5.3.6 IMPACT OF ASIAN FINANCIAL CRISIS

The recent Asian financial crisis will mainly affect the Lao power expansion in three ways. First, the tightening of credit from foreign banks will affect the financing of large projects. Korean and Thai developers had been active in Lao PDR before the Asian financial crisis, but they are squeezed from their home base. The banks in those countries will find it difficult to finance large power projects abroad. According to the Bank of Lao, foreign investment (commitment) in power sector as well as in banking and insurance sector is zero in 1997. Investment from both countries dropped sharply in the same year.

Second, the adjustment of EGAT's load forecast could affect the medium-term demand for power export from Lao PDR. In its December 1997's Power Development Plan (PDP), EGAT lowered its load forecast by around 11% from the previous PDP (base case), and postponed its forecast for power purchase of 1,000MW from Lao PDR in FY 2003 by 3 months and delayed another 1,100MW from March 2004 to March 2006. The downward adjustment of power demand in Thailand would affect either the sales price and the amount of energy from new power projects.

Third, the adjustment of EGAT's load forecast could affect the medium-term demand for power export from Lao PDR. In its January 1999 Power Development Plan (PDP-99-01), EGAT lowered its load forecast by around 17% from the previous PDP (base case), and postponed again its forecast for power purchase of 1,600 MW (600 MW from Hong Sa No.1 & No.2) from Lao PDR in 2003 by four (4) years and delayed another 1,100MW from 2006 to 2008. This adjustment of power demand in Thailand, on top of the previous downward adjustment of 11%, would affect either, or both, the sales price and the amount of energy from new power projects.

The East Asian currency crisis has also affected EDL, the state-owned power company, and its ability to expand its power generation capacity. The exchange rate for Kips depreciated from 1,131.9Kip/US$ in June 1997 to 3,410.5Kip/US$ in June 1998. Kips also depreciated against Bahts as Asian investors pulled their money out of Lao PDR. This has dramatically increased EDL's cost of debt and debt service, which are denominated in non-Baht foreign currencies.

5.4 POWER MARKET IN THAILAND

5.4.1 POTENTIAL OF POWER RESOURCES IN THAILAND

The hydroelectric potential in Thailand is estimated at about 15,155MW. Presently, only 3,873.7MW of hydropower capacity or 25.56% of the total potential are being exploited. Among the 3,873.7MW exploited, 1,000MW are under construction, and the rest has been in operation. Because of environment constraints, further development of hydropower is difficult. Only a few small projects will be feasible. Pumped-storage projects will be the most competitive option to peaking gas turbine in the future.

The recoverable reserves of natural gas have been estimated at about 29.3TCF, most of which are

located in the off-shore gas fields in the Gulf of Thailand. About 4.0TCF have been used in the power industry.

Crude Oil and Condensate are not major parts of the country's energy reserve, and are difficult and costly to develop.

The total reserve of lignite is estimated at about 2,480 millions tons. (1,408 million tons at Mae Moh, 120 million tons at Wian Haeng, 120 million tons at Krabi, 35 million tons at Ngao, 25 million tons at Mae Ta, 62 million tons at Chiang Muan, 100 million tons at Mae Ramad, 91 million tons at Sin Pun, and 350 million tons at Saba Yoi). EGAT has already developed 2,625MW of power from the lignite at Mae Moh.

Due to environmental restriction and opposition from the local people, new lignite-fired power projects have not been incorporated in the current power development plan.

The alternative power source could come from combined cycle units using natural gas, thermal power plants using low sulfur coal, units using imported heavy fuel oil as a back-up fuel for gas, especially for steam power plants, and power stations using domestic lignite.

Combined cycles are the best option because they are environmentally friendly and efficient. The lowest cost form of generation for Thailand is gas-fired, combined cycle. However, not enough gas can be imported in the short to medium term, in spite of contracts and MOUs with the neighboring countries.

Using imported coal should become a medium and long-term option, yet use of coal will have high impact on the environment even with modern fluid gas treatment. Imported hydropower could be from Lao PDR, Myanmar, Yunnan province of China, and Vietnam.

5.4.2 FORECAST OF ELECTRICITY DEMAND IN THAILAND

(1) Existing Power Sources

Among more than 40 power plants with a total capacity of 19,082MW operated by EGAT and IPPs, 2,874MW or 15.1% is from hydropower plants, 6,518MW or 34.2% is from thermal (oil/gas/lignite power), 5,074MW or 26.6% is from combined-cycle, 892MW or 4.7% from gas turbine and diesel, and 3,725.1MW or 19.5% from IPP, SPP, and power import from Lao PDR (as shown in Table 5.4.1). As of September 1999, the power purchase from IPP totaled 2,056MW and SPP 1,343MW.

