

**SPAIN**



## SPAIN

### 1. GENERAL INFORMATION

#### 1.1. General Overview

Spain is a constitutional democracy. The Head of State is the King. Executive power is vested in the President of the government. The Constitution was adopted in 1987. Spain is situated in south west Europe, occupying the greater part of the Iberian Peninsula, the Balearic and Canary Islands and a small part of northern Africa (Ceuta and Melilla), and bounded on the north by the Bay of Biscay, France and Andorra; on the east by the Mediterranean Sea; on the south by the Mediterranean Sea and the Atlantic Ocean; and on the west by Portugal and the Atlantic Ocean. The area of Spain is 504 800 km<sup>2</sup> large.

The climate of Spain is marked by extreme temperatures and, generally, insufficient rainfall. The variegated physical features of the country ensure pronounced climatic differences. The climate is most equable along the Cantabrian and Atlantic coasts, which are generally damp and mild. The central plateau is dry and hot. Most of Spain receives less than 610 mm of precipitation per year, the northern mountains get considerable more moisture. By contrast, the southern Mediterranean coast has a subtropical climate. Malaga, in the extreme south, has an average winter temperature of 14°C. The average precipitation in Spain is 627 mm.

The historical population data are given in Table 1. The population in Spain at the beginning of 2000 was almost 40 million; the overall density was about 79 persons per km<sup>2</sup>. Spain is increasingly urbanizing with more than three-fourths of the population in towns and cities. The population growth rate is close to zero, so the population is stabilizing.

Spain has traditionally been an agricultural country and is still one of the largest producers of farm commodities in Western Europe, but since the mid-1950s, industrial growth has been rapid. A series of development plans, initiated in 1964, helped the economy to expand, but in the later 1970s an economic slowdown came by rising oil costs and increased imports. In January 1986, Spain became a full member of the European Community.

Spain actually has nine operating nuclear units which represents 7 749 MW gross electric power and produces about 30% of the electricity generation. The reactors are of both types BWR and PWR from different suppliers namely Westinghouse, General Electric and Siemens. The energy policy goes towards the complete liberalization of the markets with the main target of decreasing the energy prices, ensuring the energy supply and the quality, also improving the energy efficiency, reducing the consumption and protecting the environment.

TABLE 1. POPULATION INFORMATION

|   | 1960  | 1970 | 1980 | 1990 | 1996 | 1997 | 1998 | 1999 | 2000 | Growth rate (%)<br>1980 to 1999 |
|---|-------|------|------|------|------|------|------|------|------|---------------------------------|
| Population (millions)                             | 30.5  | 33.8 | 37.5 | 39.3 | 39.6 | 39.7 | 39.8 | 39.9 | 39.9 | 0.3                             |
| Population density (inhabitants/km <sup>2</sup> ) | 60.3  | 66.9 | 74.4 | 77.9 | 78.6 | 78.7 | 78.8 | 79.0 | 79.1 | 0.3                             |
| Urban population as percent of total              | N/A   | N/A  | N/A  | 65   | 76.7 | 76.9 | 77.2 | 77.4 | N/A  | -                               |
| Area (1000 km <sup>2</sup> )                      | 504.8 |      |      |      |      |      |      |      |      |                                 |

Source: IAEA Energy and Economic Database.

#### 1.2. Economic Indicators

The Gross Domestic Product (GDP) has been increasing since the early 90's due to an increase in the service sector. In 1999, GDP was 97 145 billion current pts. Table 2 shows the historical GDP statistics in US\$.

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

|                               | 1970 | 1980    | 1990    | 1996   | 1997   | 1998   | 1999   |
|-------------------------------|------|---------|---------|--------|--------|--------|--------|
| GDP <sup>(1)</sup>            | N/A  | 213,308 | 491,938 | 60,900 | 55,900 | 58,200 | 59,600 |
| GDP <sup>(2)</sup> per capita | N/A  | 5,682   | 12,516  | 15,496 | 14,224 | 14,772 | 15,127 |
| GDP growth (%)                |      |         |         | 2.34   | 3.84   | 3.96   | 3.75   |
| GDP by sector (%):            |      |         |         |        |        |        |        |
| -Agriculture                  | N/A  | N/A     | 5       | 5      | 4      | 4      | 4      |
| -Industry                     | N/A  | N/A     | 28      | 28     | 28     | 28     | 28     |
| -Services                     | N/A  | N/A     | 67      | 67     | 68     | 68     | 67     |

<sup>(1)</sup> Millions of current US\$.

<sup>(2)</sup> Current US\$ per capita.

Source: IAEA Energy and Economic Data Base; Data & Statistics/The World Bank; Country Information.

### 1.3. Energy Situation

The main indigenous energy sources in Spain are coal and hydro (Table 3). The primary energy consumption raised to about 120 Mtoe in 1999. This figure is obtained as the result of adding every non-electric final energy consumption and the energy sector consumption (self consumption and transformation consumption) and the energy losses. The final energy demand in the same year was about 88 Mtoe and the national primary energy production was 34 Mtoe. Table 4 shows the historical energy statistics from the IAEA Energy and Economic Data Base.

TABLE 3. ESTIMATED ENERGY RESERVES

|                       | Exajoule |        |      |                        |                      |       |
|-----------------------|----------|--------|------|------------------------|----------------------|-------|
|                       | Solid    | Liquid | Gas  | Uranium <sup>(1)</sup> | Hydro <sup>(2)</sup> | Total |
| Total amount in place | 10.40    | 0.04   | 0.08 | 6.66                   | 13.30                | 30.49 |

<sup>(1)</sup> This total represents essentially recoverable reserves.

<sup>(2)</sup> For comparison purposes a rough attempt is made to convert hydro capacity to energy by multiplying the gross theoretical annual capability (World Energy Council - 1998) by a factor of 10.

Source: IAEA Energy and Economic Data Base.

### 1.4. Energy Policy

The legal framework is based in Law 54/1997 on Electric Sector and Law 34/1998 on Hydrocarbon Sector and the rules in relation with them. The energy policy tends to liberalize progressively the markets with the main target of decreasing the energy prices ensuring the energy supply and the quality, trying also to improve the energy efficiency, to reduce the consumption and to protect the environment.

