2
14	Operation support	14.3

Experience

Designing and manufacturing conventional and Class-1E electric motors, for all Spanish NPPs and Laguna Verde NPP (Mexico).

CONTACT

www.cantarey.com / **comercial.cantarey@gamesacorp.com**
(+34) 942 77 41 12 – (+34) 670 48 16 08
Paseo de Alejandro Calonge, 3 - 39200 Reinosa, Cantabria

CESPA CONTEN

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	
8	Construction and erection	8.2.6
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	(11.2.11)
12	Fuel procurement and fabrication	
13	Commissioning	13.2
14	Operation support	14.1, 14.2

Experience

The following are among the services the company currently provides to the nuclear sector:

- Industrial cleaning and decontamination, hot and cold laundries, chemistry support and waste management at Cofrentes NPP.
- Setting the point of SRVs at Cofrentes NPP and supporting the setting of points of SRVs at Garoña NPP.
- Management of hazardous and non-hazardous waste at Almaraz NPP.
- Management of non-hazardous waste at Trillo NPP.
- Radioactive decontaminations at iron and steel plants – following accidents for melting radioactive sources in furnaces – belonging to Acerinox, Siderúrgica Sevillana, CBC, etc.
- Chemical pickling of nuclear installations at Vandellòs II, Lemóniz and Valdecaballeros NPPs and chemical cleaning at other nuclear facilities during commissioning and operation.
- Work for the dry preservation of the secondary at Trillo and Vandellòs NPPs.
- Supporting the lancing by Siemens at Almaraz, Trillo and other NPPs

CONTACT

www.cespa.es / sugerenciasweb@cespa.es
San Cesáreo, 30 - 28021 Madrid

COAPSA

Activities

1	Preliminary and feasibility studies	1.2, 1.3
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	6.1.1, 6.1.2, 6.1.3, 6.2.3, 6.2.4
7	Procurement and suppliers inspection	7.3
8	Construction and erection	8.2.2, 8.2.3, 8.2.4, 8.2.5, 8.3
9	Quality assurance programmes and procedures	
10	Education and training	10.2
11	Components manufacturing	11.2.10
12	Fuel procurement and fabrication	
13	Commissioning	13.1, 13.2
14	Operation support	14.1.2, 14.3

Experience

Collaborating with and advising the CIEMAT and Spanish NPPs about the required characteristics of cranes and fuel and plant handling devices. Training of plant personnel at Garoña, José Cabrera and Trillo NPPs.
Adapting and remodelling polar and gantry cranes of fuel buildings at several NPPs, including start up.
Modifying and improving existing systems with new technologies. Programming PLC, SCADAS for plant system management.
Special transport of fuel within NPPs.
Designing, documenting, building and approving Class-1E equipment for the EJ system of Vandellòs II NPP.
Replacing mechanical components of cranes at NPPs.
Designing, documenting and building equipment that improvise the precision of the placement of parts involved in reactor assembly and disassembly.
Providing qualified personnel for supervision and maintenance work both in operation and during refuelling outages.
Three-year crane maintenance contracts in the main Spanish NPPs, including the yearly scheduling of system improvements.

CONTACT	**www.coapsa.com** Sant Miquel de Toudell, 7 - Nau 10, Pol. Ind. Can Mir - 08232 Viladecavalls, Barcelona

COBRA INSTALACIONES Y SERVICIOS

Activities

1	Preliminary and feasibility studies	
2	Siting studies	2.3
3	Selection of technology	
4	Support to licensing and permits	4.4
5	Project management	5.2, 5.3
6	Engineering and design	
7	Procurement and suppliers inspection	7
8	Construction and erection	8
9	Quality assurance programmes and procedures	9
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	13.1, 13.2
14	Operation support	

Experience

Experience in site licensing and development of projects promoted by Cobra (solar thermal plants, wind farms, natural gas stores, etc.).

Experience in EPC project management, procurement, construction and assembly and support of commissioning of cogeneration power plants. In the coal field, experience in LT/STONES and all the auxiliary facilities.

ISO 9002 for industrial plant- and EPC project-related activities.

