

THE SPANISH INDUSTRY

THE SPANISH NUCLEAR INDUSTRY IN THE INTERNATIONAL MARKET

The first three Spanish Nuclear Power Plants were ordered turnkey from international vendors in the '60s. Domestic participation was about 45 percent and covered mainly erection services and civil works. When the second round of seven stations was ordered in the early '70s the turnkey approach was replaced by competitive purchasing of packages, including the NSSS from international vendors, who in turn sourced equipment and services in Spain. A domestic content of more than 70 percent was achieved, exceeding expectations.

Equipment and services meeting the strict nuclear requirements were supplied by the existing industry, which reorganized itself to meet the new Quality Assurance concepts. Spanish firms working in the nuclear market became accustomed to deal with international vendors operating in Spain, who helped them qualify in the difficult nuclear industrial environment.

When the third round of orders was placed later in the '70s, new industries were created in the manufacturing and fuel areas, and nuclear industry reached maturity. The stations that entered commercial operation during the late seventies had domestic contents over 85 percent.

The experience obtained by Spanish firms in their dealings with international vendors and industries was very valuable in establishing them as competitive, high quality entities in the international market. After the nuclear moratorium was ordered in Spain in 1984, industry for equipment and services turned successfully to the export activity, in addition to supplying the necessary services to the domestic plants in the fuel, maintenance, repairs and other high quality areas.

Several Spanish firms working in the nuclear field have contributed summaries of their past and present activities overseas. NUCLEAR ESPAÑOLA is pleased to present these to its readers and is proud to see the international nuclear operators seek quotations from these and other Spanish firms not appearing in this necessarily short listing.

CIEMAT (RESEARCH CENTER FOR ENERGY, ENVIRONMENT AND TECHNOLOGY)

The international activities of CIEMAT in the nuclear sector can be structured on three areas; Nuclear Safety, Management and Storage of Radiactive Wastes, and Radiation Protection. In the Nuclear Safety area, CIEMAT has established collaboration lines with EPRI (USA), EDF and Framatome (France), to exchange research results from Steam Generator Material Performance Study and from Non-destructive Test of Real Steam Generator Pipes through Anger and ESCA methods.

In the severe accident study field, CIEMAT take part on LOFT (OCDE), LACE and ACE (EPRI - USA), PHEBUS - CSD (CEA-France) and PHEBUS-FP (C.E.C.) projects. Within the E.C. Framework Program, CIEMAT takes part on Source Term Assessment Project and also works on pool scrubbing and SPARC and BUSCA related codes validation.

Likewise, within IAEA coordinated

program, CIEMAT collaborates on the third phase of the Program of Optimization of Steel Vessel Surveillance Procedures; the work on material irradiation has been carried out on European experimental reactors.

Finally it is working on the Certification Program of the new General Electric design for a passive reactor, SBWR (Simplified Boiling Water Reactor).

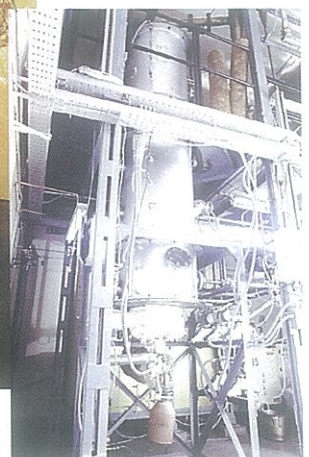
Referring to work carried out on Nuclear Safety Assistance Programs for Central and East European Countries, CIEMAT participates (within the E.C. TACIS and PHARE Programs) as a TSOG member (Technical Safety Organization Group) of VVER 440 and VVER 1000 reactors (Rovno Project) and as a Steering Committee member of Western Consortium for RBMK-Project.

On the Radioactive Waste area, CIEMAT carries out an important R+D effort connected with the R+D strategies of ENRESA and the Radioactive Waste Management and Disposal Programs promoted by the Commission of the E.C. though shared cost action. The main works developed are the E.C. R+D Program on Management and Storage of Radioactive Waste, with projects such as:



Instrumented system for Impact Testing, Fractographic Observation and Hardness

Combustion in Fluidized Bed



"Basic leaching test for pure beta long lived emitters in radioactive wastes", with CEA (France)."

"Inventory and characterization of important radionuclides for safety of storage and disposal, correlation with nuclides which are easy to measure in typical streams", with CEA (France), GRS (Germany), ONDRAF/NIRAS (Belgium), ENEA (Italy), AEA-Technology (United Kingdom) and ENRESA (Spain)."

"Decommissioning of the JEN-1 EXPERIMENTAL REACTOR"; With U. of Hannover, ENRESA, LAINSA and ENSA."

Special attention has been devoted to the research on the migration phenomena and processes of actinides in the geosphere, characterization and behavior studies of filling and sealing materials, natural analog properties related to radionuclide migration, and development of sampling and analysis laboratories for environmental hydrogeochemistry.

The experimental station of "El Berrocal", a granitic formation in the central part of Spain, where an uranium mine was developed and abandoned, is the natural laboratory used by the CIEMAT for migration research and as a natural analogue of radionuclide evolution and transport. The principal "in situ" studies follows: Major geological, hydrogeological and geochemical parameters; fluid flow paths; water/rock interactions; radionuclide speciation; retardation processes; modelling and validation of models. In this field, the activities are carried out in close cooperation with: CEA-Fontenay aux Roses and CEA-Cadarache (France) AEA-Harwell, British Geological Survey and INTERA (United Kingdom) and CEC-JRC-Ispra (Italy). In this work, for the Spanish side, CIMNE-U. Autónoma de Barcelona, ZAIDIN-CSIS Granada and U. de Oviedo participate together with CIEMAT.

On the Radiation Protection area, most of the activities are performed in the frame of the European R.P. Programs and, therefore, in collaboration with other European R.P. research institutions.

CIEMAT is now developing ten R.P. - projects and related research European multipartner projects, involving twenty European institutions active in the field. Two out of those projects are jointly worked out with various institutions of the Commonwealth of Independent States.

These projects are related with radiobiology, dosimetry, radioecology, resuspension countermeasures, dose assesment, etc. aiming at providing for waste management and post-accident reclamation.

