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 neighboring 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 air mass. 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.

Korea has its own language, called Hangul, which belongs to the Ural-Altaic language group, a group which includes such languages as Mongolian, Hungarian and Finnish.

As of 2000, the Republic of Korea had a population of 47.3 million inhabitants (Table 1).

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

TABLE 1. POPULATION INFORMATION

								Growth rate (%)
	1960	1970	1980	1990	1996	1999	2000	1980 to 2000
Population (millions)	25.0	31.9	38.1	42.9	45.5	46.9	47.3	1.09
Population density (inhabitants/km²)	252	322	385	433	461.3	474.6	478.8	1.09
Urban population as percent of total	28	41	57	74	78.9	81.2	81.9	1.83
Area (1000 km²)	9.260							

Source: IAEA Energy and Economic Database; National Statistical Office in Korea; Data & Statistics/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 1980 to 2000 Korea’s Gross Domestic Product (GDP) growth rate has averaged nearly 10.4% per year and in 2000 GDP reached 457.2 billion US$.

However, by the onset of 1998, Korea had successfully starved 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, the government immediately tackled the situation and overcame the crisis far more quickly than expected. The GDP growth rate leapt a remarkable 10.9 percent in 1999 from the minus 6.7 percent a year earlier. In 2000, the GDP growth

boomed another 8.8 percent, despite slowing considerably in the fourth quarter. Despite fears that such expansion would stoke inflation, it posted just 0.8 and 2.3 percent increases, respectively, through 1999 and 2000.

While the immediate task of subduing the crisis is completed, the administration's economic policy mandate is to transform the fundamentals of the Korean economy so that an open, transparent, and full-fledged market mechanism can operate to global standards. Ambitious reform plans have been launched to restructure all segments of the Korean economy. In many areas, the effort has surpassed expectations. Table 2 shows the historical GDP & GNI statistics and Table 3 the GDP Per Sector for 1999.

TABLE 2. GROSS DOMESTIC PRODUCT (GDP) & GROSS NATIONAL INCOME (GNI)

							Growth rate (%)
	1970	1980	1990	1996	1999	2000	1980 to 2000
GDP [1]	8.9	62.3	252.5	520.2	406.0	457.2	10.4
GNI [1]	64.3	133.7	318.2	517.6	400.7	455.2	-
GNI [2] per capita	280	1,647	5,886	11,380	8,551	9,628	8.8
GDP by sector (%):							
- Agriculture	27	14.8	8.5	6	5.1	4.6	
- Industry	29	39.9	43.1	43	42.5	42.7	
- Services	44	45.3	48.4	51	52.4	52.7	

[1] Billions of current US$

[2] Current US$

Source: IAEA Energy and Economic Database; National Statistical Office in Korea; Data & Statistics/The World Bank.

TABLE 3. GROSS DOMESTIC PRODUCT (GDP) PER SECTOR IN 1999 AT 1995 CONSTANT PRICES

billion Won

Sector	GDP
Agriculture	24,666.1
Mining and Quarrying	1407.7
Manufacturing	142,185.2
Construction	37,890.4
Electricity	10,769.9
Wholesale & Retail Trade, Restaurants, Hotel	52,951.7
Finance & Insurance, Estate and Business Service	80,075.1
Transport, Storage and Communication	35,866.3
Services	76,236.4
Others	45,777.2
Total	483,777.8

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 progress in Climate Change Convention negotiations. The impact of the two oil crises in 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.

Table 4 shows the Korean energy reserves and Tables 5 and 6 the primary and final energy consumption, respectively 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 one of its major energy sources in the future. Under the government's Power Development Programme, nuclear power is to become the major energy source by 2015 with the construction of 12 nuclear power plants, supplying about forty percent of the nation's total electrical power.

TABLE 4. ESTIMATED ENERGY RESERVES

Exajoule

	Solid	Liquid	Gas	Uranium [1]	Hydro [2]	Total
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 - 1998) by a factor of 10.
Source: IAEA Energy and Economic Data Base.

TABLE 5. PRIMARY ENERGY CONSUMPTION

1000 toe

	1970	1975	1980	1985	1990	1995	1999
Coal	5,829	8,075	13,199	22,022	24,385	28,092	38,155
Petroleum	9,293	15,637	26,830	27,142	50,175	93,955	97,270
LNG	N/A	N/A	N/A	N/A	3,023	9,213	16,847
Hydro	305	421	496	915	1,590	1,369	1,517
Nuclear	0	0	869	4,186	13,222	16,697	25,766
Others	4,251	3,420	2,517	2,031	797	1,051	1,806
Total	19,678	27,553	43,911	56,296	93,192	150,437	181,363
- Domestic production	10,333	11,397	12,491	17,579	25,520	21,593	30,800
- Imports	9,345	16,156	31,420	38,717	68,673	128,844	150,563
Per capita (toe)	0.61	0.78	1.15	1.38	2.17	3.34	3.87

Source: Country Information.

TABLE 6. FINAL ENERGY CONSUMPTION

1000 toe

	1970	1975	1980	1985	1990	1995	1999
Total	17,882	23,424	37,597	46,998	75,107	121,962	143,060
- Coal	5,593	7,566	12,426	17,940	19,855	17,758	18,498
- Petroleum	7,373	11,004	19,824	22,580	45,252	82,876	92,821
- Town gas	-	4	15	84	1,011	5,594	10,513
- Electricity	666	1,430	2,815	4,363	8,117	14,041	18,422
- Others	4,250	3,420	2,517	2,031	872	1,692	2,806
Growth rate (%)	12.3	3.1	1.7	4.4	14	8.7	8.3
Per capita (toe)	0.55	0.66	0.99	1.15	1.75	2.70	

Source: 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 Planning and Budget (MPB) and 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.

