REPUBLIC OF KOREA

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1. GENERAL INFORMATION

1.1. General Overview

The Korean Peninsula is located on the eastern edge of the Asian continent and is covered by mountains over 70% of its land area. The Peninsula has been divided in two since 1945, the Republic of Korea, commonly referred to as South Korea and the Democratic People's Republic of Korea, also called North Korea. The Korean Peninsula is 222,154 km^2, while the administrative area of South Korea is 99,260 km^2. The Republic of Korea (ROK) lies on the southern part of the Korean peninsula neighbouring China. The terrain is mostly rugged and mountainous with only 21% of the land being arable.

Located in the East Asian Monsoon belt, Korea has a temperate climate with four distinct seasons. Winter is bitterly cold and is influenced primarily by the Siberian airmass. Summer is hot and humid due to the maritime Pacific High. The transition seasons, spring and fall, are sunny and generally dry. Annual precipitation is about 1,500mm in the southern region and about 1,300mm in the central region. More than a half of the total rainfall is concentrated in the summer season, while the winter precipitation constitutes less than 10% of the total.

Korean, the official language of Korea, belongs to the Ural-Altaic language group, a group which includes such languages as Mongolian, Hungarian and Finnish. Although Korean has borrowed many words from Chinese and seems to resemble Japanese grammatically, its phonetic system differs from both completely. Chinese characters are still used, especially in newspapers and academic publications, though their use has been gradually decreasing since the 1980s due to the younger generation's preference for the simpler indigenous han-gul alphabet.

As of 1998, the Republic of Korea had a population of 46.4 million inhabitants (Table 1).

Korea is an energy resource-poor country. Consequently, energy security is a prime concern of the Korean government. There are no significant oil or gas resources and only limited anthracite coal deposits in the ROK. Uranium deposits identified are low grade and no development of these have taken place. Thus, energy security is a prime concern of the ROK government.

TABLE 1. POPULATION INFORMATION

								Growth rate (%)
	1960	1970	1980	1990	1996	1997	1998	1980 to 1998
Population (millions)	25.0	31.9	38.1	42.9	45.5	46.0	46.4	1.1
Population density (inhabitants/km²)	252	322	384	432	459	463	467	1.1
Urban population as percent of total	28	41	57	74	82	83	N/A	-
Area (1000 km²) 99.260								

Source: National Statistical Office in Korea; World Development Indicators (The International Bank for Reconstruction and Development/The World Bank).

1.2. Economic Indicators

The Korean economy has over the last thirty years been through a remarkable period of growth. Over the period 1961 to 1990 Korea's Gross Domestic Product (GDP) growth rate has averaged nearly 8.8% per year and in 1990 GDP reached 179.6 trillion Won. Korea's large economic growth

has slowed somewhat in recent times. Over the last few years the Korean economy has experienced rapid wages growth, high inflation, rising imports and falling exports, etc.

However, by the onset of 1998, Korea had successfully staved off total catastrophe in the foreign exchange market. The negative growth of -1% for the year of 1998 was inevitable due to the doldrums in investment and domestic demand.

Amidst the foreign exchange turmoil in Korea, there are few that are sceptical about Korea's fundamental economic strength. Korea has good competitive advantage, as proven by its No. 11 standing in GDP and its No. 12 standing in trade volume. The Korean economy will soon be back on track. Table 2 shows the historical GDP statistics and Table 3 the GDP Per Sector for 1997.

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

							Growth rate (%)
	1970	1980	1990	1996	1997	1998	1980 to 1998
GDP[1]	8,923	62,803	253,670	484,570	442.540	297,900	9.0
GDP[2]	64,344	133,740	318,190	488,590	515,530	N/A	-
GDP[3] per capita	280	1,647	5,917	10,639	9,622	6,420	7.9
GDP by sector (%) :							
Agriculture	27	15	9	6	6	6	-5.0
Industry	29	40	43	43	43	43	0.4
Services	44	45	48	51	51	51	0.7

[1] Millions of current US$.

[2] Millions of constant 1995 US$.

[3] Current US$ per capita.

Source: World Development Indicators (The International Bank for Reconstruction and Development/The World Bank).

TABLE 3. GROSS DOMESTIC PRODUCT (GDP) PER SECTOR IN 1997 AT 1990 CONSTANT PRICES (BILLION WON):

Agriculture	18,103.0
Mining and Quarrying	814.1
Manufacturing	88,031.9
Construction	31,945.1
Electricity	7,729.5
Wholesale & Retail Trade, Restaurants, Hotel	35,885.4
Finance & Insurance, Estate and Business Service	50,173.2
Transport, Storage and Communication	26,157.3
Others	32,048.7
Total	290,888.2

Source: Country Information.

1.3. Energy Situation

The primary objective of Korea's energy policy has been to secure an economical and stable supply of energy. At present, environment-friendly energy policies gained ground due largely to a decline in oil prices and progress in Climate Change Convention negotiations.

The impact of the two oil crises of the 1970s on the Korean economy was severe. In response, the government tried to limit the annual increase in energy consumption to about 7-8%. By the 1990s, however, consumption was growing at more than 10% annually.

In 1998, Korea's total energy consumption fell to 167 million TOE, a 7.4% drop compared with the previous year. This marked the steepest year-on-year decline since 1962. The primary cause of the sharp fall off in energy use was the nation's yearlong economic slump. Other factors that limited energy demand were higher oil prices due to the Won's weakness against the dollar and mild winter temperatures.

Table 4 shows the Korean energy reserves and Tables 5 and 6 the primary and final energy consumption, respectively. Table 7 gives the overall energy balance. In Korea, as in many other countries that are not endowed with fossil fuel reserves, nuclear power is considered to be the most reliable energy source capable of meeting the soaring energy demand necessary for economic development (i.e. an economic growth rate of some 10% per year). Korea has, consequently, chosen nuclear power as its major energy source in the future. Under the government's Power Development Programme, nuclear power is to become the major energy source by 2006 with the construction of 23 nuclear power plants, supplying about fifty percent of the nation's total electrical power.

TABLE 4. ENERGY RESERVES

Exajoule

	Estimated energy reserves in 1993					
	Solid	Liquid	Gas	Uranium [1]	Hydro [2]	Total
Total amount in place	3.42	N/A	N/A	0.01	8.50	13.87
	Estimated energy reserves in 1996					
Total amount in place	1.53	N/A	N/A	16.93	6.94	25.40

[1] This total represents essentially recoverable reserves.

[2] For comparison purposes a rough attempt is made to convert hydro capacity to energy by multiplying the gross theoretical annual capability (World Energy Council - 1996) by a factor of 10.

Source: IAEA Energy and Economic Data Base; Country Information.

TABLE 5. PRIMARY ENERGY CONSUMPTION

1000 toe

	1970	1975	1980	1985	1990	1995	1998
Coal	5,829	8,075	13,199	22,022	24,385	28,092	36,058
Petroleum	9,293	15,637	26,830	27,142	50,175	93,955	91,082
LNG	N/A	N/A	N/A	N/A	3,023	9,213	14,072
Hydro	305	421	496	915	1,590	1,369	1,525
Nuclear	0	0	869	4,186	13,222	16,697	22,423
Others	4,251	3,420	2,517	2,031	797	1,051	1,526
Total	19,678	27,553	43,911	56,296	93,192	150,437	166,686
Per capita (toe)	0.6	0.8	1.2	1.4	2.2	3.3	3.6
Domestic production	10,333	11,397	12,491	38,717	68,672	21,751	27,435
Imports	9,345	16,156	31,420	17,579	24,520	157,094	199,007

Source: Country Information.

TABLE 6. FINAL ENERGY CONSUMPTION

1000 toe

	1970	1975	1980	1985	1990	1995	1997
Coal	5,593	7,566	12,426	17,940	19,855	17,759	18,917
Petroleum	7,373	11,004	19,824	22,580	45,252	82,876	82,224
Town gas		4	15	84	1,012	5,482	8,093
Electricity	666	1,430	2,815	4,363	8,117	14,041	17,267
Others	4,250	3,420	2,517	2,031	871	1,691	2,253
Total	17,882	23,424	37,597	46,998	75,107	121,850	138,755
Growth rate (%)	12.3	3.1	1.7	4.8	14	12	6.9
Per capita (toe)	0.55	0.66	0.99	1.15	1.75	2.70	2.99

Source: Country Information.