CHEMTROL ESPAÑOLA, S. A.

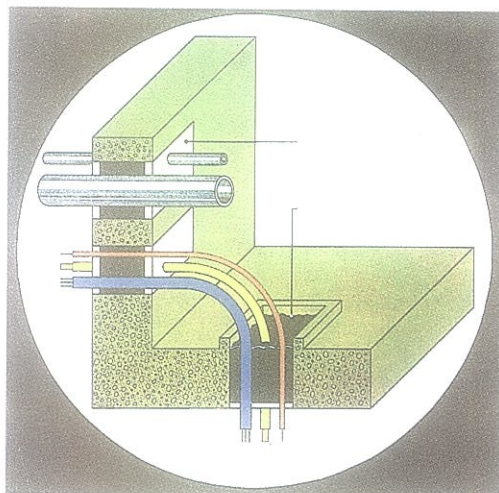
Company formed in May 1976 specialized in the engineering, supply, installation and supervision of security and safety systems, such as:

- Active fire protection (detection, extinguishing and centralized control).
- Passive fire protection (penetration seals; fire doors and dampers; fireproofing, etc.).

- Security (access control, perimetral detection, anti-intrusion alarms, etc.).

- High-Tech buildings (centralized control of installations).

Chemtrol Española, S. A. performed most of the Spanish nuclear power plants passive fire protection installations as well as other security and safety systems in both nuclear and conventional plants. Abroad, Chemtrol Española, S. A., has been awarded also with different contracts of fire protection and security installations in nuclear (Cirene; Latina; E. Fermi-Italy) and other industrial plants (offshore platforms; petrochemical; refineries; shipyards, steel mills, etc.).



EMPRESARIOS AGRUPADOS

INTERNATIONAL ACTIVITIES IN THE NUCLEAR FIELD

EMPRESARIOS AGRUPADOS (EA) is a leading engineering organization in Spain with strong participation in the international market. EA is a permanent joint venture formed by three Spanish engineering companies - EPTISA, GHESA and TRSA - with headquarters in Madrid, rendering consultancy, engineering and construction management services to the electric utility industry and the aerospace and defense sectors.

The EA group of companies currently employs 2500 persons, about 1000 of them devoted to engineering projects and services for the electric utility industry, 60% of whom are university graduates.

Over the past 23 years, since its creation in 1971, EA has been responsible for preliminary studies, technical and economic feasibility analyses, site selection studies, project management, overall plant engineering and design, safety evaluations and analyses, licensing support to plant owners, equipment procurement, quality assurance, construction management, plant commissioning and operational support for numerous nuclear and fossil-fired power plants, both in Spain and abroad.

As regards the nuclear generation sector, EA has been the main or sole

Architect-Engineer in six 1000-MWe nuclear units constructed in Spain using the "by components" approach and presently provides engineering and support services to all nine LWR units (PWR and BWR types) in operation in Spain.

Over the years, EA has been present on the international scene promoting nuclear power generation and providing consultancy and engineering services for nuclear projects, operating units and electric utilities in foreign countries with active nuclear programs such as Argentina, Mexico, Brazil, USA, Germany, Italy, Bulgaria, Czech Republic, Slovakia, Croatia, Slovenia, Russia, Ukraine, Iran, People's Republic of China, etc. Some recent references of such activities are discussed briefly below.

PHARE Program Projects

Within the framework of the CEC PHARE Program for Central and East European countries, EA has been awarded four contracts for engineering services to VVER-type NPPs. Three of these projects were implemented in Bulgaria for the Kozloduy NPP VVER 440-230 units (Qualification of Confinement, Qualification of Safety-Related Equipment under Accident Conditions, and Seismic Upgrading Design); the fourth was in the Czech Republic for Temelin NPP VVER 1000

MWe (Basic Engineering for the Information and Control System), providing technical assistance to the plant owner, CEZ, in the replacement by Westinghouse of the plant instrumentation and control systems that will now utilize state-of-the-art western technology.

TACIS Program Projects

VVER-Type Plants. Recently, within the CEC TACIS-91 Program, nine projects have been awarded to an international consortium (Belgium - Spain - UK) of which EA is a leading member. They concern VVER 440-230 and 213, as well as VVER-1000 plants in Russia. Of these nine projects, EA is the project manager of three - Probabilistic Safety Assessment, Residual Lifetime Evaluation, and Confinement - and is in charge of the technical management in a fourth on Operating Procedures. Other projects in which EA is participating, also awarded to the Consortium, are Modernization of VVER 440-230, PSA Support Data, Quality Assurance, and Training Procedures and Material. At the beginning of 1993, the CEC funded the safety assessment of VVER 440-213 and VVER 1000-320 reactors, taking the Ukraine Rovno NPP (Units 1 and 3) as the pilot plant. This project was contracted to the Technical Safety Organizations Group (TSOG), comprising the Technical Safety Support Organizations to Regulatory Bodies of EC countries. EA, supporting CIEMAT, is carrying out the assessment of the reactor containment and site conditions. The object of the first phase, presently under way, is to identify the weak points in these plants which may require urgent attention. Recommendations on short-term safety improvements will also be provided. Technical assistance in the preparation of a Safety Analysis Report is also included in the project.

RBMK-Type Plants. After the Chernobyl accident, RBMK reactor safety has been the subject of several analyses and improvements developed by Russian designers and international nuclear organizations. In 1992, a Consortium was formed to carry out wide-ranging safety reviews of these reactors. This Consortium consisted of organizations from EC countries involved in nuclear programmes, as well as from Canada, Sweden, Finland and from the countries which now operate these reactors (Russia,

Lithuania and Ukraine). A project, partly sponsored by the CEC TACIS-91 Program, was launched in October 1992 to review various aspects of RBMK design and operation, and propose priority safety improvements. Western countries not belonging to the EC funded their own contributions. EA was contracted by this Consortium to take part in two projects: Human Factors Analysis and Probabilistic Safety Analysis. The human factors review was carried out through team visits to most RBMK plants. EA's



involvement in the PSA was focused on the preparation of a Pilot Risk Study for Smolensk-3. A simplified methodology was applied, quantifying the failure probabilities based on system design and operational practices. It is envisaged that a second phase will be launched to implement modifications.