Table 5.4.1 Existing Power Plants in Thailand

No.	Power	FY1998		FY1999	
		MW	%	MW	%
1.	Hydropower Plants	2,873.7	15.8%	2,873.7	15.1%
2.	Thermal Power Plants	6,517.5	35.9%	6,517.5	34.2%
3.	Combined Cycle Power	5,073.6	27.9%	5,073.6	26.6%
4.	Gas / Diesel Power Plants	892.0	4.9%	892.0	4.4%
5.	IPP/SPP/Import from Laos	2,817.7	15.5%	3,725.1	19.5%
Total		18,174.5	100.0%	19,081.9	100.0%

Source: EGAT (PDR 99-01, January 1999)

(2) Present Power and Energy Demand

The power generation demand of Thailand reached 90,414GWh in the fiscal year 1999. The consumption was largely 50% in the industrial sector, followed by 23% in the residential sector, and 22% in the commercial sector.

Energy consumption demonstrated rapid growth during the past 10 years. With the Asian economic crisis, however, energy consumption declined against the levels in previous years, both in 1997 and 1998. In 1998 peak power fell by 2.25% against the previous year, followed by a decline of 3.3% in 1999. Electricity generation also fell by 0.64% and 1.87% in these respective years.

Figure 5.4.1 shows monthly trends for peak power during the three years from 1997 through 1999. From the middle of 1999 peak demand began to grow, and from August of that year exceeded the levels of the past two years. EGAT has projected a strong recovery during 2000, and an increase in peak demand of 7.65 % against the previous year during fiscal 2000 (October 1999 through September 2000), up to 14,762 MW. This projected demand is based on 4.0 to 4.5% growth in GDP during the year 2000, as predicted by the Bank of Thailand.