TABLE 7. ENERGY STATISTICS

Exajoule

	1960	1970	1980	1990	1996	1997	Average annual growth rate (%) 1960 to 1980	Average annual growth rate (%) 1980 to 1996
Energy consumption								
- Total[1]	0.15	0.83	1.76	3.76	6.61	N/A	13.20	8.6
- Solids[2]	0.11	0.44	0.64	1.12	1.43	N/A	9.07	5.2
- Liquids	0.03	0.38	1.06	1.96	3.95	N/A	19.79	8.6
- Gases	N/A	N/A	N/A	0.13	0.50	N/A	-	-
- Primary electricity[3]	0.01	0.01	0.05	0.55	0.73	0.71	11.86	18.2
Energy production								
- Total	0.12	0.46	0.52	0.91	0.87	N/A	7.57	3.3
- Solids	0.11	0.45	0.46	0.37	0.14	N/A	7.25	-7.2
- Liquids	N/A	N/A	N/A	N/A	N/A	N/A	-	-
- Gases	N/A	N/A	N/A	N/A	N/A	N/A	-	-
- Primary electricity[3]	0.01	0.01	0.05	0.55	0.73	0.71	11.86	18.2
Net import (import - export)								
- Total[4]	0.03	0.38	1.33	2.93	6.13	N/A	21.33	10.0
- Solids	N/A	-0.01	0.20	0.67	1.32	N/A	-28.23	12.5
- Liquids	0.03	0.39	1.13	2.14	4.29	N/A	20.07	8.7
- Gases	N/A	N/A	N/A	0.12	0.52	N/A	-	-

[1] Energy consumption = Primary energy consumption + Net import (Import - Export) of secondary energy.
[2] Solid fuels include coal, lignite and commercial wood.
[3] Primary electricity = Hydro + Geothermal + Nuclear + Wind.
[4] Electricity losses are not deducted.
Source: IAEA Energy and Economic Database; Country Information.

1.4. Energy Policy

The key objectives of Korea's general energy policies can broadly be described under four main headings:

- Korea has a high level of dependency on energy imports and particularly oil. Thus, one of the main aims of Korea's energy policies has been to improve the country's energy security.
- A second concern has been the desire to ensure that the Korean energy sector is managed in such a way as to provide low cost energy supplies to encourage and sustain economic development and growth.
- Energy conservation is seen as a tool for improving energy security, and is now receiving increasing attention from the government. However, in a number of cases the increased government focus on conservation has yet to be reflected in the thinking within government controlled energy corporations.
- The fourth major aspect of Korea's energy policies is the development and implementation of comprehensive environmental and safety protection policies.

2. ELECTRICITY SECTOR

2.1. Structure of the Electricity Sector

The ministries chiefly responsible for developing electricity policy in Korea are the Ministry of Commerce, Industry and Energy (MOCIE) in consultation and close co-operation with the Ministry of Finance and Economy (MOFE), the Korea Electric Power Corporation (KEPCO) among others.

With energy being regarded as a key component of Korea's rapid economic development, the government has maintained a strong presence in the sector.

MOCIE, through the direct or indirect government ownership of energy companies, utilities and several energy research institutes, has maintained a high degree of control in all aspects of energy policy development and implementation.

The electricity industry in Korea is dominated by KEPCO, the government controlled, vertically integrated electric utility that owns and operates 85% of the installed electricity capacity. KEPCO is also the statutory monopoly for the transmission and distribution of power.

In addition to KEPCO, there are two medium sized and some small electricity generating companies in Korea that own and operate the remaining 15% of Korea's total installed capacity. Korea Water Resource Corporation (KWRC) and Hanwha Energy are obliged to sell all the power they produce to KEPCO. There are also a few industrial auto producers who sell their surplus power to KEPCO.

The Ministry of Commerce, Industry & Energy (MOCIE) finalized a far-reaching restructuring plan for the electric power business on January 21, 1999. Among the plan's core components, the state-owned Korea Electric Power Corporation (KEPCO), which has long monopolized the industry since 1961, was designated for privatization. According to this plan, privatization efforts for KEPCO include:

1) Some of the government's holding of KEPCO stock will be sold in the overseas market and the company is seeking to register with the U.S. Securities Exchange Commission (SEC) with a view to selling its shares in 1999,
2) Some of fossil power plants will be sold off through international bidding; and,
3) MOCIE has reviewed its restructuring plan of the electric power industry.

A summary of restructuring directives is as follows:

First, the power generation business of KEPCO will be divided into one nuclear power plant and five or six hydro/thermal power plants, one of which will be sold off to either a domestic or foreign corporation within this year. The rest will be privatized step by step until the year 2002.

Second, the power distribution business will also be divided into five or six regional firms beginning in 2003. This will ultimately open the power distribution network to full competition, allowing customers to choose their energy supplier and deal directly with power generation firms. However, power transmission will remain monopolized by KEPCO.

Third, beginning next year, the price and transaction volume of electric power will be regularly publicized like stock market information. Open competition in the power distribution market is likely to commence from 2003.

Finally, MOCIE will establish 'Power Commission' this year in order to implement its restructuring plan and to review the operation of the power pool market. The entire restructuring plan will be completed by 2009.

2.2. Policy and Decision Making Process

The fundamental objective of the power plan is to achieve a stable power supply while maintaining minimum costs with an optimum combination of energy resources. Under the Electric

Enterprises Act, rates are approved by MOCIE. Electricity price determination is based on the principle that prices should be based on costs, including a fair return on the utility's investment. At present, prices vary among customer classes, times of use, season and level of voltage.

Under the Electricity Enterprises Act, KEPCO is obligated to apply to MOCIE for a rate change. MOCIE, under the Price Stabilization Act and in consultation with MOFE, requests the Price Stabilization Committee (which includes some consumer representatives) to review KEPCO's application. After a final review by the Cabinet and the President of the Republic, the Minister of Commerce, Industry and Energy approves the new rates.

Electricity rates in Korea are "bundles", i.e., there is one charge covering generation, transmission and distribution costs. Consequently the Korean government plays a major role in the setting of nearly all energy prices.

In August 1998, the Korean government announced a revised long-term electric system expansion plan, covering the period from 1998 to 2015 as shown in Figure 1. According to the plan, the annual growth rate for power demand is expected to be around 3.8% on average from 1998 to 2015. Consequently, total electricity sales are expected to reach 250,627 GWh in the year 2000, 329,412 GWh in 2005, and 426,769 GWh in 2015.

2.3. Main Indicators

The total installed capacity in 1998 was 43,406 MW, which accounts for an additional 2,790 MW per year since 1991. The share of oil-fired power plants rapidly decreased from 65.5% in 1970 to 10.9% in 1998. Instead, nuclear energy became the largest electric power source in Korea, with a 27.7% share. The LNG, as a peak source, increased to 28.1%. This fuel mix shows a remarkable improvement in fuel diversity compared with the heavy reliance on oil that prevailed until the early 1980's.

Total power generation in 1998 decreased from 224,445 GWh in 1997 to 215,300 GWh due to the economic slump. This breaks down to 89,689 GWh (41.7%) from nuclear power plants, 75,499 GWh (35.1%) from coal-fired power plants, 17,712 GWh (8.2%) from oil-fired power plants, 26,302 GWh (12.2%) from LNG combined power plants, and 6,099 GWh (2.8%) from hydro power plants. The latter are also shown in Figure 2.

Table 8 gives the historical electricity production and installed capacities. The energy and electricity related ratios are given in Table 9.