In July 1998, in order to enhance economic efficiency, to improve the quality of public services, and to reduce the extent and level of the government's direct involvement in economic activities, the Korean government announced a privatization plan for state-owned enterprises (SOEs) including the KEPCO, HANJUNG (Korea Heavy Industries and Construction Co.), and KEPCO's subsidiaries (KOPEC, KPS, etc.).

Following the plan, the government announced the "Basic Plan for Restructuring of the Electricity Supply Industry" to introduce competition into the electricity supply industry in January 1999, as a precondition to the privatization, and sold a 5% stake of KEPCO to overseas investors in March 1999. According the restructuring plan, KEPCO's power generation sector has been split-up in April 2001, into six generation companies (GENCOs), i.e. five non-nuclear GENCOs which will be privatized step-by-step, and one hydro-nuclear GENCO, which is called KHNP, Korea Hydro & Nuclear Power Co., Ltd and will remain as a subsidiary of KEPCO in consideration of the importance of nuclear safety.

In the long-run, as the restructuring plan shows, KEPCO will undergo a split-up of the power distribution sector into several power distribution companies thereby introducing competition in the wholesale and retail sectors, and opening-up of the transmission network to guarantee open access for private enterprises, thereby creating a fair competitive environment. Figure 1 shows the electricity restructuring plan.

While most of South Korea's generating capacity is controlled by the subsidiaries of KEPCO, a few independent power producers (IPPs) exist. LG Power, owned by the LG Group, operates a 540-megawatt (MW) independent power plant at Bugok near Asan Bay. The facility began operation in April 2001. LG Power purchased the existing Anyang and Puchon plants in June 2000, with a combined capacity of 950 MW, from KEPCO after a competitive tender. Tractebel is also investing in a new 519-MW IPP plant in Yulchon in partnership with Hyundai. In another significant development, South Korea's original IPP, Hanwha Energy was spun off from the Hanwha Group in June 2000, in a deal in which El Paso Energy acquired a 50% stake. Hanwha Energy operates a 1,800-MW plant at Inchon.

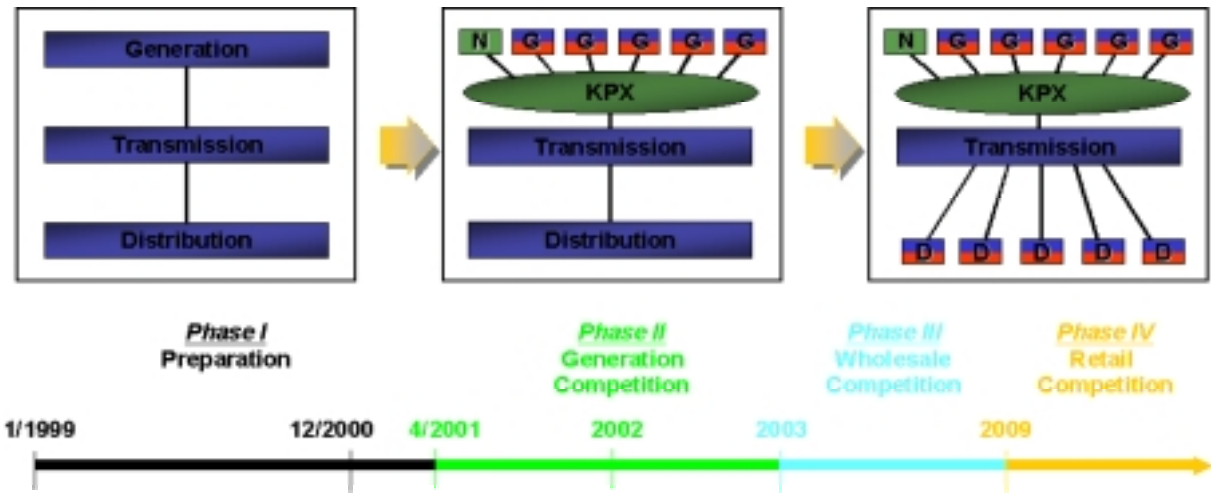

FIG. 1. Electricity Industry Restructuring Plan

2.2. Main Indicators

The total installed capacity in 2000 was 48,451 MW(e), which accounts for an additional 27,340 MW(e) per year since 1991. The share of oil-fired power plants rapidly decreased from 65.5% in 1970 to 10.0% in 2000. Instead, nuclear energy became one of the largest electric power sources in Korea, with a 28.3% share. The LNG, as a peak source, increased to 26.2%. This fuel mix shows a remarkable improvement in fuel diversity compared with the heavy reliance on oil that prevailed until the early 1980s. Figure 2 shows the Long Term Power Development Plan.

The total power generation in 2000 increased from 184,661 GW·h in 1995 to 266,400 GW·h. This breaks down to 108,964 GW·h (40.9%) from nuclear power plants, 97,538 GW·h (36.6%) from coal-fired power plants, 26,142 GW·h (9.8%) from oil-fired power plants, 28,146 GW·h (10.6%) from LNG combined power plants, and 5,610 GW·h (2.1%) from hydro power plants. The latter are also shown in Figure 3. Table 7 gives the historical electricity production and installed capacities. The energy and electricity related ratios are given in Table 8.

