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THE CO-ORDINATION OF NUCLEAR ACTIVITIES IN THE ELECTRICITY SECTOR

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PRELIMINARY CONSIDERATIONS: THE INITIATIVE WITHIN THE ELECTRICITY SECTOR

Since the earliest days of the electrical applications of nuclear power, the use of this power source was considered in Spain as a possible means of helping to satisfy the growing demand for electricity. Therefore, following the Government's establishment in 1948 of the first nuclear bodies and on a parallel with their activities, in the 1950s after the necessary preparation and with the Electricity Sector's initiative, three companies were set up: CENUSA, NUCLEONOR and TECNATOM with the specific objective of developing in Spain the use of nuclear energy for electricity generation. The results are now well known. To sum up, there are now eight operating units in Spain with an installed capacity of 5,815 MWe, with nuclear currently accounting for over 29 % of total electricity generation. With the upcoming commissioning of two more units, nuclear generation is forecast to account for 35 % of the total in 1988.

The development of the application of nuclear energy to the generation of electrical energy has been governed by the highest level of scientific and technical excellence, which has made it possible to reach the high standards of quality that we now know.

Experience gained has always been used as a means for improvement, in as much that any result and in particular any significant event has been the object of careful analysis in order to improve the efficiency and the safety of the nuclear installations.

At the present time, with a capacity of more than 285,000 MWe in the world in 406 units, with a production in 1986 of 1,600 TWh and an accumulated generation up to that year of 11,500 TWh, and with 139 more units under construction for an additional 125,000 MWe, the level of maturity reached warrant new achievements in the permanent challenge presented by the efficient and safe application of nuclear energy. On the occasion of the first reports on the accident at Three Mile Island in 1979, the American Industrial Forum stated that there was no reason to

claim that nuclear plants, as designed and constructed, were unsafe. However, certain areas for improvement were marked out, without limiting efforts to this effect only to the immediate causes of the accident and to topics exclusively related to the design and operation of the power stations. And so, in fact, arising from the basic reports on the accident (Kemeny, Rogovin, etc.), attention was focussed on two main aspects: regulatory activities should be reassessed and brought up to date, and organization aspects to do mainly with the constructors and above all the operators of nuclear plants, that is the electric utilities, should be revised.

A key figure in this scenario is therefore the Operator, who in Spain is defined by the Nuclear Law of 1964 as the holder of the authorizations required for construction, start-up and commercial operation of the installation. The inalienable responsibility associated to these authorizations confers upon the Operator the principal role in relations with main suppliers, constructors, architect-engineers and manufacturers, who have always been contracted by the holder of the rights. The contraction of the world nuclear market during the last decade has given emphasis to this inalienable nature of the operator's responsibility.

In the United States, already since 1979 the first results of the application of the new criteria to the operating organisation of the various power stations, including relevant aspects such as staffing and training, were readily seen. The organisations providing technical support to the operation of the power stations were also reinforced. Recommendations were made to higher levels, referring to the direct responsibility and participation by the Management of the owner electric utility in the conduct of nuclear activities. The need was also made clear for co-ordination and co-operation among different plants, starting with an effective exchange of operational experiences.

In short, the need was made apparent for greater co-ordination, integration and development of the nuclear activities within the regular activities of the electricity sector.

In the United States various initiatives came forth in the electricity sector already in 1979. INPO (Institute of Nuclear Power Operations), created by the utility industry, is intended to promote an improved safety level and greater reliability in the construction and operation of nuclear plants. The industry also founded NSAC (Nuclear Safety Analysis Center), within the EPRI (Electric Power Research Institute), for the in-depth analysis of opera-

ting events. On March 7, 1984 NUKEMARC (now Nuclear Management and Resources Council) was set up to deal with problems with human resources and management, and to develop solutions valid for the whole industry. Its activities are backed up by UNPOC (Utility Nuclear Power Oversight Committee), a body comprising the chairmen and qualified officials of the nuclear utility industry (*).