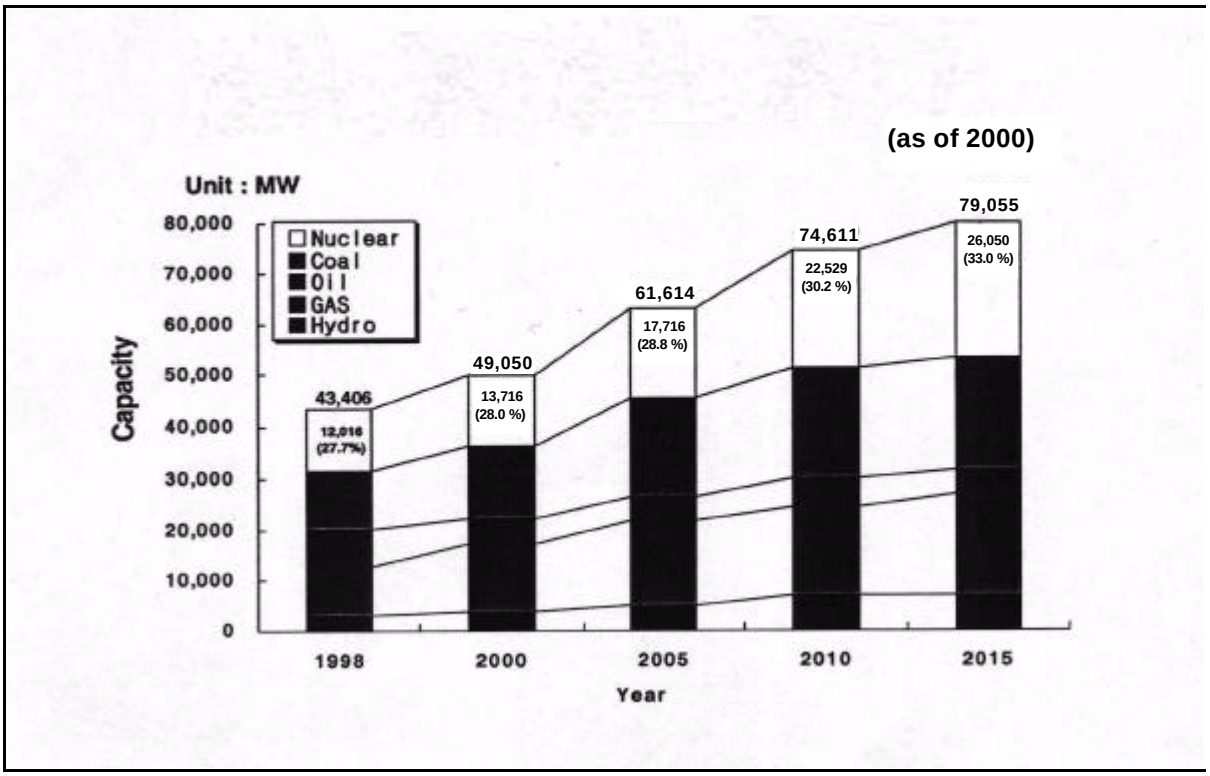

FIG. 1. Long Term Power Development Plan

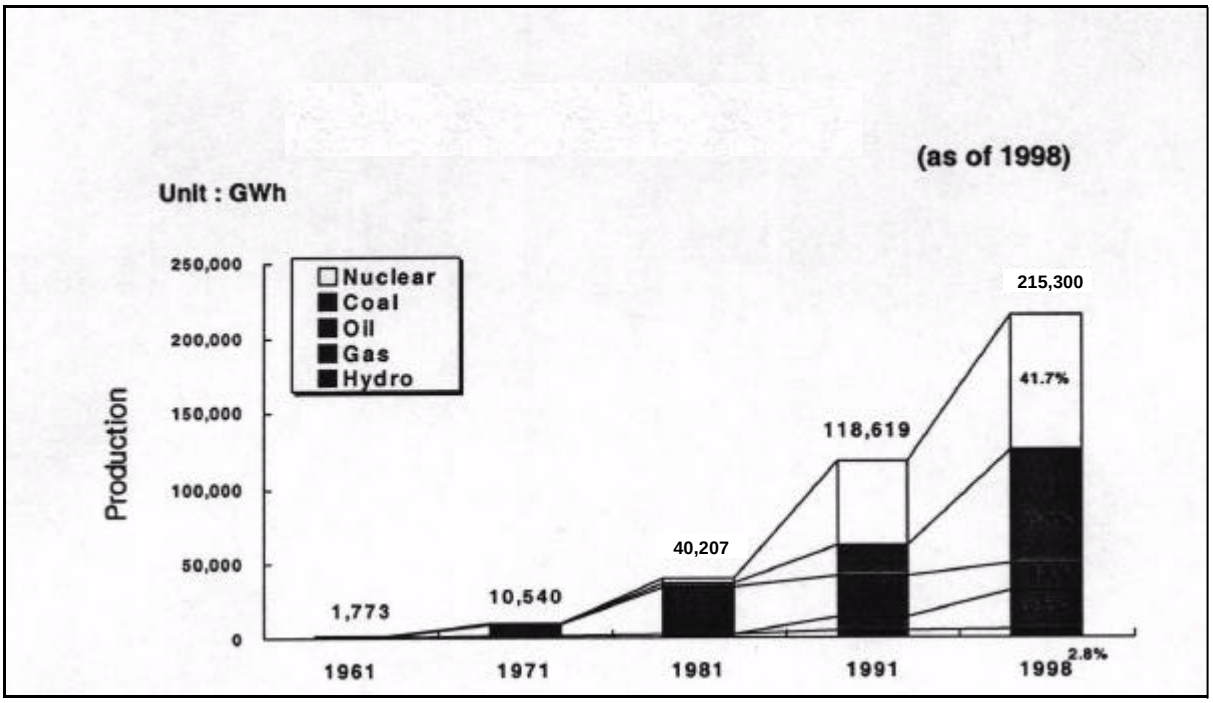

FIG. 2. Electricity Generation

3. NUCLEAR POWER SITUATION

3.1. Historical Development

Nuclear activities in Korea were initiated in 1957 when Korea became a member of IAEA. In 1959, the Office of Atomic Energy was established as a government organization in conformity with

the global trend toward developing peaceful uses of atomic energy. The Atomic Energy Law was promulgated in the previous year.

