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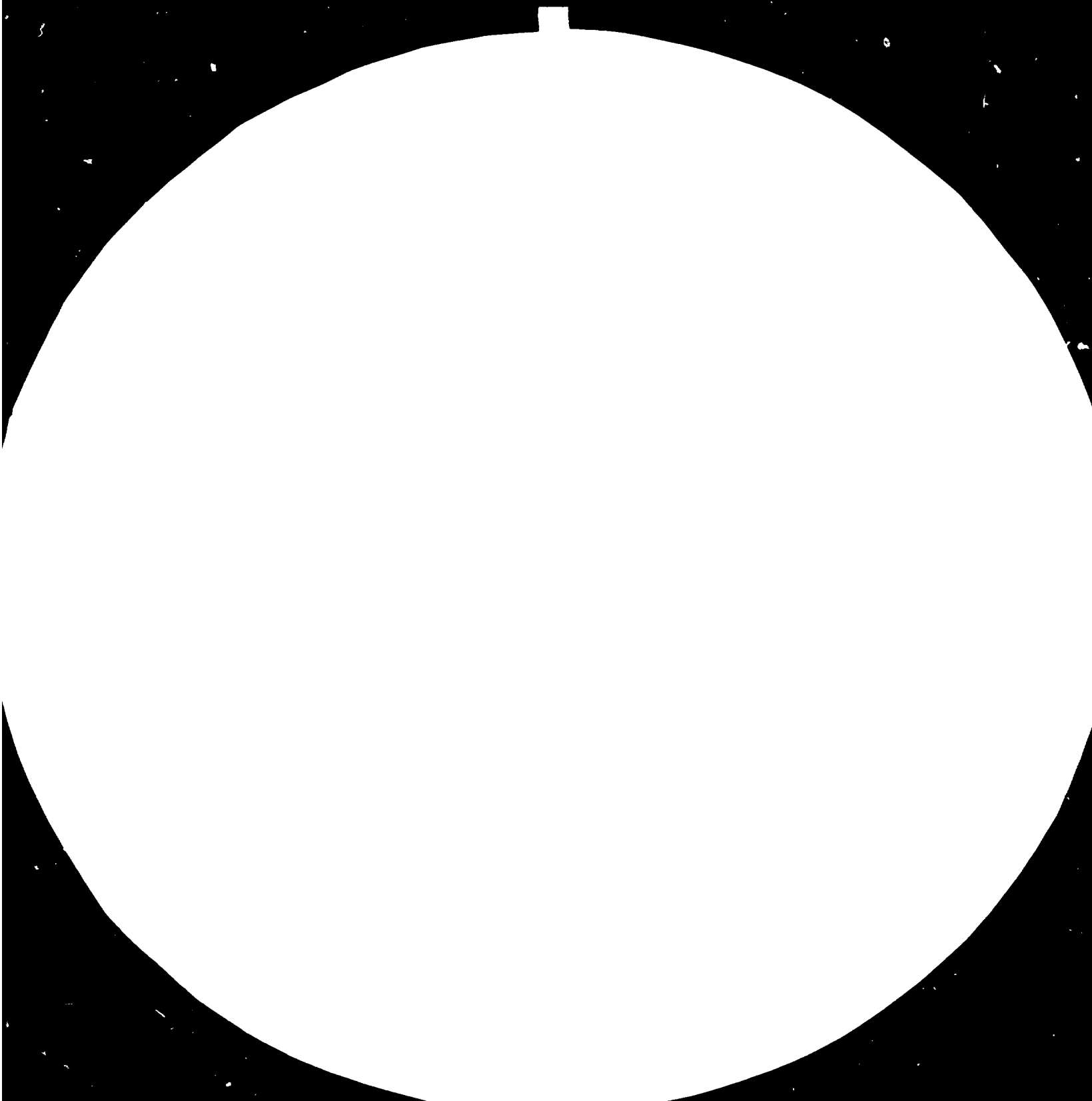

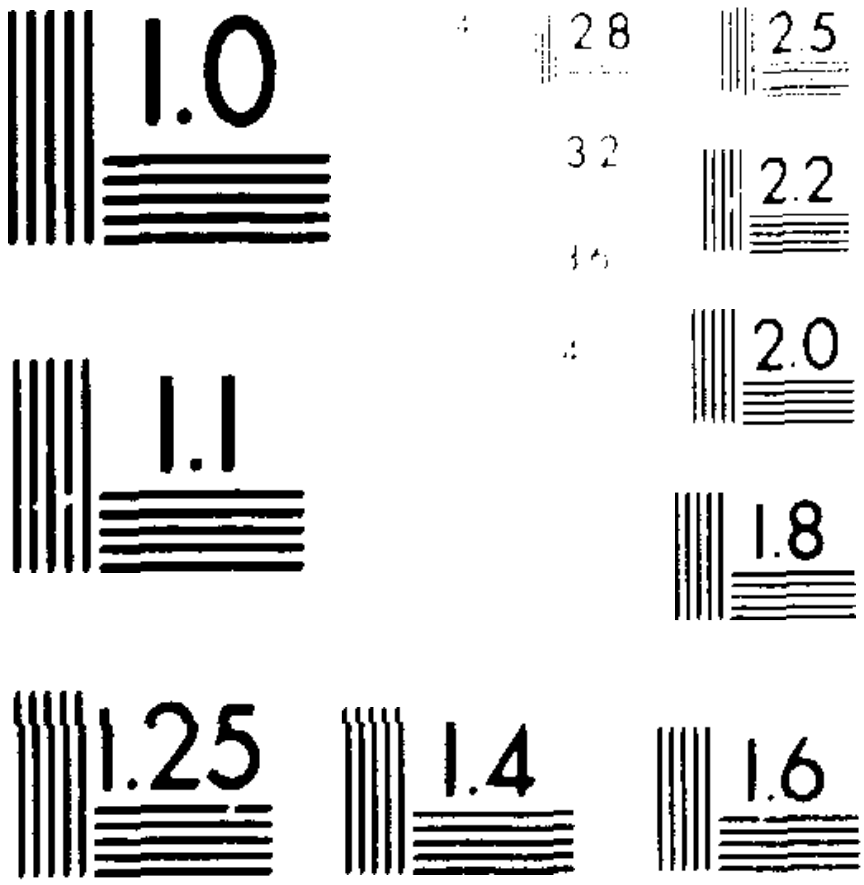

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Case Study on the Capital Goods Industry in the Republic of Korea

Han Kwee Lim

1984. 3.

from: V. Pekarek
D-2611

1. Selection of equipment

Division 71 : Power generating machinery and equipment (excluding nuclear reactors)

- 711 : Boilers, other boiler house equipment, steam turbines
- 714 : Gas turbines
- 716 : Electric motors and generators
- 718 : Other power generating machinery (including water turbines)

Division 77 : Electrical machinery, apparatus and appliances

- 771 : Electrical power machinery (transformers, static converters, inductors, etc.)
- 772 : Switchgear
- 773 : Equipment for distributing electricity (excluding low voltage domestic installations and apparatus)

2. General and Statistical Information

a) DOMESTIC PRODUCTION OF PRIMARY ENERGY (in Terajo

Energy source / Year	Coal		Other solid energy		Crude Petroleum		Natural ga	
	TJ	%	TJ	%	TJ	%	TJ	%
1972	363,502	67.5	170,027	31.6	-	-	-	
1973	397,733	71.2	156,476	28.0	-		-	
1974	447,322	74.0	150,212	24.9	-		-	
1975	515,609	77.3	145,737	21.8	-		-	
1976	481,436	77.3	135,297	21.7	-		-	
1977	506,084	78.6	132,826	20.6	-		-	
1978	529 119	78.6	129,459	19.2	-		-	
1979	533,633	79.2	120,681	17.9	-		-	
1980	545,825	81.1	107,258	15.9	-		-	
1981	582,195	82.2	106,192	15.0	-		-	
1982	589,551	82.6	102,996	14.4	-	-	-	
1983								

(c f. para. 2.a)

...oules)

...s	Electricity						Total	
	hydro		nuclear		geothermal			
	TJ	%	TJ	%	TJ	%	TJ	%
-	4931	0.9	-	-	-	-	538,469	100
	4630	0.8	-	-	-		558,839	100
	6870	1	-	-	-		604,404	100
	6066	0.9	-	-	-		667,412	100
	6448	1	-	-	-		623,181	100
	5021	0.8	256	0	-		644,187	100
	6516	1	8378	1.3	-		673,472	100
	8394	1.2	11362	1.7	-		674,070	100
	7152	1.0	12534	1.9	-		672,769	100
	9764	1.3	10433	1.5	-		708,584	100
-	7229	1.1	13615	1.9	-	-	713,391	100
								100

Annex III

b) 1. ELECTRIC ENERGY GENERATION AND CONSUMPTION (PAST AND PRESENT DATA)