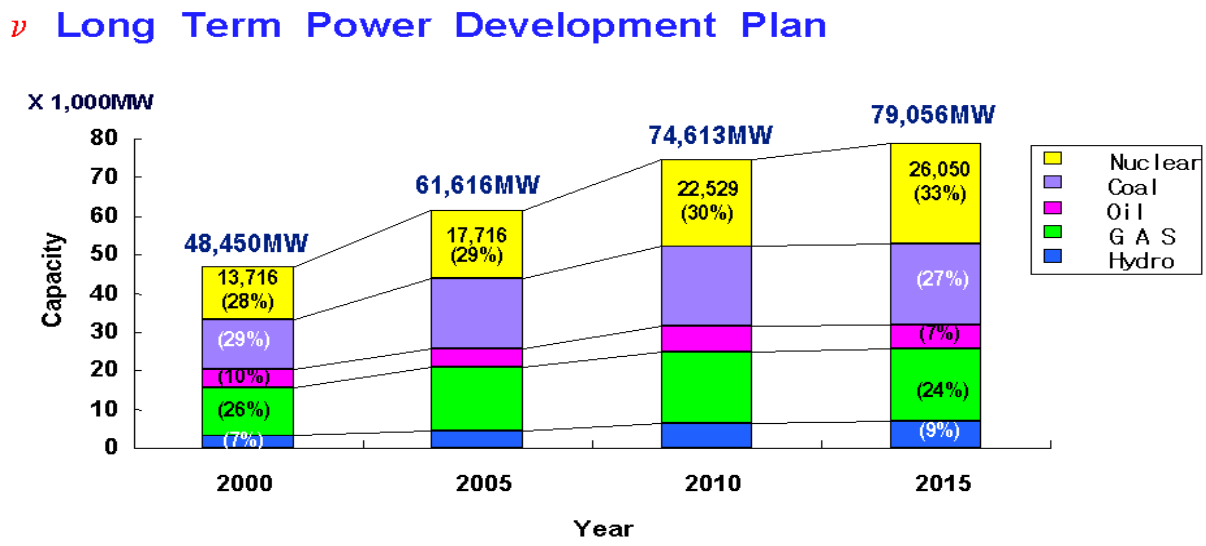

FIG. 2. Long Term Power Development Plan

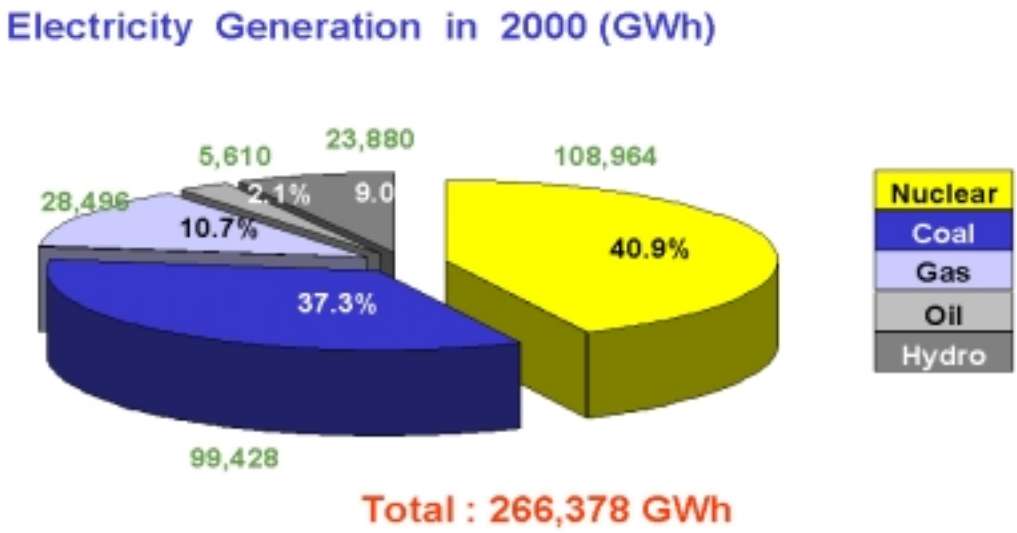

FIG. 3. Electricity Generation

TABLE 7. ELECTRICITY PRODUCTION AND INSTALLED CAPACITY

							Avg. annual growth rate(%)	
	1961	1970	1980	1990	1995	2000	1961 to 1980	1980 to 2000
Electricity Production (TW·h)								
- Total	1.77	9.17	37.24	107.67	184.66	266.40	16.45	10.34
- Thermal	1.12	7.95	31.78	48.42	112.15	151.83	18.21	8.13
- Hydro	0.65	1.22	1.98	6.36	5.48	5.61	5.73	5.35
- Nuclear	-	-	3.48	52.89	67.03	108.96	-	18.79
Capacity of Electricity Plants (GWe)								
- Total	0.37	2.51	9.39	21.02	32.18	48.45	17.55	8.55
- Thermal	0.224	2.18	7.65	11.07	20.48	31.59	19.31	7.35
- Hydro	0.143	0.33	1.16	2.34	3.09	3.15	11.03	5.12
- Nuclear	-	-	0.59	7.62	8.62	13.72	-	17.04

Source: Country Information.

