Manuel MARCO participated in the Valdecaballeros NPP project and in start-up of the Almaraz I, Cofrentes and Vandellós II nuclear power plants. He was also a consultant to the Comisión Federal de Electricidad for start-up of the Laguna Verde NPP. Mr. Marco was Head of the Hidroeléctrica Española Nuclear Engineering and Analysis Service, and Head of the Nuclear Plant Support (Fuel Division - Iberdrola). He has been seconded to UNESA where he is Director of the Passive Nuclear Power Plant Programme.

Ramón REDON started his professional career in the area of thermal power stations, and was in charge of start-up of the Sant Adoria 3 plant (310 MW). In the nuclear area, he participated in the Ascó NPP project, initially in design of I&C systems, subsequently as the person in charge of start-up of the Ascó I and II plants, and finally in Management of Operations Support Technical Services. He has been seconded to UNESA where he is Director of the European Evolutionary Nuclear Power Plant Programme.I.

THE SPANISH ADVANCED NUCLEAR POWER PLANT PROGRAMME

M. MARCO - R. REDON

INTRODUCTION

SUMMARY

The world's energy needs require reactivation of nuclear energy, by way of new designs satisfying public concern, facilitating operation and minimising costs and construction periods.

In keeping with the Spanish National Energy Plan (PEN) and the strategy adopted by the country's Electricity Sector, a series of actions has been undertaken in the area of Advanced Plants. The aim of these actions is to develop solutions for the future in the nuclear field and contribute to maintaining Spain's technological capacity.

Collaboration between the Companies involved in the Electricity Sector and their industrial partners, with support provided by the Administration, has led to the establishment of a Steering Committee responsible for management and direction of activities in this field.

BACKGROUND

Many industrialized nations have undertaken programmes aimed at achieving optimum nuclear power plant designs, based both on electricity demand forecasts and on the pressure increasingly brought to bear by public opinion with respect to conventional, fossil-fuelled power stations.

As regards the different efforts made to systematise current designs considered as advanced, special mention might be made of those made by the National Academy of Science in response to requests from the United States Congress; some of the results of these efforts are shown in the following table (Figure I). It may immediately be appreciated that the plant designs which have scored most highly in this study are of the light water type, both evolutionary and passive, a fact which supports Spain's decision to centre its participation on this type of reactors. Also worthy of underlining is the

F I

ASSESMENT OF ADVANCED REACTOR TECHOLOGIES

REACTOR	ECONOMY	MARKET SUITABILITY	FUEL CYCLE	MATURITY OF DEVELOPMENT	LICENSING	OVERALL ASSESMENT
ABWR [1]	○	○	⊖	○	○	○
APWR [1]	○	○	⊖	○	○	○
SYS 80+ [1]	○	○	⊖	○	○	○
AP 600 [2]	⊖	○	⊖	⊖	○	○
SBWR [2]	⊖	○	⊖	⊖	○	○
CANDU	◌	⊖	⊖	○	⊖	⊖
SIR	⊖	◌	⊖	◌	◌	◌
MHTGR	◌	◌	⊖	◌	◌	◌
PIUS	⊖	○	⊖	○	○	○
PRISM LMR	◌	○	○	◌	○	⊖

○ High ⊖ Moderate ◌ Low

[1] Large evolutionary LWRs
[2] Mid-sized LWRs with passive safety features

American approach in this regard and the absence of any European initiative following this study.