Participation in ENAC

EA is a member of ENAC (European Nuclear Assistance Consortium), a European economic interest grouping formed by major European reactor suppliers and engineering companies (Ansaldo, Belgatom, EDF, Empresarios Agrupados, Framatome, NNC Ltd, Nucom and Siemens) with the purpose of performing generic engineering studies for VVER plants.

EA has pooled its efforts with two other major nuclear companies in Spain - TECNATOM and ENSA - to promote the coordinated participation of the three companies in nuclear projects in the CIS and in Central and East European countries. In this respect, EA represents the Spanish group in ENAC.

Other Activities in Central and East Europe

Under direct contract with the Czech Power Board (CEZ), EA has been responsible for preparing specifications, evaluating bids and supporting contract

negotiations for a spent fuel storage facility for Dukovany NPP.

Other activities in the Czech Republic and Slovakia include consultancy services to CEZ and SEP (Slovak Power Board) for the preparation of Preliminary Bid Invitation Specifications for the Next NPP in these countries, followed by the evaluation of preliminary bids from main reactor suppliers, in order that they become acquainted with western nuclear technology, specifications and contracting practices. These consultancy services have recently been extended to provide technical support in the preparation of site selection criteria and a public information plan for a centralized spent fuel storage facility in both these countries.

Collaboration with the IAEA

EA has been collaborating for many years with the IAEA of Vienna in numerous international missions. Recently, EA has been active in the Agency's programme for Safety of VVER

440/230 NPPs, providing experts for the Instrumentation and Control Working Group, and for various missions to Russian (Kola NPP, I&C Safety Evaluation), Slovakia (Bohunice 1 and 2 NPP, Mechanical Component Integrity Safety Evaluation and I&C Safety Evaluation) and Bulgaria (Kozloduy NPP, Safety Systems Evaluation). A similar Safety Evaluation Programme presently being organized by the Agency for VVER-1000 type plants also counts on the participation of EA engineers. EA has also been actively involved in IAEA-organized seminars on specific safety topics such as PSA, Fire Protection, NPP Safety Evaluation and Quality Assurance.

USA, Central and South America

As-built drawings to be used in the design of plant modification are being obtained by EA utilizing photogrammetric techniques in various plants in the USA. Work contracted includes Calvert Cliffs, Haddam Neck and Hope Creek NPPs. In these projects, as-built drawings are produced applying METADAT, a close-range photogrammetry system developed by EA.

EA has long been collaborating in nuclear programmes in Central and South American countries. At the present time, EA is executing a project

for the Secretariat of Energy (Ministry of Economy and Public Works) of the Argentine Republic to establish strategies for the country's nuclear electric sector. In Mexico, EA is involved in the preoperational testing of Laguna Verde Unit 2, in the area of piping vibration and thermal displacement testing. In Brazil, EA has been retained by Furnas to carry out a situation study on the Angra Unit 2 project (Siemens PWR), as well as an evaluation of the budget necessary for plant completion.

Preparing for the Future

Spain has a keen interest in participating with other countries in international programs to develop a standard design for advanced reactors that could be used in the next generation of nuclear plants. In this respect, under the sponsorship of the Ministry of Industry and UNESA (Spanish Association of Electric Utilities), EA - along with other prominent Spanish companies in the nuclear field - is an active member of an international team collaborating with Westinghouse in the development of the AP-600, passive type, advanced PWR. EA is collaborating too with General Electric in the development of the Simplified BWR (SBWR) which is also a 600-MWe advanced plant of the

passive type. Both passive plant designs are in compliance with EPRI utility requirements for future nuclear plants in the USA. Moreover, EA - through UNESA - is participating in the drawing up of the European Utility Requirements (EUR) documents, presently being prepared by a group of leading European nuclear utilities to establish the requirements for the next generation of nuclear plants in Europe. Within this strategy of preparing for the future, EA is participating with other major European utilities, main suppliers and engineering companies in a project funded by the CEC (DG-XI) consisting in a joint EC - Russian Federation analysis of nuclear challenges and solutions for the next generation of NPPs.

Finally, it should also be mentioned that EA has formed an economic interest grouping with SENER, another Spanish company. This grouping, called IBERTEF, participates as a member of the European Fusion Engineering and Technology (EFET) - a consortium of relevant European companies, namely Belgatom, CITIF (Ansaldo and Fiat), Framatome, IBERTEF (Empresarios Agrupados and Sener), NNC Ltd and Siemens - in the engineering and design phase of the ITER project which is a world-wide effort to develop the fusion reactor of the future.

management and radiation protection as well as in the Direct Action Programs of the Joint Research Center. Besides, a close follow-up of these programs is achieved through the participation in the main committees and expert working groups existing in the structure of the mentioned programs. It is to be stressed that since 1986 more than 30 projects have been undertaken, with a very active and high technical standard of the Spanish Universities, Technical Schools, Research Centres and Engineering firms. Some projects like, HAW, BACCHUS, EVEREST, INTERCLAY or El Berrocal, are only some remarkable examples of the multinational participation in these programs.

In the bilateral context, ENRESA is collaborating with most Agencies and enterprises with similar competences in other countries. Bilateral agreements have been established with the French agency ANDRA, with the Office for Civilian Radioactive Waste Management of the U.S. Department of Energy (OCRWM/DOE) and with the German company DBE.

Some others are currently being discussed and are expected to be set in the near future. Important collaborations are also taking place with the Swedish agency SKB, with the German Research Institute KfK and with Atomic Energy of Canada Limited (AECL), among others.

It is worth mentioning that ENRESA along with Virginia Electric Power Company (VEPCO); Nuclear Assurance Corporation (NAC) and the Electric Power Research Institute (EPRI) are developing and licensing before the US authorities a dual - purpose metal cask which will serve both for storage and transport of spent fuel elements. The first unit of the storage cask has been manufactured and a license has been requested from the Spanish regulatory Agency (CSN).