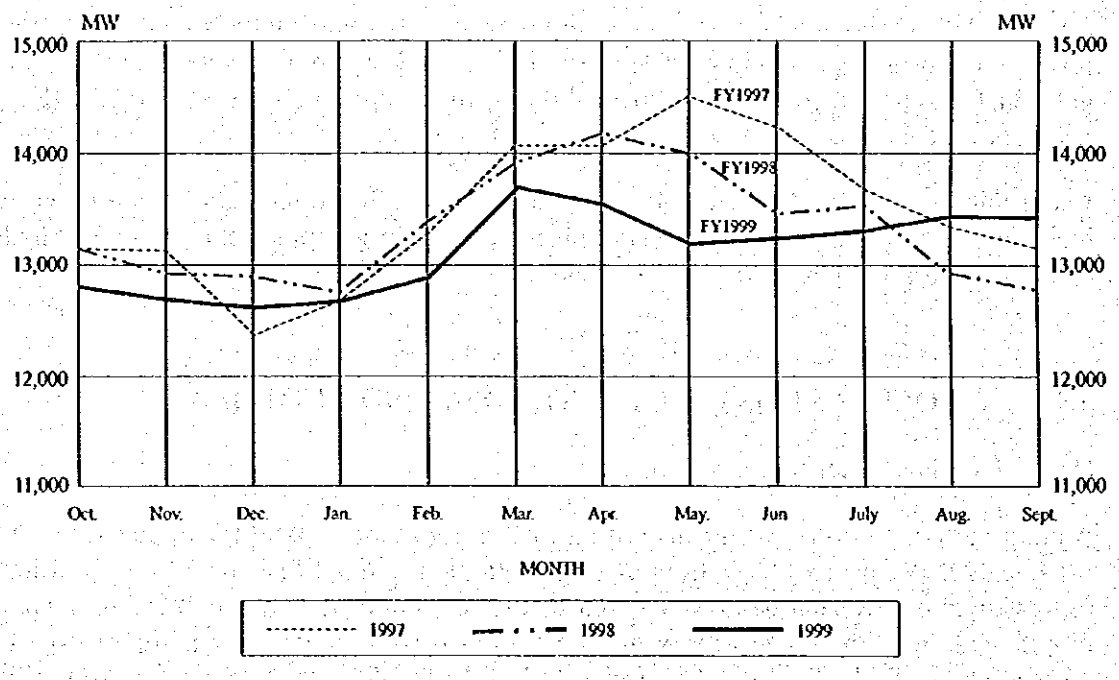
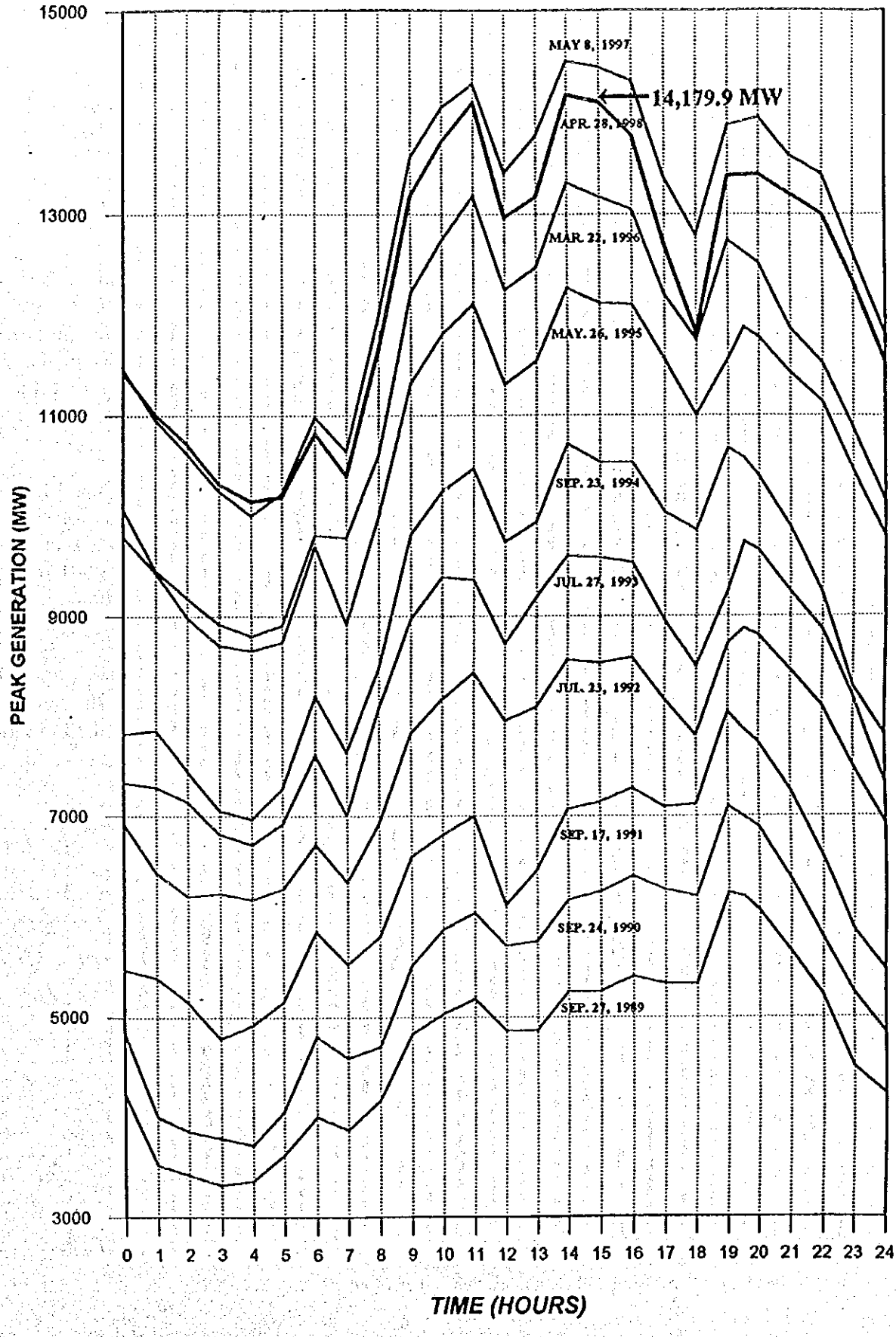


Figure 5.4.1 Monthly Trends in Peak Demand (FY 1997 to 1999)

The daily load curves on a peak day for past 10 years in Thailand is shown in Figure 5.4.2.

(3) Future Increase of Electricity Demand

According to the latest power development plan (revised PDP99-01) as shown in Table 5.4.2, EGAT has reduced the requirement for the installed capacity by 5,600MW between FY1999 to FY2011. The Houay Ho HEPP (126MW) commenced to deliver power in September 1999. But, in EGAT's plan, the total power purchase from Lao PDR was postponed by several years. Between the year 2002 and 2006, there will not be any new projects for power import from Lao PDR due to various reasons.



