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UNESA PARTICIPATION IN INTERNATIONAL R&D PROJECTS IN THE FIELD OF NUCLEAR SAFETY

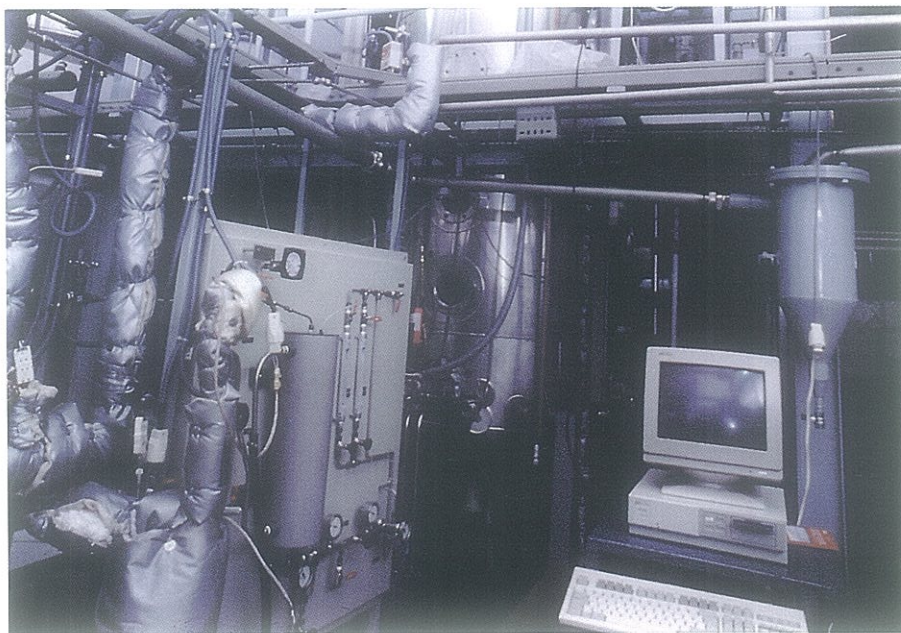
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BACKGROUND

Efficient management of a country's nuclear power plants requires permanent updating and improvement of the knowledge, tools and capacities on which such management is based.

This may be achieved either by acquiring finished, ready to use products or by participating in development of such products. Generally speaking, participation is to be preferred since, economic considerations apart, it provides

LACE test facility



additional capacities and know-how which facilitate the transference and application of the products obtained.

Research and development into nuclear safety follows courses of action which are either mapped out by the leading countries in the field or defined within the framework of international organisations or meetings, sometimes under the impact of dramatic events. In addition, if the aim is to undertake programmes of far-reaching content, cooperation with other countries is necessary since the resources and capabilities required normally exceed the possibilities of a single nation, for example Spain.

INTRODUCTION

UNESA was founded in 1944 as the association of the main electric utilities of Spain to coordinate their activities. One of these activities is research and development.

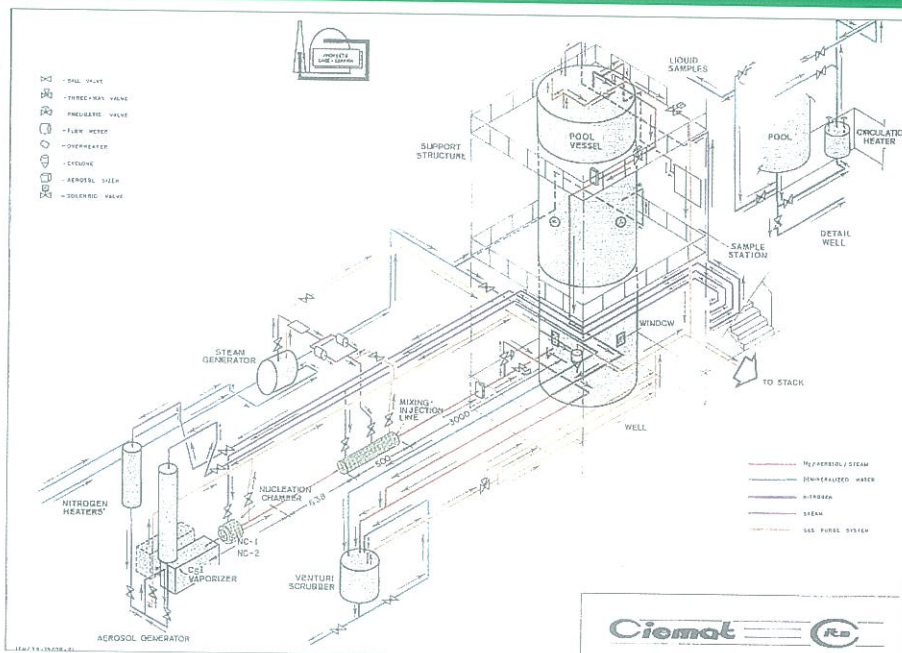
Since 1980, as required by the Spanish Government, the electric utilities devote 0.3% of the total sales of electricity to Research and Development, which today accounts for an equivalent of some 50 million US Dollars per year. The Nuclear Area accounts for some 15% of these funds and within this Area Nuclear Safety represents about 15%.