The common denominator in all these developments, which are still evolving, is the achieving on the part of the industry of levels of excellence in the construction and operation of nuclear power plants, using practices and methods of conduct which satisfy the Regulatory Authorities. In this way a reliable and safe operation is achieved, maintaining a suitable and necessary margin for freedom of movement and initiative on the regulatory side. NUKEMARC takes the lead in this context as the institutional interlocutor with the regulatory authorities.

In general, the market economy countries have followed a similar pattern, each according to the particular structures of their institutions and its electricity sector.

In Spain, 1979 saw the peak of activity in the construction of the second-generation nuclear power stations, therefore calling for particular dedication on the part of the electric utilities to ensure their completion and start-up. Once this was achieved, the efficient and safe operation of the plants as the only way to make the investment profitable was the following challenge.

The Spanish Electricity Sector is convinced that the two aspects are inseparable and complementary, and is making efforts to reach higher and higher levels of quality in both.

The described development in the United States has not been ignored by the Spanish utility industry when facing these challenges and in a similar way a new frame has been defined exceeding the previous narrow limits of each nuclear power plant. The developments have reached, on the one hand, the upper management of each nuclear utility which is increasingly aware of the realities and implications of nuclear technology and of the need to follow it more closely; on the other hand they have affected the whole Electricity Sector and its internal relations as well as those on a national and international level. The whole concept includes sharing experience, co-ordinating activities, adding up capacities, modifying standards, foreseeing situations in which reciprocal help is necessary, and providing mutual back-up among utilities and power stations.

With reference to the timescale of these developments, at the beginning of this decade and coinciding with the completion of the second-generation nuclear power plants in Spain, the idea of structuring and maximising their co-ordination in the face of their imminent operation gained considerable credence, as with the first generation units which had been operating successfully for more than ten years.

It is worth noting as precedents the contacts of various natures and frequencies maintained among experts of diverse fields of specialty from the different power stations, and particularly that for many years there had been a Nuclear Generation Subcommittee in ASINEL (Institute of the utility industry for R + D) and that in 1983 and 1984 an "ad-hoc" group had operated in UNESA (the association of electric utilities of Spain) on the co-ordination of off-site Emergency Plans, in contact with the regulatory agency -the Nuclear Safety Council (CSN)- and the Public Safety Office of the Ministry of the Interior. Also in 1982 the boiling water reactor power stations formed an Owners Group that has been very active since then.

To consolidate these initiatives into a suitable framework the UNESA Board of Directors decided on October 30, 1984 upon the creation of a Nuclear Committee, with the aim of co-ordinating the nuclear activities of the Electricity Sector and formalising the various steps taken up to this point.

This Committee has since been extremely active, working basically at three levels: internal co-ordination of the Sector, in relation with national institutions, and with those of similar nature at the international level.

To sum up, the Utility Sector has organised its nuclear activities in two spheres: the UNESA Nuclear Committee to deal with all activities of a generic nature and the Owner Groups both BWR and PWR to deal with specific topics related to each of the reactor technologies.

THE STRUCTURING OF THE INTERNAL CO-ORDINATION OF THE UTILITY SECTOR

The UNESA Nuclear Committee's principles of organisation are based on the fact that the power stations have an individual and inalienable responsibility on safety aspects in accordance with the legislation. The majority of the Spanish nuclear stations are owned by several utilities in various proportions. Each nuclear station is represented at its highest management level in the Nuclear Committee.

The utilities owning the power stations

are also individually represented in the Committee, which is chaired by UNESA's General Manager; UNESA also provides the Secretariat to the Committee.

As for the objectives pursued by the UNESA Nuclear Committee, they can be defined as the coordination of the activities and efforts of the Electricity Sector in the nuclear field, sharing costs and combining talents, and in the exchange of information and experience within the Sector.