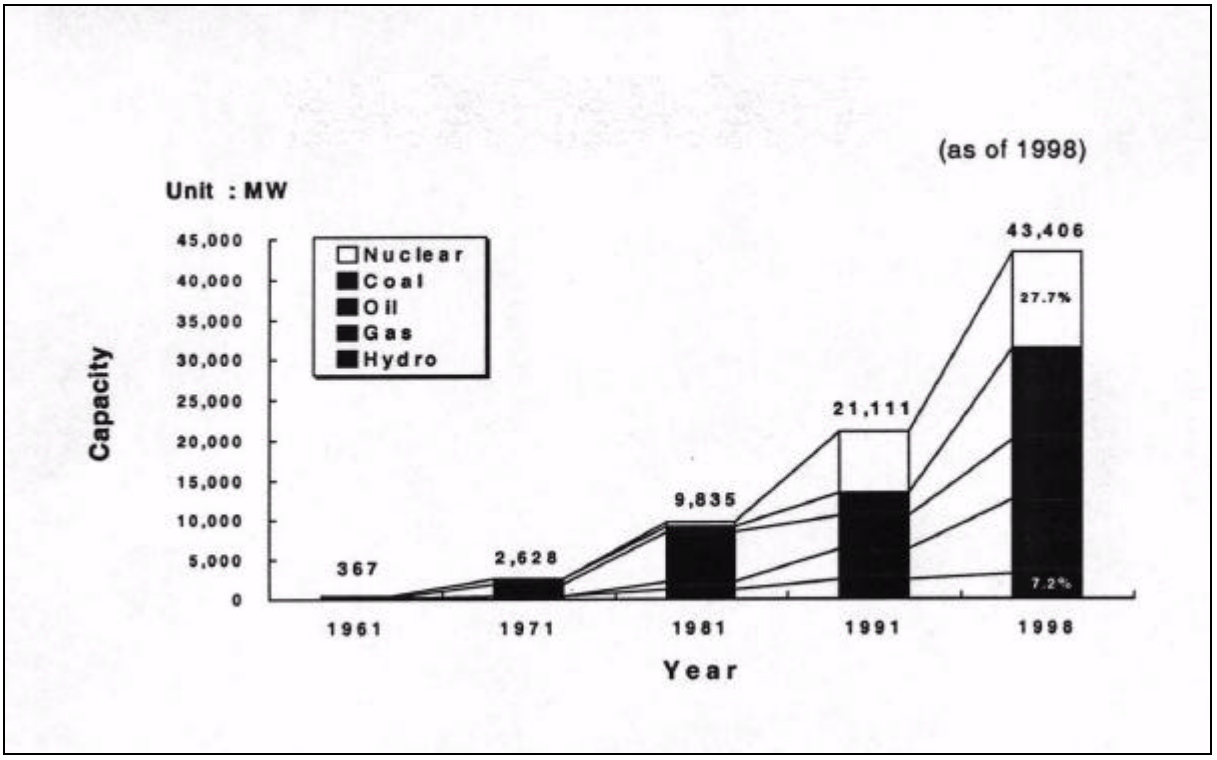

FIG. 3. Installed Capacity by Plant Type

TABLE 8. ELECTRICITY PRODUCTION AND INSTALLED CAPACITY

							Average Ann. Growth Rate (%)	
	1960	1970	1980	1990	1996	1997	1960 to 1980	1980 to 1996
Electricity production (TWh)								
- Total[(1)]	1.76	9.60	37.24	107.67	205.49	224.45	16.92	11.1
- Thermal	1.18	8.38	31.78	48.42	126.37	141.95	18.42	9.2
- Hydro	0.58	1.22	1.98	6.36	5.20	5.40	6.34	6.1
- Nuclear	0.00	0.00	3.48	52.89	73.92	77.09	-	20.0
- Geothermal	N/A	N/A	N/A	N/A	N/A	N/A	-	
- Wind	N/A	N/A	N/A	N/A	N/A	N/A	-	
Capacity of electrical plants (GW(e))								
- Total	0.44	2.76	9.39	21.02	35.72	41.04	17.13	9.1
- Thermal	0.30	2.44	7.60	11.07	23.01	27.61	18.37	7.9
- Hydro	0.14	0.33	1.16	2.34	3.09	3.11	11.02	6.0
- Nuclear	0.00	0.00	0.59	7.62	9.62	10.32	-	18.3
- Geothermal	N/A	N/A	N/A	N/A	N/A	N/A	-	-
- Wind	N/A	N/A	N/A	N/A	N/A	N/A	-	-

[(1)] Electricity losses are not deducted.

Source: IAEA Energy and Economic Database.

The Republic of Korea has one of the most dynamic nuclear power programmes in the world. It has carried out a very ambitious nuclear power programme since the 1970's in parallel with the nation's industrialization policy, and has maintained a strong commitment to nuclear power development as an integral part of the national energy policy aimed at reducing external vulnerability and insuring against global fossil fuel shortage.

TABLE 9. ENERGY RELATED RATIOS

	1960	1970	1980	1990	1996	1997	1998
Energy consumption per capita (GJ/capita)	6	26	46	88	146	N/A	N/A
Electricity per capita (kW·h/capita)	70	288	997	2,644	4,823	5,151	N/A
Electricity production/Energy production (%)	14	19	71	120	244	N/A	N/A
Nuclear/Total electricity (%)	0	0	9	44	32	34	41
Ratio of external dependency (%)[1]	19	47	75	78	93	N/A	N/A
Load factor of electricity plants							
- Total (%)	46	40	44	59	66	N/A	N/A
- Thermal	45	39	46	52	64	N/A	N/A
- Hydro	46	42	20	31	19	N/A	N/A
- Nuclear	-	-	68	79	88	86	90.5

[1] Net import / Total energy consumption

Source: IAEA Energy and Economic Database.

During the early years of nuclear power development, power plants were constructed mostly through "Turn-Key" contracts, providing little opportunity for domestic industries to participate in the construction. Since then, however, domestic participation in overall construction management, design, equipment supply, and civil construction has continuously increased through the adoption of the “Non Turn-Key” approach. Recently, a high degree of technological self-reliance is being achieved through the construction of Yonggwang Nuclear Units (YGN) 3 and 4 in various fields of the nuclear industry. At present, nuclear power plant technology and related fuel cycle technologies are maturing.

The first domestic reactor was a 1000 MW(e) PWR built at Yonggwang-3, which entered commercial operation in 1995. The eleventh nuclear unit, Yonggwang-4 (a 1000 MW(e) PWR) was also connected to the grid in 1995, three months ahead of schedule, bringing the total nuclear installed capacity to more than 9 GW(e). The Yonggwang units 3 and 4 are considered as the reference reactor for future construction. Two more of these domestic PWRs are being built at Yonggwang. The next domestic reactor was a 700 MW(e) pressurized heavy water reactor (PHWR), fabricated by Korea Heavy Industries & Construction Company. The reactor was shipped to Wolsong for installation in units 2, 3 and 4. This evolution is shown in Figure 4.

3.2. Status and Trends of Nuclear Power

Since the first commercial operation of Kori unit 1 in 1978, nuclear energy has been an important energy source in Korea. As of December 1998, nuclear power generation accounts for 41.7% of the total electric power output of the country, which is a total of 90 billion kilowatt-hours of electricity. The average capacity factor is 90.2%, ranking among the world's top 5 and indicative of the efforts to improve nuclear power technology in Korea.

The performance of Korean nuclear power plants has been maintained above the 87% level for the last 7 years. In addition, the number of unplanned trips of a nuclear unit fell to 0.4 in 1998, down from 1.1 in 1997. Sixteen nuclear units totalling 13 GW in capacity are currently in commercial operation and four units are under construction, totalling 3.8 GW.

KEPCO has regularly replaced aged components and during the last refuelling outage of Kori Unit 1, two steam generators were successfully replaced for the first time in Korea. By the year 2015, the share of nuclear energy generated will increase to 44.5% of the total electricity generation, with twenty-eight nuclear units in operation.

In 1992, Korea launched the Next Generation Nuclear Reactor Programme to develop a 1,300 MW class standardized advanced light water reactor, which utilizes the expertise accumulated through the Korean Standard Nuclear Plant's design and technology self-reliance programme.