FEASIBILITY STUDY ON THE NAM NGIEP-1 HYDROELECTRIC POWER PROJECT IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC JAPAN INTERNATIONAL COOPERATION AGENCY	Figure 5.4.2 Daily Load Curves on Peak Day for Past 10 years in Thailna

Table 5.4.2 Peak Demand Under PDP 99-01

National Economic & Social Develop. Plan	5-Year Plan	Start Year (MW)	End Year (MW)	Increased (MW)	Increased (%)
8th NESDP	1997-2001	13,311	16,214	2,903	4.02
9th NESDP	2002-2006	16,214	22,168	5,954	6.46
10th NESDP	2007-2011	22,168	30,587	8,419	6.65

Source: EGAT (Revised PDR 99-01, January 1999)

In PDP97-02, EGAT had predicted the purchase of power from Hong Sa No.1 and No.2 Thermal Plant (2x304MW) and an unspecified power purchase of 1,000MW from Lao PDR in 2003, and 1,100MW in 2006. The new power development plan envisions a lump-sum purchase of 1,600MW from Lao PDR in 2006 and 1,700MW in 2008. The new plan actually increases the capacity requirement from Lao PDR, up 592MW from the PDP92-02 plan, except that it pushed the original purchase by several years. The impact of this change has yet to be studied for the Nam Theun 2 HEPP.

The Thai Load Forecasting Subcommittee (TLFS) has jurisdiction for power demand forecasts. In September 1999 TLFS made demand forecast on the basis of three scenarios for economic recovery, rapid, moderate and low. The results are presented in Tables 5.4.3 and 5.4.4. According to these forecasts, peak demand will grow by 4 % per year through 2001 under the moderate recovery scenario, which is the basic scenario taken for predictions, and will subsequently increase by 6.5% per year from 2002 through 2006.

TLFS made a similar power demand forecast one year before in September 1998. Figure 5.4.3 combines the three scenarios predicted (RER, MER, and LER) with the actual values achieved. According to NEPO both peak demand and power consumption have in general followed the moderate scenario (MER) although there were seasonal fluctuations.

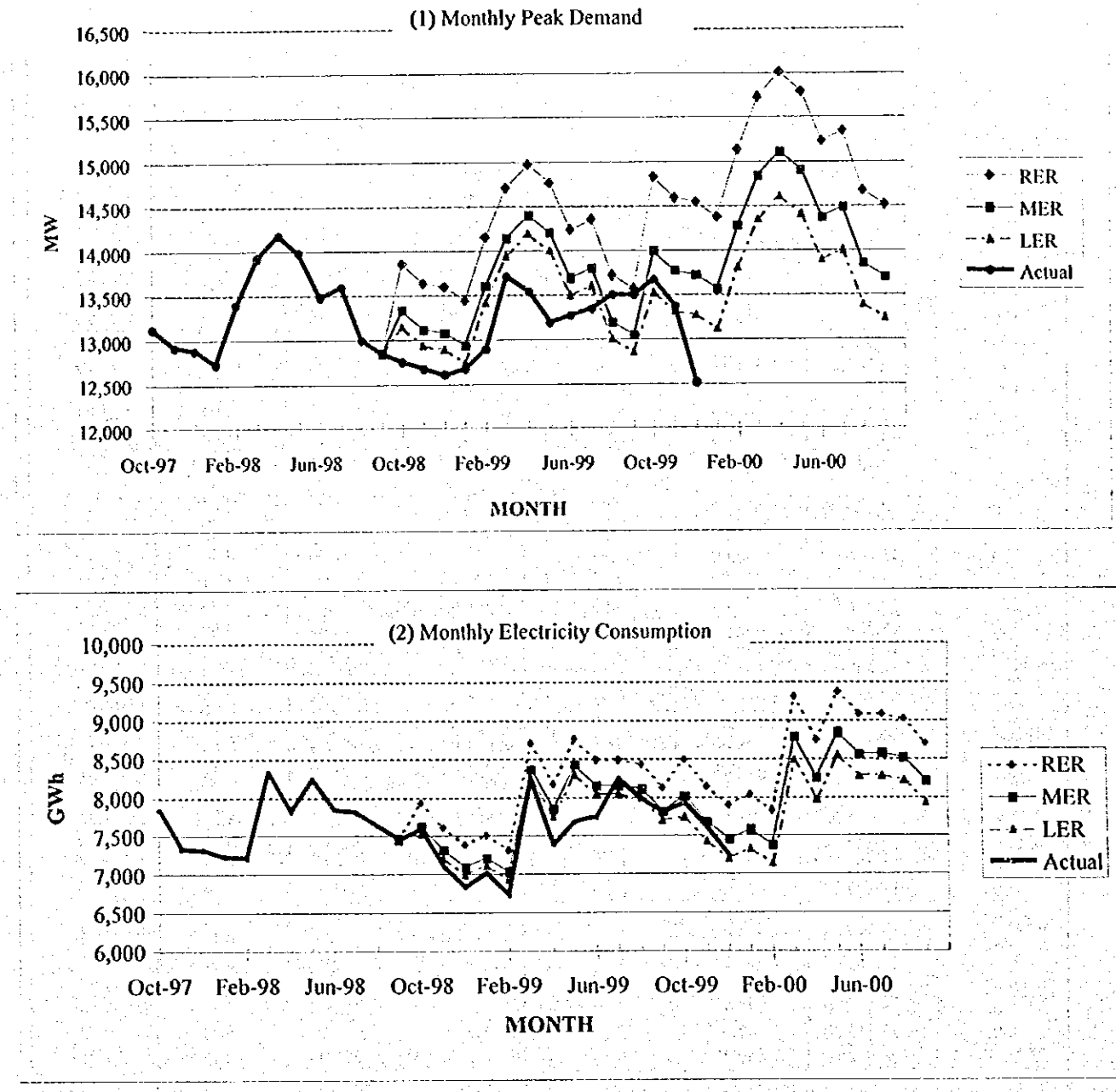
Table 5.4.3 EGAT Averaged Generation Requirements