CONTACT

www.grupocobra.com / central@grupocobra.com
(+34) 91 456 95 00
Cardenal Marcelo Spínola, 10 - 28016 Madrid

CT3 INGENIERÍA

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	6.1
7	Procurement and suppliers inspection	
8	Construction and erection	8.3
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

Engineering, design, construction and assembly supervision, and operation design activities in design modifications of plants in operation, in the areas of mechanical engineering, I&C, electrical engineering and civil engineering, in different projects at foreign NPPs (ITER Project, AP 1000 Project, Cernavoda II NPP (Romania), Laguna Verde NPP (Mexico), Bohunice NPP (Slovakia), Angra NPP (Brazil)) and Spanish NPPs (Almaraz NPP, Trillo NPP, Cofrentes NPP, Ascó NPP, Vandellós NPP, El Cabril Temporary Storage Facility and José Cabrera NPP).

CONTACT

www.ct3.es / **info@ct3.es**
(+34) 91 634 06 01
Avda. Reyes Católicos 6, 3ª Planta - 28220 Majadahonda, Madrid

FUNDACIÓN CENTRO TECN. DE COMPONENTES

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	6.1.1
7	Procurement and suppliers inspection	
8	Construction and erection	
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

Thermal and structural calculations of vessel and nozzles: PBMR (2006), ABWR (2007), ESBWR (2009). CFD thermal-hydraulic analyses for the licensing of fuel storage ponds for Cofrentes NPP and ESBWR (2009). CFD analyses of BWR installations and recirculation loops. Studies of the environmental effect on the life-to-stress of components. Analysis of the effect of neutron irradiation on the embrittlement of vessel steels. Failure analysis. Tool design.

CONTACT

www.ctcomponentes.es / info@ctcomponentes.com
(+34) 942 76 69 76
Parque Científico y Tecnológico de Cantabria, C/ Isabel Torres 1 - 39011 Santander, Cantabria

DRADAGOS

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	6.1.4
7	Procurement and suppliers inspection	
8	Construction and erection	8.1, 8.2.1, 8.2.3, 8.2.5, 8.2.6, (8.3)
9	Quality assurance programmes and procedures	(9)
10	Education and training	
11	Components manufacturing	11.2.9
12	Fuel procurement and fabrication	
13	Commissioning	13.1, (13.2), (13.3)
14	Operation support	

Experience

Engineering, design, construction, assembly and commissioning of the enlargement of circulation water cooling and discharge system at Ascó NPP (1985).
Construction and assembly:

- Trillo I NPP (1977-1988).
- Enlargement and refurbishment at José Cabrera NPP (1983).
- Assembly of 1,441-MW turbo-generator at Trillo NPP (1984-1987).
- Design, supply and assembly of cover for fuel pond at Trillo NPP (1984-1986).
- Metal structure of turbine and demineralisation buildings at Trillo NPP (1981-1983).

Maintenance and support services at Ascó NPP (1988-1992).
Design, supply and assembly of cover for fuel pond at Trillo NPP (1984-86).
Industrial cleaning, laundry and waste management service at Ascó NPP (1991-1995).
Maintenance during normal operation and refuelling outages at Vandellòs NPP (1988-1991).
Design, manufacturing, assembly and testing of semi-automatic refuelling machine for Doel IV (Belgium), Sayago (Spain) and Tihange III (Belgium) NPPs for Westinghouse Nuclear Española (1986).
Design, manufacturing, assembly and testing of functional assemblies for Almaraz, Lemóniz, Sayago and Ascó NPPs for Westinghouse Nuclear Española (1986).

CONTACT

www.grupoacs.com y www.dragados.com / **epascual@dragados.com**
(+34) 91 703 84 99; (+34) 91 343 93 00
Avda. Camino de Santiago, 50 - 28050 Madrid

DURO FELGUERA ENERGÍA

Activities

1	Preliminary and feasibility studies	1.3
2	Siting studies	2.2.1, 2.3
3	Selection of technology	3
4	Support to licensing and permits	
5	Project management	5.2
6	Engineering and design	6
7	Procurement and suppliers inspection	7
8	Construction and erection	8
9	Quality assurance programmes and procedures	9
10	Education and training	10.2, 10.3
11	Components manufacturing	11.1.1, 11.1.5, 11.2.1, 11.2.2, 11.2.4, 11.2.5, 11.2.6, (11.2.7), (11.2.8), 11.2.9, 11.2.10, 11.2.11, 11.2.12
12	Fuel procurement and fabrication	
13	Commissioning	13.1, 13.2
14	Operation support	