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
INSTALLED CAPACITY (MW)												
Public and self-producer total	3,872	4,272	4,523	4,720	4,810	5,790	6,916	8,033	9,391	9,835	10,304	12,115
Hydro	341	621	621	621	711	711	711	912	1,157	1,202	1,202	1,202
Conventional thermal	3,531	3,651	3,902	4,099	4,099	5,079	5,617	6,[illegible]4	7,647	8,047	7,837	9,998
Nuclear	-	-	-	-	-	-	587	587	587	587	1,266	1,916
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	925	525	525	525	615	615	615	615	660	705	705	705
Hydro	-	200	200	200	290	290	290	290	335	380	380	380
Conventional thermal	925	325	325	325	325	325	325	325	325	325	325	325
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
GENERATION (GWh)												
Public and self-producer total (Gross)	11,839	14,826	16,835	19,837	23,117	26,587	31,510	35,600	37,238	40,207	43,122	46,850
Hydro	1,368	1,284	1,906	1,683	1,789	1,393	1,808	2,329	1,984	1,709	2,085	2,561
Conventional thermal	10,471	13,542	14,929	18,154	21,328	25,123	27,378	30,119	31,777	34,601	37,340	36,575
Nuclear	-	-	-	-	-	71	2,324	3,152	3,477	2,897	3,777	7,714
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Public total	1,953	2,450	2,406	2,530	2,510	2,736	2,632	2,7[illegible]	2,119	2,779	2,543	2,287
Hydro	-	62	412	345	449	443	527	6[illegible]1	517	1,007	625	704
Conventional thermal	1,953	2,388	1,994	2,185	2,061	2,293	2,005	2,036	1,602	1,771	1,918	1,583
Nuclear	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-
Net production	11,208	13,956	15,912	18,752	21,919	25,172	29,844	33,669	35,083	37,950	40,555	43,576
Transmission and distribution losses	1,215	1,589	1,864	2,121	2,299	2,338	2,517	2,524	2,348	2,526	2,675	2,876
Imports	-	-	-	-	-	-	-	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-
CONSUMPTION (GWh)												
Total (net production + imports - exports - transmission and distribution losses)	9,952	12,367	14,048	16,630	19,620	22,833	27,326	31,145	32,734	35,424	37,880	40,700
Industry and construction	8,850	10,640	12,195	14,500	17,160	19,843	23,367	26,[illegible]71	27,626	29,780	31,564	33,9[illegible]3
Transport	-	-	-	-	-	-	-	-	-	-	-	-
Household and other consumers	1,442	1,727	1,853	2,130	2,460	2,990	3,959	4,954	5,108	5,644	6,316	6,742
GENERATION PER INSTALLED CAPACITY (GWh/MW)	3,0576	3.[illegible]71	3.722	[illegible].203	4.806	4,592	4.[illegible]56	4.432	3.965	4.088	4,185	3.872

(cf. para 2.b)

b) 2. ELECTRIC ENERGY GENERATION (PROJECTIONS)

	1984	1985	1986	1987	1988	1989	1990
CAPACITY (MW)							
Total	14,616	16,574	17,604	18,564	19,514	20,464	22,174
Hydro	1,202	2,205	2,285	2,305	2,305	2,305	3,115
Conventional thermal	10,548	10,553	10,553	10,543	10,543	10,543	10,543
Nuclear	2,866	3,816	4,766	5,716	6,666	7,616	8,516
Geothermal	-	-	-	-	-	-	-
GENERATION (GWH)							
Total (Gross)	53,138	58,928	65,340	71,615	78,456	85,936	94,068
Hydro	2,138	2,766	2,909	3,106	3,117	3,117	3,339
Conventional thermal	38,409	37,730	36,295	36,247	40,538	42,124	44,185
Nuclear	12,591	18,429	26,136	32,262	34,801	40,695	46,544
Geothermal	-	-	-	-	-	-	-
Imports							
Exports							

(cf. para 2.b)

* Remark : 1. Only for information

2. Not yet decided and will be modified

2.C) In order to explain the historical development of agencies or bodies involved in electric energy we need to introduce how the Korea Electric Company was incorporated on July 1, 1961 from three following companies.

i) Korea Electric Power Co. started its business in August 1943 with Chosun Hydroelectric Co., Chosun Transmission Co., and Buryung Hydroelectric Co., that were consolidated and then Yanggye Hydroelectric, Namsun Hydroelectric Chosun electric and Hunyang Hydroelectric were absorbed by the above company on October 1943.

ii) Seoul Electric Co. was founded by two American on Junuary 1898 with the name of Hansung Electric Company and operated the street car in 1899. Eventually it was changed to Seoul Electric Company in 1915.

iii) South Korea Electric Co. was originated from Daegu Electric and Hanheung Electric which were consolidated into Daeheung Electric Company in 1918 and then it was consolidated into South Union Electric Company with Chosun Gas Electric, Chosun Lights, Mogpo Lights, Daejeon Electric and Namchosun Electric in 1937 The name of change into South Korea Electric Company was done on May 1946.

As explained earlier the above three companies were incorporated into Korea Electric Company as date of July 1961 and was further developed into Korea Electric Power Corporation on January 1, 1982 under which Korea Power Engineering Company

increases their capability as Architectural Engineering Company and Korea Nuclear Fuel Company keeps trying their best effort for self producer in the field of nuclear fuel, Korea Heavy Industry Company as one of capable manufacture in Korea is ready to supply all the equipments in relation with power plants through their large scale factory.

Regarding governmental agencies in relation with electric energy the Ministry of Energy and Resources is responsible for the development of overall national energy policy. It also undertake all the supervisory functions our major activities of KEPCO based on the electricity business law. There are also other governmental authority such as the Minister of Science and Technology for nuclear regulatory function, international corporation and control research and development of nuclear technology with the assistance of Korea Advanced Research Institute to deal with nuclear research and safety evaluation. The research institute has a division called Nuclear Safety Center which performs the essence of safety reviewing process.

Other Ministry such as the Economic Planning Board and the Ministry of Finance deal with mostly finance matter like budget and financing for not only Korea Electric Power Corporation but also the other government or private enterprises.

2. d) For the information required under this d) please refer the planned future projection for electrical energy as part of the above b). Because it is normal practice that we should have decided the long term power plant development program. However, due to the various reasons including whether the continuous construction of nuclear projects in Korea is more economic rather than constructing coal power plants, the long term plan for power plant development has not been decided yet. That is why the following statistics only shows the plans about the development of transmission, distribution, substation and rural electrification together with small hydro power program. As to the rural electrification the ratio of total electrification in Korea reached to 99.4% which means the number of 16,423 houses as non-electrification as date of December 31, 1983.

However, some of them don't want the electricity and some houses are not necessary to make it due to the various reasons such as the planned dam and removal schedule. Therefore, as in the following table for electrification program touched the number of 5,633 houses. It is also interesting for us to introduce the separate table about the small hydro power plants with the explanation (SHP Development Program).

- SHP Development Program

1. Introduction

Small hydro power plants are not a new concept in hydroelectric design. They have been in existence since the end of the last century.

Energy resources in Korea are very limited and the major sources of energy have been all imported from overseas, and in search for new sources of energy, there has been a resurgence of interest in the exploitation of hydro power energy as a result of the rising price of oil, and the far-reaching adverse environmental impacts which are now associated with fossil generation of electrical energy. So this one of the most promising energy sources today is the water power from small and hitherto neglected rivers and streams.

Due to the recent increase in energy costs, the concept of utilizing low-head and small hydro power plants in Korea is being considered as a possibility for an energy source. There is no standard definition of the term "small" with regards to hydro power generation but the generally accepted definition of small hydro power plant in Korea is 5,000 KW or less in capacity.

Government set up an Appraisal Committee within Korea Electric Power Corporation (KEPCO) in March 9, 1982 to review and evaluate the small hydro power projects pending for licenses and permit to construct.

A table is attached on the next page showing the major features of the existing and planned small hydro power plants in Korea.

