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NUCLEAR ENERGY IN SPAIN

by Manuel Isla, Director General, ENUSA

My presentation will be based on the "Plan Energético Nacional de 1983" (1983 National Energy Program) (PEN-83) which was approved recently by the Spanish Government and presented to the "Cortes Españolas" (Spanish Parliament) in May 1984. The PEN-83 is being discussed at present in the Parliament and it is possible that some modifications be introduced, but expectedly will be rather limited and minor.

"Plan Energético Nacional de 1983" (PEN-83) (1983 National Energy Program)

The PEN-83, which covers the period 1983-92, includes a comparative analysis of the evolution and situation in OECD countries and in Spain of the offer, supply and consumption of primary energy and of the interrelation with other economic indicators, such as the gross domestic product, inflation rate and unemployment, concluding that the Spanish economy, as compared with that of the industrialized OECD countries, has shown a much lower capability to adapt its structure to the energy price increases, and that the Spanish energy situation presents three main problems:

- excessive growth in the last decade of oil and total primary energy consumption relative to the GDP.
- low participation of domestic energy production to meet the demand, with strong dependency on oil imports, which increases the vulnerability of the energy supply and is the major cause of deficit of the Spanish trade balance.

- production overcapacity, particularly in oil refining, l.n g. regasification and electric power generation.

The PEN-83 is critical of some energy policies in the past, particularly of maintaining low internal energy prices, insufficient energy conservation measures and poor planning of investments in new production capacity, based on too high energy demand forecasts.

The objectives, forecasts and projections of the PEN-83 are shown in the enclosed Tables 1 to 9, which have been taken from the PEN-83 document presented to the Parliament in May, 1984. Tables 2, 3 and 4 include also the comparison of forecasts and projections between the PEN-83 and the PEN-79, which was approved by the Parliament, and the Revision of 1981 (REV-81), which was prepared by the Government but not approved by the Parliament.

Table 1 shows the objectives of final energy consumption, and Table 2 the comparison between the forecasts of consumption growth rates, which are substantially lower in the PEN-83 than in the REV-81, where they were generally lower than in the PEN-79. This important reduction in the forecast growth rates is based fundamentally on:

- The reduction already experienced up to 1983: in the period 1980-83 the final energy consumption has decreased at the annual rate of 1.3%.
- The present forecast of growth of the Spanish economy, expected to be, in terms of the GDP, an average of 3.3% p.a. for the period 1982-90.
- The energy conservation and substitution policies planned in the PEN-83, consisting mainly on the application of energy prices reflecting adequately the costs of supply, and of financial incentives (credits and subsidies) for energy conservation and substitution projects: the targets with these policies are savings in the final energy consumption of 8.45 and 10.5% up

to 1990 and 1992, respectively, which will expectedly reduce between 1982 and 1992 by 7.7% the final energy and by 5.6% the primary energy consumptions per unit GDP.

The projections of consumption of the various primary energies in the PEN-83, REV-81 and PEN-79 included in Table 3 show that those of the PEN-83, as compared with the previous ones, are lower in absolute terms for all kinds of energies, except hydro, and that in terms of their percentage participation, the reduction by 1990 is in natural gas and in nuclear energy. This is reflected in the comparative projections of the various kinds of electric power generating capacities (Table 4), which show a substantial reduction of the nuclear power capacity planned in the PEN-83 with respect to that planned in the PEN-79 and REV-81. The main reason for such a comparative reduction in earlier years is the delays in the construction and starting-up of the nuclear plants under advanced construction, while in later years the nuclear moratorium has an additional substantial effect. Even so, the participation of the nuclear energy in the total consumption of primary energy will increase from 2.8% in 1982 to 10% in 1986 and 11.8% in 1990 and 1992.

The installed electric power generating capacity planned by the PEN-83, for the various power plant types and for each of the years up to 1992, is shown in Table 5. These planned capacities and the corresponding projections of electric power generation and annual utilization (Tables 6 and 8) are based on growth rates of demand, measured as net power plant production, of 4.5% in 1983 (actual) and 3.3% per annum for the period 1984-92. This rate, consistent with the general forecasts and projections of the PEN-83, is defined in it as a target demand growth rate and the most probable one. It is also indicated that without the adoption of the planned energy saving policies, this annual rate would increase to 4.1% for the same period.