ENRESA also forms part of the European Economic Interest Grouping CASSIOPEE which has been formally established in February 1993. This CASSIOPEE Grouping, constituted by six national waste management agencies of the EC, aims at providing the Eastern European countries with assistance in developing their radioactive waste management systems by transferring its experience and expertise, and by advising on the implementation of adequate engineering resources to be undertaken, mainly in the framework of the existing E. C. assistance programs. At present, a study is being carried out for the CEC in seven Eastern countries (Slovakia, the Czech Republic, Bulgaria, Hungary, Lithuania, Poland and Rumania) aiming at identifying problem areas, assigning priorities for their solution and elaborating possible waste management schemes.

Other activities of a different nature, although complementary to the above

ENRESA

The National Radioactive Waste Management Company (ENRESA) was set up in 1984 with the mandate to be responsible for the radioactive waste management in Spain. From the very beginning ENRESA was fully conscious of the fact that international cooperation plays a very important role in the development of national programs. Such aspects as the setting up of international data bases, the development and validation of models or site characterization techniques, require such an enormous effort and resources that could hardly be undertaken individually. Besides, the joint participation in the research, development and demonstration work reinforces the degree of confidence in the decision making process as well as in the techniques used.

ENRESA's participation in the international context is largely defined, on the one hand by the necessities coming from its technical programs, as reflected in the General Radioactive Waste Plan or the Research and Development Plan, and on the other hand by the need to support the Spanish governmental institutions in

their participation in intergovernmental fora.

The cooperation formulae vary according to the needs, and generally are accomplished either by means of bilateral agreements with other institutions of similar competences or by participation in the programs of intergovernmental bodies.

The R+D activities promoted by ENRESA are in a very close connection with programs of other countries having a longer experience in this field, and are coordinated to a large extent with the programs of international organizations working in the field. Among the latter, reference must be made to the Commission of the European Communities (CEC), mainly to the participation in the programs and activities of the Directorate General for Science, Research and Development (DG-XII) and the Directorate General for the Environment, Nuclear Safety and Civil Protection (DG-XI).

In this framework, ENRESA and its collaborating institutions participate very actively in the shared cost programs dealing with, decommissioning of nuclear installations, radioactive waste

mentioned ones are also being carried out in the framework of the Nuclear Energy Agency of the Organization for Economical and Co-operation Development (NEA/OECD) and the International Atomic Energy Agency (IAEA).

The NEA provides a forum mainly for information exchange and for the coordination of international projects, aiming at obtaining international consensus in matters which by no means could be undertaken individually. ENRESA, along with the CIEMAT, CSN and the Ministry of Industry and Energy are participating in the committees and groups leading these activities. It is worth mentioning the participation in the Radioactive Waste Management Committee (RWMC), and in its two main leading groups: the Performance Assessment Advisory Group (PAAG) and the Site Evaluation and Design of Experiments (SEDE).

The programs of the IAEA aim fundamentally at obtaining wide consensus regarding basic issues and at providing a forum for the interchange of information on the activities carried out by the member states. This is

achieved by means of scientific meeting and systematic review of progress by groups of experts. It plays a very important role in providing technical assistance to developing countries, as well as in developing guidance in regulatory matters. ENRESA is currently involved in the Radioactive Waste Management Program, through the participation in the INWAC Committee, as well as in some Technical Committees, Advisory Groups or Coordinated Research Programs. A special mention should be made to the RADWASS program, aimed at developing a complete and coherent set of documents on criteria and methods covering all aspects related to the management of radioactive waste, in which the CSN and ENRESA are participating very actively. ENRESA is also collaborating with the Agency in some expert missions providing advice to Eastern European countries.

This brief overview obviously does not pretend to be comprehensive, but only to reflect an outline of ENRESA's involvement in the international programs dealing with waste management activities.

significant experience has been accumulated up to July 1993 and is summarized as follows:

RELOAD CORE DESIGN AND LICENSING (Number)

PWR :	49
BWR :	16

The European Fuel Group (EFG) consortium was set up in 1991 between ENUSA, British Nuclear Fuels plc (BNFL) and Westinghouse to jointly act in different PWR European markets. Also agreements were reached with General Electric to manufacture BWR fuel for several European markets.

This international activity has proven to be successful since in the last two years several contracts have been secured to supply reload fuel to utilities in France, Belgium, Sweden and Germany.

ENUSA has technology license agreements for fuel and core design and fuel manufacturing with General Electric for BWR plants and with Westinghouse for PWR plants.

Also Joint Development Agreements exist with both companies. ENUSA also has an important R+D program, in some cases within collaboration with electric utilities, and participates in several international R+D programs in fuel development.

ENUSA

Empresa Nacional del Uranio, S. A. (ENUSA) is a Spanish state owned company. Its shareholders are:

- TENEO, a state owned industrial holding who owns 60% of ENUSA's shares.

Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT), a governmental research center that owns 40% of the shares.

ENUSA's activities cover the front end of the nuclear fuel cycle:

- It operates the uranium mining facilities at Ciudad Rodrigo, Salamanca, Spain.

- It holds minority participations in the following companies:

- Cominak (Republic of Niger).
- Eurodif (France).

- It has contractual responsibilities to supply enriched uranium to the existing Spanish nuclear power plants.

- It owns and operates the Juzbado fuel manufacturing facility at Salamanca, Spain, and runs a significant fuel and core engineering organization with an important computation center at the Madrid headquarters.

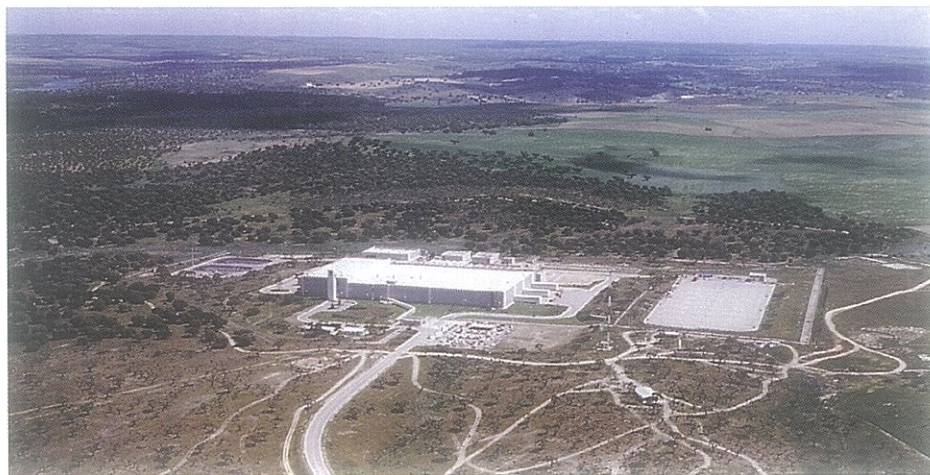
The ENUSA Fuel Division is responsible for the design and manufacture of fuel assemblies, both for PWR and BWR reactors, as well as for the performance of core engineering analysis and complementary services.