2. The status of small hydroelectric potential and existing SHP in Korea.

(1) Small Hydroelectric Potential

: The total of 2,400 candidate sites (Capacity; 593,000KW)

Range of Power(KW)	Number of site	Capacity(KW)	Remarks
0 - 100	1,530 (63.8%)	82,000 (14%)	
100 - 1,000	763 (31.7%)	238,000 (40.7%)	
1,000 - 3,000	107 (4.5%)	263,000 (45.3%)	
Total	2,400 (100%)	593,000 (100%)	

(2) SHP in Korea

PLANT NAME		CAPACITY (KW)	REMARKS
OPERATED	AN - HUNG	450	o CONNECTED WITH NATIONAL GRID.
	CHOO - SAN	1,400	
	SUB - TOTAL	1,750	
PLANNED	DUCK - SONG	1,340	o TO BE CONNECTED WITH NATIONAL GRID
	LOTTE HAN - TAN	934	
	YUN - DANG	1,500	
	PONG - YONG	1,650	
	DO - WON	610	
	SAN - CH	1,355	
	IM - GY	696	
	JUNG - UB	1,420	
	GUN - TAN	3,000	
	SUB - TOTAL	12,[illegible]	
TOTAL		13,935	

Transmission & Distribution Program

Classification / Year	Transmission Line (C - Km)					Distribution Line (Km)
	345KV	154KV	66KV	22KV	Total	
'84	3,025	7,830	4,519	35	15,409	151,565
'85	3,585	8,477	4,519	35	16,616	158,875
'86	4,585	9,119	4,469	-	18,173	166,434
'87	4,695	9,620	4,369	-	18,684	172,572

Substation Program

Classification / Year	No of Substation					Installed Capacity (MVA)				
	345KV	154KV	66KV	22KV	Total	345KV	154KV	66KV	22KV	Total
'84	13	133	127	58	331	11,667	14,503	2,303	645	29,118
'85	15	145	119	43	322	13,667	16,088	2,203	595	32,553
'86	17	150	109	30	316	15,667	17,308	2,103	555	35,633
'87	17	173	101	18	309	16,667	19,748	2,003	510	38,928

Electrification Program

1. Number of houses & construction cost

Classification	Number of Houses	Construction Cost	Construction cost per a house
Isolated areas	2,287	$4,144,044	$1,812
Islands	3,351	$7,318,584	$2,184
Total	5,638	$11,462,628	$2,033

(1$ = 780 Won)

2. Annual Program

(Unit : 1,000$)

Year	Criteria		Number of houses	Partial Charge of Construction Cost			
				Total Cost	Loans	Residents Charge	KEPCO Charge
'84	isolated area	under $1,923 per house (over 6 houses)	1,408	2,209	1,805	304	100
	island	over $2,564 per house	3,351	7,317	4,296	2,785	236
	Sub-total		4,759	9,526	6,101	3,089	336
'85	isolated area	under $2,564 per house (over 6 house)	879	1,936	1,127	747	62
	Total		5,638	11,462	7,228	3,836	398

3. Specific information on the national electric power system

a) Existing Electric Power Equipment

(only for the equipment commissioned after 1970)

I. Generation Stations

o Hydro

Plant Name	Plant size(MW)	Commissioning Date	Equipment	Local Content (%)	Foreign Supplier
Namgang	6.3 x 2 (12.6)	1971	Turbine Generator Sub-station Others	No Localy Supply	SFAC Alsthim Alsthim Alsthim
Paldang	20 x 4 (80)	1973	Turbine Generator Sub-station	No Local Supply	Neyrpic Jeumont Schneider Alsthom
Cheong Pyeong Pumped Storage	200 x 2 (400)	1980	Turbine Generator Sub-station	No Local Supply	Fuji Fuji Fuji
Soyang gang	100 x 2 (200)	1973	Turbine Generator Sub-station	No Local Supply	Fuji Fuji Fuji
Andong	45 x 2 (90)	1976	Turbine Generator Sub-station	No Local Supply	Fuji Fuji Fuji
Dae Cheong	45 x 1 45 x 1 (90)	1980 1981	Turbine Generator Sub-station	No Local Supply	Toshiba Toshiba Toshiba

o Thermal (Steam)

Plant Name	Plant Size(MW)	Commission-ing Date	Equipment	Local Content(%)	Foreign Supplier
Nam Jeju	10 x 1 10 x 1 (20)	1979 1980	Boiler Turbine/ Generator Sub-station B.O.P	51.76 22.14 — 88.35	Mitsubishi Fuji - -
Buk Jeju	10 x 1 (10)	1982	Boiler Turbine/ Generator Sub-station B.O.P.	86.95 19.14 — 90.15	- Fuji - -
In Cheon #1, 2	250 x 2 (500)	#1 : 1970 #2 : 1974	Boiler Turbine/ Generator Sub-station B.O.P.	No Local Supply	I H I Toshiba Toshiba -
In Cheon #3, 4	325 x 2 (650)	1978	Boiler Turbine/ Generator B.O.P.	No Local Supply	Stein industrie Alsthom Alsthom
Yeong Nam #1	200 x 1 (200)	1973	Boiler Turbine/ Generator Sub-station B.O.P.	No Local Supply	C.E. Man/Siemens G.E -

Plant Name	Plant Size(MW)	Commission-ing Date	Equipment	Local Content(%)	Foreign Supplier
Yeong Nam #2	200 x 1 (200)	1970	Boiler Turbine/ Generator Sub-station B.O.P.	No Local Supply - -	MAN A.E.G A.E.G -
Ulsan #1,2,3	200 x 3 (600)	#1 : 1970 #2 : 1971 #3 : 1973	Boiler Turbine/ Generator Sub-station B.O.P	- No Local Supply - -	B.A. Siemens Siemens -
Ulsan #4,5,6	400 x 3 (1,200)	1980	Boiler Turbine/ Generator Sub-station B.O.P	38.48 20.78 - 50	Steinmuller(LCS) B B C - -
Kyeong in	162.4 x 2 (324.8)	1972	Boiler Turbine/ Generator Sub-station B.O.P	No Local Supply	Babcock,Hitachi Hitachi Hitachi -
Honam #1,2	280 x 2 (560)	1973	Boiler Turbine/ Generator Sub-station B.O.P	No Local Supply	B.A. Alsthom Alsthom -
Yeong dong #1	125 x 1 (125)	1973	Boiler Turbine/ Generator Sub-station B.O.P	No Local Supply	Babcock/Hitachi Hitachi Hitachi -

Plant Name	Plant Size(MW)	Commissioning Date	Equipment	Local Content(%)	Foreign Supplier
Yeong dong #2	200 x 1 (200)	1979	Boiler	37.67	Babcock/Hitachi
			Turbine/ Generator	30.48	Hitachi
			Sub-station	—	—
			B.O.P	39.45	—
Pyeong Taeg	350 x 4 (1,400)	#1,2 : 1980 #3,4 : 1983	Boiler	52.07	Babcock-Hitachi
			Turbine/ Generator	22	Hitachi
			Sub-station	—	—
			B.O.P	60	—
Yeosu #1	200 x 1 (200)	1975	Boiler	No Local Supply	Stein & Roubaix
			Turbine/ Generator		Franco Tosi/ Marrelli
			Sub-station	—	Ansaldo, SanGiorgio
			B.O.P	—	—
Yeosu #2	300 x 1 (300)	1977	Boiler	No Local Supply	B & W
			Turbine/ Generator		G E C
			Sub-station		G E C
			B.O.P		—
Seo hae #1,2	200 x 2	1983	Boiler	50.1	C.E
			Turbine/ Generator	36.26	G.E
			Sub-station	-	-
			B.O.P	63.68	—

o Thermal (Internal Combustion)

Plant Name	Plant Size(MW)	Commission-ing Date	Equipment	Local Content(%)	Foreign Supplier
Gunsan Combined Cycle	50 x 4 100 x 1 (300)	1979	Boiler Turbine/ Generator Sub-station B.O.P	No Local Supply	G.E G.E G.E -
Yeong Wol Combined Cycle	50 x 4 100 x 1 (300)	1977 1979	Boiler Turbine/ Generator Sub-station B.O.P	-	G.E G.E G.E -
Ulsan Combined Cycle	55 x 4 100 x 1	1979	Boiler Turbine/ Generator Sub-station B.O.P	-	UTI (USA) Toshiba - -

o Gas Turbine

Plant Name	Plant Size(MW)	Commission-ing Date	Equipment	Local Content(%)	Foreign Supplier
Bu Pyeong	55	1977	Turbine Generator Sub-station B.O.P	-	U.T.I Brush -

* Abbreviations

- o AEG : Allgemeine Electrizitats Gesellschaft (Germany)
- o BA : Babcock Atlantique (France)
- o B&W : Babcock & Willcox (U.S.A)
- o CE : Combustion Engineering (U.S.A)
- o GE : General Electric (U.S.A.)
- o IHI : Ishikawaxima Harima Heavy Industry (Japan)
- o MAN : Maschinenfabrik Augoburg-Nurnberg Aktiengesellschaft (Germany)
- o UTI : United Technology Institute (U.S.A.)
- o BBC : Brown Boveri Company (Swiss)