In consequence, the following functions are carried out:

- Systematic co-ordination among nuclear power stations.
- Centralized management of the generic nuclear subjects within the Electricity Sector, contributing to the making of the Sector's policy decisions in this field.
- Co-ordination and information with and about other UNESA Committees and organisations dealing with related topics.

THE NUCLEAR COMMITTEE

Through its Chairman, the Committee has a direct link with UNESA's highest decision-making body, the Board of Directors. Since January 15th, 1985, the date of its first meeting, the Committee has held monthly ordinary meetings. The Committee is structured into homogeneous Working Groups dedicated to the study of specific topics, made up of specialists assigned by the nuclear power stations and generally chaired by a member of the Nuclear Committee. In the case of a Working Group Chairman not being a member of the Nuclear Committee, the corresponding Committee member from the same plant as the Chairman reports directly to the Committee. The Secretariat of the Working Groups will always be held by an UNESA specialist.

The following Groups are currently in operation:

- Plant Superintendents.
- Radioactive Waste.
- Nuclear Fuel.
- Safety and Licensing.
- Research and Development.
- Emergency Planning.
- Administrative matters.
- Quality Assurance.
- Nuclear costs.

Information about the activities of Owners Groups of BWR and PWR power stations reaches the UNESA Nuclear Committee through their respective chairmen, always members of the Committee.

The Nuclear Committee supervises the work of the AMYS Working Groups with nuclear links, i.e.:

- Radiation Protection Working

Group.

- Nuclear power station Medical Group.
- Working Group for the Standardisation of Radiation Protection Instrumentation.

To this end there is a co-ordinator in UNESA for the nuclear work of AMYS (AMYS is the Utility Sector's institute for industrial safety and medicine).

Furthermore, the Nuclear Committee supervises the work of the Joint Negotiating Commissions and the Parity Commissions in connection with standard contracts between the Electricity Sector and the two State-owned Companies ENUSA and ENRESA responsible for the activities of the nuclear fuel cycle (supply of enriched uranium and back-end management respectively), and of the Joint Technical Commissions UNESA-CSN set up to deal with generic safety-related subjects.

Of all the Working Groups, that for Nuclear R + D also has a functional relationship with the UNESA Applications Committee for R + D. It is this Committee which channels the research proposals of the Electricity Sector to OCIDE, the joint body (Ministry of Industry and Electricity Sector) which administers the Sector's R + D budget. This budget consists of 0.3 % of the income from the sale of electricity and is now equivalent to 30 million of US Dollars per year.

Once approved by OCIDE, the proposals for nuclear research become ongoing projects, each under the supervision of a Steering Committee, made up of experts from the power stations and a UNESA representative who thereby ensures a permanent link with OCIDE. There is close contact over R + D between UNESA, CIEMAT (the central national laboratory previously known as JEN) and the CSN (nuclear regulatory agency) with a view to establishing a joint action plan.

The described structure is represented in the attached diagram.

INSTITUTIONAL LINKS IN SPAIN

The organisational structure described above allows the Sector to co-ordinate its activities with institutions in the nuclear field. The basic institutional bias tends towards those bodies within the Administration with competence in nuclear matters, especially the Energy Directorate of the Ministry of Industry and Energy, and the Nuclear Safety Council (CSN).

One of the basic aims of the current improvement drive is greater effectiveness in relations with the Nuclear Safety Council, based on both sides maintaining their own independence, mutual

understanding and respect. Although the roles may be different, we must bear in mind the fact that they share the aim of making power stations ever safer.

To this end, the Plenum of the Nuclear Safety Council met in July 1985 with the Chairmen of the electric utilities which own nuclear plants, exchanging various ideas and establishing the need for a permanent link between the above mentioned Council and the Electric Utilities. As a result of that meeting the nuclear electric utilities set up a Liaison Committee with the Nuclear Safety Council, which serves as the liaison body between the Electricity Sector and the Nuclear Safety Council to deal with generic safety-related issues. The nuclear electric utilities participate through their high-rank representatives in this Committee in a permanent dialogue with the Nuclear Safety Council, with the specific aims of:

- Establishing areas of interest for the development of joint efforts between the Electricity Sector and the CSN.
- Defining operating links at various levels to deal with generic topics.
- Following the work of the joint commissions at a technical level.
- Communicating to the CSN the results of the Electricity Sector's activities in the field of nuclear energy.