ACTIVITIES IN SPAIN

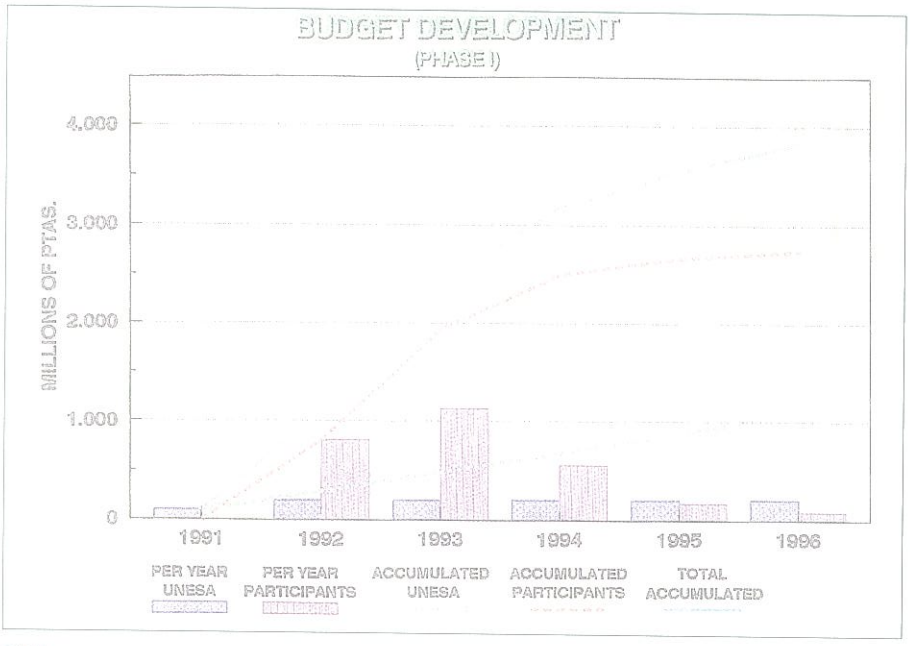
The Position of the Administration

Although the Spanish Administration has established in its National Energy Plan that no nuclear power plants will come on line during this plan's period of validity, it has also shown clear interest in maintaining the technological capacity 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 in order for it to be competitive on the international nuclear market, goes to create an ideal framework for participation by the Spanish industrial and electricity sectors in advanced nuclear power plant programmes.

The Strategy of the Electricity Sector

For some time the Electricity Sector has been involved in a series of mutually coherent initiatives, initially centred on the three projects indicated below. There is also a fourth project, now completed, undertaken by the Spanish National Institute for Industry (INI):

- *PROJECT 1.- Passive Nuclear Power Plant Programme (EPRI Programme)*
- *PROJECT 2.- European Evolutionary Plant Programme*
- *PROJECT 3.- European Fast Reactor Project (EFR),* including project tracking through associate member ship of EFRUG.
- *PROJECT 4.- APWR-1000 Programme (INI Programme)* (Now completed).



F III

PASSIVE NUCLEAR POWER PLANT PROGRAMME

DESCRIPTION

The Passive Nuclear Power Plant Programme includes participation in design, certification and detailed engineering activities within the framework of the EPRI Advanced Plant Programme *(American programme).* Spanish participation centres on the following projects:

- *Certification Project.* This consists of certification by the NRC of standard advanced plant designs.
- *General Electric SBWR Project.*
- *Westinghouse AP600 Project*

BUDGET AND COMMERCIAL COMPENSATIONS

The Programme includes two phases: Phase I (Basic Design) and Phase II (Detailed Design). Both refer to the SBWR and AP600 reactors.

Spain's participation in both phases consists of technological developments carried out by the country's collaborating organisations: UTE (INITEC, Empresarios Agrupados), CIEMAT, ENUSA, ENSA and TECNATOM, these being delivered as "contributions in kind" by the official head of the Programme (UNESA) to the Promoters (Westinghouse and General Electric) in return for economic compensations and rights to commercialisation.

The original budget proposed in the Official Report is shown in the following table (Figure II), its development for Phase I being reflected in Figure III. The structure of the target compensations is shown in the graph included in Figure IV, for a typical value of 10 M$

TECHNOLOGICAL AREAS OF PARTICIPATION

Phase I includes 69 activities, shared among the collaborating companies depending on their areas of specialization. These activities correspond to the technological areas described in the following table (Figure V).

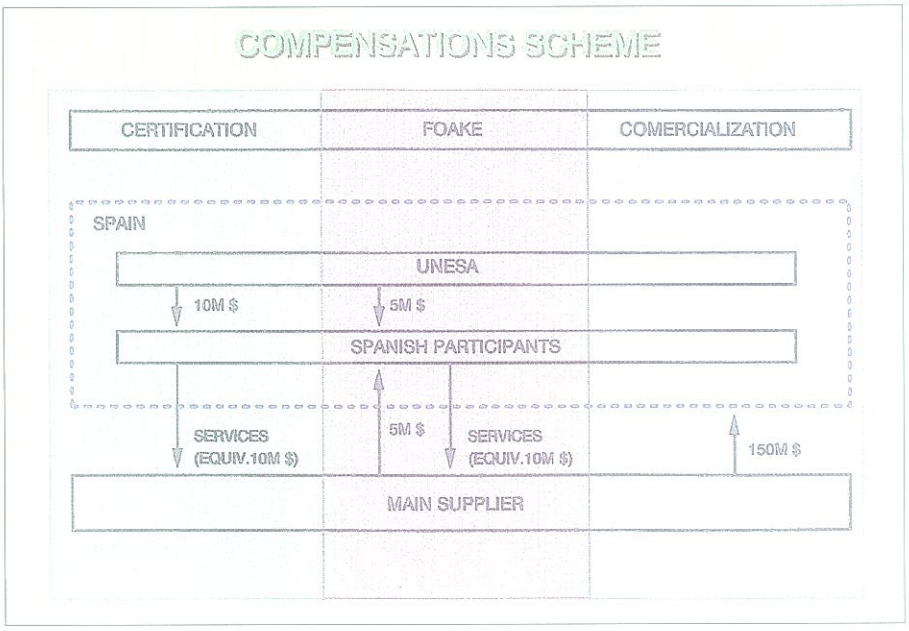
In Phase II, the activities will be performed mainly in these same areas but with a greater degree of detail. This will mean a move away from conceptual design towards the development of patentable and possibly marketable products.