In the field of electricity generation, the principle of freedom is established to set up and to operate on a free market basis. The electric transportation and distribution are liberalized allowing to third parts to the grid. The electric sale is based in a free election of the supplier, with a transition period established in ten years to spread the free election to all consumers. Law 54/1997 joins to Spanish regulations European Directive 96/92/CE, relative to common standards for inner electric market. Law also establishes other targets like to improve energy efficiency, to reduce consumption and to protect the environment.

Law 34/1998 on Hydrocarbon Sector is in the same way than Law 54/1997, intending to establish liberalizing markets, where the Government only establishes the rules. In all cases being aware about environmental protection. This Law considers the different stages in the hydrocarbon industry, for liquid and gas. Law 34/1998 creates the Energy National Commission (Comisión Nacional de Energía), to regulate the energy systems, to maintain the free competence among them and the transparency of the performance, to benefice all the organizations working in the system and the consumers.

TABLE 4. ENERGY STATISTICS

|                                      | Exajoule |      |      |      |      |      |      |              | Average annual growth rate (%) |  |
|--------------------------------------|----------|------|------|------|------|------|------|--------------|--------------------------------|--|
|                                      | 1960     | 1970 | 1980 | 1990 | 1997 | 1999 | 2000 | 1960 to 1980 | 1980 to 2000                   |  |
| Energy consumption                   |          |      |      |      |      |      |      |              |                                |  |
| - Total <sup>(1)</sup>               | 0.70     | 1.73 | 3.03 | 3.72 | 4.66 | 4.86 | 5.10 | 7.59         | 2.64                           |  |
| - Solids <sup>(2)</sup>              | 0.35     | 0.47 | 0.56 | 0.85 | 0.90 | 0.74 | 0.72 | 2.38         | 1.22                           |  |
| - Liquids                            | 0.20     | 1.00 | 2.07 | 1.88 | 2.40 | 2.55 | 2.63 | 12.31        | 1.20                           |  |
| - Gases                              | N/A      | N/A  | 0.08 | 0.23 | 0.46 | 0.62 | 0.71 |              | 11.50                          |  |
| - Primary electricity <sup>(3)</sup> | 0.15     | 0.26 | 0.32 | 0.75 | 0.90 | 0.96 | 1.05 | 3.91         | 6.08                           |  |
| Energy production                    |          |      |      |      |      |      |      |              |                                |  |
| - Total                              | 0.50     | 0.65 | 0.85 | 1.40 | 1.49 | 1.36 | 1.44 | 2.71         | 2.67                           |  |
| - Solids                             | 0.34     | 0.37 | 0.45 | 0.54 | 0.57 | 0.38 | 0.37 | 1.32         | -0.99                          |  |
| - Liquids                            | N/A      | 0.01 | 0.07 | 0.05 | 0.02 | 0.04 | 0.03 | 17.47        | -3.25                          |  |
| - Gases                              | N/A      | N/A  | N/A  | 0.06 | 0.02 | 0.01 |      |              | 28.93                          |  |
| - Primary electricity <sup>(3)</sup> | 0.15     | 0.28 | 0.33 | 0.75 | 0.90 | 0.94 | 1.03 | 4.07         | 5.79                           |  |
| Net import (import - export)         |          |      |      |      |      |      |      |              |                                |  |
| - Total                              | 0.34     | 1.22 | 2.33 | 2.54 | 3.13 | 4.01 | 4.25 | 10.06        | 3.04                           |  |
| - Solids                             | 0.01     | 0.08 | 0.17 | 0.29 | 0.28 | 0.39 | 0.39 | 16.30        | 4.24                           |  |
| - Liquids                            | 0.34     | 1.14 | 2.09 | 2.08 | 2.39 | 2.96 | 3.08 | 9.57         | 1.97                           |  |
| - Gases                              | N/A      | N/A  | 0.08 | 0.17 | 0.46 | 0.66 | 0.78 |              | 12.07                          |  |

<sup>(1)</sup> Energy consumption = Primary energy consumption + Net import (Import - Export) of secondary energy.

<sup>(2)</sup> Solid fuels include coal, lignite and commercial wood.

<sup>(3)</sup> Primary electricity = Hydro + Geothermal + Nuclear + Wind.

Source: IAEA Energy and Economic Database; Country Information.

## 2. ELECTRICITY SECTOR

### 2.1. Structure of the Electricity Sector

In Spain, there are four large electricity producers: Endesa, Iberdrola, Unión Eléctrica and Hidroeléctrica del Cantábrico. The most important are the first two mentioned companies; they produced in 1998 about 60% of the national electricity.

Endesa was created in 1958, owned by the State of Spain, with the objective of promoting electric generation in power plants fed by national coal. In the last years has been increasing the private participation in the company, and in 1998 the company became totally private. In the last years, Endesa bought other smaller electric companies, like ENHER, GESA, Electra de Viesgo, UNELCO; FECSA, ERZ and Compañía Sevillana de Electricidad. Iberdrola was created in 1991, when Iberduero and Hidroeléctrica Española were united. The size of the other two important companies (Unión Eléctrica and Hidroeléctrica del Cantábrico) is significantly smaller than the two big ones.

Also, there are “special producers” which with the targets of energy saving and efficiency, produce electric energy using cogeneration (production of heat and electricity) or wind, biomass and wastes energies. In 1999, they produced about 13% of the national electric generation.

Another important company in the Spanish electrical sector is Red Eléctrica de España, S.A. (REE), responsible for the electricity transportation and the load distribution. It was created in 1985, when the electric companies changed the majority of their installations in relation with electricity transportation, and they got a participation in the capital of this company. At the beginning, the majority of the capital of the company was owned by the State, now every main electric company has 10% of the capital, the rest belongs to private investments and the Spanish State.

The “Compañía Operadora del Mercado Español de Electricidad” (Market Operator), created by the Law 54/1997 on the Electric Sector, is in charge of the management of the electricity sector from the economic point of view. Specifically, it is in charge of the reception of sale and purchase

bids, their subsequent matching and settlement of the transactions. In parallel to the Market Operator, the same Law on the Electric Sector set up the System Operator, to take charge of the technical management.

The National Energy Commission (Comisión Nacional de Energía) was created by Law 34/1998 on the Hydrocarbon Sector, its objective is to regulate the energy systems, to maintain free competition and transparency of the performance, to benefit all the organizations working in the system and the consumers. The Commission has a Steering Committee with the President, Secretary and eight more members, all of them stay in the Commission for a six year period and can be renamed for the same period. The Commission has advising organizations.