Experience

Studies, selection of technology, project management, engineering and design, procurement and supplier inspection, construction and assembly, quality assurance, training, manufacturing and commissioning of 32 EPC projects at conventional and cogeneration power plants since 2000.
Assembly of the structure of the Almaraz NPP's turbine building (1974).
Assembly of mechanical equipment in almost all Spanish NPPs (1984-1997).
Periodic checks and retrofitting in all Spanish NPPs since 1984.
Cranes for practically all Spanish NPPs. Supervision of crane assembly at Cofrentes NPP.
Manufacturing of:

- Trillo NPP's reactor vessel support (1983).
- Anchors of the Valdecaballeros NPP's reactor pedestal (1982).
- Trillo NPP's primary and secondary safety piping (1983).
- Ascó I and II NPP's turbine cooling piping (1978).
- Vandellòs NPP's H-1 and LP exchangers (1980).
- Many measures, heaters, coolers, evaporators, U-tubes, tanks, ducts, and other components for almost all Spanish NPPs.

CONTACT	**www.durofelguera.com** / **dfe@durofelguera.com** (+34) 98 517 94 95 C/ Rodríguez Sampedro, 5 - 33206 Gijón, Asturias

ELECTROMEDICIONES KAINOS

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	
8	Construction and erection	8.2.2
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

Installation of electrical equipment in all Spanish NPPs.

CONTACT

www.kainos.com.es / **sballus@kainos.es**
(+34) 93 474 23 33
Energía, 56 - 08940 Cornellá, Barcelona

EMPRESARIOS AGRUPADOS

EMPRESARIOS AGRUPADOS

Activities

1	Preliminary and feasibility studies	1
2	Siting studies	2
3	Selection of technology	3
4	Support to licensing and permits	4
5	Project management	5
6	Engineering and design	6
7	Procurement and suppliers inspection	7
8	Construction and erection	8.1, 8.3
9	Quality assurance programmes and procedures	9
10	Education and training	10
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	13
14	Operation support	14.1, 14.2, 14.3

Experience

Recent experience in nuclear programmes being launched: Switzerland, Czech Republic, Finland and Slovakia.

Support in IAEA activities.

Support for the renewal of the licences of all Spanish NPPs.

Taking part in the certification of the design of the ESBWR.

Renowned experience in Design Engineering; recently: Lungmen and ESBWR.

Taking part in Training from time to time.

Taking part in the Commissioning of Spanish NPPs and crucial design modifications such as Power Uprating.

Ample experience in Radiation Protection at all Spanish NPPs and the certification of the ESBWR.

Execution of approximately 80 design modifications per year and unit supporting Spanish NPPs.

CONTACT

www.empre.es / **empresarios@empre.es**
(+34) 91 309 80 00
Magallanes, 3 - 28015 Madrid

ENSA

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	6.1.1, 6.1.2, 6.1.3
7	Procurement and suppliers inspection	7
8	Construction and erection	8.2.2, 8.2.3, 8.2.4, 8.3
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	11.1.1, 11.1.2, 11.1.3, 11.1.4, 11.1.5, 11.2.3, 11.2.4, 11.2.5, 11.2.6, 11.2.7, 11.2.8, 11.2.9, 11.2.11
12	Fuel procurement and fabrication	
13	Commissioning	
14		

Experience

Designing, manufacturing and assembly different components for many Spanish and overseas NPPs.

CONTACT

www.ensa.es / **commercial@ensa.es**
(+34) 915 553 617
José Ortega y Gasset 20, 5º - 28006 Madrid

ENUSA

GRUPO ENUSA

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	4.2.1, 4.3
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	
8	Construction and erection	
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	12
13	Commissioning	
14	Operation support	

Experience

Supporting licensing studies, transient and LOCA analyses and Tech Specs at Spanish Westinghouse PWR and BWR NPPs.

Procurement and fabrication of nuclear fuel for all Spanish Westinghouse PWR and BWR NPPs and different European PWR and BWR NPPs (France, Sweden, Finland and Belgium).