Trend of Transmission & Substation Facilities

Items / Year (KV)	Line Length (c - m)					Number of Substation					Installed Capacity (KVA)				
	345KV	154KV	66KV	22KV	Total	345KV	154KV	66KV	22KV	Total	345KV	154KV	66KV	22KV	Total
1970	-	1,590,242	2,913,488	2,811,917	7,315,647	-	30	136	260	426	-	1,602,000	1,083,525	537,260	3,423,585
1971	-	1,600,140	2,947,307	2,635,863	7,183,310	-	33	137	260	430	-	2,539,000	1,265,750	603,615	4,408,165
1972	-	1,767,506	3,003,408	2,585,373	7,356,287	-	36	138	265	439	-	2,679,000	1,536,050	674,990	4,890,840
1973	-	1,852,327	3,161,318	1,929,219	6,942,864	-	40	140	260	440	-	3,232,900	1,434,850	755,190	5,422,840
1974	-	1,942,296	3,339,207	1,515,631	6,797,134	-	43	146	256	445	-	3,532,800	1,609,000	855,170	5,996,970
1975	-	2,049,679	3,498,386	1,057,080	6,605,145	-	48	147	246	441	-	4,012,800	1,852,150	888,680	6,753,630
1976	391,461	4,210,836	4,123,689	586,493	9,442,489	2	53	152	239	446	1,166,770	4,670,800	2,074,950	882,330	8,794,750
1977	738,332	4,631,103	4,406,778	599,954	10,336,167	3	66	154	204	427	1,666,670	5,617,800	2,101,250	876,380	10,262,100
1978	1,347,630	5,124,352	4,333,528	185,401	10,990,911	4	75	159	181	419	2,666,600	6,887,800	2,099,550	803,780	12,457,810
1979	1,635,641	5,583,379	4,533,671	101,760	11,854,451	7	86	157	143	393	5,333,340	8,531,800	2,178,450	752,900	16,796,490
1980	2,043,914	6,062,200	4,494,072	95,375	12,685,561	7	96	131	124	378	6,333,400	9,789,200	2,212,600	772,600	19,107,800
1981	2,096,676	6,381,459	4,482,873	98,004	13,059,012	8	100	130	105	363	7,333,500	10,966,500	2,269,100	754,600	21,263,700
1982	2,436,764	6,818,740	4,441,791	84,746	13,782,041	9	103	145	94	352	8,666,900	11,324,530	2,267,800	716,600	22,975,830

* Indicates route length until 1975

Transmission Facilities

As of Dec. 31, 1982

Items	Voltage(KV)	345	154	66	22	Total
Supporter (ea)	Steel tower	3,174	11,461	5,160	49	19,844
	Steel pole	-	6	871	3	880
	Panzer mast	-	52	16	-	68
	Concrete pole	-	23	1,4031	709	14,763
	Wooden pole	-	10	4,639	123	4,772
	Total	3,174	11,554	24,717	884	40,329
Insulator	Suspension Insulator	739,106	1,457,471	655,263	8,271	2,859,151
	Pin Insulator	-	132	-	2,467	2,599
	Total	739,106	1,467,603	655,263	10,738	2,872,710
Transformer	Number (ea)	48	243	277	133	703
	Capacity (KVA)	80,001	11,400	2,232	716	22,449
Switch Gear	Circuit Breaker(ea)	106	783	539	2,707	3,735
	Disconnector (Set)	304	1,109	1,416	5,867	8,296
Cable	underground line*	-	120,503	6,631	-	127,134
	underwater line *	-	-	4,800	-	4,800

* Circuit length (c - m)

Trend of Distribution Facilities

Items / Voltaye / Year	Route Length (m)			Total Length (m)		
	over 600(V)	under 600(V)	Total	over 600 (V)	under 600(V)	Total
1970	12,737,675	8,264,719	21,002,394	40,184,711	26,446,814	66,631,525
1971	18,985,001	12,703,076	31,688,077	47,459,464	37,921,632	85,381,096
1972	19,647,748	12,700,808	32,348,556	53,136,253	41,431,979	94,568,232
1973	25,834,406	16,935,121	42,769,527	65,910,868	50,668,866	116,579,734
1974	33,246,786	21,845,640	55,092,426	84,014,406	64,232,570	148,247,976
1975	40,824,429	26,540,363	67,364,792	103,336,072	73,726,759	177,062,831
1976	48,449,026	34,431,730	82,880,856	119,250,136	88,012,338	207,262,474
1977	56,361,871	40,481,152	96,843,023	136,308,911	101,922,702	238,231,613
1978	61,217,663	46,856,537	108,074,200	153,739,906	114,834,265	268,574,171
1979	65,228,151	50,337,267	115,566,418	166,362,692	123,539,740	289,902,432
1980	68,964,798	53,954,407	122,919,205	177,787,289	133,998,470	311,785,759
1981	72,942,536	56,258,645	129,201,181	189,734,012	141,076,596	330,810,607
1982	77,250,569	60,397,660	137,648,229	202,294,177	152,220,273	354,514,450

Distribution Facilities

As of Dec. 31, 19[illegible]

Items	Voltage (KV)	3.3KV	5.7KV	6.6KV	11.4KV	22.9KV	22△KV	Total
Supporter(ea)	Steel tower	2	-	34	-	979	10	1,025
	Steel pole	4	-	560	8	3,244	20	3,836
	Panzer mast	65	-	1,436	18	3,581	2	5,102
	Concrete pole	36,796	374	266,230	40,721	2,026,797	549	2,373,467
	Wooden pole	2,757	195	11,757	2,397	39,148	32	6,836
	Total	39,624	569	280,017	43,744	2,075,749	613	2,440,316
Transformer	Number (ea)	4,534	463	39,614	13,305	287,006	-	344,922
	Capacity (KVA)	82,692	20,605	978,793	48 ,268	7,510,204		9,157,570
Switchgear	Interrupt switch	2	-	10	429	6,397	44	6,882
	Automatic "	70	1	528	59	307	-	965
	Cut out "	60	-	264	1,947	33,765	12	36,048
	Air "	53	1	109	41	31	-	234
	Oil "	290	23	3,375	34	266	-	4,038
	Automatic Load Transfer SW	1	-	23	1	34	-	59
	Loop SW (Set)	-	-	-	-	57	-	57
	Total	475	25	4,309	2,531	40,907	56	48,333
Messurement & Control	Regulator (ea)	2	-	5	4	37	-	48
Route Length(m) Cable	Underground line	(under 600V) 35,427		(over 600V) 594,974				630,401
	Under water line	" -		26,227				26,227

3. b) Maintenance activities

i) Korea Electric Power Corporation (KEPCO) provides Technical Service Division of Korea Heavy Industry Company (KHIC) with necessary shop facilities, spare parts and maintenance management except labor who will actually repair and maintain.

ii) Most of repair and maintenance work are completely executed by Technical Service Division from Korea Heavy Industry Company except the first overhaul occurred after completion which is done with the foreign technical assistance.

iii) Training for repair and maintenance is executed in accordance with annual schedule at foreign countries based upon each field such as nuclear and thermal plant.

iv) KHIC's Plant Technical Services Division is, as before, exclusively performing routine maintenance work and overhaul for all power plants of Korea Electric Power Corporation, having a total installed capacity exceeding 12,000MW including fossil field, hydraulic, gas turbine diesel and nuclear units.

However, it is not easy to assess how much this service works could give any impact on the creation of technology and domestic production.

3. c) For the role of domestic and foreign engineering companies and/or consultancy services in planning, carrying out the feasibility studies and supervising the erection of the power system, there are aspects to need explanation from background to future plan.

i) Background

In 1960's, the Korean Government initiated an ambitious economic development program. Industrial plants and power plants in a great number were erected by the financing of foreign loans including a number of new power generation plants. Most of these projects were designed by foreign organizations. And all of the power plants constructed during that decade were designed, procured and constructed using the services of foreign firms with turnkey contract because there were very few modern-day engineering groups in Korea.

In the early 1970's following the Presidential Instruction on the Creation of Engineering Service Companies in Korea of 1969, the Korean Government promulgated a law for developing the engineering industry and started to invest in training engineers and specialists.

As a result, in late 1970's, the number of plant engineering companies had increased to 16 and many manufacturing and construction companies had established their own engineering subsidiaries. In mid of 1970's, Korea Electric Power Corporation (KEPCO) started changing the type of contract from turnkey to non-turnkey because it has been found that the turnkey contract is not a suitable form of contract in view of the national participation goals.

Under such a non-turnkey approach, KEPCO has decided to develop national engineering capabilities as one of the top priorities. Since then, all the power plants have been under the non-turnkey system under which KEPCO enters into a separate contract with each supplier as well as architect engineering. And foreign engineering companies hired by KEPCO were also obiligated to work with the designated Korean engineering firms.

ii) Present Domestic Engineering Capabilities

As described above, large number of domestic engineering firms were formed since early 1970's.

However, only 7 companies out of them were involved in the engineering of power plants. (See attached table 1 and 2)

- Nuclear Power Plants

  In order to achieve the goal of self-reliance in nuclear pwoer engineering capability, with endorsement of the Korean Government, Korea Advanced Energy Research Institute (KAERI) has established Korea Nuclear Engineering Services, Inc. (KNE) as its subsidiary company. (KEPCO took over its management and renamed Korea Power Engineering Company, Inc. (KOPEC), in 1982.)

  Engineering Services for the first nine nuclear plants in Korea have been provided by the overseas engineering companies as shown in Table 1.

  The first two nuclear units were constructed by Westinghouse on a turnkey basis and engineering was done by Gilbert/Commonwealth.