## 2.2. Decision Making Process

As is indicated in other paragraphs, the energy policy in Spain tends to liberalize progressively the markets with the main target of decreasing the energy prices, ensuring the energy supply and the quality, also improving the energy efficiency, reducing the consumption and protecting the environment. This position is expressed by Law 54/1997, of 27 November, on Electric Sector and the rules in relation with it. The Law establishes regulations to guarantee the electric supply, the quality of the supply and try to get the lowest cost. It creates a liberalized wholesale market where the Government only is responsible to approve the specific regulations and the prices are established by the economic agents. In relation with the terms to get the complete liberalization, Law establishes year 2007 when all consumers will be able to choose the supplier.

With regard to nuclear energy, the Ministry of Economy and the Nuclear Safety Council are the main government authorities. The main tasks and duties of the Ministry of Economy are:

- to dictate norms and rules;
- grant licenses for:
  - nuclear & radioactive installations, except minor radioactive installations responsibility of regional authorities;
  - transport of radioactive materials;
  - nuclear component fabrication;
  - nuclear materials commerce/trading.

Other powers are:

- to suspend permits, in some specific cases;
- power to sanction the law transgressions;
- to approve the radioactive waste policy.

The Nuclear Safety Council is the competent Organization in matters of Nuclear Safety and Radiation Protection. The Council is formed by 5 Members which are designated by the Government through a proposal of the Minister of Economy. They must be accepted by a 3/5 majority of Parliament. At present, its Secretariat has about 400 people. It has permanently two inspectors at every NPP site and its main tasks are:

- to issue the perceptive Safety Reports, previous to the authorization by Minister of Economy;
- to carry out all kind of inspections with capability to suspend the activity in case of a risk;
- to propose to the Government norms and rules concerning nuclear safety and radiological protection;
- to propose to MINER sanctions in matters of nuclear safety and radiation protection;
- to grant licenses for operators of nuclear and radioactive installations;
- to inform the public about subjects of its competence;
- to report every year to the Parliament about its activities.

## 2.3. Main Indicators

The main sources for electricity production are nuclear power and coal-fired plants, the first with 27% and the last with 33%. In the last years, cogeneration (production of heat and electricity) increased, basically through natural gas and wind generation. In 1999, the primary energy consumption of the electricity sector was 22 Mtoe, which represents 18% of the total primary energy consumption in Spain. Table 5 shows the historical electricity production and installed capacities and Table 6 the energy related ratios.

TABLE 5. ELECTRICITY PRODUCTION AND INSTALLED CAPACITIES

|                                       | 1960  | 1970  | 1980   | 1990   | 1997   | 1998   | 1999   | 2000   | Average ann. growth rate (%) |              |
|---------------------------------------|-------|-------|--------|--------|--------|--------|--------|--------|------------------------------|--------------|
|                                       |       |       |        |        |        |        |        |        | 1960 to 1980                 | 1980 to 2000 |
| Electricity production (TW·h)         |       |       |        |        |        |        |        |        |                              |              |
| - Total <sup>(1)</sup>                | 18.61 | 56.31 | 109.20 | 151.76 | 189.07 | 199.73 | 204.81 | 215.55 | 9.25                         | 3.46         |
| - Thermal                             | 2.99  | 27.61 | 74.49  | 73.68  | 96.43  | 99.47  | 107.40 | 108.61 | 17.44                        | 1.90         |
| - Hydro                               | 15.62 | 27.78 | 29.53  | 26.18  | 36.67  | 40.51  | 39.22  | 45.44  | 3.23                         | 2.18         |
| - Nuclear                             | 0.00  | 0.92  | 5.19   | 51.90  | 53.30  | 59.00  | 56.47  | 59.31  | -                            | 12.96        |
| - Geothermal                          | N/A   | N/A   | N/A    | N/A    | N/A    | N/A    | N/A    |        | -                            | -            |
| - Wind                                | N/A   | N/A   | N/A    | N/A    | 0.68   | 0.68   | 1.35   |        | -                            | -            |
| Capacity of electrical plants (GW(e)) |       |       |        |        |        |        |        |        |                              |              |
| - Total                               | 6.57  | 17.91 | 27.40  | 43.41  | 50.82  | 50.55  | 52.81  | 58.78  | 7.40                         | 3.89         |
| - Thermal                             | 1.97  | 6.88  | 13.48  | 19.81  | 25.15  | 25.09  | 26.33  | 27.72  | 10.10                        | 3.67         |
| - Hydro                               | 4.60  | 10.88 | 12.83  | 16.23  | 17.63  | 16.85  | 16.74  | 16.73  | 5.26                         | 1.34         |
| - Nuclear                             | 0.00  | 0.15  | 1.09   | 7.38   | 7.58   | 7.47   | 7.51   | 7.51   |                              | 10.13        |
| - Geothermal                          | N/A   | N/A   | N/A    | N/A    | N/A    | 0.02   | 0.02   | 0.02   |                              |              |
| - Wind                                | N/A   | N/A   | N/A    | N/A    | 0.46   | 1.11   | 2.21   | 6.80   |                              |              |

<sup>(1)</sup> Electricity losses are not deducted.

Source: IAEA Energy and Economic Database; Data & Statistics/The World Bank.

TABLE 6. ENERGY RELATED RATIOS

|   | 1960 | 1970  | 1980  | 1990  | 1996  | 1998  | 1999  | 2000  |
|---|------|-------|-------|-------|-------|-------|-------|-------|
| Energy consumption per capita (GJ/capita)       | 23   | 51    | 81    | 95    | 109   | 121   | 122   | 128   |
| Electricity per capita (kWh/capita)             | 606  | 1,547 | 2,732 | 3,664 | 4,203 | 4,698 | 5,027 | 5,288 |
| Electricity production/Energy production (%)    | 36   | 79    | 118   | 99    | 114   | 130   | 140   | 139   |
| Nuclear/Total electricity (%)                   | 0    | 2     | 5     | 36    | 33    | 31    | 29    | 29    |
| Ratio of external dependency (%) <sup>(1)</sup> | 49   | 70    | 77    | 68    | 74    | 77    | 82    | 83    |
| Load factor of electricity plants:              |      |       |       |       |       |       |       |       |
| - Total (%)                                     | 32   | 36    | 45    | 40    | 43    | 45    | 44    | 42    |
| - Thermal                                       | 17   | 46    | 63    | 42    | 41    | 45    | 47    | 45    |
| - Hydro   | 39   | 29    | 26    | 18    | 28    | 27    | 27    | 31    |
| - Nuclear                                       | -    | 69    | 54    | 80    | 83    | 90    | 86    | 90    |

<sup>(1)</sup> Net import / Total energy consumption

Source: IAEA Energy and Economic Database.

