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He was formerly Manager of IBERDROLA International Services (1992-94), Manager of Nuclear Production (1987-1991); Manager of Cofrentes NPP (1985-1987); Site Manager for Construction, Start-Up and Operation at Cofrentes NPP (1973-1985); and Plant Superintendent of Aceca Thermal Power Station (1956-1973).
He is a member of the following professional bodies:
- President of the Asociación de Ingenieros Industriales de Madrid
- Vice-President of the European Nuclear Society (ENS)
- First Vice-Chairman of the International Nuclear Societies Council (INSC), and
- Member of the Spanish Nuclear Society; Vice-Chairman from 1987-1988, and Chairman from 1989-1990.

DTN AND INTERNATIONAL COOPERATION OF THE SPANISH NUCLEAR SECTOR IN NUCLEAR TECHNOLOGY DEVELOPMENT PROCESSES

M. ACERO

The Spanish electrical utilities with interests in the Nuclear Sector - IBERDROLA, ENDESA, FUERZAS ELECTRICAS DE CATALUÑA (FECSA), UNION ELECTRICA FENOSA S.A., COMPAÑIA SEVILLANA DE ELECTRICIDAD S.A., and HIDROELECTRICA DEL CANTABRICO S.A. - created on September 26, 1994 the "Agrupación Eléctrica para el Desarrollo Tecnológico Nuclear, A.I.E. (DTN)" (Electrical Society for Nuclear Technology Development A.I.E.) for the purpose of promoting and managing Nuclear Technology Development, and integrating and coordinating the efforts of the Nuclear Electrical Sector with industrial companies and other related institutions in Spain and abroad. This mission is primarily accomplished by establishing a common strategy for the Nuclear Electrical Sector in the different areas of responsibility of DTN, centralizing actions by implementing a clear and coherent policy, and ensuring the presence of the entire Electrical Sector in all those fora deemed to be strategic to the Nuclear Sector.

In this context DTN designs its strategic lines of action, basing its efforts on the principle of collaboration which allows the fullest possible use of synergies between its different patners, coordinating any complementary cooperation from the industrial sector, and using the adequate combination of human resources to tailor the team to specific project requirements.

Nowadays, the establishment of alliances is a key element to be considered when defining the Technology Development process and strategies. These alliances should not be limited to the domestic market, but should include supranational organizations. For this reason, DTN is involved internationally in Technology Development initiatives in conjunction with a large number of multinational organizations, encompassing all actions and projects related to advanced nuclear power plants, guidelines for collaboration projects with third country nuclear power plants, and projects involving widely used projects in the Electrical Sector that offer marketing possibilities or that are related to new technologies.

More specifically, DTN's activities are:

ADVANCED NUCLEAR POWER PLANTS

Many industrialized nations have undertaken programmes aimed at achieving optimum nuclear power plant designs, based both on electricity demand forecasts and on the limited availability of fossil-fuels in the coming decades. In Spain, the Administration has clearly

shown an interest in maintaining the nuclear technological capability of firms involved in engineering, equipment, etc. This fact, along with the need for companies providing services to the country's current plants, for detailed knowledge of advanced plant designs and for preparing Spanish industry to be competitive on the international nuclear market, create an ideal framework for participation by the Spanish industrial and electricity sectors in advanced nuclear power plant programmes.

DTN is involved in a series of mutually coherent initiatives, initially centered on collaboration with international advanced programmes. This collaboration has been divided into two major courses of action, depending on whether it is oriented towards American technology or towards the European environment.

In this context, the approach adopted in relation to our participation in the **Passive Nuclear Plant Programme** consists of technological developments by Spanish companies: UTE (the INITEC and Empresarios Agrupados joint venture), CIEMAT, ENUSA, ENSA and TECNATOM, delivered by the Programme leader as a contribution "in kind" to the Promoters (Westinghouse-AP-600, General Electric, SBWR and ABWR), for which compensations and commercialization rights are obtained. The programme includes 100 activities, assigned to the different Spanish companies on the basis of their areas of specialization, included in the following technological fields: fuel, primary equipment, engineering, R&D, MMI, in-service inspection, systems, containment and safety analysis. The Spanish contribution also includes membership on the management committees of the international programmes.