TABLE 8. ENERGY RELATED RATIOS

	1970	1980	1990	1995	2000
Energy consumption per capita (Toe/capita·yr)	0.61	1.15	2.17	3.35	4.08
Electricity per capita (kWh/capita·yr)	288	859	2,202	3,640	5,055
Electricity production/Energy production (%)	19	71	120	244	
Nuclear/Total electricity (%)	-	9.3	45.0	36.3	40.9
Ratio of external dependency (%) [(1)]	47.5	73.5	87.9	96.8	97.3
Capacity factor of power plants					
- Total (%)	43	45	58	66	62
- Thermal	58	56	54	75	75
- Hydro	42.3	20	30	23	17
- Nuclear	-	67	79	87	90.4

[(1)] Net import / Total energy consumption

Source: IAEA Energy and Economic Database; Source: Country Information.

3. NUCLEAR ENERGY PROGRAMME

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 preceding year.

The Republic of Korea 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. Currently, Korea has one of the most dynamic nuclear power programmes in the world.

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 Ulchin, which entered commercial operation in 1998, so called Korea Standard Nuclear Power Plant(KSNP). The Ulchin units 3 and 4 are considered as the reference reactor for future construction. Four more of these domestic PWRs are being built at Yonggwang and Ulchin.

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 in Korea. In spite of the slowdown of the nuclear energy industry in the U.S. and Europe, the Korean government is steadily promoting the nuclear power generation business in response to Korea's increasing electricity demand, seeking new sites for nuclear power plants and supporting the development of commercial technology.

As of March 2001, a total of 16 nuclear power units are in operation, and twelve units are under construction as shown in Table 9. Korea has about 13 GW of nuclear power capacity, which accounts for 28.0% of its total electric power capacity. The volume of nuclear power generation in 2000 was around 109 TW·h, accounting for 41% of total power generation. Korea also has a high availability ratio of its nuclear units, which was 90.2% in 1998, 88.2% in 1999 and 90.4% in 2000, as shown in Table 10.

TABLE 10. THE AVERAGE CAPACITY FACTOR OF THE KOREAN NUCLEAR POWER PLANTS

	1980	1985	1990	1995	1996	1997	1998	1999	2000
Capacity Factor	67.4	78.7	79.3	87.3	87.5	87.6	90.2	88.2	90.4

Source : Country Information

According to the "Fifth Long-term Plan for Electric Power Demand and Supply", which was finalized by MOCIE in January 2000, 12 new nuclear power units will be constructed by 2015, including the eight units that are currently under construction or decided to be constructed. The share of nuclear power capacity and nuclear power generation will be increased to 33% and 44.5%, respectively by 2015 as shown in Figure 2.

To enhance the safety and to cut the costs of nuclear power plants, Korea has developed an advanced power reactor with a capacity of 1,400MWe, called APR1400, on the basis of technological self-reliance of the 1,000MWe Korea Standard Nuclear Power Plant (KSNP) in 1995.

TABLE 9. STATUS OF NUCLEAR POWER PLANTS

Station	Type	Net El. Capacity	Description	Operator	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
KORI-1	PWR	556	Operational	KEPCO.	WEST	01-Aug-72	19-Jun-77	26-Jun-77	29-Apr-78	
KORI-2	PWR	605	Operational	KEPCO.	WEST	23-Dec-77	09-Apr-83	22-Apr-83	25-Jul-83	
KORI-3	PWR	895	Operational	KEPCO.	WEST	01-Oct-79	01-Jan-85	22-Jan-85	30-Sep-85	
KORI-4	PWR	895	Operational	KEPCO.	WEST	01-Apr-80	26-Oct-85	15-Nov-85	29-Apr-86	
ULCHIN-1	PWR	920	Operational	KEPCO.	FRAM	26-Jan-83	25-Feb-88	07-Apr-88	10-Sep-88	
ULCHIN-2	PWR	920	Operational	KEPCO.	FRAM	05-Jul-83	25-Feb-89	14-Apr-89	30-Sep-89	
ULCHIN-3	PWR	960	Operational	KEPCO.	KHIKAECE	21-Jul-93	21-Dec-97	06-Jan-98	11-Aug-98	
ULCHIN-4	PWR	960	Operational	KEPCO.	KHIKAECE	01-Nov-93	14-Dec-98	28-Dec-98	31-Dec-99	
WOLSONG-1	PHWR	629	Operational	KEPCO.	AECL	30-Oct-77	21-Nov-82	31-Dec-82	22-Apr-83	
WOLSONG-2	PHWR	650	Operational	KEPCO.	AECL/KHI	25-Sep-92	29-Jan-97	01-Apr-97	01-Jul-97	
WOLSONG-3	PHWR	650	Operational	KEPCO.	AECL/KHI	17-Mar-94	19-Feb-98	25-Mar-98	01-Jul-98	
WOLSONG-4	PHWR	650	Operational	KEPCO.	AECL/KHI	22-Jul-94	10-Apr-99	21-May-99	01-Oct-99	
YONGGWANG-1	PWR	900	Operational	KEPCO.	WEST	04-Jun-81	31-Jan-86	05-Mar-86	25-Aug-86	
YONGGWANG-2	PWR	900	Operational	KEPCO.	WEST	01-Dec-81	15-Oct-86	11-Nov-86	10-Jun-87	
YONGGWANG-3	PWR	950	Operational	KEPCO.	KHIKAECE	23-Dec-89	13-Oct-94	30-Oct-94	31-Mar-95	
YONGGWANG-4	PWR	950	Operational	KEPCO.	KHIKAECE	26-May-90	07-Jul-95	18-Jul-95	01-Jan-96	
ULCHIN-5	PWR	960	Under Construction	KEPCO.	DOOSAN [b]	01-Oct-99			30-Jun-03	
ULCHIN-6	PWR	960	Under Construction	KEPCO.	DOOSAN	01-Oct-99			30-Jun-04	
YONGGWANG-5	PWR	950	Under Construction	KEPCO.	DOOSAN	29-Jun-97			30-Apr-02	
YONGGWANG-6	PWR	950	Under Construction	KEPCO.	DOOSAN	20-Nov-97			31-Dec-02	
SHIN-KORI-1 [a]	PWR	950	Under Construction	KEPCO	DOOSAN				Sept-08	
SHIN-KORI-2 [a]	PWR	950	Under Construction	KEPCO	DOOSAN				Sept-09	
SHIN-KORI-3 [a]	APR	1330	Under Construction	KEPCO	DOOSAN				Sept-10	
SHIN-KORI-4 [a]	APR	1330	Under Construction	KEPCO	DOOSAN				Sept-11	
SHIN-WOLSONG-1 [a]	PWR	950	Under Construction	KEPCO	DOOSAN				Sept-09	
SHIN-WOLSONG-2 [a]	PWR	950	Under Construction	KEPCO	DOOSAN				Sept-10	