## 3. NUCLEAR POWER SITUATION

### 3.1. Historical Development

Nuclear Energy in Spain was developed in the early 50's. At that time, the main organization responsible in this field was the Junta de Energía Nuclear, a subordinate organization of the Ministry of Industry and Energy, in charge of personnel training, raw materials procurement, basic scientific research and technology development. In 1964, the Law 25/1964 on Nuclear Energy was enforced, regulating this sector. (Note: the Junta de Energía Nuclear has been replaced by CIEMAT, which is now a subordinated organization of the Ministry of Science and Technology)

In the late 60's, started the construction of the first generation nuclear power plants José Cabrera, Santa Maria de Garoña and Vandellós I. These plants enabled to obtain the first experience in order to establish a nuclear programme to cover the growing electricity demand. In the early 70's the construction of the second generation NPPs as Almaraz I and II, Lemóniz I and II, Ascó I and II and Cofrentes started.

In 1972, ENUSA, the former Empresa Nacional del Uranio, S.A., now ENUSA Industrias Avanzadas, S.A., a state owned company, was established, taking charge of all the nuclear fuel cycle front-end activities. The Law 15/1980 created the Consejo de Seguridad Nuclear (Nuclear Safety Council), the only organization competent in nuclear safety and radiological protection matters in Spain. In the early 80's, started the construction of the NPPs Valdecaballeros I and II, Vandellós II and Trillo I, NPPs, and preparatory studies for Trillo II were initiated.

In 1983, a moratorium was established (construction pause) for Lemóniz I and II Valdecaballeros I and II, and Trillo II; in 1994, the definitive cessation was decided of the nuclear power plants under the moratorium.

In 1984, ENRESA (Empresa Nacional de Residuos Radiactivos, S.A.) was established. The State owned company responsible for the radioactive waste management and the dismantling of nuclear installations in Spain.

### 3.2. Status and Trends of Nuclear Power

Table 7 shows the status of the Spanish NPPs and Figure 1 shows the location of each plant, their owners and shares, the electric power, the type of reactor and the year of connection to the grid.

The Vandellós I NPP is cancelled since 1990, in January 1998 Ministry of Industry and Energy authorized activities of plant dismantling. Activities authorized consists in dismantling to Level 2, which will allow more than 80% of the site to be released. After a waiting period estimated at some 30 years will be initiated of works to Level 3 dismantling, that will leave the site completely free for subsequent unrestricted use. The period required to perform the authorized activities is estimated at five years.-

TABLE 7. STATUS OF NUCLEAR POWER PLANTS

| Station               | Type | Gross Capacity | Operator | Status      | Reactor Supplier |
|-----------------------|------|----------------|----------|-------------|------------------|
| ALMARAZ-1             | PWR  | 973.5          | CNA      | Operational | WEST             |
| ALMARAZ-2             | PWR  | 982.6          | CNA      | Operational | WEST             |
| ASCO-1                | PWR  | 1028           | ANA      | Operational | WEST             |
| ASCO-2                | PWR  | 1015           | ANA      | Operational | WEST             |
| COFRENTES             | BWR  | 1025           | ID       | Operational | GE               |
| JOSE CABRERA (ZORITA) | PWR  | 160            | UF       | Operational | WEST             |
| SANTA MARIA DE GARONA | BWR  | 466            | NUCLENOR | Operational | GE               |
| TRILLO-1              | PWR  | 1066           | CNT      | Operational | KWU              |
| VANDELLOS-2           | PWR  | 1087           | ANV      | Operational | WEST             |
| VANDELLOS-1           | PWR  | 508            | HIFRENSA | Shut down   | CEA              |

| Station                | Construction Date | Criticality Date | Grid Date | Commercial Date | Shutdown Date |
|------------------------|-------------------|------------------|-----------|-----------------|---------------|
| ALMARAZ-1              | 02-Jul-73         | 05-Apr-81        | 01-May-81 | 01-Sep-83       |               |
| ALMARAZ-2              | 02-Jul-73         | 19-Sept-83       | 08-Oct-83 | 01-Jul-84       |               |
| ASCO-1                 | 16-May-74         | 16-Jun-83        | 13-Aug-83 | 10-Dec-84       |               |
| ASCO-2                 | 07-Mar-75         | 11-Sept-85       | 23-Oct-85 | 31-Mar-86       |               |
| COFRENTES              | 09-Sept-75        | 23-Aug-84        | 14-Oct-84 | 11-Mar-85       |               |
| JOSE CABRERA-1(ZORITA) | 24-Jun-64         | 30-Jun-68        | 14-Jul-68 | 13-Aug-69       |               |
| SANTA MARIA DE GARONA  | 02-May-66         | 05-Nov-70        | 02-Mar-71 | 11-May-71       |               |
| TRILLO-1               | 17-Sept-79        | 14-May-88        | 23-May-88 | 06-Aug-88       |               |
| VANDELLOS-2            | 29-Dec-80         | 14-Nov-87        | 12-Dec-87 | 08-Mar-88       |               |
| VANDELLOS-1            | 21-Jun-68         | 11-Feb-72        | 06-May-72 | 01-Aug-72       | 31-Jul-90     |

Source: IAEA Power Reactor Information System as of 31 December 2000.