CONTACT

www.enusa.es / **CVD@enusa.es**
(+34) 913 474 200
Santiago Rusiñol, 12 - 28040 Madrid

IBERDROLA INGENIERÍA Y CONSTRUCCIÓN

Activities

1	Preliminary and feasibility studies	1
2	Siting studies	2
3	Selection of technology	3
4	Support to licensing and permits	4
5	Project management	(5.1), 5.2, 5.3
6	Engineering and design	6.1, 6.2.2, 6.2.3
7	Procurement and suppliers inspection	7
8	Construction and erection	8.3
9	Quality assurance programmes and procedures	9
10	Education and training	10.3
11	Components manufacturing	
12	Fuel procurement and fabrication	12.1, 12.2
13	Commissioning	13 .1, 13.2, 13.3.1
14	Operation support	14.1, 14.2, 14.3, 14.4

Experience

Feasibility studies: Bulgaria (2010), the UK (2008), Angra III NPP (Brazil) and others. Experience in turnkey projects: Laguna Verde NPP (Mexico). Site selection in the UK (2009). Sellafield characterisation. Selection of technology: Finland (2010), Romania (2010-2011), Laguna Verde NPP (2007-2009), Slovakia (2008-2010), and Brazil (2009). Support Licensing at Cofrentes NPP (CNC). Own methodology for transient analysis at PWRs and BWRs: CNC, Almaraz NPP (CNA) and Trillo NPP. Safety and LOCA probability analysis at CNC, CNA, Trillo NPP and Sellafield NPP. Radiation protection support and studies: Zaporozhe NPP, Laguna Verde NPP, CNC and Ispra NPP. Equipment replacement: MSR, Bohunice NPP (Slovakia); steam generators, Angra NPP (Brazil); incinerator, Bulgaria; EPC, Laguna Verde NPP; Olkiluoto IV NPP (Finland). Design engineering: CNC, Flamanville NPP (France), Laguna Verde NPP, Bohunice NPP, Angra NPP, ITER. Civil engineering at Olkiluoto III and IV NPP, Sellafield NPP, Romania: layout, 3D model. Human factors engineering and simulators: Capricore, risk monitor, severe accident guides. Supplier selection and assessment, construction and assembly supervision, drafting of quality procedures, personnel training, drafting of commissioning procedures: Romania (2011), Laguna Verde NPP (2008-2009), Bohunice NPP (2008-2010), Angra NPP (2009) and Flamanville NPP (2009-2010). Drafting of quality, support and ISI procedures: CNC. Fuel licensing support studies at CNC and CNA. Operation support: CNC, Ispra NPP, Laguna Verde NPP and Bohunice NPP.

CONTACT

www.iberdrolaingenieria.com / luisa.mayoral@iberdrola.es
(+34) 91 713 20 30, (+34) 91 713 20 23
Avenida de Manoteras, 20. Edificio D. 28050 Madrid

IDOM

Activities

1	Preliminary and feasibility studies	
2	Siting studies	2.2.1
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	5.2
6	Engineering and design	6.1
7	Procurement and suppliers inspection	7.1, 7.2
8	Construction and erection	8.1, 8.2.1, 8.2.2, 8.2.3, 8.2.4, 8.3
9	Quality assurance programmes and procedures	9
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	13
14	Operation support	14.3

Experience

Geotechnical investigations, procurement and vendor inspection, construction, assembly and quality assurance of design modification at NPPs: new buildings and new systems.

Project management at gas-fired power plants.

Design modification at NPPs in operation.

Commissioning of new or modified systems.

Development of new design modifications at NPPs.

CONTACT

www.idom.es / amorenog@idom.es
(+34) 91 444 11 50 / 52
José Abascal, 4 - 28003 Madrid

INGECIBER

INGECIBER, S.A.

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	6.1.1, 6.1.4
7	Procurement and suppliers inspection	
8	Construction and erection	
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

Engineering, drawings and specifications at Ascó and Vandellòs NPPs. Development of FEM civil engineering calculation software for NPPs.

Possibility of giving training (after five years).

CONTACT

www.ingeciber.com / ma.moreno@ingeciber.com
(+34) 91 386 22 22
Avda. Monforte de Lemos, 189 - 28035 Madrid

MECANOL (MECANIZADOS OLIVERA)

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	7.1, 7.2
8	Construction and erection	
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

30 years of experience in the nuclear services and maintenance sector, carrying out different machining, manufacturing and assembly works:

- Spare part manufacturing and supply (shafts, sleeves, bolts, etc.).
- Manufacturing of cylinder heads, compressors class-N3 gas heads.
- Manufacturing of spark plug holder, and dollies for precoat filter.
- Blade guide manufacturing.
- Manufacturing and assembly of permanent shielding in drywell pipes and valves.
- Manufacturing and assembly of shielded door for the entrance of the drywell.
- Manufacturing and assembly of shielded door for accessing the transfer tube.
- Installation of flow guides in fume hoods N71-CC101 A/B/C/D.