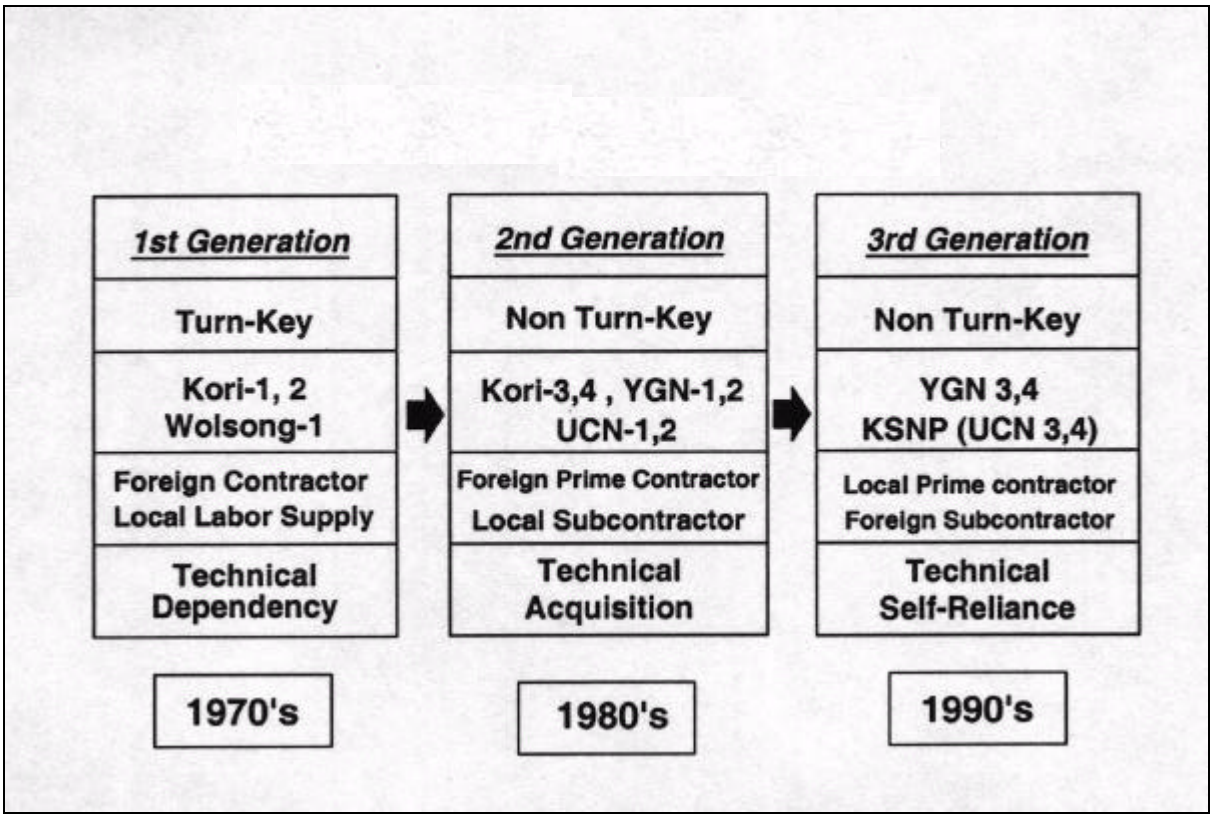

FIG. 4. Evolution of Project Structure

The Next Generation Nuclear Reactor Programme adopted world-class design standards and its reactor type is the evolutionary water-cooled reactor. In order to enhance safety and economic viability, thermal output has been increased while upgrading basic safety systems.

3.3. Current Policy Issues

In 1994, the Korean government established long-term nuclear policy directions through 2030 to demonstrate long-term national vision and basic policy directions regarding nuclear energy and its utilization. The objectives secured in this policy are:

i) To enhance stable energy supply by establishing nuclear energy as a major energy source in national electric power generation;
ii) To establish self-supporting nuclear reactor technology and non-proliferating nuclear fuel cycle technology through systematic research and development of nuclear energy;
iii) To promote nuclear technology as an export industry through upgrading nuclear industrial technology on the basis of civil creativity and participation;
iv) To develop nuclear technology for a leading role in fostering national welfare and creative science and technology by expanding the uses of nuclear energy in agriculture, engineering, medical science, and industrial applications.

Recently, Korea is placing even more emphasis on nuclear safety. To carry out its nuclear programme successfully, Korea is determined to ensure nuclear safety throughout every stage of development.

TABLE 10. STATUS OF NUCLEAR POWER PLANTS

Station	Type	Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
KORI 1	PWR	587	KEPCO	Operational	WEST	31-May-72	19-Jun-77	26-Jun-77	29-Apr-78	
KORI-2	PWR	650	KEPCO	Operational	WEST	18-Nov-78	09-Apr-83	22-Apr-83	25-Jul-83	
KORI-3	PWR	950	KEPCO	Operational	WEST	24-Dec-79	01-Jan-85	22-Jan-85	30-Sep-85	
KORI-4	PWR	950	KEPCO	Operational	WEST	24-Dec-79	26-Oct-85	31-Dec-85	29-Apr-86	
ULCHIN-1	PWR	950	KEPCO	Operational	FRAM	25-Jan-83	25-Feb-88	07-Apr-88	10-Sep-88	
ULCHIN-2	PWR	950	KEPCO	Operational	FRAM	25-Jan-83	25-Feb-89	14-Apr-89	30-Sep-89	
WOLSONG-1	PHWR	678.7	KEPCO	Operational	AECL	15-Feb-78	21-Nov-82	31-Dec-82	22-Apr-83	
YONGGWANG-1	PWR	950	KEPCO	Operational	WEST	17-Dec-81	31-Jan-86	05-Mar-86	25-Aug-86	
YONGGWANG-2	PWR	950	KEPCO	Operational	WEST	17-Dec-81	15-Oct-86	11-Nov-86	10-Jun-87	
YONGGWANG-3	PWR	1000	KEPCO	Operational	KHIKAECE	21-Dec-89	13-Oct-94	30-Oct-94	31-Mar-95	
YONGGWANG-4	PWR	1000	KEPCO	Operational	KHIKAECE	21-Dec-90	07-Jul-95	18-Jul-95	01-Jan-96	
ULCHIN-3	PWR	1000	KEPCO	Operational	KHIKAECE	16-Jul-93	21-Dec-97	06-Jan-98	11-Aug-98	
ULCHIN-4	PWR	1000	KEPCO	Operational	KHIKAECE	16-Jul-93	14-Dec-98	28-Dec-98	31-Dec-99	
WOLSONG-2	PHWR	700	KEPCO	Operational	AECL/KHI	28-Aug-92	29-Jan-97	01-Apr-97	01-Jul-97	
WOLSONG-3	PHWR	700	KEPCO	Operational	KHI/AECL	26-Feb-94	19-Feb-98	25-Mar-98	01-Jul-98	
WOLSONG-4	PHWR	700	KEPCO	Operational	KHI/AECL	26-Feb-94	10-Apr-99	21-May-99	01-Oct-99	
YONGGWANG-5	PWR	1000	KEPCO	Under Construction	KHIKAECE	29-Jun-97	N/A	N/A	30-Apr-02	
YONGGWANG-6	PWR	1000	KEPCO	Under Construction	KHIKAECE	20-Nov-97	N/A	N/A	31-Dec-02	
ULCHIN 5	PWR	1000	KEPCO	Under Construction	KHIKAECE	01-Oct-99	N/A	N/A	30-Sep-04	
ULCHIN-6	PWR	1000	KEPCO	Under Construction	KHIKAECE	01-Oct-99	N/A	N/A	30-Sep-05	

Source: IAEA Power Reactor Information System as of 31-Dec-1999.

TABLE 12. THE AVERAGE UNIT CAPABILITY FACTOR OF NUCLEAR POWER PLANTS

	1980	1985	1990	1995	1996	1997	1998
Plant factor (%)	67.4	78.7	79.3	87.3	87.5	87.6	90.2

Source: IAEA Power Reactor Information System as of 31-Dec-1999.

Public acceptance (PA) is another important factor in the development of the nuclear industry. As the social environment changes, public concern for nuclear safety rises. The Korean government is strengthening its PA activities, including the dissemination of accurate information on nuclear programmes to the public. Publication of safety evaluation reports and the development of a public hearing system are also important for PA advancement.

Korea had originally planned to build an Away From Reactor (AFR) interim storage facility for spent fuel with 3,000 ton capacity and a low/intermediate level radwaste disposal facility with a capacity of 250,000 drums by 1997 and 1995, respectively. However, it has been delayed for 3-4 years mainly because of the lack of public acceptance brought on by strong opposition from residents near the planned radioactive waste disposal sites. In December 1994, the Korean government announced that the island of Kulup-do was selected as a final repository for low level radioactive waste disposal and for temporary storage of spent fuel. The country's first radwaste disposal site, the Kulup-do island is located far off Korea's western coast, and has an area of 1.7 km^2 and 10 residents.

In accordance with the Korean government policy on the management of radioactive waste and nuclear spent fuels, KEPCO had performed many projects to extend the in-plant spent fuel storage capacity, which include transhipment among neighbouring units, reracking with high density storage racks in PWRs and construction of concrete silo type dry store in CANDU. A contingent plan is available to store spent fuel at reactor sites until the second half of the 2010s.

In order to achieve self-reliance in nuclear technology and to establish self-sufficiency in the supply of nuclear energy by the early 2000's, Korea established a long-term nuclear research and development programme to be implemented over a ten-year period. This programme consists of 20 government-led and 14 industry-led research and development projects with a total funding of 2.5 billion US$. The implementation of this programme is in progress. To support the active nuclear power development programme and to stimulate the development of basic science and technology in the Korean nuclear society, Korea Atomic Energy Research Institute (KAERI) has constructed a 30 MWth research reactor of Korean design called HANARO (renamed from the former Korea Multi-purpose Research Reactor: Hi-Flux Neutron Application Reactor). KAERI started HANARO's main construction work in February 1989 and fuel was loaded in February 1995.