Since 1978, when the first reload core

design was performed, and 1985 when the first fuel assemblies were manufactured at the Juzbado plant, a

MANUFACTURING OF FUEL ASSEMBLIES (Number)

PWR		BWR	
17 x 17 12 ft	1736	8 x 8	1594
17 x 17 14 ft	4	9 x 9	212
14 x 14	78		
15 x 15	4		



ENSA



Steam Generators for Doel - 3 in clean condition room.

Equipos Nucleares, S.A. (ENSA) was created in 1973 with the purpose of designing, manufacturing and inspecting primary circuit components for nuclear power plants, including Reactor Pressure Vessels, Steam Generators, Pressurizers and Core Structures. The manufacturing plant is near Santander, on the Bay of Biscay coast of Spain.

The facilities were designed, personnel was trained and operational procedures were established around the QA concept. Quality and workmanship were paramount.

The main components of the NSSS are always supplied to the utilities by the nuclear vendors, who usually subcontract manufacturing to qualified suppliers. Since no nuclear system vendors exist in Spain, ENSA's customers have always been non-Spanish companies, like General Electric, Westinghouse or Siemens or their licensees. This relationship has placed ENSA in the international nuclear market, where a very limited number of manufacturers supply primary equipment.

During the first few years since its plant was built, ENSA supplied many components for Spanish ultimate customers, plus a number of items for Germany, Argentina, the UK and Italy (Reactor Pressure Vessel and Steam Generator parts, pressurizers, validation mockups, etc.) Erection services were also supplied for Mexico's Laguna Verde nuclear power plant.

When the nuclear moratorium was decreed in Spain in 1984 ENSA concentrated in the export market, both in the nuclear field and in other conventional areas where the nuclear expertise provided competitive advantage. For a few years components with very strict requirements were supplied, among others, for CERN (magnet caps for Aleph experiment and muon detector

holders for L3, both on the LEP accelerator), NASA (subreflectors for deep space antennas) and several offshore oil drilling operators (elements for Gaviota and Brae-B rigs, articulations for crude oil mooring columns, etc.).

The nuclear field was never abandoned in spite of the general slump in international orders, and ENSA maintained the N-stamp and the TÜV qualification. Nuclear contracts were successively obtained for India (Steam Generators and calandria end shields), the UK (validation assemblies for AEA, spent fuel racks and pressurizer relief system for Sizewell-B), the US (spent fuel transfer cask and canisters of various sizes, spent fuel storage cask) and Belgium (Replacement Steam Generators for Döel-3, sold to Siemens). All of these components have been delivered over the last two or three years.

Most of the present activity in the shop is on manufacture of replacement Steam Generators, including 12 units sold to a Siemens/Framatome consortium for Almaraz and Ascó NPPs in Spain, and 8 subcomponents sold to

Framatome for the French replacement program. Work is also underway for a number of validation assemblies with built-in defects, for the validation program of EPRI, in the US.

ENSA has excellent relationship with all the reactor vendors and cooperates actively in their quotations for Taiwan, the Peoples Republic of China and other prospective opportunities, including the important Japanese market, which is gradually opening to overseas supply. Contracts are expected shortly for supply of spent fuel storage, high-density racks for Germany, Korea and Spain, plus casks and canisters for the US.

In addition to the supply of hardware, ENSA participates in a number of international design and R + D programs.

-In cooperation with National Assurance Corporation, ENSA is designing spent fuel dual purpose (storage and transport) casks for several non-standard types of fuel elements, for future application in Spain, Switzerland and other countries.

- For services and eventual supply in the Commonwealth of Independent States and the Eastern European countries ENSA has formed with Empresarios Agrupados (EA) and Tecnomat the Iberatom group, which is actively participating in several programs such as TACIS and PHARE for the improvement of nuclear safety in these countries.

-ENSA has participated with Westinghouse and other Spanish companies in the development of a three-loop evolutionary PWR called APWR-1000, which is been offered to several countries. It is also working on the certification program and First-of-a-kind Engineering (FOAKE) of the so-called passive plants (AP-600 and SBWR) of Westinghouse and General Electric, together with other Spanish Companies under the coordination of the utility association UNESA.

EUMYNOSA WALTHON WEIR PACIFIC (WWP)

W.W.P. has obtained the following qualifications

- Interim letter of ASME.
- ISO 9001.
- AD-MERKBLATT HPO & TRD 201, AD-MERKBLATT WO&TRD 100.
- API-Q1: API SPEC 6D.
- QUASCO (BS-5750).
- PECAL 4 OF SPANISH DEFENSE MINISTRY (NATO AQAP 4).

The range of our most important fabrications is the following:

- Gate valves: from 1/2" - 72" 150# to 36" 4500#.

- Globe valves: from 1/2" - 30" 150# to 16" 4500#.
- Check valves: from 1/2" - 60" 150# to 30" 4500#.
- Ball valves: from 1/2" 60" 150# to 24" 2500#.
- Butterfly valves: from 3" - 250# to 144" 150#.

W.W.P. also manufactures a wide range of safety and pressure relief valves under license from Crosby Valve & Gage Company, and a full line of control valves under license from Copes-Vulcan Inc.



Walthon Weir Pacific has manufactured valves in accordance with American Standards for Pressurized Water Reactors (Westinghouse), Boiling Water Reactors (General Electric) and German Standards (Kraftwerk Union) for all systems (NSSS, Turbine, Condensate, RHR, etc.) in all types of material and sizes. Our valves are located in at least 18 Nuclear Power Plants around the world, making our Company one of the most experienced in the world of valves manufacturing.