The company currently has the following certifications:

- ISO 9001:2008 for its quality management system issued by Bureau Veritas.
- External company registration certified by the Nuclear Safety Council (CSN).
- Construction sector-certified company registry (REA).
- Vendor registry (REPRO).
- Non-destructive testing staff certification (AEND).
- Welder qualification certificate.
- Environmental management plan.

CONTACT

www.mecanol.com / **mecanol@mecanol.com**
(+34) 96 23 00 507
Calle del Textil, 18 46340 - Requena, Valencia

MEDIDAS AMBIENTALES

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	4.4
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	
8	Construction and erection	
9	Quality assurance programmes and procedures	9
10	Education and training	10.2
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	13.3.1
14	Operation support	14.5

Experience

Santa María de Garoña, Cofrentes, Almaraz, Trillo, Ascó and Vandellòs NPPs' Environmental-Radiological Monitoring Plan.

José Cabrera NPP's Ground Water and Discharge Water Monitoring Plan.

Environment impact assessment of urban development plans and programmes (Madrid 2012, underground rerouting of the M-30 street in Madrid, La Moraleja Sanitas Hospital) and industrial plants (Casbega, Soto de Mozanaque, Teruel Cement Maker).

Introduction and audit of Quality Management Systems at Santa María de Garoña NPP and the University of Cordoba.

Personnel training.

CONTACT

www.medidasambientales.com / amartinc@eulen.com
(+34) 91 631 08 00 – (+34) 91 631 39 02 – (+34) 628 72 62 35
Gobelas, 25 - 28023 Madrid

NAVANTIA

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	
8	Construction and erection	
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	11.2.1, 11.2.2
12	Fuel procurement and fabrication	
13	Commissioning	13.2
14	Operation support	

Experience

Supply of turbines to Spanish NPPs.

- 1975 – 1984: Almaraz 1 y 2, Lemóniz 1 and 2, Ascó 1 and 2, Sayago, Trillo, Vandellòs.
- 1995 – 1999: Retrofitting of Ascó 1 and 2, Almaraz 1 and 2, Vandellòs 2.

CONTACT

www.navantia.es / **jmdiazb@navantia.es**
(+34) 981 33 19 60
Fábrica de Turbinas – Apartado nº 1 - 15480 Ferrol, A Coruña

PGS ENRIQUE MARÍA HIERRO

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	7
8	Construction and erection	
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

15 years of experience in the supply and provision of equipment, spares and services to all Spanish NPPs as a Purchasing Agent and Representative of the following products and companies:

- Emergency diesel generators, Engine Systems Inc. (ESI).
- Emergency water feeding Terry turbine, Dresser-Rand (D-R).
- Cooling coils, Aerofin.
- Power and I&C nuclear cables, Rockbestos (RSCC).
- Pilot solenoid valves, Automatic Valves (AVCO).
- Hydraulic, pneumatic and electric valve actuators, Rotork-RA Hiller.
- RTDs, thermocouples and temperature transmitters, Weed Instrument, etc.

Devising of an audited QA Programme – EMH 01 – for the supply of all kinds of safety-related materials.

The company has an International Forwarded for the DDP transport and supply of all types of materials.

CONTACT

www.pgsemh.es / **emh@pgsemh.es**
(+34) 91 87 33 564
Perdíz, 29 - 28510 Campo Real, Madrid

PROINSA

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	
8	Construction and erection	
9	Quality assurance programmes and procedures	
10	Education and training	10.2
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	14.1

Experience

Different-level Radiation Protection training courses at NPPs and radioactive facilities since 1984 (UTPR).

Radiation Protection support services at NPPs during normal operation and refuelling outages since 1984 (UTPR).

Radiation Protection support services during dismantling (UTPR).

Nuclear and radiological emergencies.

CONTACT	**www.eulen.com/Apartados.aspx?hid=64** / **proinsa@eulen.com** (+34) 91 631 04 33 – (+34) 902 355 366 Gobelas, 25-27 - Urbanización La Florida - 28023 Madrid

REVESTIMIENTOS ANTICORROSIVOS INDUSTRIALES

(REVANTI)

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	
8	Construction and erection	8.2.6, 8.3
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

Special paint and coating jobs on all kinds of surfaces.

Maintenance at NPPs: Almaraz, Cofrentes, José Cabrera, Ascó and Vandellòs (Spain); Civaux, PE Golfech (France); Laguna Verde (Mexico).