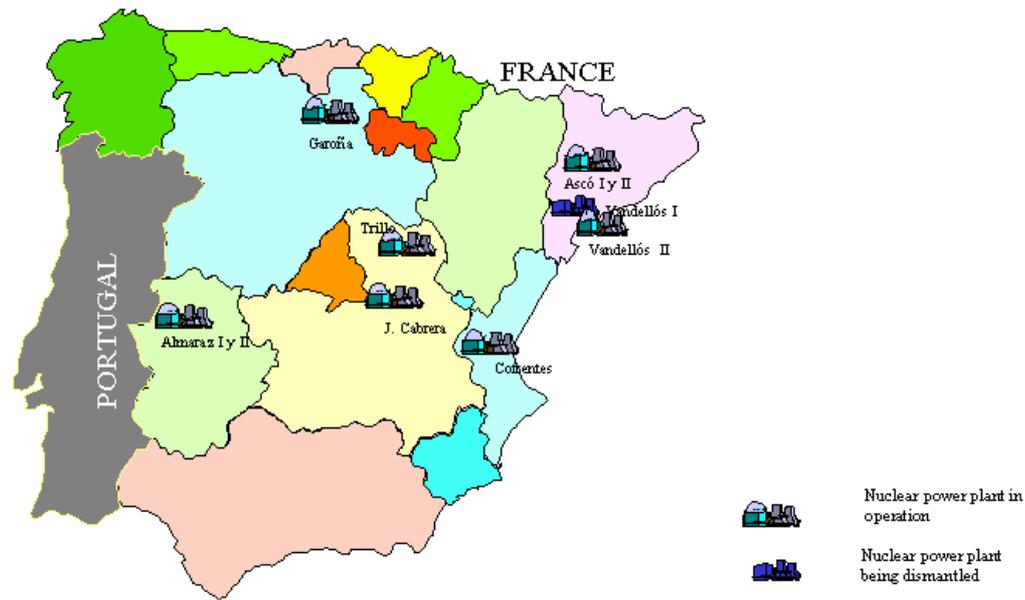


FIG. 1. Location of Spanish NPPs

### 3.3. Current Policy Issues

Law 54/1997 on the Electric Sector admits the right to the free installation in the field of generation. In relation with nuclear power plants, at this moment, there is no application to build a new one, and there is no strategy about the construction of new nuclear power plants.

### 3.4. Organisational Chart

Figure 2 illustrates the licensing process for nuclear installations.

## 4. NUCLEAR INDUSTRY

### 4.1. Supply of NPPs

#### *Architect Engineers*

The Spanish Engineering Companies which play the main role in the National Nuclear Sector are Empresarios Agrupados, Initec, Inypsa and Sener. These companies have collaborated solely or in consortium with others in launching the first generation NPPs and in successive projects, increasing progressively the nuclear installed capacity. The first NPPs were carried out as turn-key projects and only in the following projects were local engineering companies involved. The scope of each project has been different, having the engineering companies focus on different activities such as design, licensing, procurement operations and collaboration in start-up and in tests. At this moment, as there are no NPPs under construction, these Architect Engineers companies have concentrated on operational support, shutdown and decommissioning of NPPs, research and development and radioactive waste engineering activities.

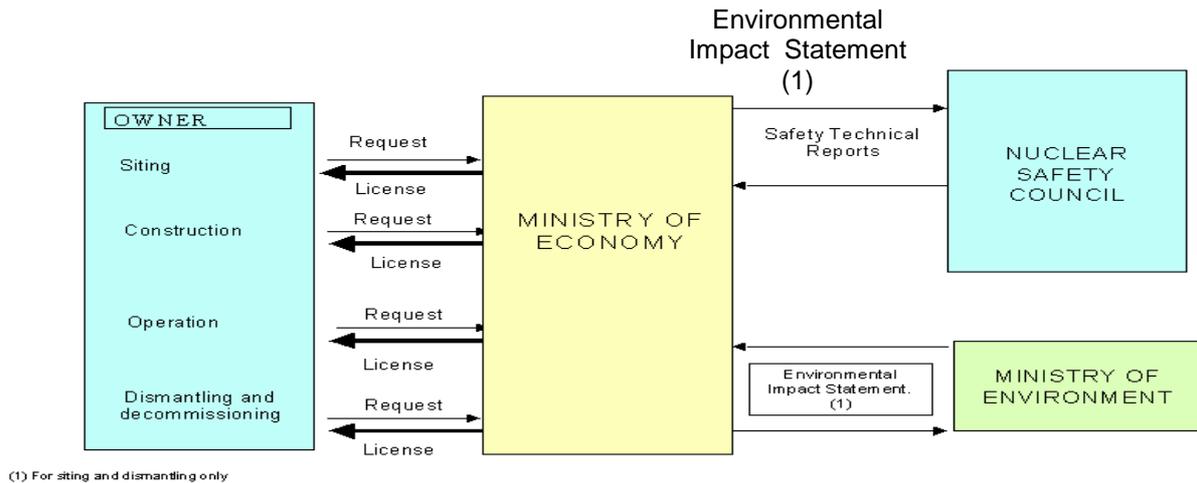


FIG. 2. Licensing of nuclear installations.

### NSSS Manufacturers

The main Spanish NSSS manufacturer is ENSA (Equipos Nucleares, S.A.), which designs, produces and inspects NPPs primary circuit equipment and components. Its manufacturing plant is located in Maliaño (Cantabria). This company is State owned through the Sociedad Estatal de Participaciones Industriales (SEPI), which controls 100% of its shares. ENSA is also constructing double purpose casks, called ENSA-DPT, to store and/or transport up to 21 PWR KWU spent fuel assemblies.

ENSA has provided primary circuit equipment's as steam generators, reactor vessels, etc. and components to the second and third generation Spanish NPPs and has exported to several countries as: Germany, Argentina, United Kingdom, India, United States of America, Belgium and others.

Mecánica de la Peña is another nuclear equipment manufacturer.

### Other Main Component Suppliers

The last NPPs built in Spain enclosed a large range of domestically made equipment and components. The following list of national manufacturers aims to be useful and includes only the main companies.

|                            |   |
|----------------------------|---|
| Turbines:                  | E.N.Bazán                                       |
| Pumps:                     | Ingersoll-Rand, Sulzer, Neyrpic.                |
| Air compressor:            | ABC, Betico.                                    |
| Valves:                    | Walthom Weir Pacific, Poyam.                    |
| Electric equipments:       | Asea Brown Boveri (ABB), Merlin-Gerin, Pirelli. |
| Instrumentation & Control: | Abengoa, CAE.                                   |
| Air conditioning:          | Sulzer.   |

## 4.2. Operation of NPPs

### *Owners/Operators*

Table 7 included in section 3.3 shows the ownership of each NPP.