Other companies of the W.W.P. Group:

- N.P.S. IBERICA, S. A.:
Pipe hangers and supports.
- ACTUATOR, S. A.:
Valve actuators and accessories.
- CROSBY ESPAÑOLA, S. A.:
Safety valves (Under license from CROSBY OF BOSTON, MA).
- VALCONTROL, S. A.:
Control valves (Under license from COPES-VULCAN INC., LAKE CITY, PA).
- EUMYNESA:
Power plant maintenance and repairs.

INITEC

INITEC is one of the largest Architect/Engineering Companies both in Spain and in the European Union, covering a wide range of services, including consultancy and studies, revamping and engineering support to operating industrial facilities, basic and detail engineering and supply of turn key installations.

INITEC operates mainly in the following fields: energy, nuclear and fossil; petrochemical; general industrial facilities; and civil works.

The manpower resources of INITEC consist of over 1000 skilled workers, 70% of them being qualified engineers.

INITEC belongs to the largest public industrial holding in Spain, the TENEO Group, which operates in the main industrial sectors in Spain, such as electricity generation, air transportation, metallurgy, mining, electronics...

INITEC has both the tradition and the will to operate in the international market. At present, over 40% of its sales come from outside Spain. Among others, important projects of fossil fired plants are currently under development in China, Chile and Morocco as well as a LPG station in Russia. Revamping of petrochemical facilities in the former Democratic Republic of Germany have been performed as well as in various countries in South America. In the State

of Maine, in the USA, a power plant operates, designed by INITEC and entirely supplied by TENEO Group companies.

In the nuclear field INITEC has participated under different consortia in the various international bidding processes of Nuclear plants which took

SAINCO

The participation of SAINCO in international projects within the Nuclear Area started with the ERF Project (Emergency Recovery Functions) for the J. M. Farley Nuclear Power Station, Groups I & II, at Alabama - U.S.A. Along this project (1985-1988), carried out in collaboration with Westinghouse Process Control Division, SAINCO implemented the engineering and software development for the Nuclear Application Programs (Delta Flux, Incore Thermocouple, Movable Detector...), including Site Acceptance Tests and System Start-up at the Site. In 1991, when the S.A.M.O. System was finally installed at Ascó I & II, SAINCO joint, invited by WPCD, the project for the Anlage Information System for Beznau I & II Nuclear

place in the 80's: El Dabaa, in Egypt; Akkuyu, in Turkey; Chashma, in Pakistan; Prevlaka, in Yugoslavia; Daya Bay in China. In these cases, INITEC was selected by Westinghouse as Architect Engineer, and Vandellós II NPP was the product and the reference plant.

In the 90's, INITEC continues bidding in the international market, namely Hungary, Czechoslovakia and China. In these cases the product was APWR 1000, an evolutionary design, based both on Vandellós II NPP and APWR 1300, currently under construction in Japan. This product has been developed in a joint effort by Westinghouse and the TENEO Group.

At present, INITEC is involved in various consultancy projects in Eastern European countries, either sponsored by the CEC or the IAEA; directly, integrating consortia or under subcontract. INITEC has been acting in this regard in Bulgaria, Slovakia, Hungary, Lithuania and Ukraine.

INITEC has been involved and takes part in various international projects, in the frame of the research and development programs launched by the CEC, namely fusion (TJ-2 stellarator), radioactive waste management (PEGASE, Analysis of gas production in disposal facilities of high level wastes; Combustion chamber for radioactive wastes; Analysis of waste management alternatives) and TELEMAR (Last Chess Pawn and IMPACTS projects).

Finally, INITEC participates in various international advanced reactors development programs, namely on the first of a kind engineering for AP600 (Westinghouse), on licensing studies for SBWR (GE) and on severe accident analysis for REP 2000.

Power Stations. SAINCO responsibilities consist in implementing engineering and software development for Advanced Nuclear Application Programs (Reactor Protection System, Primary System Leak Rate, Primary System Sump Level, Primary Plant Performance...), as well as performing the Validation Tests of such programs. This activity is still being carried out.

This last experience, unlike the Alabama's on which the System Architecture was based in a Main Computer, is being developed using the newest techniques in the field of Process Systems, because it is based on a complete distributed and redundant system, the WDPF (Westinghouse Distributed Process Family) of Westinghouse.

SENER

Exportation of consulting/engineering services in the nuclear field has been historically a goal at SENER, much more for its significance as an international confirmation of capability and efficiency than for its expected contribution to the firm's workload. This was so at the time (70's and early 80's) when nuclear activity in Spain, with the resulting market share for SENER, was really important.

Fruits of that policy have been contracts awarded, in most cases after international competition, for tasks as the following ones:

- Architect/engineering services for Chashma nuclear power plant in Pakistan (1980-1983).
- Bid evaluation for the proposed 2nd group of nuclear units in Mexico, for CFE (1982).
- Testing and startup assistance for Laguna Verde-1 en Mexico (1985-1987).
- Several jobs for Argentina (for a nuclear component manufacturer and for a heavy water pilot plant) and Chile (for the Lo Aguirre research reactor).
- Design of a muon chamber and support structure for a CERN experiment (together with CIEMAT) (1983-1985).

- Study contracts on small reactors for ANL (1982) and for the CEE (1990).

- Technical missions through IAEA for nuclear projects for Bangladesh, Yugoslavia, China, Malaysia, etc.

In the last years, the almost stagnant nuclear activity level in Spain (at least for engineering services) has enhanced the importance of, and the need for, exporting abroad the experience thus far accumulated. And now this not only as an incentive for self-perfection but rather as a need for technological subsistence in the field.

- ITER fusion reactor: participation with 9% shared with Empresarios Agrupados (as IBERTEF) in the European Consortium EFET, in charge of engineering/design activities.

- Eastern Europe nuclear plants: participation (through UNESA) in site assistance programs.

- European Fast Breeder: participation (under a UNESA project) in the design/engineering work along with Framatome, NNC and Siemens).

It can only be added that SENER is sure that its nuclear activities abroad, both in volume and technological level, will be consistent with the role played in the domestic market in the same field.