To check the capability of the planned installed capacity (Table 5) to meet higher demand, the PEN-83 contemplates also, as an alternative, and annual demand growth rate of 4% for the period 1984-92 (Tables 7 and 9). In this case, the planned capacity would be sufficient up to 1989, but additional capacity would have to be in operation from 1990. In this respect, the PEN-83 considers the possible addition of 1050 MW, in either new coal plants (assumed in Tables 7 and 9) or in one of the nuclear units affected by the moratorium which could be finished in no more than five years, as it is the case of Valdecaballeros I and Lemóniz I. Consequently, it is anticipated that, without a formal revision of the PEN-83, from 1985 a revision of the evolution of the electric demand, of the operating performance of the new nuclear plants and of the progress of the planned construction will take place every six months to determine, not less than five years in advance, the additional capacity eventually necessary.

"La parada nuclear" (The nuclear moratorium)

The total installed nuclear plant capacity of 7,690 MW planned up to 1992 (Table 5) involves that five out of the seven nuclear units presently under construction will not start operation before 1993 and, according to the PEN-83 provisions, will be subject to a moratorium, i.e., their construction will be interrupted. There will be a compensation to help the electric utilities finance the financial and other costs associated to the interruption of the construction of the nuclear units not included in the PEN-83; a fund for this compensation is already being formed officially from a quota included since October 1983 in the electric power rates of all utilities, consisting of a percentage of all their customer billings.

There is in the PEN-83 a comparative analysis, including safety, economic and public acceptance considerations, of the

nuclear plants of the third generation under more advanced stage of construction, namely Lemóniz I, Vandellós II, Trillo I and Valdecaballeros I, concluding that Vandellós II (PWR, 930 MW) and Trillo I (PWR, 1000 MW) will be the ones included within the 7,690 MW nuclear installed capacity by 1990-92. Therefore, the nuclear moratorium will affect the following units: Lemóniz I and II (PWR, 930 MW each), Valdecaballeros I and II (BWR, 975 MW each) and Trillo II (PWR, 1000 MW).

This "parada nuclear" is being one of the more controversial issues of the PEN-83, particularly regarding its application to Lemóniz I and Valdecaballeros I.

### The Nuclear Fuel Cycle

The Empresa Nacional del Uranio, S.A. (ENUSA) was formed by a Government's Decree in 1972 to undertake and develop the industrial, procurement and commercial activities of the nuclear fuel cycle. In November 1973, the Government assigned ENUSA the responsibility of procuring the natural uranium, conversion and enrichment services necessary for all Spanish reactors, in operation, under construction and planned. The PEN of 1975 included a Nuclear Program which planned about 23 GWe in nuclear plants in operation by 1985. ENUSA's role and responsibilities as the Spanish nuclear fuel company, 100% state-owned, 60% by the Instituto Nacional de Industria (INI) and 40% by the Junta de Energía Nuclear (JEN), were confirmed and defined in more detail by a Government's Decree in December 1979, in accordance with the PEN-79.

In accomplishing its responsibilities to ensure the supplies of natural and enriched uranium for the Spanish reactors, ENUSA entered into several contracts with companies from various countries for the purchase of uranium concentrates, conversion and enrichment services, and took a 10% participation in Compagnie Minière d'Akouta (COMINAK), Niger, and an 11,11% participation in EURODIF, with the corresponding rights and obligations to take deliveries of  $U_3O_8$  and SWUs, respectively.

ENUSA has also a uranium mining and milling operation in Ciudad Rodrigo, province of Salamanca, Spain, where it is producing of the order of 200 t  $U_3O_8$ /year, and is carrying out extensive uranium exploration activities in Spain, financed from the National Budget under the Plan Nacional de Exploración e Investigación de Uranio (PNEIU, National Uranium Exploration Program), the execution of which is a responsibility of ENUSA. This exploration work in Spain is being successful, and there are at present identified of the order of 30,000 t  $U_3O_8$  reserves economically exploitable, the larger part of them in the province of Salamanca, in the area of the present operation in Ciudad Rodrigo. These reserves provide the possibility of increasing substantially and in a relatively short term the domestic production of  $U_3O_8$ .