3.4. Organizational Chart

In the Republic of Korea, nuclear-related activities are planned and carried out by the Atomic Energy Commission (AEC), the Nuclear Safety Commission (NSC), the Ministry of Science and Technology (MOST), and the Ministry of Commerce, Industry & Energy (MOCIE). Under the mandate of the Atomic Energy Act, the AEC is the highest decision-making body on policy issues related to nuclear energy, including those concerning its utilization. The AEC consists of nine to eleven members representing various sectors of the government and industry. The chairman of the AEC is the Prime Minister. MOST has overall responsibility for the nation: nuclear research and development, and regulatory and licensing works. In order to deal with important issues concerning nuclear safety, the NSC was recently established under MOST. The NSC is composed of five to seven members, including its chairman, the Minister of Science and Technology. MOCIE is responsible for the construction and operation of nuclear power plants, nuclear fuel supply, and the management of low

and medium level radwaste. The Nuclear Power Development Organization in Korea is shown in Figure 5:

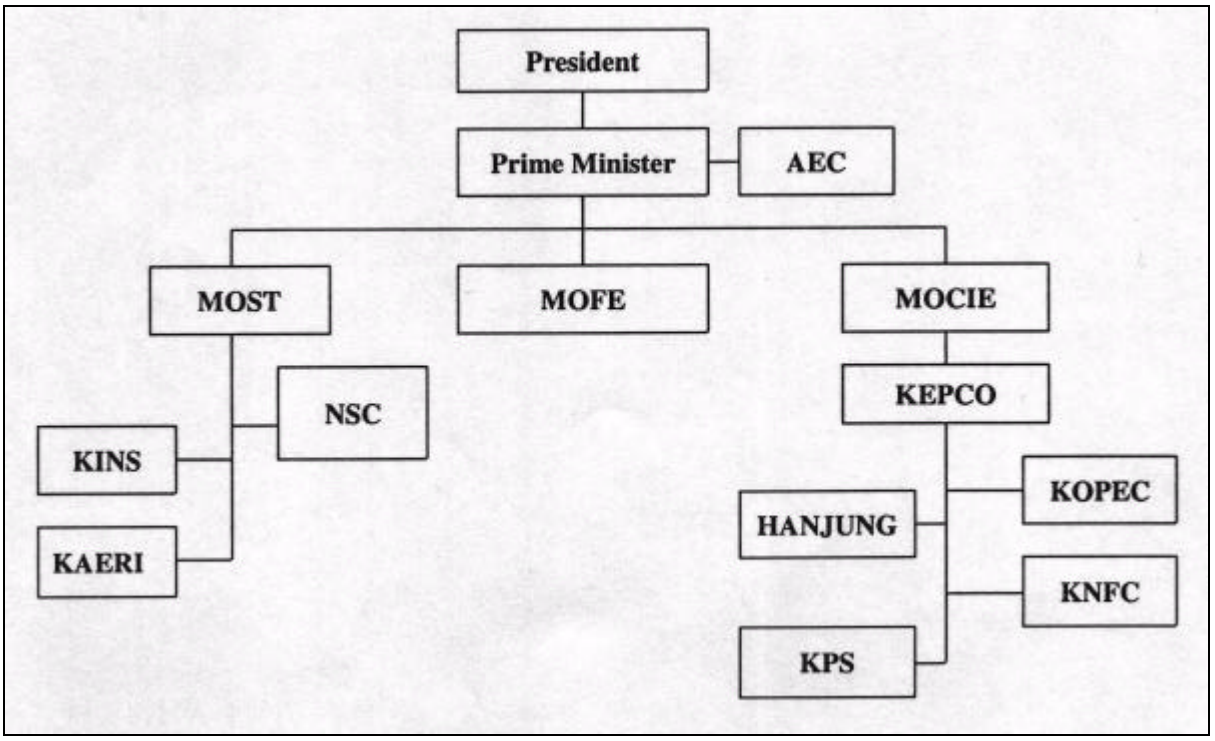

FIG. 5 Nuclear Power Development Organization in Korea

Legend:

- AEC *Atomic Energy Commission*
- MOFE *Ministry of Finance and Economy*
- MOST *Ministry of Science and Technology*
- MOCIE *Ministry of Commerce, Industry & Energy*
- NSC *Nuclear Safety Commission*
- KAERI *Korea Atomic Energy Research Institute*
- KINS *Korea Institute of Nuclear Safety*
- KEPCO *Korea Electric Power Corporation*
- KOPEC *Korea Power Engineering Company*
- KPS *Korea Power Plant Service and Engineering Co.*
- KNFC *Korea Nuclear Fuel Corporation*
- HANJUNG *Korea Heavy Industry & Construction Co.*

4. NUCLEAR POWER INDUSTRY

In 1985, the Korean government made a milestone decision to implement the national self-reliance policy and divided the role among domestic nuclear organizations. After Korea had achieved an overall self-reliance level of 95% at the end of 1995, in December 1996, according to the Government's policy of streamlining the nuclear power industry, the industries were restructured as follows:

- *Total Project Management*	KEPCO
- *Architectural Engineering and NSSS Design*	KOPEC
- *Research & Development*	KAERI
- *Maintenance Services*	KPS
- *NSSS, Turbine and Generator Manufacturing*	HANJUNG
- *Nuclear Fuel Design and Fabrication*	KNFC

This self-reliance strategy has been applied since construction of the Yonggwang 3&4 project. Domestic nuclear industries were the project's prime contractors with supporting technology transfer from foreign subcontractors.

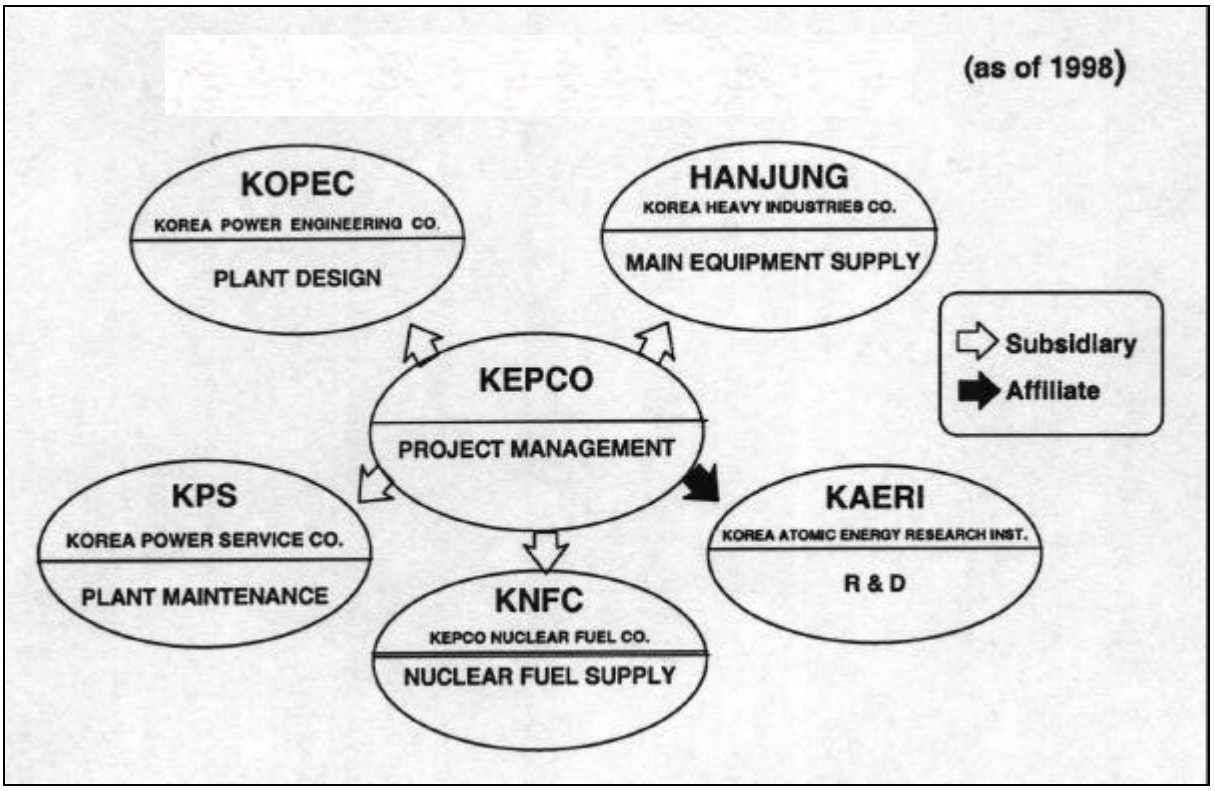

FIG. 6 Korea Electric Power Group

4.1. Supply of Nuclear Power Plants

Hanjung is taking part in power plant construction in Korea by virtue of its capability to supply heavy industrial construction equipment and machinery built to precise standards.