Another aspect of the institutional links is comprised of standard contract negotiations with ENUSA and ENRESA, links with CIEMAT, etc. Links with the Spanish Atomic Forum and with the Spanish Nuclear Society (SNE) should also be mentioned, as well as with other associations of suppliers or professionals.

THE SECTOR'S INTERNATIONAL LINKS ON NUCLEAR MATTERS

The Electricity Sector has traditionally participated in international institutions. Currently the Sector, through UNESA, maintains permanent links with some twenty organisations, the following being those that come within the nuclear sphere:

- UNIPEDE (The International Union of Producers and Distributors of Electrical Energy) in which UNESA takes part in the Committees and Working Groups on nuclear issues: *USERS* (UNIPEDE Significant Events Reporting System), *COST* (Working Group on the comparison of generation costs of conventional and nuclear power stations), *EUR-NAG* (Nuclear Advisory Group on co-ordination with the European Communities Commission) and the *Nuclear Committee* and its various

Working Groups (on Fuel, Decommissioning, Safety, Waste, Operator Training, Control Rooms, and Fast Breeder Reactors).

- The Commission of the European Communities. Utility experts take part in Working Group 1B on Nuclear Safety and its five dependent Sub-groups on Quality Assurance, ALARA, Environmental Qualification, Emergency Planning and Safety Goals and in the CEDB (component event data bank) of the Ispra research centre (belonging to the Communities' Joint Research Centre).
- INPO (Institute of Nuclear Power Operations) with which agreements have been reached since its foundation.
- EPRI (Electric Power Research Institute) with which specific agreements are reached and with which an umbrella agreement was signed in 1986.
- IAEA (International Atomic Energy Agency).
- OPEN (Organisation of Nuclear Energy Producers), made up of the European electricity industry.

The links with the NEA (Nuclear Energy Agency) of the OECD should also be mentioned since it allows Spanish participation in international nuclear research projects (e.g. LOFT). In the near future, nuclear experts from the Electricity Sector, under the supervision of UNESA Nuclear Committee, will take part in the work of the five CSNI (Committee for the Safety of Nuclear Installations of NEA) Working Groups.

As already mentioned, NUMARC is of great importance in the United States, with the supervision and support of UNPOC -groups which present clear parallels with the UNESA Nuclear Committee and the Liaison Committee UNESA-CSN- and whose developments therefore attracts considerable attention on the part of the nuclear organisations of the Spanish Electricity Sector. The "Sillin" (*) Report prepared for UNPOC in August of 1986 contains the basic criteria which are being followed in the restructuring of the institutional framework which affects the nuclear activities of the United States electricity sector.

Of particular relevance has been the international conference organized by UNIPED and INPO in Paris, on the 5th and 6th of October of 1987 with the aim to expand and deepen the links among the world's electric utilities on the safe operation of nuclear power

stations; a sizeable delegation from the Spanish utility industry has attended the conference.

THE POWER STATION OWNERS GROUPS

The American companies which own nuclear plants initially formed the Owners Groups in order to co-ordinate and share the necessary efforts at solving the generic problems which arose in the licensing or operation of such power stations.

The Spanish nuclear utilities have taken an active part in these groups, at first independently and then through their own Owners Groups, formed for this purpose, which constitute a very effective complement to the organisation of the Electricity Sector's nuclear activities. They operate independently with a suitable level of co-ordination with the Nuclear Committee to ensure the efficient performance of the nuclear utility industry.