Refurbishment of many non-nuclear facilities.

Concrete treatment.

Specialised services: shot peening, passive fire protection, metalling, equipment and machinery recovery, pipe wrapping.

CONTACT

www.revanti.com / **info@revanti.com**
(+34) 963 540 300
Av. de las Cortes Valencianas, 58. Sorolla Center, local 10 - 46015 Valencia

RINGO VÁLVULAS

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	
8	Construction and erection	8.2.3
9	Quality assurance programmes and procedures	9
10	Education and training	
11	Components manufacturing	11.2.2
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

- Current supplier of nuclear valves to all Spanish NPPs (2001 to 2010).
- Ringhals NPP. Supplier of active class-I, class-II and class-III valves (2005 to 2010).
- Koeberg NPP. Supplier of class-II valves (2008 and 2010).
- OKG NPP. Supplier of class-II and class-III valves (2005 to 2010).
- Ringhals NPP. Supplier of class-II and class-III valves.
- Doel NPP. Supplier of class-II valves (2009).
- Ringhals NPP. Supplier of class-II valves (2011).
- Atucha III NPP. Supplier of class valves (2011).
- Supplier to Laguna Verde, Mochovce IV, Qinshan II and Atucha NPPs (2002 to 2010).

CONTACT	**www.ringospain.com** (+34) 976 45 49 40 Romero, 6 – Polígono Industrial Empresarium - 50720 Zaragoza

SENER INGENIERÍA Y SISTEMAS

Activities

1	Preliminary and feasibility studies	1.1
2	Siting studies	2.1, 2.2, 2.2.1, (2.2.2), 2.3
3	Selection of technology	3
4	Support to licensing and permits	(4.1), (4.2.1), (4.2.2), 4.4, (4.6)
5	Project management	(5.1), 5.2
6	Engineering and design	6.1, (6.2.1)
7	Procurement and suppliers inspection	7.1, 7.2
8	Construction and erection	(8.1), (8.3)
9	Quality assurance programmes and procedures	9
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	(13.1), (13.2)
14	Operation support	(14.2), (14.3)

Experience

Participation in the ESS Project: feasibility and siting studies, engineering and design.

Participation in the ITER Project: siting studies, engineering and design.

Participation in the construction of Lemóniz, Cofrentes and Garoña NPPs.

For cogeneration power plants, experience in siting studies, engineering and design, procurement and supplier inspection.

Participation in the design of the European Sodium Fast Reactor (ESFR) for the European Commission within the 7th Framework Programme. BOP activities. Analysis of innovative energy conversion systems, robotics, optimisation of the primary-circuit heat removal system.

CONTACT

www.sener.es
(+34) 91 807 7000
Severo Ochoa, 4-PTM - 28760 Tres Cantos, Madrid

SIEMSA

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	6.1.2, 6.1.3
7	Procurement and suppliers inspection	
8	Construction and erection	8.2.2, 8.2.4, 8.2.6
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	13.1, 13.2
14	Operation support	14.1.2, 14.3

Experience

Engineering support for design modification and/or improvements at Cofrentes, Almaraz and Trillo NPPs.

Different assembly jobs in all the refuelling outages at Cofrentes, Almaraz and Trillo NPPs and some refuelling outages at Garoña NPP.

Design, manufacturing, assembly, commissioning and maintenance of Analyser Systems.

Collaboration in the drafting, supervision and monitoring of electricity and I&C rules and procedures during both the commissioning and maintenance of Cofrentes and Trillo NPPs and the start-up after different refuelling outages in most Spanish NPPs.

Participation with electrical equipment and I&C personnel during the commissioning of Cofrentes and Trillo NPP and the start-up after the different refuelling outages.

Support for the drafting and execution of procedures related to radiation monitors.

Execution of diverse electrical and I&C OCPs related to plant safety and improvement (adjustment of Mark IV turbine control, inspection of LPRMs, retrofitting systems with fibre optics, etc.) and those related to onsite radiological control (detectors and gates).