Since 1975, the Spanish Nuclear Program has been experiencing drastic reductions and deferments, from the 23 GWe nuclear installed capacity in operation by 1985 planned in the PEN-75, to the 7.7 GWe in operation by 1990-92 planned in the PEN-83, which have been producing progressive important reductions of the needs of nuclear fuel.

ENUSA has been using all possible contractual flexibilities and has obtained some relief from its suppliers to reduce or postpone deliveries, but all this has not been sufficient to match the continuing decline of the requirements for the Spanish reactors, and there is at present an important accumulation of inventories of natural and enriched uranium. A substantial part of these inventories constitute a national strategic stockpile ("stock básico") for which ENUSA has financial help,

from a quota included in the electric power rates, which provides funds to compensate the financial costs of the "stock básico" and the eventual costs associated with its reduction.

According to the PEN-83, the role and responsibilities of ENUSA in the front end of the fuel cycle are reaffirmed, with precise indication of the need to reduce the inventories of natural and enriched uranium, which should be limited to a "stock básico" of equivalent  $U_3O_8$  and SWU amounts substantially lower than those included in the PEN-79, adapted to the size of the present nuclear program.

Given the relatively large size of the present uranium reserves, it is planned to reduce to a minimum level the uranium exploration activities from 1985, and to prepare a program of new uranium mining and milling projects to increase progressively the domestic production of uranium concentrates, consistently with the evolution of the inventory and the committed external supplies.

There is a reference in the PEN-83 to the activities of ENUSA in the fuel design, reload and core engineering activities, which are being performed successfully for all Spanish light water reactors, and to the immediate starting-up of ENUSA's fuel fabrication plant at Juzbado (Salamanca, Spain), to fabricate PWR and BWR fuel.

Regarding the back-end of the fuel cycle, a new state company will be formed to be responsible exclusively of all radioactive waste treatment, storage and disposal, including the spent fuel discharged from the Spanish nuclear plants. In this respect, it is planned to continue the development of a transport and storage cask, already underway with a satisfactory progress, for the intermediate storage of spent fuel after it has been stored in the reactor pools. The electric utilities have expanded the reactor pool storage capacities to at least 8-10 reload-years

effective capacity, in addition to one full core discharge capacity. With this expansion, away-from-reactor storage capacity will not be needed up to 1992.

A specific committee with representatives of the various Ministries involved will control the plans and activities of the new company in charge of radioactive wastes; its programming and financing will be approved by the Parliament, which will also control its performance. A quota was already included in the electric power rates to build-up a fund from which the activities of the new company will be financed.

The new company, as it is the case of ENUSA, will have the technical collaboration and support of the JEN, which will carry-out research and development activities with a particular emphasis in the areas of nuclear safety, radioactive protection, radioactive waste treatment, storage and disposal, and nuclear fuel cycle.



TABLE 1

FINAL ENERGY CONSUMPTION OBJECTIVES

(Million Tcc)

	<u>1982</u>	<u>%</u>	<u>1986</u>	<u>%</u>	<u>1990</u>	<u>%</u>	<u>1992</u>	<u>%</u>
Coal .....	8.74	12.5	8.91	11.7	10.50	12.4	11.00	12.5
Natural Gas .....	1.54	2.2	3.17	4.1	5.31	6.3	5.48	6.2
Electricity .....	11.18	16.0	12.84	16.8	14.56	17.2	15.50	17.6
Petroleum Products ..	48.28	69.3	51.50	67.4	54.18	64.1	56.02	63.7
<u>TOTAL .....</u>	<u>69.74</u>	<u>100</u>	<u>76.42</u>	<u>100</u>	<u>84.55</u>	<u>100</u>	<u>88.00</u>	<u>100</u>

TABLE 2

COMPARATIVE FORECASTS OF FINAL ENERGY CONSUMPTION GROWTHS

(Annual Cumulative Growth Rates)