### *Operation Service Suppliers*

There are several companies who offer operational services in the nuclear sector, as TECNATOM, TECNOS, LAINSA, ENWESA and NUSIM. TECNATOM provides training services to operational personnel of NPPs. It has PWR and BWR simulators. TECNATOM has also carried out several in service inspection and maintenance activities giving support to the Spanish NPPs. TECNOS, LAINSA, ENWESA and NUSIM are focusing on maintenance and operational support to NPPs, quality assurance, radiological protection and various activities.

## 4.3. Fuel Cycle, Spent Fuel and Waste Management Service Supply

ENUSA the former Empresa Nacional del Uranio, S.A., now ENUSA Industrias Avanzadas, S.A.), the State owned company, carries out activities related to the front-end fuel cycle. Its main duties are:

- Procurement and exploitation of radioactive mineral mines, comprising the mineral treatment to obtain concentrates;
- Conversion of uranium concentrates to uranium hexafluoride;
- Uranium enrichment;
- Nuclear fuel elements manufacturing.

These duties can be carried out by ENUSA it self or by a subcontracted company. ENUSA operates a milling plant (Quercus Plant) located in Saelices el Chico (Salamanca) and also it has a nuclear fuel manufacturing Plant located in Juzbado (Salamanca).

The uranium concentrates from ENUSA comes from its own production from Quercus Plant and from COMINAK, a company from Niger, owned by several foreign companies including ENUSA which holds 10% of its shares. The rest of its uranium concentrates demand comes from several foreign companies. Due to the present lower uranium market price, the ENUSA mining activities in Saelices el Chico (Salamanca) stopped at the end of 2000. The uranium concentrates from ENUSA comes from COMINAK and from several foreign companies. COMINAK is a company from Niger, owned by several foreign companies including ENUSA, which holds 10% of its shares. There are no uranium conversion and enrichment plants in Spain. ENUSA owns 11% of Eurodif, European consortium with enrichment factories in France. ENUSA has signed several contracts with companies abroad for uranium conversion and enrichment activities.

The Juzbado plant produces fuel elements for most PWRs and BWRs in Spain and for some reactors in Sweden, Germany, France, Finland and Belgium.

ENRESA (Empresa Nacional de Residuos Radiactivos, S.A.), the State owned company, was set up in 1984 and is in charge of the radioactive waste management activities and the dismantling of nuclear installations. Its duties are as follows:

- Radioactive waste treatment and conditioning;
- Searching for locations, design, construction and operation of interim and final storage centres for high, medium and low level radioactive wastes;
- Management of the different operations related to the decommissioning of nuclear and radioactive installations;
- To establish systems for collecting, transferring and transporting radioactive wastes;
- To give support to civil protection services in case of nuclear emergencies;

- Final and safe conditioning of wastes derived from the mining and milling processes;
- Assuring of the long-term management of every radioactive waste storage facility;
- To carry out the appropriate technical and economic studies, considering the deferred costs and to outline the proper economic policy.

ENRESA draws up a proposal of General Plan for Radioactive Wastes, as established in the Royal Decree by which the company was constituted, and submits it to the Ministry of Industry and Energy for approval by the Government. On July 31<sup>st</sup> 1999, the Spanish Government approved the 5<sup>th</sup> General Plan for Radioactive Wastes.

The basic hypotheses of this Plan, for the purpose of drawing up and performing the corresponding economic calculations, are:

- Plant life for currently in operation NPPs: 40 years;
- 7 000 hours/year at 100 % capacity;
- Discount rate 2.5 %.

With respect to the wastes to be managed, some 193 500 m<sup>3</sup> of Low and Intermediate Level and 15 000 m<sup>3</sup> of Irradiated Fuel and others kinds of high level radioactive wastes are considered. The strategy settled for the fuel has three phases:

- a) Up to year 2010, a temporary storage facility for dual-purpose flasks will be constructed at Trillo NPP and commissioned in 2002;
- b) Beyond 2010 is foreseen to have a Centralized Interim Storage facility;
- c) No decision will be taken with respect to final disposal of the irradiated fuel prior 2010. Until then, it will be necessary to conjugate two lines of research work one looking towards a deep geological repository and a second one towards partitioning and transmutation.

ENRESA has a medium and low-level radioactive waste storage installation located in El Cabril, Cordoba. ENRESA main tasks, which presently are carried out, are as follows:

- Decommissioning of Vandellós NPP Unit-I, to reach Level 2;
- Different activities concerning the spent fuel and high radioactive waste management and storage;
- Management radioactive lighting rods;
- Research and Development activities;
- International relation tasks.

#### **4.4. Research and Development Activities**

CIEMAT (Centro de Investigaciones Energéticas Medioambientales y Tecnológicas) is an institution under on the Ministry of Science and Technology. One of its duties is nuclear research. It collaborates with several institutions in Spain and abroad.

CSN (Consejo de Seguridad Nuclear). This organization is the only competent organization in nuclear safety and radiological protection subjects. It handles several research programmes related with its competence, according with its duties, which have been defined by law. It collaborates with other private and public organizations in Spain and abroad.

In the ENRESA's 1999-2003 R+D programme, there are five main lines of work that deal with basic technologies, partitioning and transmutation, artificial and natural confinement of spent fuel, performance assessment and support to facilities.

DTN (Agrupación Eléctrica para el Desarrollo Tecnológico Nuclear) carries out and operates TR&D projects associated with nuclear power plants, both in Spain and abroad and for national and multinational organisations, as well as provide project-related services.

Apart from the above-mentioned organizations, other institutions as Universities and Enterprises are carrying out several research and development programmes in the nuclear field.

#### **4.5. International Co-operation in the field of Nuclear Power Development and Implementation**

Spain, as member of the European Union, carries out most of its international activities within that framework. In the EU the most important programmes are R&D Framework Programme and the Community Action Plan, as well as programmes for technical assistance to the countries of Eastern and Central Europe, mainly PHARE and TACIS. Spain participates in the Chernobyl Shelter Implementation Plan and is Member of the Contributor Assembly Fund established in EBRD (European Bank for Reconstruction and Development).

Moreover, Spain participates in the programmes of Nuclear Energy Agency (NEA/OECD) and International Atomic Energy Agency (IAEA).