CONTACT

www.services-ges.es / siemsaeste@siemsa.gamesa.es
(+34) 963 700 761
Plg. Ind. Vara de Quart. Cl. dels Ferrers, 1 - 46014 Valencia

SOCOIN
INGENIERÍA Y CONSTRUCCIÓN INDUSTRIAL

Activities

1	Preliminary and feasibility studies	1.1, 1.3
2	Siting studies	2
3	Selection of technology	(3)
4	Support to licensing and permits	4.1, 4.2, 4.4, 4.5, 4.6
5	Project management	(5.1), 5.2, 5.3
6	Engineering and design	6
7	Procurement and suppliers inspection	7
8	Construction and erection	8.1, 8.2.1, 8.2.2, 8.2.3, 8.2.4, 8.3
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	13.1, 13.2
14	Operation support	14.1, 14.3

Experience

Ample experience in support of licensing of NPPs in operation (José Cabrera NPP from 1996 to 2009): licensing documentation, nuclear safety studies, and design modifications. Licensing of new nuclear projects such as ATI and the dismantling of José Cabrera NPP, including the environmental impact assessment.

Broad experience in the construction of conventional plants (cogeneration, coal, hydraulic, wind, photovoltaic, diesel), during all project phases of the owner's engineering, from the feasibility study to the commissioning thereof.

CONTACT

www.socoin.es / **socoin@socoin.es**
(+34) 91 257 80 00
Centro Empresarial La Finca – Pº del Club Deportivo 1, Edificio 5 - 28223 Pozuelo de Alarcón, Madrid

TAMOIN POWER SERVICES

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	
8	Construction and erection	8.2.2, 8.2.3, 8.2.4
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	13.2
14	Operation support	

Experience

Assembly of electrical equipment (carried out by other companies of the Group – TME, Tamoin, Mantenimientos Especiales) at Almaraz and Trillo NPPs (2009).

Assembly of machine equipment at Almaraz, Ascó, Vandellòs, Trillo, Cofrentes, Santa María de Garoña, Lemóniz, Laguna Verde (Mexico), Valdecaballeros and José Cabrera NPPs (1968 to date).

Installation of I&C (carried out by other companies of the Group – TME, Tamoin, Mantenimientos Especiales) at Almaraz, Ascó, Trillo and Vandellòs NPPs (2009).

Commissioning support at Trillo NPP (1985).

CONTACT

www.tamoin.com / **gsanz@grupotamoin.com; pbar@grupotamoin.com**
(+34) 94 435 65 50
Ribera de Axpe, 47 - 48950 Erandio, Vizcaya

TECNALIA

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	6.1
7	Procurement and suppliers inspection	
8	Construction and erection	
9	Quality assurance programmes and procedures	9
10	Education and training	
11	Components manufacturing	11.2.9
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

Tecnalia's Energy Unit has experience in several fields:
- Evaluation of the quality and performance of materials in service conditions.
- Testing of electrical and electronic equipment.
- Quality control of materials and components for power generation applications.
- Material failure analysis, corrosion, etc.
- Materials for waste storage.

CONTACT

www.tecnalia.com / **inaki.azkarate@tecnalia.com**
(+34) 902 76 00 00
Parque Tecnológico de Miramón – C/ Mikeletegi Pasealekua 2 - 20009 Donostia-San Sebastián

TECNATOM

Activities

1	Preliminary and feasibility studies	1
2	Siting studies	
3	Selection of technology	(3)
4	Support to licensing and permits	4.2.1, 4.2.2
5	Project management	
6	Engineering and design	6.1.3, 6.2
7	Procurement and suppliers inspection	7
8	Construction and erection	8.2.4
9	Quality assurance programmes and procedures	9
10	Education and training	10
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	13
14	Operation support	14

Experience

Ample experience in personnel training.

Tecnatom is the Spanish electricity sector's Training Centre and has trained many managers and construction personnel of NPPs and conventional TPPs (gas, coal, etc.).

Broad experience in human factors engineering and man-machine interfaces

Supply of control room: Lungmen 1&2 NPP (Taiwan). STP 3&4 NPP (USA). Fuquing 1&2 NPP (China). Fangjiashang 1&2 NPP (China). Hainan 1&2 (China). SBWR, AP1000, ABWR Projects. Other projects in China and the US.

Supply of simulators: Spanish NPPs. Laguna Verde 1&2 NPP (Mexico). Atucha 2 NPP (Argentina). Angra 1 NPP (Brazil). Lungmen 1&2 NPP (Taiwan). Fuquing 1&2 NPP (China). Fangjiashang 1&2 NPP (China).

Ample experience in ISI: Spanish NPPs and over 20 countries throughout the world.

Commissioning support: Spanish NPPs. Lungmen 1&2 NPP (Taiwan). AP1000.