Fiscal Year	Peak Demand			Energy Generation			Load Factor
	MW	Increase		GWh	Increase		
		MW	%		GWh	%	%
Actual							
1987~1991	-	772.82	13.99	-	4,889.10	14.71	-
1992~1996	-	1,053.18	10.60	-	7,339.82	11.79	-
Forecast	(Slow	Economic	Recovery case)				
1997~2001	-	417.42	2.96	-	2,436.77	2.69	-
2002~2006	-	813.80	4.80	-	4,929.60	4.58	-
2007~2011	-	1,296.80	5.92	-	8,325.00	6.01	-
Forecast	(Moderate	Economic	Recovery case)				
1997~2001	-	580.62	4.02	-	3,552.17	3.83	-
2002~2006	-	1,190.80	6.46	-	7,523.00	6.39	-
2007~2011	-	1,683.80	6.65	-	10,726.00	6.65	-
Forecast	(Rapid	Economic	Recovery case)				
1997~2001	-	888.52	5.37	-	5,454.26	5.34	-
2002~2006	-	1,534.40	7.62	-	9,980.60	7.68	-
2007~2011	-	2,051.60	7.13	-	13,323.00	7.16	-

(Source)Thailand Load Forecasting Subcommittee, September 1999

Table 5.4.4 EGAT Generation Requirements

Fiscal Year	Peak Demand			Energy Generation			Load Factor
	MW	Increase		GWh	Increase		%
		MW	%		GWh	%	
Actual	(1987-1999)						
1987	4,733.90	553.00	13.23	28,193.16	3,413.63	13.78	67.99
1988	5,444.00	710.10	15.00	31,996.94	3,803.78	13.49	67.09
1989	6,232.70	788.70	14.49	36,457.09	4,460.15	13.94	66.77
1990	7,093.70	861.00	13.81	43,188.79	6,731.70	18.46	69.50
1991	8,045.00	951.30	13.41	49,225.03	6,036.24	13.98	69.85
1992	8,876.90	831.90	10.34	56,006.44	6,781.41	13.78	72.02
1993	9,730.00	853.10	9.61	62,179.73	6,173.29	11.02	72.95
1994	10,708.80	978.80	10.06	69,651.14	7,471.41	12.02	74.25
1995	12,267.90	1,559.10	14.56	78,880.37	9,229.23	13.25	73.40
1996	13,310.90	1,043.00	8.50	85,924.14	7,043.77	8.93	73.69
1997	14,506.30	1,195.40	8.98	92,724.66	6,800.52	7.91	72.97
1998	14,179.90	-326.40	-2.25	92,134.44	-590.22	-0.64	74.17
1999	13,712.40	-467.50	-3.30	90,413.99	-1,720.45	-1.87	75.27
Forecast	(Slow	Economic	Recovery case)				
2000	14,762.00	1,049.60	7.65	94,570.00	4,156.01	4.60	73.13
2001	15,398.00	636.00	4.31	98,108.00	3,538.00	3.74	72.73
2002	16,150.00	752.00	4.88	102,429.00	4,321.00	4.40	72.40
2003	16,892.00	742.00	4.59	106,947.00	4,518.00	4.41	72.27
2004	17,746.00	854.00	5.06	111,736.00	4,789.00	4.48	71.88
2005	18,588.00	842.00	4.74	116,980.00	5,244.00	4.69	71.84
2006	19,467.00	879.00	4.73	122,756.00	5,776.00	4.94	71.98
2007	20,575.00	1,108.00	5.69	129,738.00	6,982.00	5.69	71.98
2008	21,861.00	1,286.00	6.25	137,996.00	8,258.00	6.37	72.06
2009	23,286.00	1,425.00	6.52	146,979.00	8,983.00	6.51	72.05
2010	24,671.00	1,385.00	5.95	156,032.00	9,053.00	6.16	72.20
2011	25,951.00	1,280.00	5.19	164,381.00	8,349.00	5.35	72.31