In order to control this fund a Research Coordination Office -OCIDE- was established, which is governed by a Board of Members equally distributed between the Electricity Sector and the Administration, and chaired by the Secretary General of Energy from the Ministry of Industry and Energy.

The resources are allocated to the different R&D proposals, forming the "Electrotechnical Research Programme" (PIE), by decision of the Board.

THE PARTICIPATION OF UNESA IN INTERNATIONAL PROJECTS

UNESA's participation in international projects has been developed through the constitution of consortia with other national organisations having responsibilities and interests in the nuclear field.



Schematic diagram of experimental LACE/Spain test facility.

Most commonly these organisations are the Nuclear Regulatory Authority (CSN), the national laboratory with the broadest capabilities in the nuclear field (CIEMAT), the nuclear fuel supplier (ENUSA), the agency for managing radioactive waste (ENRESA), the manufacturer of nuclear heavy components (ENSA), engineering companies and universities. UNESA may undertake to play one or more of the following roles in international projects:

- Signing of international agreements
- Co-participation
- Management
- Performing technical tasks
- Co-financing

The promoters of the projects are usually either international organisations (e.g., OECD), the industry and its associations (e.g., EPRI) or administrative bodies (e.g., USNRC).

Our capacity to provide financing is determined by the contributions made within the framework of the "Research Programme-PIE". With respect to the performance of technical tasks, UNESA itself has very limited capacity although this can be increased notably when considering the resources located in the utilities and in the nuclear power stations as it has been the case in various projects.

NUCLEAR SAFETY RESEARCH

Projects in the field of Nuclear Safety are logically governed by these same criteria, generally applied to nuclear R&D projects.

In recent years, the objective of research into Nuclear Safety has been to obtain realistic codes integrating models designed to calculate phenomena, processes and reactor components and capable of simulating a commercial nuclear power plant.

The experiments performed within the framework of this research have had the dual purpose of developing and validating tools.

The tasks carried out have consisted of designing and constructing the facilities and instrumentation, and of designing, performing and interpreting experiments and applying them to the objective sought. Two types of experiments have been carried out: partial or separate effects and integral experiments.

The aim of the separate effects experiments has been to study basic phenomena or processes.

For their part, the integral experiments have sought to bring into harmony the set of models simulating the entire system.

Problems relating to scale have been addressed by means of both partial experiments at a scale of 1:1 and data recorded at the plants during start-up tests or operational transients.

From the technical point of view, the experiments are conditioned by compromises relating to the design of the facility (scaling, simulators of certain components, establishment of bounding conditions, etc.) and by the capacity of the available instrumentation.

The results are normally data, models, guidelines, codes, etc., which are generally reproducible and thus allow each participant to obtain the entire product.

UNESA's participation in international R&D projects in the field of Nuclear Safety began in 1984, with the OECD's LOFT programme. In 1987 a "Severe Accident R&D Plan" was published by UNESA which described all on-going projects relating to safety and drew the lines for future efforts.

These projects were as follows:

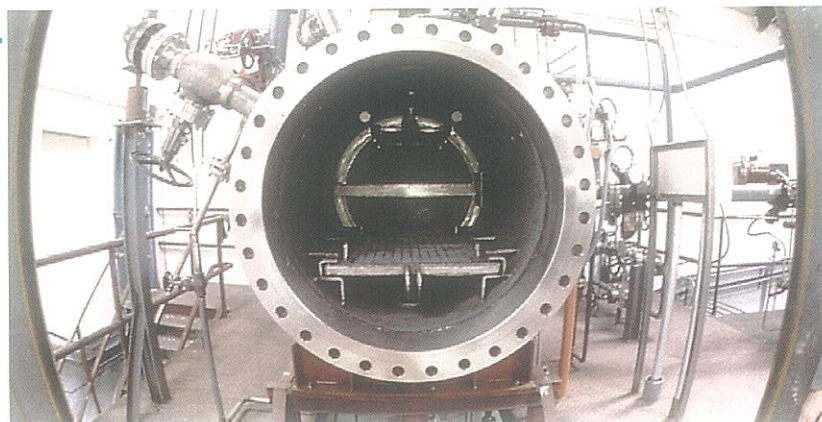
- PIACR - Phase II
- OECD LOFT
- ICAP
- LACE
- ACE
- TMI-2 GA
- PHEBUS CSD