[a] Country information.

[b] Formerly HANJUNG.

Source: IAEA Power Reactor Information System as of 31 December 2000; Country information.

The APR1400 is an improved version of a light water reactor. It is expected to be ten times safer than the KSNP. In terms of economic benefits, it will normally be more competitive than existing units or coal power generation. Its basic design was already completed and now design optimization for standard design certificate from regulatory authority is in progress. The first unit of APR1400 is expected to be in service by 2010.

3.3. Current Nuclear Energy Policy

Of the 16 nuclear power plants in the country, nine units have been in operation for more than ten years as of the end of 2000. In compliance with the Article of the Convention on Nuclear Safety, the necessity of the Periodic Safety Review (PSR) was reviewed by the Nuclear Safety Commission for legislation in order to maintain the safety of nuclear power plants in operation at current safety standards and practices.

The Nuclear Safety Commission had decided to adopt the Periodic Safety Review as a safety evaluation process during the lifetime of operating nuclear power plants. The Commission requested that the regulatory body and operators to prepare a comprehensive plan necessary to implement the PSR, such as work scopes to be conducted by each institution, selection of an applicable power plant, legislative processes, and schedule of future performance, etc.

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.

In order to achieve the objectives of the long-term nuclear energy policy, the government established a legal basis to formulate the "Comprehensive Nuclear Energy Promotion Plan (CNEPP)" every five years through the amendment to the Atomic Energy Act in January 1995. The CNEPP includes long-term nuclear policy objectives and basic directions, sector-by-sector objectives, budget and investment plan etc.

The Atomic Energy Act stipulates that the Minister of Science and Technology and the heads of the concerned ministries shall formulate sector-by-sector implementation plans for those areas under their jurisdiction every five years in accordance with the CNEPP and shall establish and implement annual action plans according to the sector-by-sector implementation plans.

The first CNEPP was formulated in June 1997. As of June 2001, the Korean government has formulated the second CNEPP, which included a direction to nuclear energy policy towards the year of 2015. The CNEPP identified 10 promotion areas which are as follows:

- Nuclear Safety and Radiation Protection;
- Nuclear Electricity Generation and Reactor Development;
- Nuclear Fuel Cycle;
- Radioactive Waste Management;
- Utilization of Radiation and Radioisotopes;
- Fostering and Promotion of Nuclear Industry;

- Basic and Fundamental Nuclear Research and Development;
- Training of Nuclear Manpower;
- Enhancement of Public Understanding and Site Acquisition;
- Nuclear Diplomacy and International Cooperation.

4. NUCLEAR POWER INDUSTRY

4.1. Supply of Nuclear Power Plants

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*	KHNP
- *Architectural Engineering and NSSS Design*	KOPEC
- *Research & Development*	KAERI
- *Maintenance Services*	KPS
- *NSSS, Turbine and Generator Manufacturing*	DOOSAN (formerly HANJUNG)
- *Nuclear Fuel Design and Fabrication*	KNFC

DOOSAN 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.

The 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.

As of March 2001, HANJUNG was already privatized through share offering. Most of its share, held mainly by the Korea Development Bank (43.8%) and KEPCO (40.5%), was sold to the public (24%) in September 2000, and to the Doosan Consortium (36%) through competitive bidding in December 2000. Recently, HANJUNG has changed its name to the "Doosan Heavy Industries and Construction".

Regarding KOPEC and KPS which are KEPCO subsidiaries, in February 2001, their ordinary shares owned by KEPCO were put to a competitive public tender for sale to Korean or foreign legal entities, and their sale contracts are scheduled to be concluded in the latter half of 2001.