The third unit, which was a CANDU reactor, was also a turnkey project by AECL which did the engineering work with some assistance from Canatom.
Units 5&6 and 7&8 are being constructed on a component basis and Bechtel is responsible for engineering, construction supervision and procurement evaluations. KOPEC is participating in these projects as a sub-contractor to Bechtel. Units 9&10 are Framatome PWR's. Framatome is in charge of engineering for the nuclear islands and Alsthom Atlantique is responsible for engineering of the conventional islands.
KOPEC's participation in those units have been increasing steadily and almost 200 KOPEC engineers have had on the job training through these projects (Table 2)

- Fossil Power Plant

The same policy applied to nuclear field was also pursued in the fossil field.
The turning point of localization of fossil power plant was Pyungtaeg 1,2 which started their construction in 1976. This plant was designed by Hyundai Engineering Company, Ltd. with the support of Brown & Root of U.S.A.. Since then, KEPCO has contracted primarily with domestic firms for the engineering of all fossil power plants in Korea.
However, their engineering capabilities were not high enough to design the plants by themselves.

Therefore, these domestic firms have used foreign firsm either in the form of subcontract or joint venture not only to get the help in designing the plant awarded but also to achieve the national goal of technical self-reliance in the power plant engineering through all available means including manpower training, project participation, facility betterment and so on.

As a result of continuous national efforts to achieve self-reliance, a domestic firm, KOPEC, is able to perform a full range of engineering services including the site survey, basic and detail design, procurement, construction management and supervision of test and startup operations without aid of foreign engineering company on Bukjeju Thermal Power Plant (5 MW) which began its engineering in 1982.

- Hydro Power Plant

Since 1970's, many multi-purpose dams were constructed in Korean not only for power generation but also for flood control, irrigation and water supply.

Before these multi-purpose dams, all hydro power plants were constructed with turnkey contract.

The domestic engineering participation ratio in the engineering of hydro power plant is low in comparison with that of fossil plant.

Saman Engineering Company was involved in the detail design of Chungju Hydro Plant as a subcontractor to Nippon Koei, the prime contractor.

Domestic engineering capability, however, is considered in the stage of which all spectrum of engineering can be performed except basic design.

iii) Future Plan

As we described in the above, present domestic engineering capability is almost in self-reliance stage except basic design and some specialized area that requires high technology. Since Government policy for national participation would not be changed, all Korean power plants will be built utilizing the domestic firms.
Especially in nuclear field, KNU 11 & 12 will be engineered by KOPEC subcontracting foreign engineering company.
Basic design will be performed in collaboration with KOPEC and foreign company while giving foreign A/E the prime responsibility. Detail design will be performed primarily by KOPEC with the technical guidance of foreign company. KOPEC also, in this stage, will hire domestic engineering company for some specialized area.
Standardization project for the nuclear power plant is now undergoing by KOPEC for the efficient construction and economic power generation. In fossile and hydro area, the trend of enlarging the domestic participation ratio will continue and basically the same policy as applied to nuclear will be applied.

Table 1

Participation Status of Foreign and Domestic Companies

Nuclear Power Plant

	Company	Feasibility Study	Basic Design	Detail Design	Consulting
Foreign	Bechtel (U.S.A)	KNU 5,6,7,8	KNU 5,6,7,8	KNU 5,6,7,8	KNU 5,6,7,8
	Ebasco (U.S.A.)	-	-	-	KNU 9,10
	Gilbert/Commonwealth (U.S.A.)	-	KNU 1,2	KNU 1,2	-
	Alsthom (France)	-	KNU 9,10	KNU 9,10	-
	Framatome (France)	KNU 9,10	KNU 9,10	KNU 9,10	-
	AECL (Canada)	KNU 3	KNU 3	KNU 3	KNU 3
	Canatom (Canada)	-	KNU 3	KNU 3	KNU 3
Domestic	Korea Power Engineering Co.	-	KNU 5,6,7,8,9,10	KNU 3,5,6,7,8,9,10	KNU 3,5,6,7,8,9,10

Fossil Power Plant

	Company	Feasibility Study	Basic Design	Detail Design	Consulting
Foreign	Bechtel (U.S.A.)	Gojeong 1,2	Gojeong 1,2	Gojeong 1,2	Gojeong 1,2 Ulsan 4,5,6
	Brown & Root (U.S.A)		Pyungtaeg 1,2,5,6	Pyungtaeg 1,2,5,6	Pyungtaeg 1,2,5,6
	Ebasco (U.S.A.)		Samcheonpo 1,2	Samcheonpo 1,2	Samcheonpo 1,2
	Gibbs & Hill (U.S.A)	Samcheonpo 1,2			
	Kaiser (U.S.A.)	Seohae 1,2	Namjeju 1,2 Seohae 1,2		Namjeju 1,2 Seohae 1,2
	UE & C (U.S.A.)		Ulsan 4,5,6	Ulsan 4,5,6	
	Fichtner (Germany)	Pyungtaeg 1,2			
	Hitachi (Japan)		Yeongdong 1,2	Yeongdong 1,2	Yeongdong 1,2
Domestic	Amtai Company			Gojeong 1,2	
	Daewoo Engineering Co.		Ulsan 4,5,6	Ulsan 4,5,6	
	Hyundai Engineering Co.		Pyungtaeg 1,2,5,6 Samcheonpo 1,2	Pyungtaeg 1,2,5,6 Samcheonpo 1,2	Pyungtaeg 1,2,5,6 Samcheonpo 1,2
	Korea Keiser Engineering Co.	Seohae 1,2	Seohae 1,2 Namjeju 1,2	Seohae 1,2 Namjeju 1,2	Seohae 1,2 Namjeju 1,2
	Korea Power Engineering Co.		Bukjeju 1,2,3 Honam 1,2 Coal Conv.	Bukjeju 1,2,3 Honam 1,2 Coal Conv.	

Hydro Power Plants

	Company	Feasibility Study	Basic Design	Detail Design	Consulting
Foreign	Nippon Koci	Daechung Chungju	Daechung Chungju	Daechung Chungju	Dcechung Chungju
Domestic	Saman Engineering Co.			Chungju	
	Industrial Sites & Water Resources Development Co. (ISWACO)	Daechung Chungju			

Table 2

KOPEC Participation Ratio in Nuclear Plant

Unit No.	Contract Type	A/E Company	KOPEC Partcipation Ratio
1.2	Turnkey	Gilbert	5%
3	Turnkey	AECL	15%
5.6	Component	Bechtel	26%
7.8	Component	Bechtel	31%
9.10	Island	Framatome/Alsthom	46%
11.12	Component	KOPEC	Over 70%

Table 3

Fossil Plant Contractor

Plant Name	Prime Domestic Engineering Contractor	Foreign Subcontractor	Capacity
Pyeongtaeg 1,2,5,6	Hyundai Engineering Co.	Brown & Root (U.S.A)	350 MW x 4
Namjeju 1,2	Korea Keiser Engineering Co.	Keiser (U.S.A)	10 MW x 2
Ulsan 4,5,6	Daewoo Engineering Co.	UE & C (U.S.A)	400 MW x 3
Seohae 1,2	Korea Keiser Engineering Co.	Keiser (U.S.A)	200 MW x 2
Samcheonpo 1,2	Hyundai Engineering Co.	Ebasco (U.S.A)	560 MW x 2
Gojeong 1,2	Amtai Company	Bechtel (U.S.A)	500 MW x 2
Homan 1,2 Coal Conversion	Korea Power Engineering Co.	Burns & Roe (U.S.A)	-
Bukjeju 1,2,3	Korea Power Engineering Co.	-	5 MW x 3

3. d) There are many experienced and excellent local erection firms available for power system projects. Among them, Hyundai and Dong-Ah Construction Companies have been utilized even in the field of nuclear projects.
Even if they performed erection and installation work from the civil work under the supervision of foreign contractors for the most of power system projects, they are now capable to perform prime contractors of construction work subsequent nonturnkey projects.

4. Domestic production of electric Power equipment

a) Macro-economic data

(Unit : $1,000)

Code	Division of Industry	Year	i) Gross out put	ii) Value added	iv) Employees	Exchange Rate in US Dollar
38	manufacture of fabricated metal products, machinery and equipment	1977	6,699,877	2,734,120	468,653	484Won/$
		1978	10,556,590	4,092,827	568,522	485 "
		1979	12,998,794	4,587,264	596,257	485 "
		1980	10,510,059	3,907,075	534,507	662.30 "
		1981	14,822,292	5,436,696	543,968	750.70 "

— iii) Exports and imports

Unit : 1,000$

Equipment	Exports					Imports				
	1978	1979	1980	1981	1982	1978	1979	1980	1981	1982
Division 71										
711	423	2,751	1,425	1,910	2,164	64,546	182,710	42,172	103,964	48,451
712	176	43	33	108	202	27,807	132,377	35,142	86,124	14,795
714	14,969	32,695	54,650	8,717	43,979	86,911	66,540	102,750	99,848	94,335
716	8,068	12,747	19,257	34,713	31,359	124,474	172,134	87,949	143,402	176,690
718	545	956	327	1,726	29,541	1,177	46,540	44,097	34,252	58,530
Division 77										
771	34,126	54,841	71,731	75,656	98,616	60,316	68,852	68,194	87,502	84,779
772	44,630	57,158	60,610	52,660	43,880	191,316	280,069	218,303	206,592	224,449
773	45,841	52,690	62,443	100,312	119,989	40,533	73,354	46,363	47,195	48,112

b) Historical development of the electric power equipment industry.

i) The progression in the locally manufactured equipment.