F II

ORIGINAL BUDGET

(Millions of Ptas)

BUDGET	PHASE I: CERTIFICATION	PHASE II: DETAILED DESIGN (FOAKE)	TOTAL
PIE (Electrical Research Programme)	3.501	1.352	4.853
UNESA (Spanish utilities)	143	50	193
SPANISH PARTICIPANTS	178	136	314
MAIN SUPPLIERS W y GE (target)		1.372	1.372
TOTAL	3.822	2.910	6.732



F IV

CURRENT SITUATION

The participating companies initiated work within Phase I prior to formal approval of the project, providing the necessary financial resources up front. On 7th May 1993, the Management Council of the Research Coordination Office (OCIDE) finally approved provisional financing of the project (Phase I) for activities scheduled and performed up to December of this year, the maximum amount referenced for this period being 2,147 million Pesetas.
In relation to Phase II (Detailed Design), arrangements were initiated with General Electric and Westinghouse half way through 1992, with a view to defining the scope of the activities to be performed within the certification Programme and First of a Kind Engineering respectively, in accordance with criteria of continuity of Phase I and technological interest.
Mention should be made of the fact that the National Institute for Industry, in parallel with the UNESA Passive Plant Programme and following completion of the design activities performed with respect to the Westinghouse APWR-1000 in December 1992, has centred its efforts on collaboration in AP-600 detailed design tasks.

EUROPEAN EVOLUTIONARY PLANT PROGRAMME

GENERAL

Spanish participation in nuclear efforts at European level began with collaboration with EdF in the REP 2000 Programme, the aim of which was to define the characteristics of a European advanced nuclear reactor.

This project opens up three complementary lines of collaboration:

- Analysis and evaluation of alternatives for the REP 2000.
- Drawing up of the EUR document in relation to European utility requirements.
- Participation in design of the European reactor EPR.

CODEVELOPMENT TASKS

The activities relating to analysis and evaluation of alternatives for the future European reactor, initially performed within the framework of the REP 2000 project promoted by EdF and now part of the European Pressurized Reactor (EPR) project promoted by France and Germany,and designed by Nuclear Power International (NPI), company formed by Siemens and Framatome, have led to performance of the following tasks in Spain:

- Suppression of intermediate pressure safety injection.
- Corium recuperator.
- Linear power reduction.

EUROPEAN UTILITY REQUIREMENTS DOCUMENT

The electricity utilities of Germany, Belgium, Spain, France and the United Kingdom, convinced of the need to adopt a common position in relation to the forthcoming generation of plants, decided to work jointly in drawing up the requirements to be met by the plants that will be installed in Europe in the future. Italy and Holland later began to adopt a position close to that of this group.

The main reference used in drawing up the European Utility Requirement (EUR) has been the equivalent document prepared by EPRI, the aim being to avoid establishing differences not justified by either different technical approaches or differences between America and Europe.

EUROPEAN PRESSURIZED REACTOR

At the beginning of 1992, the French and German electricity utilities EdF and EVU decided to collaborate in developing a new plant based on Framatome and Siemens technology, and known as the European Pressurizer Reactor (EPR). This collaboration has been carried out by bringing the basic design concepts of the Framatome N4 and the Siemens Konvoi into harmony within the framework of the EPR, with the objective of meeting all the EUR requirements.
Another aspect of the joint French and German EPR worthy of special mention is the collaboration that is taking place between the Regulatory Authorities of the two countries with a view to joint licensing of the design, this resulting from agreements between the governments of France and Germany.
Spain aims to participate in the basic design of the EPR, and in this respect conversations have been initiated with EdF-EVU, on the one hand, and NPI on the other. The Administration has on several occasions indicated its interest in participating in the European projects. Apart from anything else, this is a way of ensuring full meaning for the efforts performed within EUR.

F V

SPANISH PARTICIPANTS / AREAS OF ACTIVITY

PARTICIPANT / AREA	UTE	CIEMAT	TECNATOM	ENUSA	ENSA
BUILDING CONCEPTUAL DESIGN					
I y C / MMI					
SAFETY ANALISES					
CONTAINMENT					
EQUIP./SISTEM. CONCEPTUAL DESIGN					
MAIN COMPONENTS					
FUEL					