4.2. Operation of Nuclear Power Plants

KEPCO has been the sole electricity generator in Korea. As mentioned in Section 2.1, KEPCO’s generation sector has been split early 2001 into five non-nuclear GENCOs and one hydro-nuclear GENCO: KHNP. KHNP is the sole entity in Korea responsible for long-term planning, development and generation of nuclear and hydropower. 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

Korea's demand for Uranium and nuclear fuel cycle service has continuously increased with the expansion of its nuclear power capacity. The demand is expected to account for more than 5% of the world's demand from the year 2000. Korea imports Uranium concentrates from Australia, Canada, the U.K, France, Russia, the U.S. and South Africa. In 1999, Korea imported a total of 4.5 million pounds of Uranium.

KHNP, the sole consumer of nuclear fuel in Korea, has a basic guideline to ensure the nuclear fuel supply and to pursues the economic efficiency at the same time by applying an international open bid. For Uranium concentrates, KHNP has tried to maintain the optimal contract condition through both long-term contracts and spot-market purchase. Whereas conversion and enrichment services come from the U.S., the U.K., France, Canada, and Russia by long-term contracts. Fuel fabrication services are fully localized to meet domestic needs.

The Nuclear Environment Technology Institute (NETEC) of KHNP 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.

A new radioactive management plan was proposed by MOCIE and approved by the Atomic Energy Commission in September 1998. According to the plan, a low-and-intermediate-level radioactive waste (LILW) repository will be constructed by 2008 and spent fuels will be stored at each nuclear power plant site until interim storage facilities are constructed in 2016.

In order to secure the repository site of 2 million m^3, open selection, soliciting rural autonomy, having direct access to the sea, for the proposal of sites, has started in June 2000, and was extended to the end of June 2001 with no proposal from local autonomy as of March 2001.

4.4. Research and Development Activities

The Atomic Energy Act stipulates that the Minister of Science and Technology shall formulate the National Nuclear R&D Programme according to the sector-by-sector implementation plan.

The Nuclear R&D Programme, otherwise called the "National Medium-and-Long-term Nuclear R&D Programme", is implemented mainly by KAERI, KCCH and KINS. Besides, an industry-led R&D Programme is implemented by KHNP, KOPEC, KPS and KNFC etc.

Originally, the "National Medium-and-Long-term Nuclear R&D Programme" was launched in June 1992 as a 10-year (1992-2001) programme. It was modified into a new R&D programme to be implemented for 1997-2006 term, to take account of major changes in national and international situations. There are 28 major projects that are being carried out currently and are funded by both the government and the Nuclear R&D Endowment fund.

The R&D Programme covers six fields as follows; ❶ nuclear reactor & nuclear fuel, ❷ nuclear safety, ❸radioactive waste management, ❹ radiation/ radioisotopes application & radiation protection, ❺ current issues related to the NPP, and ❻ basic nuclear technology.

With respect to nuclear reactor R&D, a conceptual design of a fast-breeder reactor, the 330 MW(e) Kalimer plant is under development to be ready by 2002 and a basic design by 2006.

Construction is foreseen soon after 2010. An ADS HYPER concept development roadmap will be finished in 2001 and the conceptual design will be completed by 2007.

5. REGULATORY FRAMEWORK

5.1. Safety Authority and the Licensing Procedures

5.1.1. Safety Authority

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.

Nuclear regulatory organizations are mainly composed of MOST as a regulatory authority, the Nuclear Safety Commission (NSC), and Korea Institute of Nuclear Safety (KINS) as an technical expert body. The NSC's function is to deliberate and decide on important issues related to nuclear safety. The NSC is independent of the Atomic Energy Commission.

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. The basic concept of nuclear safety is not only to protect the public health and safety from radiation hazards, but also to protect the environment from any subsequent harmful effects.

In September 1994, the MOST issued the "Nuclear Safety Policy Statement" containing five regulatory principles of nuclear safety: "Independence, Openness, Clarity, Efficiency, and Reliability" in order to secure consistency, adequacy, and rationality of regulatory activities. The Nuclear Safety Policy Statement declares that securing safety is a prerequisite to the development and utilization of nuclear energy, and that all workers engaged in nuclear activities must adhere to the principle of "priority to safety". It emphasizes the importance of developing the nuclear safety culture that the International Atomic Energy Agency (IAEA) has referred to.

It also prescribes that the ultimate responsibility for nuclear safety rests with the operating organizations of nuclear installations, and is in no way diluted by the separate activities and responsibilities of designers, suppliers, constructors, or regulators. Finally, it prescribes that the government shall fulfil its overall responsibility to protect the public and the environment from radiation hazards that might accompany the development and utilization of nuclear energy.

5.1.2. Licensing Procedures

Regulation and licensing procedures for nuclear power plants in Korea 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.

Regulatory inspections of NPPs under construction or in operation are implemented according

to the procedure of a pre-operational inspection of the nuclear installation, a periodic inspection of the operating nuclear installations, a quality assurance audit, a daily inspection by resident inspectors, and a special inspection.

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.

5.1.3. Radiation Protection Policy

The Atomic Energy Act prescribes the basic matters on radiation protection to be applied to nuclear installations, as follows:

- provisions on protective measures against radiation hazards that keep the radioactive material release and the occupational radiation exposure as low as reasonably achievable (ALARA),
- provisions on safety measures relating to operations stipulating the necessary actions to be taken for protecting human life, materials, and the environment from radiation hazards which may accompany the operation of nuclear installations,
- performance criteria for the personnel dosimetry service for radiation workers or persons having access to nuclear installations, and
- training requirements for the workforce involving radiation exposure.