All these projects have now been completed, and overall it may be stated that the Plan has provided highly satisfactory results, especially in the areas of thermohydraulics, system reliability analysis and the quantification of accident sequences. The Electricity Sector has paid special attention to the field of thermohydraulics, via the OECD-LOFT and ICAP projects. The PIACR-PHASE I and PHASE II projects have served to create a set of satisfactory computer tools and important know-how for probabilistic safety analysis. In addition, research into severe accidents has been covered by the LACE, ACE and TMI-2 GA projects, the actual results of which have also been highly satisfactory. Substantial progress has been made as regards gaining insight into thermohydraulic phenomena and transients causing degradation of the reactor core, as well as in developing analytical tools and training qualified users for them.

March 1992 saw publication of a new edition of the nuclear safety and severe accidents research plan, on this occasion in the form of a chapter of the "Electricity Sector's Nuclear Research and Development Programme".

The objectives sought continue to be those originally mapped out, that is:

- To increase knowledge of the different phenomena associated with those significant sequences that might lead to severe accidents, with a view to controlling such emergency situations and substantially reducing the risk and consequences of these accidents.
- To acquire evaluation and calculation technology allowing full advantage to be taken of the results of R&D projects, and their application to specific analyses of Spanish nuclear power plants.
- To coordinate and minimise economic and research efforts, such that maximum benefit be obtained and possible duplicity of work be avoided in certain areas.
- To ensure that decisions relating to the requirements for possible modifications or analysis be sufficiently supported by results contrasted with the R&D programmes.
- To maintain a dialogue with the Regulatory Body/Administration, allowing mutual understanding to be developed with respect to those



LOCA test simulation facility.

measures which might possibly be derived as a result of research into severe accidents, and their specific applicability to each plant. The issues to be addressed are as follows:

- IPE studies
- Containment Management
- Source term
- Accident Management
- Codes, scalability and uncertainties.

As might be expected, these issues, identified by the representatives of the Spanish Plant Owners Groups participating as members of the committee established for drawing up of the Plan, coincide with those considered to be of interest in those other countries belonging to the same economic and political environment as Spain and having a nuclear programme. They are the same also as those tacitly or implicitly included by the Spanish Nuclear Safety Council (CSN) in its letter for the **Performance of Probabilistic Safety Analysis (APS)**, dated 20th July 1989.

Two projects, OMEGA and CAMP, are currently in the launching phase. Both have been approved by the competent bodies of UNESA and are pending financing decisions by OCIDE.

THE OMEGA PROJECT

Unlike previous projects, the aim in this case is not to carry out integral or large-scale experiments. On the contrary, this project will concentrate on achieving common interpretation by the nuclear power plants and the regulatory body of the processes and physical properties required to realistically represent important phenomena occurring inside containment during the course of a hypothetical severe accident. In any case, a limited programme of small-scale experiments might be added to the analytical programme, with a view to filling in gaps and completing the data obtained

from experiments already conducted in other projects.

The areas covered are as follows:

- Retention of gases, vapours and aerosols in water beds.
- The behaviour of iodine and its chemical species in containment and under severe accident conditions.
- Medium and long-term interactions between the molten corium and concrete, and the corresponding

cooling capacity.

Consideration is also being given to including maintenance of reactor vessel integrity by means of external cooling, in response to a proposal issued by OECD (RASPLAV project).

The Spanish participants would be CSN, CIEMAT and UNESA, with international participation through agreements with EPRI (for the ACES project) and OECD.

THE CAMP PROJECT

This project aims to maintain and improve the capacity for plant simulation during transients and accidents with maintained core cooling, and constitutes a follow on from the course of action adopted by the ICAP project. As in ICAP, the international promoter is the USNRC, the Spanish signatory to the international undertaking is the CSN and UNESA participation is by way of a bilateral agreement with this latter organization. All the Spanish nuclear power plants will participate with their operational support personnel. The result of the project will be a set of computer codes replacing the current RELAP and TRAC codes, knowledge of these codes and confidence in them and a model of each plant with its appropriate code.

CONCLUDING REMARKS

The participation of the Spanish Electricity Sector, in the framework of UNESA, in international efforts to carry out nuclear safety research projects has been successful for the fulfilment of the original objectives. The direct involvement in the development of the work of technical staff from the utilities and the nuclear power plants has proven to be an efficient way to transfer technology and valuable results to the final users. UNESA looks forward to continuing this way of participation in R&D projects in the nuclear safety area as part of the general involvement of the Spanish Electricity Sector in the international nuclear scene.