In the development of self-reliance technical capabilities in manufacturing a electric power equipment, it has been developed slower comparing to those of the other industry since manufacturing work of the most of electric power equipment reqires high-level and sophisticated technology as well as accumulated experience in long-term basis. However, in 1970's the positive localization program for the electric power equipment industry was established as a result of continuous efforts and close cooperation between government concerned and related manufacturing industries. As an example, Turbine-Generator which had been totally imported from overseas was attempted firstly to manufacture it domestically by KHIC (Korea Heavy Industries and Construction Co., Ltd.) for Seo-Hae thermal power plant #1,2 (200,000KW x 2) with technical assistance of General Electric Co. of U.S.A..

After that, localization rate for electric power equipment has been gradually increased with each project up to 55.5%. As for the electric equipment such as transformer, switch gear and circuit breaker etc..

In 1979, very high voltage transformer of 345KV class was developed and manufactured by local manufacturer, Hyo-sung Heavy Industries Co., Ltd. and the maintransformer of 345KV class, 3ϕ, 475MVA was ordered by Hyo-sung Heavy Industries Co., Ltd. for Ul-San combined cycle power plant in same year and also the step-up transformer of 390MVA for Pyeong-taeg thermal power plant.

Accordingly maintransformer of 345KV class was totally locally manufactured in the late of 1970.
And also SF6 gas circuit breaker of 170KV, 31.5KA was manufactured and ordered to Seo-hae thermal power palnt by local manufacturer.

Besides above, many other power equipments including large size electric motors were began to manufacture to meet domestic demands for several power plants.
Now, we are much proud of remarkable progression in the locally manufactured equipment and keep trying to put on the best effort in developing self-reliance technical capabilities under the support of government concerned and the close relationship between government and related industries.

Furthermore, we are open to exchange information in relation to electric power industry including nuclear plant not only with the developing countries and also the under-developed countries.

And also we are keep tracing of advanced new technology from the advanced countries by means of technical licensing agreement and joint venture with foreign company.
The details of localization status are explained in para 3.a), 4.c).

ii) The organization of production facilities.
Data is not available.

iii) Licensing agreements with KHIC

	Source of technology	Contract Date	Contents	Contract Periods
Thermal	G.E	76. 7.26	Steam TBN/GEN	'76.11.27 - '91.11.26
	C.E	77. 2.15	Steam Boilers	'77. 4.20 - '89. 4.19
	B & W	81. 2.27	Boilers	'81. 4. 2 - '84. 4. 1
Hydraulic	Neyrpic	76. 11.30	TBN	'77. 8.30 - '87. 8.29
	A.A	77. 2.19	GEN	'77. 8.30 - '85. 8.29
	Hitachi	81. 6.30	Pump TBN	'81. 7.16 - '86.12.15
Nuclear	Framatome		NSSS	'83. 2.12 - '93. 2.11
	Wooley Ltd.		Nuclear Components	'79. 4.13 - '84. 4.12
	C.E		NSSS	'77. 8.30 - '89. 8.29
	Westinghosue		NSSS	'81. 5.29 - '91. 5.28

as for the licensing agreements on the manufacturing of electrical equipment, please refer to para 4.d)

c) Domestic Production of Electric Power Equipment

Equipment	Unit	Annual Production											Local content(%) as of 1983	Local manufacturer	Source of Technology
		1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982			
Transformer	KVA	1,070,411	2,079,843	2927,527	3308,598	3,063,152	4,976,165	10318,458	13,464,721	7,289,764	8137,077	1,384 ,770			
A.C Generator	KW	-	-	17	1,768	10,092	14,298	1,669	516	29,802	2847(ea)	2,193(ea)			
Circuit breaker ; 345KV	ea	-	202	49	495	780	1,618	1,839	19,168	38,058	60,347	106,981			
Circuit breaker ; 154KV	ea	-	13,721	40,254	108,660	248,317	357,040	748,921	1,187,808	1,100,504	1042,180	1461,980			
High Voltage SW	ea	-	-	-	-	1,581	4,546	108,573	1,726	3,272	1,410	7,380			
Low Voltage SW	ea	-	-	-	-	39,667	16,127	13,024	108,975	4,615	-	-			
Control Panel	Sheet	-	-	-	-	2,001	3,399	8,108	20,575	425,535	29,986	6,399			
Distributing Panel	ea	-	-	-	-	3,934	2,399	4,270	7,152	12,500	63,854	15,678			
High Voltage Condenser	KVA	-	-	-	-	355,480	416,801	460,146	308,638	287,365	332,651	268,791			
Tower	M/T	-	7,582	-	9,831	8,285	14,506	18,513	21,821	39,335	-	-			
Power Wire and cable insulated	M/T	-	-	-	18,188	28,018	27,787	63,217	62,935	53,160	58,569	56,372			

Note : o 1983 data is not available

o * ; details of the status are described in the seperate table as follows

i) transmission

ii) sub-station

iii) distribution

* Status of Localized Electric Power Equipment

i) Transmission

Equipment	Size	Local Manufacturer	Local Content as of 1983 (%)	Source of Technology
1. Transmission Accessories	345 KV Class	IL JIN	77.3	-
2. Transmission Line	A.C.S.R 480 $^{m/m}$	KUK. JAE & Many Others	100 %	-
3. Oil Filled Cable	154 KV 2000 $^{m/m^2}$ Class	Dae - Han	100 %	Sumitomo (JAPAN)
4. CV (Cross - Linked Polyethylene Insulated and Vinyl Sheated) Power Cable	154 KV 1200 $^{m/m^2}$ Class	Keum-Sung	100 %	Hitachi (Japan)
5. Suspension Insulators	10" Class	• Shin Han • Ko Ryo	100 %	Doulton (UK) Joslyn (U.S.A)
6. Tower	345 KV Class	Hyun Dai and many Others	100 %	-

ii) Sub-Station

Equipment	Size	Local Manufacturer	Local Content (%) as of 1985	Source of Technology
1. Gas Insulated Switchgear	345 KV Class	Hyo Sung Heavy Industricus Co., LTD.	49.97	HITACHI (JAPAN)
	154 KV Class	"	60.7	"
2. Gas Circuit Breaker	345 KV Class	"	55.4	"
3. Disconnecting Switch	345 KV Class	"	62.8	Merin -Gerlin (France)
	154 KV Class	"	83	"
4. Transformer	345 KV Class	"	70	Westinghouse (U.S.A.)
	154 KV Class	"	70	"

iii) Distribution

Equipment	Size	Local Manufacturer	Local Content (%) as of 1983	Source of Technology
1. Recloser	27 KV Class	IL JIN	25.1	-
2. Sectionalizer	27 KV Class	• IL JIN • Shin - A	100 %	-
3. Cut out Switch	25 KV Class	• SAM HEUNG • IL JIN • JOONG WON	100	-
4. Lighting Arrestors	18 KV Class	• Shin - A • IL JIN	71.72	OHOWA(JAPAN) [illegible] - Edison Co. (U.S.A)
5. C.V Cable	22 KV Class	Dae Sung & Many Others	100	-
6. Line Post Insulators		Nam Yang & Many Others	100	-
7. Suspension	$7\frac{1}{2}$ Class	• Shic Han • Ho Yuce	100	Doulton (U.K) Joslyn(U.S.A)
8. A.C. Load Interrupter Air Switch	27 KV Class	Shin - A & Many Others	77.5	TOSHI (Japan) S/C (U.S.A.)

d) Organization of Production

Name	Address	Foundation Date	1982 Annual turn-over (1,000$ won)	Equipment as of 1982	Capital Formation	Main Product	Technology Sources
1. KHIC (Korea Heavy Industries & Construction Co., Ltd.)	Guygok-dong, Changwon, Kyungsangnam-do	Sep. 1962 (under the name of Hyundai International Inc.)	341,415	11,286	KEPCO's (Korea Electric Power Corp.) Subsidiary	1. Power Generating equipment o Thermal (Turbine, Generator, etc) o Hydraulic (Turbine, Generator, etc) o Nuclear (Rx Vessel etc.) 2. Chemical of petrochemical plant equipment 3. Cement plant equipment 4. Iron and steel making machinery 5. Casting and forgings	G.E (U.S.A.) Turbine ; Nerypic-Creusot Loire(France) FRAM (France) W, CE (U.S.A.) Fuller Company (U.S.A.) Terni-societa perl' industria el' Electricita S.P.A.(Italy) * Condenser, H.P. & L.P, Feedwater heaters ; Delas Weir (France) Gates & Penstocks Sasebo Heavy Industries Co., Ltd. (Japan)