Spain is also participating in the **European Passive Plant** *(EPP) project, along with electrical utilities from Italy, France, United Kingdom, Belgium, Switzerland, Sweden and Finland.* This project consists of adapting the AP600 design to European requirements, including a probable upgrading to some 1000 MWe, and it is currently in the conceptual design phase (phase I). Initiation of the basic design (phase II) is scheduled for April 1996.

Also worth mentioning are our participation in the **European Fast Reactor** (EFR) project, consisting of tracking through Spain's associated membership of EFRUG, as well as our involvement in the preparation of the **European Requirements Document** (EUR), which is a joint effort of several European countries to establish a common position in relation to the forthcoming generation of plants and to define the requirements under which these plants will be built. In keeping with its mission, DTN is currently drawing up the Strategy Plan for this area in order to define the future position of the Spanish electrical sector in relation to reactor types, international consortia, etc.

TECHNOLOGICAL SUPPORT

In order to support the safe and efficient operation of the Eastern countries' NPPs, cross-border funds have been established and experts in nuclear safety enhancement and operational improvements have been involved in the East European nuclear power plants.

In this scenario, the **European Union** (E.U.) has allocated important budgetary resources through the Commission to carry out the Phare and Tacis programmes (which cover assistance to **Central and Eastern European Countries** in all economical sectors, including energy).

As concerns nuclear safety, these programs are the most important in the world and in particular cover the following aspects:

- Design studies aimed at upgrading existing less safe power plants (mainly VVER-230 and RBMK reactors).
- Assistance to safety regulatory authorities.
- On-site assistance at ten sites (6 in Russia, 3 in Ukraine and 1 in Bulgaria), developing operational safety-related projects which include the purchase of required equipment.

Expertise and support are drawn from the E.U. to assist the Commission in managing the above indicated programmes.

To represent and channel the overall *operational expertise* and know-how *of all the Spanish utilities with nuclear generation means, DTN*, through its "Technological Support" Area, is involved in the identification, programming and development of the above mentioned programmes.

DTN is an active member of the **Twinning Programme Engineering Group** (T.P.E.G.) with responsibility for the following activities:

- Participation in TPEG's internal organization, having occupied the post of chairman on TPEG's Board during 1995.
- Sharing in day-to-day tasks, occupying the posts of "Contracts and Administration Manager" and "Technical Secretariat".
- Collaboration through the participation of highly qualified experts in developing yearly Phare and Tacis programmes, producing technical project specifications and participating in bid evaluations.

DTN is leading an **On-Site Assistance Tacis Programme** in Ukraine which involves the long-term presence of experts at the site (South Ukraine Nuclear Power Plant), primarily covering the following two aspects:

- Improvement of plant safety culture by transferring Western practices in operating procedures use, maintenance and training programmes.
- Enhancement of safety equipment by purchasing new devices and spare parts or by repairing existing equipment.

It should be noted that the permanent presence at the site of the Team Leader or his assistant is helping to strengthen contacts with the plant staff by providing information on and support for several issues related to the "safety culture", in addition to the specific projects that are being developed. Frequent visits by plant experts to Spanish Nuclear Power Plants have been organized for training purposes.

Another line of activity is the assistance provided through "Spanish (or Western) Short-Term Expert visits" in order to study and analyze specific aspects and make recommendations to the plant, which can result in the identification and launching of a new project. A budget of 6 MECU has already been allocated to the following specific projects for the period 1995-1996:

- Reactor pressure vessel in-service inspection
- Automatic control of primary circuit piping welds
- Steam generator water level and feedwater flow control
- Maintenance Enhancement Programme
- Erosion-Corrosion Inspection Programme
- Primary Circuit Welding Process Monitoring
- Electrical Equipment Diagnosis.

For this programme, DTN is collaborating with other Western utilities: TRACTEBEL (Belgium), ENEL (Italy), GKN (Netherlands).

DTN is also participating in another On-Site Assistance Tacis Programme in Kalinin Nuclear Power Plant in the Russian Federation, which is directed by TRACTEBEL. In this programme, DTN is providing the team leader deputy who is jointly in charge of management of the entire programme. In addition, DTN is providing qualified experts for the following two specific projects:

- Equipment for Diagnosis System (vibration)
- System for Inside Erosion-Corrosion Monitoring.

The same as for the South Ukraine On-Site Assitance Programme, there are plans for visits to Spanish plants in order to develop training activities in some areas, mainly in relation to the enhancement of the operational safety culture.