Operation support: Spanish NPPs.

Accident calculation and RP support: Spanish NPPs.

CONTACT

www.tecnatom.es / jortega@tecnatom.es
(+34) 91 659 86 00
Avda. Montes de Oca, 1 - 28703 San Sebastián de los Reyes, Madrid

THUNDER ESPAÑA SIMULACIÓN

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	4.2.2
5	Project management	
6	Engineering and design	6.2
7	Procurement and suppliers inspection	
8	Construction and erection	
9	Quality assurance programmes and procedures	
10	Education and training	10.1, 10.2
11	Components manufacturing	
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

Support to Garoña NPP's Level-II APS with MAAP. University of Cantabria (1996-2001).

Emulation of several DCSs (GE Mark VI, Bailey Infi 60, Foxboro, etc.) for North American NPPs (Hope Creek, Calvert Cliffs, Davis Besse, etc.) under contract with Corys Thunder Inc. (2009-2011).

+10 years previous experience in simulators (University of Cantabria, RNI Technologies Inc., GSE Systems Inc., Corys Thunder Inc.).

Design and development of a new, fully computerised control room for the Technical Training Centre of the US NRC under contract with Corys Thunder Inc. (2010-2011).

Framework contract with Corys Thunder Inc. (the largest provider of services for training simulators in the US). Modelling of hydraulic, electrical and control systems, graphic interfaces, simulation platform and applications (2009-2011).

CONTACT

www.thunderesp.com / **mario.garces@thunderesp.com**
(+34) 942 764 984
Avenida de los Castros s/n, CDTUC Fase A (Industriales) - Mod. 20739005 Santander

TUBACEX

Activities

1	Preliminary and feasibility studies	
2	Siting studies	
3	Selection of technology	
4	Support to licensing and permits	
5	Project management	
6	Engineering and design	
7	Procurement and suppliers inspection	
8	Construction and erection	
9	Quality assurance programmes and procedures	
10	Education and training	
11	Components manufacturing	11.1.5, 11.2.6, 11.2.9
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

- Primary-circuit piping: client Mondranska Potrubni. Mochovce Project. Primary-circuit piping. Russian-design reactor (2009).
- Heat exchangers: several clients in Europe, including ENSA. Class-2 heat exchanger tubing of EPR reactor. Okiluoto and Taishan Projects (2008 and 2009).
- Clients throughout the world for secondary-circuit piping for Russian-design, Areva, Doosan, Westinghouse, GE, Siemens, and CANDU NPPs (since 1997).

CONTACT

www.tubacex.es / **sales@tubacex.es**
(+34) 94 671 93 00
Tres Cruces, 8, PO Box 22 - 01400 Llodio, Alava

VECTOR & WELLHEADS ENGINEERING

Activities

1	Preliminary and feasibility studies	1.3
2	Siting studies	
3	Selection of technology	3.1, 3.3
4	Support to licensing and permits	4.3
5	Project management	
6	Engineering and design	6.1, 6.1.1
7	Procurement and suppliers inspection	7.1, 7..2
8	Construction and erection	8.2.3
9	Quality assurance programmes and procedures	9
10	Education and training	
11	Components manufacturing	11.2.2
12	Fuel procurement and fabrication	
13	Commissioning	
14	Operation support	

Experience

Activities related to the manufacturing, supply and assembly of nuclear-type valves.

Personnel qualification as per ASME Code, Sections III and V, for the manufacturing of nuclear valves.

END testing according to SNT-TC-1A or UNE:EN 473:2000.

References:

- Cofrentes NPP (2004). Acquisition of OPC-4357 valves. Nuclear class-C 1500# 1”-2” ball valves.
- Cofrentes NPP (2009). Acquisition of OPC-4357 valves. 1500# 3/4”-1” full-flow gate valves. Nuclear class ND.
- India NPC. Bellows globe valves, swing-type check valves, butterfly valves, control valves. Sizes ranging from 1” to 3”, 1500#. Nuclear class ASME III NB (2007-2010).
- Specifications for nuclear class-I valves (Trillo and Ascó-Vandellòs) in the part corresponding to valving.

CONTACT	**www.vectorvalves.com** / **info@vectorvalves.com** (+34) 902 19 60 92 – 976 46 27 89 Autovía Zaragoza, km 13 – Polígono El Águila, naves 103 a 10550180 Utebo, Zaragoza

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