Name	Address	Foundation Date	1982 Annual turn-over (1,000$ won)	Employment as of 1982	Capital Formation	Main Product	Technology Sources
2. Hyosung Heavy Ind. Ltd.	Nae-dong, Changwon, Kyung Sang Nam Do	May 14,1962	99,872	2,506	Domestic Private	1. Transformer 2. Electric motor 3. Circuit breaker	Westinghouse Elec. (U.S.A.) . SF6 gas circuit breaker ; Japan . Circuit breaker; Merin-gerlin (France)
3. Hyundai Electric Engineering Co., Ltd.	460, Junha-dong, Ulsan Kyung Sang Nam-do	Nov.1,1978	61,452	1,455	domestic private	1. transformer 2. circuit breaker 3. electric motor	Siemens (Germany)
4. Dae Myung Manufactory Co., Ltd.	427-3 Sang Dae Won-dong, Sung nam, Kyung Ki-Do	May 16,1966	4,596	185	domestic private	1. transformer 2. welding machine	
5. Shin han Electric Co., Ltd.	5-27 Mun Rae-dong, Yeong Deung Po-ku, Seoul	May 9, 1966	8,372	285	domestic private	1. transformer 2. welding machine	

Name	Address	Foundation Date	1982 Annual Turn-over(1,000$-won)	Employment as of 1982
6. Syin young Electric Corp.	197 Deung Chon-dong, Gang Seo-ku, Seoul	Apr. 22, 1971	32,568	1,299
7. E Hwa Electric Mfy. Co., Ltd.	207-10 Gu-eui-dong, Seong dong-ku, Seoul	Jun. 10, 1966	18,186	285

	Capital formation	Main Product	Technology Sources
	domestic private	1. Distribution panel 2. Control panel 3. Circuit breaker	
	domestic private	1. Electric power source equip. 2. Rectifier	

o Status of manufacturers designated by government for each item

Item \ Classification	Number of Manufactuers	Ratious in each type (%)			
		I	II	III	IV
Transformer	29	24.1	31.0	10.4	34.5
Circuit breakers	22	27.3	4.5	22.7	45.5
Switches	16	12.5	-	18.8	68.7
Control & distribution panel	49	16.3	34.7	12.3	36.7
Welding machine	10	20.0	40.0	10.0	30.0
Retifier	22	22.7	13.6	22.7	40.9
Electric furnace	3	66.7	33.3	-	-
Voltage Regulators	21	42.9	9.5	4.8	42.8
Insulators & Bushing	6	50.0	33.3	-	16.7
Total	178	23.3	22.1	15.4	39.1

* Remark

I : designated manufacturer
II : small-size manufacturer
III : large-size manufacturer
IV : Others

e) Mastering of technology

i) Indigenous development of technology at industry and national levels.

The industrial infrastructure in Korea includes a number of engineering, manufacturing and construction firms that participate in the conventional power plant and nuclear power plants.

Korea Power Engineering Company, (KOPEC) is designated to as a sole company to perform all the engineering works of power plants including nuclear power plants in Korea.

KOPEC is a KEPCO's (Korea Electric Power Corporation subsidiary company.

KEPCO has 96% of KOPEC shares and the balance is held by KAERI and the other private industries concerned.

KOPEC's major functions are as follows;

a. Feasibility studies of various project
b. Planning, basic and detail design, and engineering of power plant
c. Assistance in plant test and start-up
d. Quality assurance
e. Standardization in development of Advanced Nuclear Power system most suitable to Korean conditions.

KOPEC has now about in trained and experienced engineers and began generating profits starting in 1981.

Among the many manufacturing companies, Korea Heavy Industries and Construction Company, Ltd. (KHIC) was designated to manufacture all the major components of power plant except the electrical equipment such as transformers and circuit breakers manufactured by other qualified local firms.

The KHIC Changwon manufacturing facility has got the right to affix ASME. N-stamp, which certifies that the design, fabrication, manufacture and inspection of certain components meet the requirements of section III of the ASME code.

Local participation in component manufacturing has progressively increased with each project as described in Sec. 4.(b)

Majority of localization is attributable to less engineering content items.

In order to be a more reliable manufacturer with its indepth inhouse manufacturing design capability, emphasis will be placed on increasing the "know why" as well as "know how" of manufacturing design and analysis.

This technology will be accumulated through the optimum utilization of existing technical cooperation agreement with foreign manufacturers, through incentive training and actual participation in design works.

ii) Import of technology

This subject is touched briefly in the above para 4.(b).(c). Therefore, I will describe the status of import of technology on the electro mechanical equipment so far as follows.

* Status of Import of Technology

Classification / Item	Number of Manufacturer	Number of Import	Contract Duration (yr)					Import Sources in Country					Imported Year		
			1-3	5	7-8	10	More Than 10	Japan	U.S.A	German	Swiss	Others	Before '70	'70-79	After '80
Electric Motor	16	18	8	5	1	2	2	12	1	3	1	1	1	14	3
Generator	9	11	3	6	-	2	-	7	-	2	1	1	1	8	2
Transformer	9	10	2	4	2	1	1	6	1	2	1	-	2	6	2
Circuit Breakers & Disconnecting Switches	21	31	8	10	6	6	1	19	8	1	1	2	3	24	4
Control & Distributing Panel	5	14	2	9	-	3	-	9	3	2	-	-	-	11	3
Total	60	84	23	34	9	14	4	53	13	10	4	4	7	63	14

f) Constraints on the domestic production of electric power equipment and measures that have been and being taken to remove these constraints;

- Executed as part of the government policy of fostering electric power equipment industry, the guidelines for the avoidance of investment duplication and the specialization program for each individual technology development package to strengthen the international competition capabilities are gradually setting down, and related firms are exerting themselves for the digestion of state of the art high technology and the development of their own technical capabilities. The following informations are about the specified subjects that we were requested to describe.

- Markets and financing

  In general, the electrical industry does not grow faster than the other fields of industry since its demand is heavily dependent upon the growth of the other industrial facilities and the power development program, furthermore domestic demand is limited. One of the other constraints is that the cost of new product development is so high and the long lead time from the receiving orders to deliveries also results some difficulties in the financial structure,and the hesitation to develop new items. However, our government policy in view of financial terms is enough for encouraging them in their effort to conquer this kind of constraints.

- Infrastructure

  Considering the requirements of detail and preciseness in the field of this heavy electric equipment it is necessary that the localization should be done step by step from the easy parts to the possible area by avoiding keen competition in between the similar manufactures. Eventually our goal of this industry should reach to the standardization and putting their best to save product cost for international competiveness.

- Manpower

  As a matter of fact, it is recognized that professional engineers, design engineers and highly educated persons have not been secured in this area.
  Consequently, the technical transfer in relation with this area is also hard. Therefore, it is necessary to set up some kind of system including training center inside Korea and overseas professional training center for the purpose of securing the necessary manpower.

- Technical and technological barriers

  Due to the high technology requirement of the manufacturing process, it is difficult to apply a systematization program to this particular industry and the restriction of automation also makes it hard establish a system suitable for the mass production and standardization. It is true that technology localization for some items is being delayed as in the case of power circuit breakers which are said to have been localized.

- Lack of negotiating skills and other constraints.

  we have no reason to feel lack of negotiating skills in terms of licensing, transfer of technology agreements. Regarding other constraints, most of manufactures think that they could'nt make the profit as long as they have to invest lot of capital money for accumulating the technical capability. It is also true that some of items are cheaper in case of assembling the parts from foreign supplier than developing them through the investment.

  So the manufacturer is in the format of using the advanced technique of assembling the parts.

  This will be improved soon. It is expected that the method of foreign technology introduction which has prevailed on turn-key basis, will be diverted to non-turnkey method in which technical capabilities of Korean manufacturers can forge ahead and eventually our electric power equipment industry will not only meet the domestic demand, but also will become a strategic export industry.