Germany, Hungary, Italy, Mexico, Pakistan, the People's Republic of China, Rumania, Switzerland and Yugoslavia.

Since 1985, Tecnatom S. A. has been participating in several nuclear power plant safety-related technical aid programs in East European countries, sponsored mainly by the European Community and the IAEA.

The major activities performed recently or currently underway include the following:

The consortium formed by Tecnatom S. A. ENSA and Empresarios Agrupados, together with Belgian and British groups, have been awarded 8 of the 23 contracts of the technical aid program for countries of the Community of Independent States (TACIS-91).

Spanish industry plays a leading role in five of the eight projects. Specifically, Tecnatom S. A. is participating in three projects and is the leader of the "Training procedures and materials" project.

Additionally, D. G. XI (Environment, Nuclear Safety and Civil Protection) of the E.C. has awarded Tecnatom S. A. two contracts for performance of two projects in Russia in collaboration with agencies of that country. The first project is a study to identify existing requirements in Russia to improve the reliability of mechanized in-service inspection of Soviet designed power plants. This study will be performed jointly with two other European institutions, AEA Technology and Siemens.

The other project involves analysis and validation of VVER nuclear power plant piping inspection procedures. In collaboration with VNIIAES, a seminar will be held for the exchange of experiences in the field of inspection.

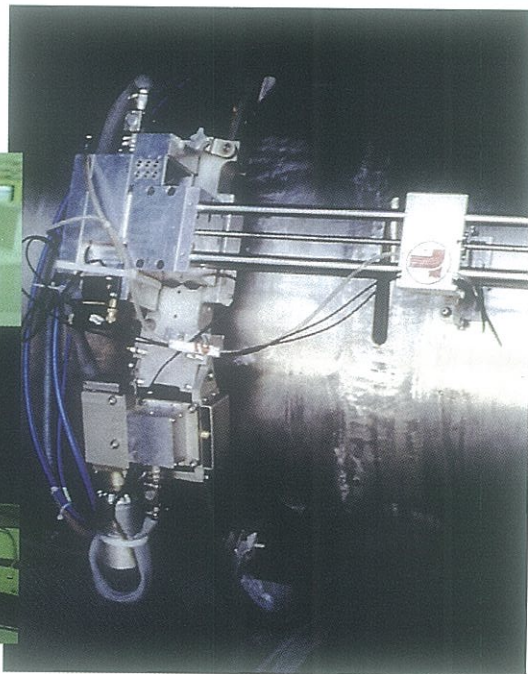
TECNATOM, S. A.

Tecnatom S. A. is a services engineering company established in 1957. The company's activities have centered mainly on the training of plant operations personnel providing support in resolving operational problems and improving production processes, and guaranteeing the structural integrity and capacity of plant installations through inspection, testing and analysis. It possesses highly qualified human resources and applications and research and development laboratories allowing technological independence and high levels of availability to be ensured.

Tecnatom S. A. main building located near Madrid houses company's headquarters, laboratories, workshops, stores and BWR and PWR full-scope simulators. Tecnatom S. A. workforce consists of 470 employees half of them university graduates.

Tecnatom S. A. has been performing a wide range of activities overseas. These

activities, which commenced in the field of training and quickly extended to all other areas of services, have given Tecnatom S. A. points of reference in countries such as Argentina, Belgium, Brazil, Bulgaria, Finland,



Later, inspection procedures will be drawn up in accordance with Western code criteria, by means of VVER plant configuration mock-ups, and compared with the procedures presently used in Russia.

During the third quarter of 1993, the first phase of the plant technical aid project sponsored by the TPEG (Twinning Program Engineering Group) within the framework of the TACIS-92 programs, has been performed at South Ukraine NPP. In this UNESA-headed project, Tecnatom, S. A. is responsible for implementation of scheduled in-service inspection and operator training activities. This phase has included definition of the overall project scope, which envisages supplying the Plant with the equipment and procedures necessary for automatic reactor vessel and primary circuit piping inspection.

In Hungary, Tecnatom S. A. began to work with the Paks Nuclear Power Plant through a contract sponsored by the International Atomic Energy Agency. The purpose of this contract was to establish testing requirements and procedures, personnel training and supply of reactor vessel and primary circuit piping inspection equipment.

As a result of this first contract, Tecnatom was awarded a contract to supply Paks NPP with a Data Acquisition System for ultrasonic inspection of reactor vessels and other important components.

In 1993, Tecnatom S. A. performed the automatic, remote-controlled inspection of the reactor vessel of one of the four Paks NPP units. As a result of the satisfactory results of this inspection, and of previous contracts, it is expected that in coming years reactor vessel inspection activities will continue, and extend to other components such as steam generator channel heads and tubes, primary circuit piping inspection, etc.

In Rumania Tecnatom S. A. has accomplished an IAEA-sponsored contract for technical aid in the construction of a training simulator.

Tecnatom S. A. will also supply a mechanized equipment control console and a data acquisition system for ultrasonic inspection of the reactor vessel, primary circuit piping and other components at Kozloduy NPP in Bulgaria.

Likewise, Tecnatom S. A. is supplying eddy current sensors for inspection of Kozloduy NPP heat-exchangers and condenser tubes.

In August 1992, Tecnatom S. A. performed the ultrasonic inspection of the welds and flange of three steam generator headers of Unit I of Loviisa NPP in Finland. The new SUMIAD-III Data Acquisition System developed by Tecnatom S. A. was used for performance of the inspection.

In August 1993, Tecnatom, S. A., performed the CRD inspection at the Leibstadt and Mühlebergh plants in Switzerland, after qualification by the Swiss regulatory agency and within the framework of a collaboration agreement with General Electric.

In Argentina, Tecnatom S. A. has performed an automatic inspection of the turbine low pressure stage rotors at Embalse NPP (Candu type).

This General Electric-design turbine was manufactured by ANSALDO of Italy. Equipment designed and manufactured some time ago by Tecnatom S. A. under a contract of the Electric Power Research Institute (EPRI) was used for performance of the inspection.

More recently, Tecnatom S. A. has been awarded a contract to provide technical aid and equipment to North African countries through the IAEA in 1994 and 1995.