#### **4.6. Other Organisations in the Nuclear Field**

There are several non-profit associations that operate in the nuclear field. The main associations are as follows:

- Sociedad Nuclear Española (Spanish Nuclear Society), established in 1974, was founded by relevant persons related to the nuclear sector. It accomplishes several activities such as congresses, round tables, seminars, etc. It issues a monthly publication and it is member of the European Nuclear Society.
- Sociedad Española de Protección Radiológica (Spanish Society for Radiological Protection), established in 1980. It includes persons and agencies that are involved in the radiological protection field. It is a partner of the International Radiological Protection Association.
- Foro de la Industria Nuclear Española Forum Atómico España (Spanish Nuclear Industry Atomic Forum), founded in 1962. It is an institution whose members are industries and agencies interested in nuclear energy. It encourages information exchange activities and organises courses, mainly in nuclear safety, economics and training aspects. It is associated with analogue foreign institutions in FORATOM.

### **5. REGULATORY FRAMEWORK**

#### **5.1. Safety Authority and Licensing Process**

The nuclear installation licensing procedure in Spain is regulated by the Law 25/1964 on Nuclear Energy as amended. The provisions of this Law have been developed by Royal Decree 1836/1999 Nuclear and Radioactive Facilities Regulation, approved December 3<sup>rd</sup> 1999, on the procedure for licensing the nuclear and radioactive installations regulation that preceded the Law. To license-nuclear installations, the following successive authorizations are needed:

- Siting authorization: it is a formal acknowledge of the purpose and the location submitted;
- Construction authorization: it permits to start up the construction of the installation;
- Operation authorization: it permits to introduce nuclear fuel in the plant and to operate the plant.

Also for plant dismantling and plant modification, an authorization is required prior to begin of the activity. Figure 2 shows the nuclear installation licensing procedure. These authorizations and permissions are granted by the Ministry of Economy, under previous and perceptive advise referring to nuclear safety and radiological protection issued by the CSN (Nuclear Safety Council). This report is liable in case of authorization denying, as same as its requirements if there exist. Before granting a construction authorization, the project must be submitted for an environmental appraisal to the Ministry of Environment. As a consequence of this analysis, the project can be yield to certain requirements.

To obtain these authorizations and permissions, the documents determined in the current regulations must be submitted to the licensing authorities and the suitable tests, analyses and validations must be performed. Nuclear installations require authorizations granted by other administrative bodies, belonging to local administrations, according to the rules of these bodies. Before granting the siting authorization, a 30 days period is established for public hearings. During this period anyone can present allegations.

## 5.2. Main Laws and Regulations

Law 25/1964 on Nuclear Energy (Ley 25/1964 sobre Energía Nuclear, del 29 de abril) as amended. This Law has been developed by the Royal Decree 1836/1999 for Nuclear and Radioactive Facilities Regulation and by the Royal Decree 53/1992, which formulates the regulation of Sanitary Protection against ionized radiation. Nuclear and Radioactive Facilities Regulation was approved December 3<sup>rd</sup> 1999, this Regulation substitutes the previous one, in force since 1972.

In the new Regulation have been considered the rules in relation with the adherence of Spain to the European Community, the new Autonomous Communities created into Spain and several Laws issued in these years. All of these modified the framework in relation with the performance of different organizations in the Spanish Administration.

The main changes introduced in the Regulation are:

- In nuclear installations, the documents required in the different steps of the authorization are adapted to the new requisites, successive extension of the provisional operation permission is changed for operation permission with a determined time limit and is regulated the procedure for dismantling and closure authorizations;
- Radioactive waste storage installations, nuclear reactors and research critical assemblies, must obtain previous authorization, therefore they will require Environmental Impact Assessment;
- In relation with radioactive installations, the activities to put radionuclides out of administrative control are changed and, depending on the installation category the administrative procedure is modified;
- Only is necessary to obtain manufacturing authorization for equipment containing radioactive materials or generating ionizing radiation;
- A record of companies, which transport nuclear substances and radioactive materials, is established.

El Consejo de Seguridad Nuclear (Nuclear Safety Council) was established by Law 15/1980, of April 22, and a Royal Decree defined the status of its employees. From this time several acts and regulations have amended some of the initial provisions, particularly Law 14/1999 governing Public Tariffs and Prices for its services.

The provisions related with nuclear fuel cycle, initially contained in a Royal Decree of 1979, are at present covered by different legal texts. Royal Decree 1464/1999, governs the front-end of the nuclear fuel cycle and tends to liberalize the supplies, according to Law 54/1997 on the Electric Sector. Several acts and Decrees are applicable to the back-end of the fuel cycle.

The regulation of the back end of nuclear fuel cycle started in 1983 with Ministerial Order providing that percentage of electric bill shall be deducted of electricity price to create a fund for covering the costs of the various activities that this back implies. Namely the storage of irradiated fuel, the management of radioactive waste and closing out of nuclear installations. In 1984, the Empresa Nacional de Residuos Radiactivos, S.A. (ENRESA), the company in charge of these activities was created. Law 54/1997 on Electric Sector and other regulations have developed the way and means that ENRESA shall apply to finance its activities with the fund composed by the deduction of electricity prices.

The civil liability for nuclear damage is ruled in accordance with the principles on International Conventions in this field in which Spain is Contracting Party. The amount imposed to operators to cover its liability is of 25 000 millions pesetas (around 150 millions SDR). A lower limit can be imposed by the Ministry of Economy to installations and transports of lesser risk, provided that the amount was not inferior to 1 000 millions pesetas (around 6 millions euros).

Royal Decree 158/1995, governs the physical protection of nuclear materials.

### 5.3. International, Multilateral and Bilateral Agreements

In 1985, Spain adhered to the Treaties that constitute the European Communities and in the first January 1986 Spain became a European Communities Member State. From this moment, international and national legislation applicable in Spain is accomplished according to the rules of the European Union. Moreover, Spain is a Member State of the IAEA and of the OECD/NEA, whose Constitutive Treaties, Conventions and additional Treaties have been ratified.