5. Linkages with the other capital goods industries

a) Supply of raw materials and intermediate products to the electric power equipment industry

Unit : M/T

	Iron and Steel Basic Industries										
	Pig Iron	Steel Ingot	Semi-finished Steel products	Shapes or Section of Steel	Steel Bar	Wire Rod	Thin Plates (less 3mm)	Pipe and Tube of Cast Iron	Steel Pipe and Tube	Galvanized Sheet	Thin Plates
1975	1,186,343	2,009,733	2,183,653	149,067	146,734	164,267	-	27,926	348,028	49,337	30,225
1976	1,937,395	2,698,332	3455,038	215,427	230,794	191,228	-	31,879	13,757	66,688	41,186
1977	2,425,410	2,736,669	4,528,331	290,496	191,662	240,984	-	47,945	668,280	131,236	57,264
1978	2,741,147	3,138,497	5,184,491	414,363	271,015	299,300	-	42,637	946,094	166,842	82,665
1979	5,062,549	5,199,930	7,631,938	417,163	359,275	424,975	-	62,523	1,089,994	184,697	67,079
1980	5,377,361	5,712,084	7,385,208	360,728	298,282	552,954	1,045,871	76,412	1,092,434	191,092	70,766
1981	7,928,331	5,890,943	9,840,758	464,874	391,164	589,867	1,112,628	74,542	1,415,271	301,268	85,047
1982	8,444,672	5,636,121	10,863,397	630,788	425,472	685,921	929,969	77,128	1,282,408	339,278	105,370

	Non-ferrous Metal Basic Product				
	Electric Copper Ingot	Lead Ingot	Zinc Ingot	Copper Plates and Bands	Aluminum Plate
1975	21,959	5,740	20,937	-	3,315
1976	30,912	7,780	27,548	-	8,931
1977	42,880	6,742	32,756	-	11,401
1978	52,442	7,218	58,970	-	16,835
1979	63,082	7,600	83,014	-	19,834
1980	72,931	10,413	79,150	9,796	18,834
1981	107,984	14,659	83,915	31,292	23,518
1982	110,818	16,093	99,211	44,381	24,621

Unit : M/T

Fabricated Metal Products		
Bare Copper Wire	Welding Rod	Tube Fittings
19,316	19,491	13,564
35,742	28,478	22,015
42,659	42,181	28,543
71,546	54,026	36,090
66,136	54,708	34,008
48,597	51,678	30,582
64,533	71,212	35,063
84,401	73,452	33,561

	Machinery Except Electrical (Each)			Electrical Machinery, Apparatus and Appliances				
	Motor Pump	Compressor	Moulds	Alternating Current Motor (HP)	Transformer (KVA)	Integrated Circuit (1000 each)	Cable of Communication and Power (M/T)	Power Wire and Cable Insulated (M/T)
1975	91,844	1,092	-	-	3,308,598	273,699	4,675	18,818
1976	150,138	1,907	-	-	3,063,152	556,215	7,294	28,018
1977	239,426	2,349	-	-	4,976,165	649,732	20,552	27,787
1978	404,939	3,308	-	-	10,310,458	713,812	24,615	63,217
1979	445 647	3,195	-	-	13,464,721	888,418	24,852	62,935
1980	361,530	2,611	196,525	1,289,664	7,289,764	943,161	26,148	58,160
1981	498,969	3,967	166,162	1,393,001	8,137,077	886,420	37,447	58,569
1982	664,573	2,895	257,116	1,643,331	13,845,770	1,070,279	42,686	56,372

b) Availability of services of basic facilities

Among many manufacturing companies, Korea Heavy Industries and Construction Company (KHIC) was designated to manufacture all the major components of power plant except electrical and other minor equipment.

As an example, major facilities equipped in KHIC's Changwon plant for manufacturing electric power equipment are as follows.

i) Machine shop

- o Area : 27,848m^2
- o Major facilities and equipment
  - Generator core line

    400 Ton punching press and others
  - Turbine blade line
  - Jig and fixture manufacturing line

ii) Heavy machine shop

- o Area : 59,706m^2
  - Machining facilities
  - Assembly and handling facilities

iii) Fabrication shop

- o Area : 35,129m^2
- o Major facilities and equipment
  - Tube machining line
  - Panel fabrication line
  - Header and high pressure piping line

iv) Heavy fabrication shop

- o Area : 46,066m^2
- o Major facilities and equipment
  - machining facilities
  - fabricating and handling facilities
  - heat treatment and inspection facilities

V) Steel foundry

- o Area : 48,126m^2
- o Major facilities and equipment
  - electric arc furnaces (30 ton, 120 ton)
  - vacuum ladle refining and holding furnace (155 ton)
  - vacuum stream degassing equipment (500 ton)
  - vacuum oxygen decarbonizing equipment (100 ton)
  - furnace resin sand preparation and reclaiming plant (60 ton/hr)
  - shot blast (20 ton, 250 ton)
  - ladle cranes (150 ton, 250 ton)
  - ingot stripping crane (350 ton)
  - mobile sand mixer (50 ton/hr)

vi) Forge shop

- o Area : 47,686m^2
- o Major facilities and equipment
  - 10,000/13,000 ton free forming press with 400 ton manipulator
  - 4,200 ton forging press with 160 ton manipulator
  - 1,600 ton forging press with 25 ton manipulator
  - electro slag remelting furnace (1,650 dia)
  - heat treatment furnaces (max. 300 ton)
  - nitrogen atmosphere controlled heat treatment furnace (50 ton)
  - vertical heat treatment furnace (20,000 depth x 3,000 dia, 250 ton)
  - roll hardening equipment (1,800 dia x 7,600 length, 80 ton)

6. Policies and strategies

a. In order to explain the major energy policy in Korea it is necessary to know the change of energy policy. As in the following there have been three different characteristic of energy policy under the period before first oil shock, the period from first oil shock to 2nd oil shock and after the second oil shock.

i) Energy policy before first oil shock

- o Non-existence of energy problem
- o High energy-consumption industry
- o No control of energy price

ii) Energy policy from 1st oil shock to 2nd oil shock

- o Priority in stable supply of required quantity
- o Necessity of transition to a low energy consumption industry
- o Government control on energy price
  - Social stabilization and industrial policy reflected in energy price
    - . Kerosene and anthracite price control
    - . Low price policy for Bunker-C oil and Naphtha
- o Realization of the need for the rational use of energy
  - . Energy saving movement (One Lamp saving campaign per house)

iii) Energy policy after 2nd oil shock

- o Require toal energy policy
  - . Establishing long & medium term policy
  - . Stronger control in demand side
  - . Stable supply of low price energy
- o Transition of industrial structure to a low energy consuming type
- o Minimization of government control on energy price
  - Extra-economic factor elimination
    - . Adjustment of anthracite briquette price to the level of production cost

. Adjusting oil price structure so as to meet the international price level

. Normalization of relative price structure among energy sources

o Practicing of the rational use of energy

. Fundmental saving plan to be actualized (innovative method)

. Systematization of energy saving movement (related financial support to be actualized. ex:energy saving fund etc.)

iv) Current Energy Policy

o Continuing economic growth on stable base
o Int'l competitiveness to be promoted
o Better quality of life

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Active adjustment to the world energy situation

o Energy conservation - Energy saving to become a habit/well planned utilization

o Stable supply

- Decrease in oil
  . More consumption of bituminous coal
  . Atomic and hydraulic energy development
  . More supply of gas
- Stable supply of oil
  . Import of low price oil
  . Oil-well exploration
  . Adquate oil stocks
- Resource exploration (domestic/overseas)
  . Supply for coal industry
  . Exploration of mineral resources
  . More development of overseas resource
- Stable supply of electricity
  . Optimum development plan of electric power
  . Better management of electric enterprise

o Development of new energy

- Introduction of advanced technology, accumulation and development of domestic technology.

b) The role of government

As explained in the relative agencies of our government the Ministry of Energy and Resources is responsible for the overall energy policy. In order to do their role they work together with the relevant agencies such as Economic Planning Board which is responsible for the national budget policy.

c) It is very hard for anybody to cover this subject. Therefore, you had better contact with our government directely.

7. Measures to be taken to increase the domestic production of electric power equipment and to improve linkages with other capital good industries means that Korea Electric Power Corporation should invest in Korea Heavy Industry & Construction Company (KHIC) in the amount of 13 million dollar as part of the scheduled investment which will be done gradually. This is due to the Government Policy that KEPCO has participated into the capital to upgrade the KHIC manufacturing technology in power plant facilities and to insure the credibilitity of KHIC in and outside the country.
KHIC is operating various plants at Changwon with a capital investment of more than 560 million dollars and produces lot of equipment for nuclear power generating plant as well as thermal and hydraulic plants.
Currently, KHIC is reinforcing its foundation for sound management under the positive support from Government

and capital participation from KEPCO. KHIC is also contacting foreign firms for possible technology agreement or joint venture to increase its capability and competitiveness in abroad. The company presently holds nine ASME manufacturing stamps including "N" and "NPT" certificates covering major components for nuclear power plants.
In addition, the plant has a steel foundry and for forging facilities with capacities up to 30,000 tons/year.
KHIC has developed expertise in the engineering of manufacturing, construction management and commissioning of nuclear power plants through direct participation.
And KHIC has strengthened and expanded the acquisition of related technology from major suppliers around the world, and now become prime contractor for the supply of power plant equipment and site construction too. In technical cooperation with world-fame companies, KHIC, to meet capacity requirements requested by the utility engineers, manufacturers and installs entire thermal power plants. However, there is no other international organization for this purpose.

8. Regarding other energy-related technologies other than electric power equipment there are so many small factories in relation with heating system such as the small size of coal and Kerosene boiler and stove industry to meet the demand mostly required by houses and buildings.