As a result of the company's equipment, technology and highly-qualified personnel, and its growing experience in work abroad, more and more clients are placing their trust in Tecnatom S. A. and the company is gaining in prestige around the world.

The Companies forming the present SGS-Ciat Group, namely TECNOS, Garantía de Calidad and CIAT, under the name of CIAT INTERNATIONAL, S. A. started support and service activities outlined below for COMISION FEDERAL DE ELECTRICIDAD (Mexico) at the Laguna Verde NPP in 1978 and since then have been involved in such activities.

Most significant activities carried out during the different project stages have been as follows:

- Quality Assurance during the design stage performed at the Offices of EBASCO ENGINEERING in New Jersey (USA).

- Quality Assurance during the procurement stage, the piping and support supply control being the most relevant activities which were carried out in the facilities of Mannesmann Alangebau (Germany).

- Quality Assurance and Control during the construction stage of Units 1 and 2.

- Quality Assurance and Control during the start-up stage of Unit 1.

- Consultancy and technical support to Quality Assurance and Engineering during the operation stage of Unit 1.

- Comparative study of Code ASME 1977 summer 1978 Edition with 1986 Edition for feasibility review of the edition change in future procurement activities.

- Evaluation audits during all the project stages, the most relevant being the following:

- Evaluation of the Construction Quality Plan.

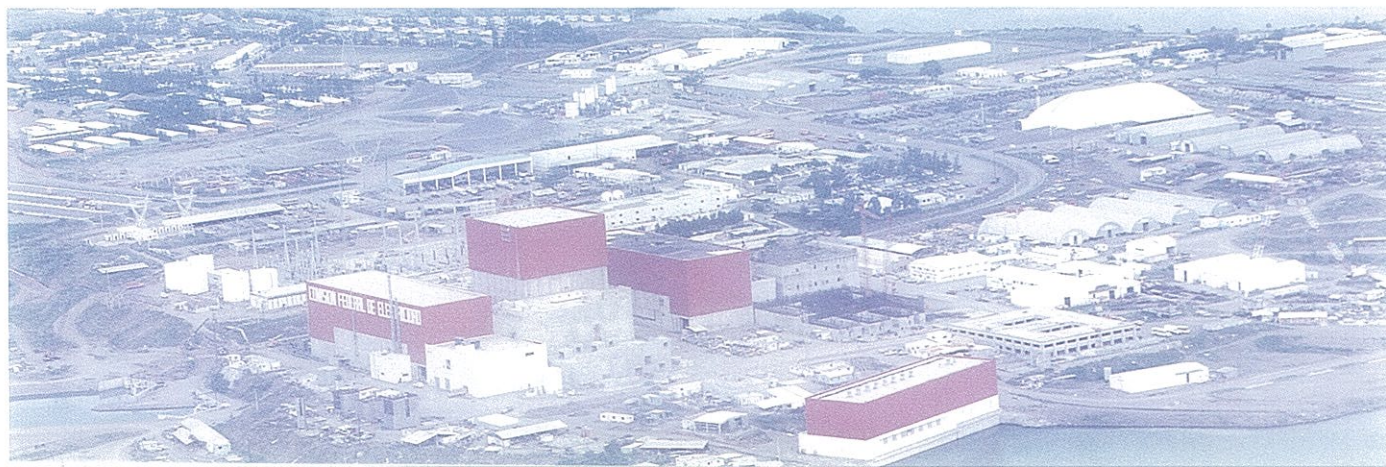
- Evaluation of the Operation Quality Plan.

- Evaluation of the External Emergency Plan.

At present CIAT INTERNATIONAL is performing Qualification Engineering services for spare parts in Mexico, USA and Spain, specialized training activities for Laguna Verde technicians, as well as supporting activities during refueling shut-down of Unit 1.

TECNOS

INTERNATIONAL EXPERIENCE OF THE CIAT GROUP AT LAGUNA VERDE (MEXICO)



UITESA

UNION IBEROAMERICANA DE TECNOLOGIA, S.A. (UITESA) is a Technological Consultancy and Advanced Engineering Services company, entirely owned by H.I.Holding (IBERDROLA Industrial Group), specializing in high technology sectors, fundamentally in the energy area. In the field of Nuclear and Thermal Engineering, UITESA has gained extensive know-how centered on specific technological fields related to thermal and nuclear power plant design and operational support.

The range of services offered by UITESA covers the following technological areas:

- Thermohydraulic analysis based on major codes (RETRAN, RELAP, TRAC) covering safety and operational support issues.
- Nuclear design based on Studvik codes (CASMO, SIMULATE).
- Severe accident analysis and source term evaluation.
- Fuel mechanical performance and radioactive inventory.
- Analysis of fossil-fuelled thermal

output and efficiency enhancement.

- Probabilistic Safety Analysis of Nuclear Power Plants (PSA).
- Development of Post-PSA applications.
- Development of software for man-machine interface to improve operational support and design.
- Development of software for on-line core monitoring, based on three-dimensional simulators.
- Development of in-house computer structure (ARIES) for PSA Analysis and Post-PSA applications.

UITESA has been involved in different projects in the international market. The more representative are as follows:

- Verification and Validation of EPRI RETRAN-03 code. Benchmarking of the code with operational transients of PWR and BWR plants.
- Collaboration with Tractebel for PSA accident sequence analysis. Development of transient and accident analysis for Doël-3 and Tihange-2

power plants using the RELAP/MOD2 code.

- Participation in the REP-2000 project with EDF. The work performed was the licence limiting transient analysis with the TRAC-PF1 code in order to justify the possibility of suppressing the medium head injection system in the base design of the future European PWR reactor.

- Development and installation of our PISCIS system in the Leibstadt (EGL) power plant in collaboration with Scandpower.

Customization of the PISCIS system of UITESA to the PRESTO code to be used in the design analysis and fuel management for the Leibstadt plant.

- Participation in collaboration with other Spanish and International companies, in the project 1.4 "Probabilistic Safety Analysis" of the TACIS-91 programme.

In addition to specific projects or collaborations, UITESA has in place a software package license agreement with Scandpower Inc. for the commercialization of the PISCIS -E001 version.

Now, we are in process for a similar agreement with Studsvik of America for the PISCIS-SM01 version.

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