KOPEC was established in 1975 to foster the nation's self-reliance in power technologies, particularly in nuclear power engineering for pressurized water reactors. As such, KOPEC carries out the prime architect engineer's responsibility for PWR's in Korea. KOPEC is collaborating with Canada to obtain also PHWR engineering experience.

KPS provides maintenance services for all the power stations including NPP's under operation or under start-up.

KNFC was established in November 1982 by the joint investment of KEPCO and KAERI to localize the nuclear fuel fabrication for pressurized water reactors.

4.2. Operation of Nuclear Power Plants

KEPCO is the sole entity in Korea responsible for long-term planning, development, generation, transmission, and distribution of electric power. KEPCO is also the largest stockholder of KOPEC, Hanjung, KPS and KNFC. It has implemented a comprehensive programme for improving the NPP's capacity factor leading to a steadily improvement of the Korean NPP's operation.

4.3. Fuel Cycle and Waste Management Service Supply

KAERI is a government-supported national nuclear research and development institute established to promote peaceful uses of nuclear energy in Korea. In September 1990, the Nuclear Environment Management Centre (NEMAC), an affiliated organization of KAERI, was established as the responsible organization for management of low-level radwaste and spent fuels in the nation. In order to carryout Korea's radioactive waste management programme more successfully, the government promulgated a law relating to the promotion of radioactive waste management programmes with support to neighbouring local support programmes, such as improvements in the standard of living, public works and education.

There are plans to build an Away From Reactor interim storage facility for spent fuel and a low/intermediate level radwaste disposal facility.

4.4. Research and Development Activities

The nuclear power R&D programme of the Republic of Korea, carried out by KEPCO and the Korean Atomic Energy Research Institute (KAERI) in co-operation with foreign companies, covers advanced reactor development and fuel cycle activities including fabrication of enriched uranium and mixed oxide fuel and management of spent fuel and radioactive waste. The development of an advanced reactor of domestic design is planned to be completed by the end of the century and the first unit of this type is schedule for commissioning before 2010.

Under the basic principle of promoting the peaceful uses of nuclear energy and securing nuclear safety, the Korean government has actively pursued the following goals:

- to provide a stable electricity supply through the development of nuclear energy as the primary source of generation;
- to achieve technological self-reliance in nuclear reactor and non-proliferation of nuclear fuel cycle development;
- to make the nuclear industry one of the major export industries through the participation of the private sector by actively promoting the development of commercial nuclear technologies; and
- to expand the applications of nuclear technology to medical, agricultural and industrial areas.

In order to successfully achieve these goals, the Korean government established the Comprehensive Nuclear Energy Promotion Plan in June 1997, which aims at effectively utilizing the nation's nuclear manpower and resources.

In 1992, the Ministry of Science & Technology (MOST) launched a 10-year national R&D programme. The programme aims at developing a wide range of technologies needed for the peaceful uses of nuclear energy, and also at building a foundation for national energy self-sufficiency.

In 1997, in consideration of the changing domestic and foreign research trends, MOST re-established the second phase of the 10-year national R&D programme, which is effective from 1997 to 2006.

The national nuclear R&D programme is funded by both the government budget allocation and the Nuclear R&D Fund derived from a designated fraction of revenues from nuclear power generation.

4.5. International Co-operation in the Field of Nuclear Power Development and Implementation

Korea is eager to share with other countries its experience in solving the difficult problems that arise in the various stages of planning and implementation of nuclear programmes for the peaceful uses of nuclear energy. The Republic of Korea has entered the international market as a nuclear technology supplier and in 1994 Korean companies signed agreements with China and Turkey. With respect to the latter, KAERI won a contract to provide comprehensive consultancy services to Turkey's first nuclear power plant project. Construction of Turkey's Akkuyu nuclear plant is scheduled to start in 1998. Because high-level technological consultation will be required during the construction of the Akkuyu Nuclear Power Plant, KAERI will supervise all administrative and technological activities related to the project, including evaluation of foreign suppliers of nuclear equipment. Under the contract, signed between KAERI and the Turkish Electricity Authority on December 30 1994, KAERI's consultancy work began in early 1995.

International co-operation activities in Korea aim at promoting the peaceful and safe uses of nuclear energy through technical co-operation. The Korean government has concluded bilateral co-operation agreements on the peaceful uses of nuclear energy with fourteen countries: USA (73), Canada (76), Spain (76), Australia (79), Belgium (81), France (81), Germany (86), Japan (90), Russia (90), the U.K. (91), China (95), Argentina (97), Vietnam (97), and Turkey (98). Such agreements facilitate the exchange of scientists and engineers, the exchange of information, joint research, and other co-operative activities in nuclear R&D and safety. Korea is making every effort to increase its contributions and role in the international nuclear community. The Memorandum of Understanding between the International Atomic Energy Agency (IAEA) and the Ministry of Science and Technology (MOST) was concluded in November 1998 to strengthen the technical co-operation through the IAEA: regional and inter-regional training courses and workshops. This MOU will contribute to the advancement of nuclear technology in developing countries.

In March 1995, the Korean Peninsula Energy Development Organization (KEDO) was established for the supply of two units of the Korean Standard Nuclear Power Plant (KSNP) in North Korea. The Executive Board of KEDO is composed of representatives from the Republic of Korea, the United States of America, Japan and the EU.

5. REGULATORY FRAMEWORK

5.1. Safety Authority and the licensing Procedures

The assurance of nuclear safety is the highest priority in the use and development of nuclear energy in Korea. The goal is to protect plant personnel and neighbouring inhabitants by keeping radiation effects as low as possible.

There are three nuclear regulatory organizations in Korea:

- AEC national level decision-making body;
- MOST governmental regulatory authority with enforcement power;
- KINS technical expert group established to support MOST.

Nuclear energy issues are principally the responsibility of the Atomic Energy Office within the Ministry of Science and Technology (MOST) and headed by an Assistant Vice Minister. The Korea Institute of Nuclear Safety (KINS) was established in February 1990 to support MOST with its technical expertise in the development of nuclear regulatory policy.

MOST has the overall responsibility for ensuring the protection of public health and safety through regulatory control and safety inspections, based on the provisions of the Atomic Energy Act. KINS entrusted with the regulatory works by MOST, carries out technical assessments according to the licensing documents prepared by the utility and conducts safety inspections on all nuclear facilities.

Regulation and licensing procedures for nuclear power plants in Korea (Figure 7) are divided into three stages:

- In the site selection stage, the conceptual design is examined to determine the appropriateness of the proposed site. The safety requirements of the site have been previously reviewed from standpoints of the design, the construction, and the operation of the plant.

- For the construction permit, the utility submits a Preliminary Safety Analysis Report (PSAR) and an overall quality assurance programme for the Project along with the reference design of the plant. Additionally, the utility is required to prepare an environmental impact statement.

- When the utility requests an operating license, MOST must confirm that the as-built plant conforms to the submitted design. In this stage, operational technical specification, and emergency plans and procedures against radiation hazards are submitted.

The Korean government is continually improving its nuclear control system as the amount of domestic nuclear material increases in parallel with the growth of the nuclear industry. The government established a State System for the Accounting and Control of nuclear materials (SSAC) within MOST. In order to develop nuclear control technology and to technically assist the government, the Technology Center for Nuclear Control (TCNC) at the Korea Atomic Energy Research Institute (KAERI) was established in 1994.

5.2. Main National Laws and Regulations

The Korean government promulgated the Atomic Energy Act as a fundamental legislation to regulate the nuclear activities in Korea. The regulatory organizations and functions are also described in the Act. MOST has ultimate responsibility for the protection of the public and environment, while the prime responsibility rests with the utilities.