	<u>PERIOD 82/87</u>			<u>PERIOD 82/90</u>	
	<u>PEN - 83</u>	<u>REV - 81</u>	<u>PEN - 79</u>	<u>PEN - 83</u>	<u>REV - 81</u>
Coal .....	1.1	6.9	- 1.3	2.3	5.3
Natural Gas .....	22.3	36.1	36.5	16.7	24.5
Electricity .....	3.5	6.5	8.5	3.4	6.1
Petroleum Products ..	1.4	2.7	7.0	1.5	2.8
<u>TOTAL .....</u>	<u>2.4</u>	<u>5.2</u>	<u>7.5</u>	<u>2.4</u>	<u>4.6</u>

TABLE 3

## COMPARATIVE PROJECTIONS OF PRIMARY ENERGY CONSUMPTION

	1 9 8 7						1 9 9 0					
	PEN - 83		REV - 81		PEN - 79		PEN - 83		REV - 81			
	10 <sup>6</sup> TEC	%	10 <sup>6</sup> TEC	%	10 <sup>6</sup> TEC	%	10 <sup>6</sup> TEC	%	10 <sup>6</sup> TEC	%		
Coal .....	30.7	25.7	31.9	24.0	23.5	16.2	31.5	24.3	34.7	23.2		
Oil .....	58.6	49.2	64.2	48.2	78.7	54.3	61.6	47.6	68.8	46.0		
Natural Gas ....	5.2	4.4	7.6	5.7	7.7	5.3	6.3	4.9	9.3	6.2		
Nuclear .....	11.4	9.6	16.4	12.3	21.5	14.8	15.2	11.4	22.9	15.3		
Hydro-Electric..	13.2	11.1	13.0	9.8	13.6	9.4	14.8	11.8	13.9	9.3		
<b>TOTAL</b>	<b>119.1</b>	<b>100</b>	<b>145.0</b>	<b>100</b>	<b>133.1</b>	<b>100</b>	<b>129.4</b>	<b>100</b>	<b>149.6</b>	<b>100</b>		

TABLE 4

## COMPARATIVE PROJECTIONS OF ELECTRIC POWER GENERATING CAPACITY (MW)

	1 9 8 7			1 9 9 0	
	PEN - 83	REV - 81	PEN - 79	PEN - 83	REV - 81
Hydro-Electric .....	15,050	16,006	18,479	18,092	18,692
Nuclear .....	5,690	10,539	10,500	7,690	12,546
Coal .....	10,557	12,089	8,401	10,203	12,263
Fuel Oil .....	7,395	5,259	7,358	6,984	4,450
<b>TOTAL</b> .....	<b>38,692</b>	<b>(44,738)</b>	<b>(43,893)</b>	<b>42,969</b>	<b>47,951</b>

TABLE 5

## INSTALLED ELECTRIC POWER GENERATING CAPACITY PLANNED

FOR PERIOD 1983/92

(MW)

Year Power Plant Type	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Conventional and Reversible Hydro-Electric .....	12,605	12,635	12,658	12,706	12,821	13,332	13,918	14,542	15,614	16,571	17,205
Pumping .....	863	1,118	1,318	1,718	1,718	1,718	1,718	2,228	2,478	2,478	2,728
Total Hydro-Electric ...	13,468	13,753	13,976	14,424	14,539	15,050	15,636	16,770	18,092	19,049	19,936
Nuclear .....	*1,460	3,785	4,760	5,690	5,690	5,690	6,690	6,690	7,690	7,690	7,690
Domestic Coal .....	4,007	4,007	5,057	6,316	6,175	6,107	6,107	5,959	5,753	5,679	5,056
Brown Lignite .....	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950
Black Lignite .....	1,462	1,462	1,462	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Exported or Non-Priority Domestic Coal .....	-	-	550	1,100	1,100	1,100	1,100	1,100	1,100	1,320	1,853
Fuel Oil and Other .....	8,147	8,147	8,081	7,528	7,395	7,395	7,177	7,177	6,984	5,984	5,450
Total Thermal .....	17,026	19,351	21,860	23,984	23,710	23,642	24,424	24,276	24,877	24,023	23,399
TOTAL .....	30,494	33,104	35,836	38,408	38,249	38,692	40,060	41,046	42,969	43,072	43,335

(\*) Assuming Almaraz I at 50%.