#### AGREEMENTS WITH THE IAEA

- |  |   |                   |
|--|---|-------------------|
| • NPT related safeguards agreement INFCIRC/193                             | Accession:  | 5 April 1989      |
| • Project related safeguards agreement; INFCIRC/99                         | Entry into force:                                       | 23 June 1967      |
| • Additional Protocol (GOV/1998/30)  | Signature:  | 22 September 1998 |
| • Improved procedures for designation of safeguards inspectors             | Rejected, but as EC member agreed to special procedure. |                   |
| • Supplementary agreement on provision of technical assistance by the IAEA | Entry into force:                                       | 10 June 1980      |
| • Agreement on privileges and immunities                                   | Entry into force:                                       | 21 May 1984       |

#### OTHER RELEVANT INTERNATIONAL TREATIES etc.

- |  |                      |                                   |
|--|----------------------|-----------------------------------|
| • NPT  | Entry into force:    | 5 November 1987                   |
| • EURATOM  |                      | Member (1985)                     |
| • CTBTO  | Signed:<br>Ratified: | 24 September 1996<br>31 July 1998 |
| • Convention on physical protection of nuclear material                                | Entry into force:    | 6 October 1991                    |
| • Convention on early notification of a nuclear accident                               | Entry into force:    | 14 October 1989                   |
| • Convention on assistance in the case of a nuclear accident or radiological emergency | Entry into force:    | 14 October 1989                   |

- Vienna convention on civil liability for nuclear damage      Signature:      6 September 1963
- Paris convention on civil liability for nuclear damage      Signature:      31 October 1961
- Protocol to amend the Paris convention on civil liability for nuclear damage      Ratification:      1988
- Brussels supplementary to the Paris convention      Signature:      27 July 1966
- Protocol to amend the Brussels supplementary convention      Ratification:      1988
- Convention relating to civil liability in the field of maritime carriage of nuclear materials      Accession:      21 May 1974
- Joint protocol      Signature:      21 September 1988
- Protocol to amend the Vienna convention on civil liability for nuclear damage      Not signed
- Convention on supplementary compensation for nuclear damage      Not signed
- Convention on nuclear safety      Entry into force:      24 October 1996
- Joint convention on the safety of spent fuel management and on the safety of radioactive waste management      Entry into force:      18 June 2001
- ZANGGER Committee      Member
- Nuclear Export Guidelines      Adopted
- Acceptance of NUSS Codes      Summary: Codes consistent with Spanish standards.
- Nuclear Suppliers Group      Member

#### *BILATERAL AGREEMENTS*

- Co-operation agreements with France
- Co-operation agreements with Germany
- Co-operation agreements with Portugal
- Co-operation agreements with United Kingdom
- Co-operation agreements with Spanish speaking countries in America
- Co-operation agreements with Brazil

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- [4] Fifth General Radioactive Waste Plan, Ministerio de Industria y Energía (July 1999).
- [5] IAEA Energy and Economic Data Base (EEDB).
- [6] Data & Statistics/The World Bank, [www.worldbank.org/data](http://www.worldbank.org/data).
- [7] IAEA Power Reactor Information System (PRIS).

## Appendix

### DIRECTORY OF THE MAIN ORGANIZATIONS, INSTITUTIONS AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

#### *NATIONAL ATOMIC ENERGY AUTHORITY*

Ministerio de Economía  
Paseo de la Castellana 160  
E-28046 Madrid  
Tel: +34 91 583 74 00  
Fax: +34 91 349 60 45  
<http://www.mineco.es/>

Consejo de Seguridad Nuclear (CSN)  
Nuclear safety and radiological protection  
Justo Dorado, 11  
E-28040 Madrid  
Tel: +34 91 3460100  
Fax: +34 91 3460471  
<http://www.csn.es/>

#### *MAIN POWER UTILITIES*

Trillo 1 FRAMATOME OWNERS GROUP  
<http://www.cntrillo.es/>

Vandellós II  
<http://www.cnv.es/>

#### *OTHER NUCLEAR ORGANIZATIONS*

CIEMAT  
Research and Development Centre  
Avenida Complutense, 22  
E-28040 Madrid  
Tel: +34-91-3466000  
Fax: +34-91-3466005  
<http://www.ciemat.es/index.html>

UNESA  
Asociación Española de la Industria Eléctrica  
Francisco Gervás, 3  
28020 Madrid  
Tel: +34 91 5674800  
Fax: +34 91-5674988

TECNATOM, S.A.  
Service inspection and maintenance  
Km.19 C.N. I Madrid-Irun  
28709 SAN SEBASTIAN DE LOS REYES  
Tel: +34-91-6598600  
Fax: +34-91-6541531

DTN (Desarrollo Tecnológico Nuclear A.I.E.)  
Projects associated with nuclear power plants  
Glorieta de Quevedo, 9, 5º  
28015 Madrid  
Tel: +34-91-5934566  
Fax: + 34-91-5934937

EMPRESARIOS AGRUPADOS A.I.E.  
Architect-Engineering  
Magallanes, 3  
28015 Madrid  
Tel: +34-91-3098000  
Fax: +34-91-4450113

ENRESA  
Back-end of the fuel cycle  
Emilio Vargas, 7  
28043 Madrid  
Tel: +34-91-5668100  
Fax: +34-91-5668169

|  |   |
|--|---|
| ENUSA<br>Front-end of the fuel cycle<br>Santiago Rusiñol, 12<br>28040 Madrid | Tel: +34-91-3474200<br>Fax: +34-91-3474215<br><a href="http://www.gui.uva.es/~polyfemo/enusa/nusa.html">http://www.gui.uva.es/~polyfemo/enusa/nusa.html</a> |
| The LLS Project  | <a href="http://www.lls.ifae.es/">http://www.lls.ifae.es/</a>   |
| The EURATOM-CIEMAT<br>Association for fusion (Spain)                         | <a href="http://www-fusion.ciemat.es/">http://www-fusion.ciemat.es/</a>   |
| Nuclear Engineering Department<br>Polytechnical University of Madrid         | <a href="http://www.din.upm.es/">http://www.din.upm.es/</a>   |
| Iberdrola  | <a href="http://www.iberdrola.es/index.htm">http://www.iberdrola.es/index.htm</a>   |
| Union Fenosa   | <a href="http://www.uef.es/">http://www.uef.es/</a>   |
| Institute of Solar Energy<br>Polytechnical University of Madrid              | <a href="http://www.ies-def.upm.es/">http://www.ies-def.upm.es/</a>   |
| Spanish Nuclear Industry Forum   | <a href="http://www.foronuclear.org/">http://www.foronuclear.org/</a>   |
| Spanish Nuclear Society (SNE)  | <a href="http://www.sne.es/">http://www.sne.es/</a>   |