There are currently two Spanish Owners' Groups. The Boiling Water Reactors Owners Group (BWR) was formed in February 1982. Subsequently, in February 1986, the similar Pressurised Water Reactor Group was set up (PWR). The basic aims of these Groups are:

- To co-ordinate the activities of their members in specific areas of common interest.
- To develop study or work programmes in specific areas.
- To facilitate the communication between members of the results of work programmes.
- To promote the acquisition of information and technology of interest to their members and to share the costs.

The collaboration of the Owners' Groups in activities outside Spain has not been limited to their participation in the respective American Owners Groups or to agreements reached with organisations in that country. There are exchanges of experience with utilities from other countries, particularly in Europe, the first steps already having been taken towards the creation of European Owners Groups with the initiation of regular co-ordination meetings among European power stations with boiling water technology.

The Owners Groups maintain links with the Nuclear Safety Council (CSN), within the framework of the Liaison Committee, to analyse the generic licensing issues which affect their specific types of plant.

The Spanish Owners Groups are structured through work commissions, are very active, and maintain contacts and collaboration with many companies

and organisations at home and abroad, both collectively and through their members.

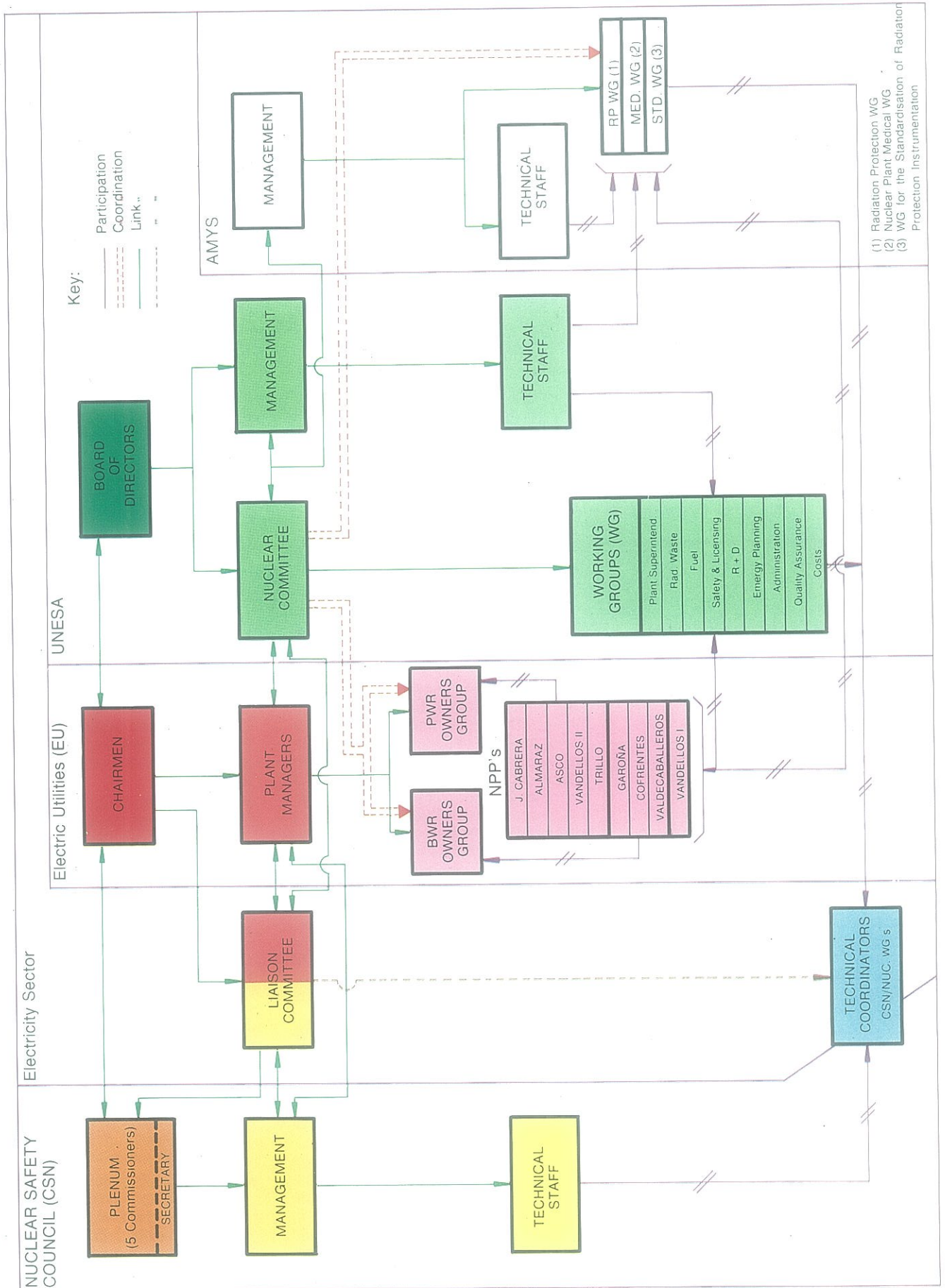
SIGNIFICANT ACHIEVEMENTS OF THE NUCLEAR COMMITTEE

Among the most important activities carried out by the UNESA Nuclear Committee thus far are the following:

- The preparation of comments on the draft version of the new Regulations for Radioactive and Nuclear Installations, of the different CSN Safety Guidelines as well as of the various Application Guidelines prepared by the SNE.
- The preparation of other reports or documents such as the following: "The Chernobyl Accident and the Spanish Nuclear Plants" (published in Spanish and English). "A Global Programme for Nuclear Research and Development in the Electricity Sector". "Electricity Sector Research Plan on Severe Accidents". "The Setting up of Technical Information channels". "Programme for the Training of Technical Personnel in Nuclear Power Plants", and "The Amortization of Nuclear Plants in Thirty Years".