TABLE 6

PROJECTION OF ELECTRIC POWER GENERATION IN CONTINENTAL SPAIN

Forecast demand growth rates: 1983: 4,5%; 1984-92: 3,3% p.a.

(Power Plant Net GWh)

	<u>1982</u>	<u>1 9 8 6</u>		<u>1 9 9 0</u>		<u>1 9 9 2</u>	
		<u>Average year</u>	<u>Dry year</u>	<u>Average year</u>	<u>Dry year</u>	<u>Average year</u>	<u>Dry year</u>
Hydro-Electric .....	25,641	33,970	24,880	38,990	28,690	40,380	29,600
Nuclear .....	8,364	29,660	29,660	39,080	39,080	40,970	40,970
Coal .....	41,211	48,010	54,370	49,546	55,080	54,794	56,989
Fuel Oil and Gas .....	27,496	2,317	5,466	2,564	7,958	2,737	11,909
Total .....	102,712	113,957	114,376	130,180	130,808	138,881	139,468
Pumping Consumption ...	1,606	987	1,406	1,540	2,168	1,611	2,198
Demand .....	101,106	112,970	112,970	128,640	128,640	137,270	137,270

TABLE 7

PROJECTION OF ELECTRIC POWER GENERATION IN CONTINENTAL SPAIN

Forecast demand growth rates: 1983: 4,5% 1984-92: 4% p.a.

(Power Plant Net GWh)

	<u>1982</u>	<u>1 9 8 6</u>		<u>1 9 9 0</u>		<u>1 9 9 2</u>	
		<u>Average year</u>	<u>Dry year</u>	<u>Average year</u>	<u>Dry year</u>	<u>Average year</u>	<u>Dry year</u>
Hydro-Electric .....	25,641	34,000	24,900	39,110	28,770	40,430	29,970
Nuclear .....	8,364	29,660	29,660	39,080	39,080	40,970	40,970
Coal .....	41,211	49,970	55,530	57,439	60,650	62,320	64,223
Fuel Oil and Gas .....	27,496	2,688	6,645	935	8,561	3,821	12,840
Total .....	102,712	116,318	116,735	136,564	137,061	147,541	148,003
Pumping Consumption ...	1,606	1,028	1,445	1,694	2,191	1,671	2,133
Demand .....	101,106	115,290	115,290	134,870	134,870	145,870	145,870

TABLE 8

ANNUAL UTILIZATION OF INSTALLED CAPACITIES

Forecast demand growth rate from 1984: 3,3% p.a.

(Hours/year)

	<u>1982</u>	<u>1986</u>		<u>1990</u>		<u>1992</u>	
		<u>Average year</u>	<u>Dry year</u>	<u>Average year</u>	<u>Dry year</u>	<u>Average year</u>	<u>Dry year</u>
Hydro-Electric .....	2,035	2,360	1,729	2,177	1,602	2,046	1,500
Nuclear .....	6,062	5,545	5,545	5,400	5,400	5,660	5,660
Coal .....	6,216	4,859	5,502	5,222	5,805	5,743	5,973
Fuel Oil and Gas .....	3,346	330	778	391	1,215	529	2,300

TABLE 9

ANNUAL UTILIZATION OF INSTALLED CAPACITIES

Forecast demand growth rate from 1984: 4% p.a.

(Hours/year)

	<u>1982</u>	<u>1986</u>		<u>1990</u>		<u>1992</u>	
		<u>Average year</u>	<u>Dry year</u>	<u>Average year</u>	<u>Dry year</u>	<u>Average year</u>	<u>Dry year</u>
Hydro-Electric .....	2,035	2,362	1,730	2,184	1,606	2,048	1,518
Nuclear .....	6,062	5,545	5,545	5,400	5,400	5,660	5,660
Coal .....	6,216	5,057	5,620	5,853	6,180	5,925	6,106
Fuel Oil and Gas .....	3,346	383	946	143	1,307	738	2,480