The Enforcement Decree and Regulation of the Atomic Energy Act specifies the details necessary for implementing the basic matters referred to in the Act. The Notice of the Minister of Science and Technology (titled "Radiation Protection Standards") prescribes technical requirements on radiation protection such as the conditions of radioactive effluent release and dose limits.

The safety regulatory activities for radiation protection are classified into safety reviews, regulatory inspections, and the development of technical standards. In the safety review, items are examined concerning ALARA assurance of radiation exposure to workers, source term assessment, characteristics of radiation protection design, dose assessment, health physics programme, and the appropriateness of equipment.

The regulatory inspection confirms whether or not the radiation monitoring system in nuclear installations is properly operated. It also confirms that any personal exposure to radiation is maintained as low as reasonably achievable (ALARA) by checking the health physics programme, the procedures for the radiation exposure control, the ALARA programme, and radiation work management.

Korea is now developing the Information System on Integrated Radiation Safety (ISIRS). This system can easily trace and monitor all processes related to the use of radioactive sources from production and importation to final disposal through the Internet. ISIRS can provide a more accurate and extensive information on radiation safety on a real time basis to the general public and to all other related organizations.

As of December 1999, the number of licensed organizations for radiation utilization in Korea is 1,571, which consists of industrial firms 49.4%, educational and research institutes 24.3%, hospitals 7.6%, N.D.T. companies 2.3%, and sales companies 1.8%.

5.1.4. National Environmental Radiation Monitoring Network

KINS, entrusted by MOST, installs and operates the nation-wide environment radiation monitoring network in addition to the above safety regulatory activities. KINS measures the

radioactivity in airborne dust, fallout, rainwater, livestock products, farm products, soil, drinking water, and background radiation levels throughout the nation. This enables KINS to quickly detect and properly respond to any abnormal situations or symptoms in environmental radioactivity.

The nationwide environmental radiation monitoring network, as shown in Figure 4, consists of an environmental radiation monitoring center in KINS, local monitoring stations situated at ten cities of large population, monitoring posts located in Ulnongdo and Baekryongdo, monitoring posts around four nuclear installation sites, and a monitoring network connected with a military monitoring post.

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.

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.

There are two major legislative instruments regarding civil nuclear third party liability, namely the "Act on Compensation for Nuclear Damage" (so-called Compensation Act) and the "Act on Indemnification Agreements for Nuclear Liability" (so-called Indemnity Agreement Act).

Reflecting developments in related international conventions, the Compensation Act was amended in December 2000 and will enter into force on January 1, 2002. Highlights of amendment are as follows:

- Expansion of applicable scope not only to nuclear incidents in the territory but also in the EEZ (Exclusive Economic Zone);
- Increase of compulsory insurance amount to 300 million SDRs;
- Extension and clarification of the definition for "nuclear damage" according to the 1997 Protocol to Amend the Vienna Convention;
- Exclusion of a grave natural disaster from exonerations;
- Extension of prescription period for personal injury to 30 years.

According to the amended Compensation Act, the Indemnity Agreement Act will be revised in the year 2001.

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.

In 1999, the Atomic Energy Act was amended to reflect the reorganization of the government, deregulation, and the rearrangement of the legal system. The relevant lower level enactment was completed in the first half of 2000. Subsequently, the Atomic Energy Act was amended again in 2000 to take into account the strengthening of nuclear safety as follows:

- Increase of NSC members to guarantee more participation of specialists in the policy and decision-making process;
- Introduction of the Periodic Safety Review (PSR) to ensure that the safety of operating NPPs is maintained at current safety standards and practices;
- Introduction of the Standard Design Certificate to streamline the licensing process for the

construction of NPPs with same design.

- Introduction of the ICRP Pub. 60 on a step-by-step basis with full implementation starting in January 2003.

5.3. International, Multilateral and Bilateral Agreements

Since Korea became an IAEA member in 1957, Korea have been assisted in training nuclear manpower through IAEA's technical cooperation projects. The experience and technological independency that Korea has acquired so far can certainly enable to help other members' manpower training. Following the signing of the Memorandum of Understanding (MOU) with IAEA in 1998, Korea has expanded its nuclear education and training programmes for developing countries, and is also planning to strengthen the activities and programmes of international training and education center.

In addition, Korea has proposed in 2000 to host the regional office of the RCA (Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology in Asia and Pacific Region) to strengthen technical cooperation and to facilitate technology transfer among Member States.

Korea has been actively participating in joint research projects of OECD/NEA (Nuclear Energy Agency) such as Halden Reactor Project, RASPLAV Projects, ISOE (International System on Occupational Exposure) Project, and International Co-operative Decommission Programme, since joining the NEA in 1993.

Korea also joined international conventions under IAEA Auspices, such as the Convention on Early Notification of a Nuclear Accident in 1996, the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency in 1990, the Convention on Physical Protection of Nuclear Material, and the Convention on Nuclear Safety as well as the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter in 1994. Korea is now in process to ratify the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

As of March 2001, the Korean government has concluded 16 bilateral agreements on cooperation in the peaceful uses of nuclear energy with the governments of the USA, Canada, Spain, Australia, Belgium, France, Germany, Japan (arrangement), the UK, China, Argentina, Vietnam, Turkey, Russia, Brazil, and Czech Republic.