- The preparation and communication to the CSN of the Sector's opinions on specific topics such as probabilistic safety analysis, reactor containment leak testing, and the transmission link with the CSN to send data from the plant meteorological system.
- Contracting engineering services, of interest to all the nuclear plants, for the evaluation and follow-up of the Chernobyl accident, for the decay heat removal system, for the monitoring of the aging of class 1E electric equipment and for the loss of external emergency power.
- The management of the Nuclear R + D projects currently in progress: Probabilistic Risk Assessment, Intergranular Stress Corrosion Cracking, Advanced Simulation Models, Inertial Confinement Fusion, Magnetic Confinement Fusion, steam generators, LOCA simulation testing chamber, solid radioactive products bleaching factor, tests on radioactive waste drums, participation in international R + D projects (LOFT, LACE, PHEBUS), etc.
- Co-ordination for potential participation in other international R + D projects (ACE, IPIRG and ICAP projects). Other projects are: the behaviour under irradiation of vessel materials, an integrated programme of

(*) "Leadership in Achieving Operational Excellence: The Challenge for all Nuclear Utilities" - August 1986. Lelan F. Sillin, Marcus A. Rowden, Eugene P. Wilkinson.

NUCLEAR ACTIVITIES DIAGRAM OF THE LINKS BETWEEN THE CO-ORDINATED ELECTRICITY SECTOR SYSTEM AND THE CSN



intergranular corrosion, and Plant life extension.

- Negotiation with ENUSA over the standard contract for the supply of enriched uranium and supervision of the ENUSA-UNESA Parity Commission.
- Negotiation with ENRESA over the standard contract for the handling of radioactive wastes and the eventual dismantling of the Spanish nuclear plants and the supervision of the ENRESA-UNESA Parity Commission. The preparation for ENRESA of "A Study of the Systems of Super-Compaction and Incineration of Low and Medium Level Radioactive Waste Produced in Spanish Nuclear Power Stations". Also the preparation of the document titled: "The Treatment of Radioactive Waste in the Operation of Spanish Nuclear Power Stations".
- Co-ordination of information on operating events in nuclear plants

(INPO, USERS).