R&D

DTN promotes the **Nuclear Technology Development** process in NPPs by identifying and executing Nuclear R&D programmes, managing them with homogeneous criteria, and financing,

minimizing and controlling costs and schedules. The programmes should comply with the following requirements:

- They are related to new technologies.
- They have major international or multi-institutional relations.
- They offer possibilities for commercial development.

The process can be outlined in the following phases:

- Identification of NPP technological needs. Although these needs could be covered by the market, in some cases it may be advisable to initiate some developments due to strategic (e.g. undesirable technological dependence) or economic reasons (excessive current costs).

Opportunities are identified on the basis of **technological demands** by potential customers, and they should meet two basic requirements:

- they have an attractive cost/benefit ratio for the Nuclear Sector, and
- the initiatives must not be executed by "third parties" with the same added value.

- Analysis of the proposals. The role played by international organizations must not be overlooked. As a result, proposals will be analuyzed and assessed on the basis of transparent and homogeneous criteria.

This phase involves a portion of the above mentioned added value provided by DTN, which basically consists of integrating the NPP's interest and matching it to available industrial capabilities. DTN acts as a "catalyst" in ths process by stimulating the generation of initiatives and by channelling them.

In the mid-term, strong NPP-Industry cooperation will provide economic benefits resulting in part from joining forces and reducting separate efforts.

- Launching the identified projects. The above mentioned constructive dialogue results in the design of projects with well-defined objectives, schedules and costs. The project financing structure must be consistent with the role of the companies participating in project development and in marketing its results. On the other hand, such a structure must abide by the requirements imposed by the Authorities in the specific legal framework (National Research System).

DTN leads the process of obtaining the resources needed for executing the project.

- Project follow-up and control. Although DTN assumes responsibility for project control, it is obvious that this is a common objective for all participants. This task consists of assuring that results, costs and deadlines are in line with established objectives. Customer participation in project follow-up (NPP) is an additional mechanism to guarantee the transfer of technology.

At present, there are on-going projects in the areas of O&M, Fuel and Materials, in response to the need for reducing O&M costs and enhancing the cost-effectiveness of operations while keeping the facilities in safe conditions for as long as possible.

FUSION

In the last few decades, the major industrialized countries have carried out quite extensive R&D programmes on Fusion Energy. Research on fusion energy development is also one of the components of the European Union Enery R&D Framework Programme for 1994-1998, accounting for a total of 891 million ECUs. *The long-term objective of Fusion R&D Programmes is the joint creation of safe, environmentally sound reactor prototypes* by the middle of the next century.

Historically, industry's involvement in fusion programmes has either been nonexistent or limited solely to the supply of components and services to the major experiments generally conducted by National Laboratories or Governmental Institutions. Hence most of the utilities have not formed an opinion on fusion; current projects are very complex installations, the commercial fusion reactor and its potential benefits for an electricity generating utility are still far in the future, and consequently little knowledge about fusion has been transferred to the utilities.

The Spanish Nuclear Electrical sector has always been very interested in tracking the development of the different new nuclear technologies which could eventually become real alternative sources of electricity supply. Since 1989, the Spanish Nuclear R&D framework programme has included some activities on Fusion Energy, conducted within the area of advanced nuclear technologies. This programme is carried out by the Spanish utilities, and by 1993 two projects had been developed on magnetic confinement and inertial confinement.

The project on **Inertial Confinement** was conducted by the Institute of Fusion Studies of the Polytechnic University of Madrid. The project results have given the Spanish utilities the opportunity to access an annual updating of the developments of essential confinement fusion science and technology and to promote a small amount of resources in this field.

The approach followed in the **Magnetic Confinement Fusion** project was more experimental and connected to the experimental devices in operation both nationally and internationally. During the period 1982-1992, the Spanish electricity sector worked with the JET joint venture, which provided Spanish utilities with on-line information on magnetic fusion development. The Spanish utilities also collaborate with the Spanish National Fusion Programme conducted by the EURATOM-CIEMAT Association.

In the last two years, with the beginning of the ITER-EDA (International Thermonuclear Experimental Reactor/Engineering Design Activities) by the magnetic confinement fusion community and the approval by the United States Department of Energy of the National Ignition Facility (NIF) based on the intertial confinement fusion approach, the Spanish utilities have launched two new projects through the DTN which sum up their activities on fusion energy research.