Korea regularly holds bilateral talks with the USA, Canada, Australia, the UK, France, Japan, Russia and China. In 2000, Korea held joint meetings with USA, Japan, Canada, Australia, China, and Russia. Korea is planning to hold bilateral meetings with the USA, France, the UK, Canada, Russia, China and Australia in 2001.

Korea also engages in talks on bilateral agreements with developing countries, which have programmes for the peaceful uses of nuclear energy. Through the conclusion of such an agreement, technology transfer and the safety of nuclear installations can be facilitated.

AGREEMENTS WITH THE IAEA

• Amendments to Articles VI and XIV of the Agency Statute	Not Ratified	
• Agreement on privileges and immunities	Entry into force:	17 January 1962
• NPT related agreement INFCIRC/236	Entry into force:	14 November 1975

• Additional protocol	Signature:	21 June 1999
• Supplementary agreement on provision of technical assistance by the IAEA	Entry into force:	21 January 1980

OTHER MULTILATERAL SAFEGUARDS AGREEMENTS

• Korea/USA INFCIRC/111	Entry into force:	5 January 1968
• Korea/France INFCIRC/233	Entry into force:	22 September 1975
• RCA	Entry into force:	4 December 1992

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
• Vienna convention on civil liability for nuclear damage	Not signed	
• Joint protocol relating to the application of Vienna and Paris conventions	Not signed	
• 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

OTHER UNDERTAKINGS

• Improved procedures for designation of safeguards inspectors	Not yet accepted	
• ZANGGER Committee	Member	

- Nuclear Suppliers Group — Member
- 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, on Technical Co-operation between Korea and France; in effect since 1974.
- 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)
Government Complex-Gwacheon City
Gyeonggi-do 427-760, Republic of Korea
Tel: +82-2-503-7646
Fax: +82-2-503-7673

Ministry of Science and Technology (MOST)
Government Complex-Gwacheon City
Gyeonggi-do 427-760, Republic of Korea
Tel: +82-2-503-7600
Fax: +82-2-504-7636
http://www.most.go.kr

Ministry of Commerce, Industry & Energy (MOCIE)
Government Complex-Gwacheon City
Chungang-dong, Gyeonggi-do 427-760
Republic of Korea
Tel: +82-2-503-7171
Fax: +82-2-503-9603
http://www.mocie.go.kr

NUCLEAR INDUSTRY

Korea Atomic Energy Research Institute (KAERI)
150, Dukjin-dong
Yusong-gu
Daejon 305-353, Republic of Korea
Tel: +82-42-868-2000
Fax: +82-42-868-9161
http://www.kaeri.re.kr

Korea Institute of Nuclear Safety (KINS)
19, Kusong-dong
Yusong-gu
Daejon 305-338, Republic of Korea
Tel: +82-42-868-0014
Fax: +82-42-861-1700
http://www.kins.re.kr

Korea Cancer Center Hospital(KCCH)
215-4, Gongneung-dong
Nowon-gu
Seoul 139-706, Republic of Korea
Tel: +82-2-974-2501
Fax: +82-2-978-2005
http://www.kcch.re.kr

Korea Electric Power Corporation (KEPCO)
167, Samseong-dong
Gangnam-gu
Seoul 135-791, Republic of Korea
Tel: +82-2-3456-3511
Fax: +82-2-3456-3599
http://www.kepco.co.kr

Korea Hydro & Nuclear Power Co., LTD (KHNP)
167, Samseong-dong
Gangnam-gu
Seoul, Republic of Korea
135-791
Tel: +82-2-3456-2212
Fax: +82-2-3456-2219
http://www.khnp.co.kr

Doosan Heavy Industries and Construction Co.
555, Guygok-dong
Changwon
Kyungnam 641-792, Republic of Korea
Tel: +82-55-278-6114
Fax: +82-55-264-5551
http://www.doosanheavy.co.kr

Korea Power Engineering Co., Inc. (KOPEC)
360-9, Mabuk-ri, Guseong-eup,
Yongin-si
Geonggi-do 449-910, Republic of Korea
Tel: +82-31-289-3114
Fax: +82-31-283-6215
http://www.kopec.co.kr

Korea Nuclear Fuel Co., Ltd. (KNFC)
493, Deokjin-dong
Yuseong-gu
Daejon 305-353, Republic 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, Bundang-gu Geumgok-dong
Seongnam-si
Geonggi-do 463-480, Republic of Korea

Tel: +82-31-710-4114
Fax: +82-31-710-4115
http://www.kps.co.kr

ENERGY RESEARCH INSTITUTES

Korea Basic Science Institute — http://comp.kbsi.re.kr/

Korean Superconducting Tokamak Advanced Research (KSTAR) — http://www.knfp.net/

Korea Institute of Energy Research (KIER) — http://www.kier.re.kr/indexe.htm

Korea Advanced Institute of Science and Technology (KAIST) — http://www.kaist.ac.kr/

Pohang University of Science and Technology — http://www.postech.ac.kr/e/

Pohang Accelerator Laboratory (PAL) — http://pal.postech.ac.kr/docs/english/index.htm

OTHER ORGANIZATIONS

Korean Nuclear Society — http://www.nuclear.or.kr/

Korea Nuclear Information System (KORNIS) — http://kornis.kaeri.re.kr

Organization for Korea Atomic Energy Awareness (OKAEA) — http://okaea.or.kr/english/index.php

Korea Atomic Industrial Forum — http://www.kaif.or.kr/