- The organisation of data bases on the reliability of nuclear plant components.
- Participation in the preparation of the Basic Nuclear Emergency Plan, of support documents for the Emergency Information and Training Plans, and of the Emergency Aid Procedures among Spanish Nuclear Plants.
- Co-operation with AMYS in some of its tasks, such as the development of a nuclear plant radiological dosimetry data bank, the purchase of mobile internal dosimetry units (whole body counters) and the preparation of an information booklet on radiation protection.

Furthermore some noteworthy work has been carried out in other fields, such as the preparation of reports on nuclear costs, replies to various surveys, and the regular provision of information to technical publications.

FINAL COMMENTS

As concluded in the report published by UNESA in October 1986, an accident like the one at Chernobyl could not take place at a power station in Spain, but its significance entails lessons which must be born in mind.

Of these the most relevant to market economy countries reinforce and confirm the decisions made after the TMI-II accident and their subsequent modifications, which gave rise to the above developments.

To sum up, it can be said that the road to perfection in the efficient and safe operation of nuclear power stations calls for an expansion and deepening of the collaboration, both at a national and an international level among the electric utilities that own the installations. This co-operative and co-ordinated improvement constitutes a prerequisite to ensuring the contribution of nuclear energy to meeting the current and future energy needs.

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detailed studies in order to adjust their design to those existing in the industry, avoiding in this way price increases of the machine and unnecessary delays. In spite of the special characteristics of a research project, it does have some common features with an industrial projects, especially in the technological aspects and their organization. Thus, in the TJ-II project, two clearly different stages can be distinguished insofar as engineering is concerned, the basic or conceptual one and that of development or detail.

In the first one, a close relationship must exist between the engineering group and the scientists who carry out the theoretical studies, so that the design will be the most suitable one for the intended purposes. In this stage, as well, is when the design parameters, tolerances and operating limits must be clearly and accurately established, and also the preparation of general plan drawings and accesses to buildings and location of main equipment must take place. Finally, the equipment specifications will be drafted to send to suppliers.

With regard to the detail design of the chamber and taking into consideration its special characteristics, the selected equipment manufacturer must have prior experience in the construction of devices of this type, although, since it is a new design, it will be necessary to have a constant exchange of impres-

sions with project engineering members.

The problems which arise in this stage of manufacturing may make it necessary, in some cases, to build models of those parts of the machine whose behavior must be checked against expected requirements. However, since this means an increase in price and possible delays in the execution schedule, this procedure will be followed only if necessary. Therefore, it is absolutely essential that the manufacturer should have the sufficient calculation means, so that he is not forced to choose the experimental method.

In this stage, the manufacturers will provide detailed drawings, both of the chamber and of the coils, as well as all the related documents presenting erection, testing and operational requirements.

It must be pointed out that the complete device engineering will be somewhat modular, that is, there will be different people responsible for the detail design and construction of the various components, confinement chamber, gyrotrons, cooling, power sources, etc.

These suppliers will perform their tasks with their own engineering staffs, although always under the overall, continuous supervision of CIEMAT who, in order to comply with this task, could be aided by the resources which an engineering firm such as INITEC has in the field of management.

Lastly, in closing following is a brief description of the responsibilities of the various members that make up the Operation and Systems Section, under the coordination of an engineering chief who, also supervises their work. As in a conventional project, the division of skills may be made in the following manner:

- Civil Engineering. Responsible for the layout of the experimental device, as well as the infrastructure for the building, foundations, accesses and services.
- Mechanical Engineering. In charge of the structural design of the vacuum chamber, location of coils, supporting elements of the chamber, projecting accesses for diagnostics, stresses and deformations of the chamber and coils, etc.
- Electrical Engineering. Establishing the needs of electric power for the machine, desing conditions of the coils, study of the alternator and impelling group, redressing, system controls, design of electrical conduits, grounding systems, lighting and communications.
- Finally, other activities which do not belong to the above classifications, such as the effects of heating of the chamber walls and the core coils due to electromagnetic radiation and particles from the plasma, and limiter's study.