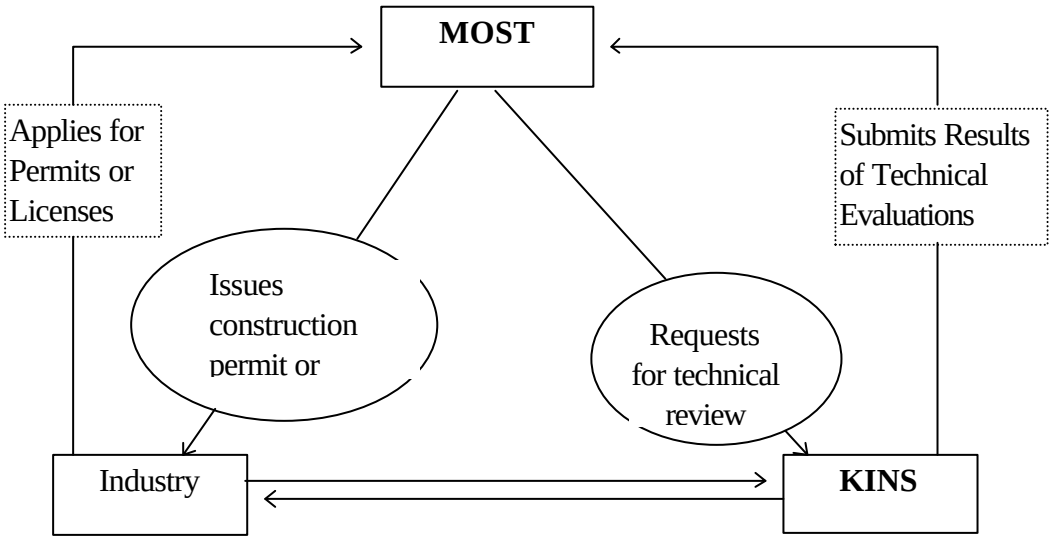

FIG. 7. Licensing Procedure for Nuclear Facilities in Korea

In Korea, the legislative system of Atomic Energy law has several levels according to origination and applicability, i.e., the Atomic Energy Act, Enforcement Decree, Enforcement Regulation, Notice of the Minister of MOST, and Technical Specification which is a part of the safety analysis reports. The regulatory authority for regulating nuclear industry activities is based on the Atomic Energy Act. In conformity with the atomic energy laws, the licensee submits to MOST various documents demonstrating the adequacy of the proposed design.

A Nuclear Damage Compensation Deliberation Committee within MOST co-ordinates extra-judicial settlement of claims for nuclear damage compensation and surveys and evaluates nuclear damage.

5.3. International, Multilateral and Bilateral Agreements

AGREEMENTS WITH THE IAEA

• NPT related agreement INFCIRC/236	Entry into force:	14 November 1975
• Additional Protocol	Entry into force:	21 June 1999
• Improved procedures for designation of safeguards inspectors	Not yet accepted	
• Korea/USA, safeguards related INFCIRC/111	Entry into force:	5 January 1968
• Korea/France, safeguards related INFCIRC/233	Entry into force:	22 September 1975
• Korea/France, agreement on Technical Co-operation	In effect since	1974
• Supplementary agreement on provision of technical assistance by the IAEA	Entry into force:	21 January 1980
• RCA	Entry into force:	4 December 1992
• Agreement on privileges and immunities	Entry into force:	17 January 1962

OTHER RELEVANT INTERNATIONAL TREATIES etc.

• NPT	Entry into force:	23 April 1975
• Convention on physical protection of nuclear material	Entry into force:	8 February 1987
• Convention on early notification of a nuclear accident	Entry into force:	9 July 1990
• Convention on assistance in the case of a nuclear accident or radiological emergency	Entry into force:	9 July 1990

• Conventions on civil liability for nuclear damage and joint protocol	Non-Party	
• Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage	Not signed	
• Convention on Supplementary Compensation for Nuclear Damage	Not signed	
• Convention on nuclear safety	Entry into force:	24 October 1996
• Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management	Signature:	29 September 1997
• ZANGGER Committee	Member	
• Nuclear Export Guidelines	Not adopted	
• Acceptance of NUSS Codes	No reply	
• Partial Test-Ban Treaty	Entry into force:	24 July 1964

BILATERAL AGREEMENTS

- Agreement for Co-operation between the ROK and the USA concerning Civil Uses of Atomic Energy, in effect since 1956.
- Agreement between Korea and France for the Peaceful Uses of Nuclear Energy, signed in April 1981.
- Agreement between Korea and Canada for Co-operation in the Peaceful Uses of Atomic Energy, in effect since 1976.
- Agreement between Korea and Australia concerning Co-operation in Peaceful Uses of Nuclear Energy and the Transfer of Nuclear Materials, in effect since 1979
- Notes between Korea and Japan for co-operation in the field of peaceful uses of nuclear energy, exchanged in May 1990
- Protocol on co-operation in the field of peaceful uses of nuclear energy between the Ministry of Science and Technology of the ROK and the Ministry of Atomic Power and Industry of the USSR, in effect since December 1990.
- Agreement between the ROK and the UK for co-operation in the peaceful use of nuclear energy, signed in November 1991.

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Appendix

DIRECTORY OF THE MAIN ORGANIZATIONS, INSTITUTIONS AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

NATIONAL ATOMIC ENERGY AUTHORITY

Atomic Energy Commission (AEC)
Chungang-dong
Kwachon
Kyunggi-do
Rep. of Korea

Tel: +82-2-503-7646
Fax: +82-2-503-7673

Ministry of Science and Technology (MOST)
Government Complex-Kwacheon
Chungang-dong,
Kyunggi-do 427-760
Rep. of Korea

Tel: +82-2-503-7600
Fax: +82-2-504-7636
Cable: MOSTROK SEOUL
http://www.most.go.kr

Ministry of Commerce, Industry & Energy (MOCIE)
Government Complex-Kwacheon
Chungang-dong,
Kyunggi-do 427-760
Rep. of Korea

Tel: +82-2-503-7171
Fax: +82-2-503-9603
http://www.mocie.go.kr

OTHER NUCLEAR ORGANIZATIONS

Korea Atomic Energy Research Institute (KAERI)
150 Dukjin-dong
Yusong-gu
Taejon 305-353
Rep. of Korea

Tel: +82-42-868-2131
Fax: +82-42-861-2702
http://www.kaeri.re.kr

Korea Institute of Nuclear Safety (KINS)
19 Kusong-dong
Yusong-gu
Taejon 305-338
Rep. of Korea

Tel: +82-42-868-0025
Fax: +82-42-861-1700
http://www.kins.re.kr

Korea Electric Power Corporation (KEPCO)
167 Samsong-dong
Kangnam-gu
Seoul 135-791
Rep of Korea

Tel: +82-2-3456-3114
Fax: +82-2-3456-4198
http://www.kepco.co.kr

Korea Heavy Industries and Construction Co. (HANJUNG)
555 Kwigok-dong
Changwon
Kyongsangnam-do 641-420
Rep. of Korea

Tel: +82-551-69-6114
Fax: +82-551-64-5551
http://www.hanjung.co.kr

Korea Power Engineering Co., Inc. (KOPEC)
360-9 Mabuk-ri, Kusong-myon,
Yongin, Kyunggi-do 449-910
Rep. of Korea

Tel: +82-331-289-3114
Fax: +82-331-283-6215
http://www.kopec.co.kr

Korea Nuclear Fuel Co., Ltd. (KNFC)
150, Dukjin-dong
Yusong-gu
Taejon 305-353
Rep. of Korea

Tel: +82-42-868-1000
Fax: +82-42-861-2380
http://www.knfc.co.kr

Korea Plant Services and Engineering Co., Ltd. (KPS)
196, Heungin-dong, Kumgok-dong
Chung-gu, Pundang-gu, Seong nam, Kyonggi-do
463-480
Rep. of Korea

Tel: +82-2-710-4114
Fax: +82-2-710-4115
http://www.kps.co.kr