The two projects cover a four-year period (1995-1998) and are a continuation of previous efforts with slight modifications of details of the general scope, which is to maintain knowledge on both the inertial and magnetic confinement methods of fusion energy development. The inertial confinement project has three specific objectives:

- A full computational study of the behavior, design and diagnosis of fuel targets for future inertial fusion reactors.
- Studies on reactor technology: optimization of nuclear parameters, analysis of microscopic damage to materials, safety-related issues and waste management.
- Annual report on inertial fusion developments.

The magnetic fusion programme has been divided into nine different activities covering the main points of development of a magnetic fusion reactor: impunity control systems, advanced materials for first wall and plasma fusing components, tritium technology, blanket design and materials, structural materials, advanced engineering systems, power systems and power electronics. These nine activities will be carried out by three different organizations: personnel from the utilities working in the leading projects (i.e., JET project, ITER-EDA team), collaboration with the CIEMAT/EURATOM Association, and the Spanish nuclear industries.

The ultimate goal of the current effort of the Spanish utilities in the field of fusion is to achieve a minimum technological position at the end of the four-year period (1998) that will allow them to make a decision on further fusion energy development projects. In order to do so, DTN is continually tracking the evolution of international projects while establishing strategic directions for potential Spanish participation.

MARKETING

Marketing applies to R&D *projects* developed by the Spanish electrical sector and industrial collaborations that offer commercial possibilities; project patents, commercial rights, etc., *are identified and* the appropriate *commercial agreements are drawn up for* purposes of *marketing in the nuclear sector* and in other industries when applicable.

Market commercialization projects:

• PETAVA: PWR Vessel Head Penetration Inspection and repair for the detection and sizing of defects in penetrations with or without thermal sleeves.
This project has been developed by the Spanish electrical sector through ENDESA with TECNATOM S.A., ENSA, ENWESA and CIEMAT. Commercial operation was started in 1994 and inspections were performed at the following Spanish Nuclear Power Plants: ALMARAZ II, ASCO II, VANDELLOS II and JOSÉ CABRERAS. There are some foreign companies that are very interested in this product.

• SICOM: Fuel Assemblies Inspection System, developed for spent fuel assemblies of pressurized water reactor nuclear plants. It has been developed by the Spanish electrical sector through IBERDROLA with TECNATOM, S.A. and ENUSA S.A. Commercial operation was started in January of this year and it has been used in ALMARAZ I, VANDELLOS II and BELLEVILLE (FRANCE) NPPs.

• N/TH; Neutronic-Thermohydraulic Code PWR Core Simulator for on-line surveillance and prediction. The code is the so-called SIMTRAM-EL that has been developed by the Spanish electrical sector through VANDELLOS II Nuclear Power Plant with DENIM-UPM, PMSA. Commercial operation was begun in October and the system was validated and installed on-line at VANDELLOS II NPP.

• CLO2: Comparative treatment of sea water cooling circuits in fossil-fuel and nuclear power plants with sodium hypochlorite and chlorine dioxide. This system reduces the release of organic halogenates by a factor of 30 as compared to the alternative use of sodium hypochlorite in sea water.
The project was developed by the Spanish electrical sector with PIEMMA and the chlorination facilities were designed by ENWESA. Commercial operation was begun this year; the pilot plant has been working in VANDELLOS II NPP since 1994.

• LOCA: Thermodynamic testing laboratory, used for the qualification of equipment under the environmental conditions of design basis accidents (LOCA, MSLB, HELB) of nuclear power plants. The laboratory is completed with auxiliary equipment for performance of thermal and mechanical accelerated aging tests and functional verification tests. The existing collaboration agreement between the Spanish electrical sector, CIEMAT (the National Irradiation Laboratory), VIRLAB (Seismic Laboratory) and TECNATOM (LOCA test simulation chamber) provides a complete and coordinated equipment qualification service. Commercial operation was started in 1990, and since that time the following equipment and components have been qualified: wires, electrical motors, lubricants, O-rings and gaskets, electrical connectors, solenoid valves, etc.

• VISSP: In-situ surveillance of pressure transmitters and differential pressure transmitters, resistance temperature detectors and thermocouples. It was developed by the Spanish electrical sector and CIEMAT. Commercial operation began in December, and it was validated and installed at ASCO NPP.