Forecast	(Modelate	Economic	Recovery case)				
2000	15,254.00	1,541.60	11.24	97,858.00	7,444.01	8.23	73.23
2001	16,214.00	960.00	6.29	103,685.00	5,827.00	5.95	73.00
2002	17,308.00	1,094.00	6.75	110,436.00	6,751.00	6.51	72.84
2003	18,399.00	1,091.00	6.30	117,341.00	6,905.00	6.25	72.80
2004	19,611.00	1,212.00	6.59	124,532.00	7,191.00	6.13	72.49
2005	20,818.00	1,207.00	6.15	132,228.00	7,696.00	6.18	72.51
2006	22,168.00	1,350.00	6.48	141,300.00	9,072.00	6.86	72.76
2007	23,728.00	1,560.00	7.04	151,322.00	10,022.00	7.09	72.80
2008	25,450.00	1,722.00	7.26	162,438.00	11,116.00	7.35	72.86
2009	27,232.00	1,782.00	7.00	173,532.00	11,094.00	6.83	72.74
2010	28,912.00	1,680.00	6.17	184,213.00	10,681.00	6.16	72.73
2011	30,587.00	1,675.00	5.79	194,930.00	10,717.00	5.82	72.75
Forecast	(Rapid	Economic	Recovery case)				
2000	16,037.00	2,324.60	16.39	103,709.00	13,295.01	14.70	73.82
2001	17,286.00	1,249.00	7.79	111,475.00	7,766.00	7.49	73.62
2002	18,678.00	1,392.00	8.05	120,148.00	8,673.00	7.78	73.43
2003	20,042.00	1,364.00	7.30	129,080.00	8,932.00	7.43	73.52
2004	21,597.00	1,555.00	7.76	138,647.00	9,567.00	7.41	73.28
2005	23,223.00	1,626.00	7.53	149,439.00	10,792.00	7.78	73.46
2006	24,958.00	1,735.00	7.47	161,378.00	11,939.00	7.99	73.81
2007	26,950.00	1,992.00	7.98	174,490.00	13,112.00	8.13	73.91
2008	29,021.00	2,071.00	7.68	188,005.00	13,515.00	7.75	73.95
2009	31,090.00	2,069.00	7.13	200,949.00	12,944.00	6.88	73.78
2010	33,132.00	2,042.00	6.57	214,215.00	13,266.00	6.60	73.81
2011	35,216.00	2,084.00	6.29	227,993.00	13,778.00	6.43	73.91



(Source) NEPO

Figure 5.4.3 Comparison of Three Scenarios and Actual Demand for Monthly Peak Power

5.4.3 POWER IMPORT PLAN OF THAILAND

The recent finished the Nam Theun 2 HEPP Study drew the following conclusions:

(i) Apart from lignite, Thailand has insufficient energy resources to meet to its own needs. Yet, the development of the lignite-based power plants has not been included in the power development plan, because of their environmental constraints.

(ii) The cheapest and environmentally friendly form of generation for Thailand is gas-fired, but not enough gas in the neighboring countries can be imported in the short to medium term.

(iii) That leaves the next choice, imported coal. With its stable price and supply, coal is very attractive and could be imported from probably Indonesia or Australia. The generation cost for a major coal plant is in the order of 5.0-6.0USc/kWh. The negative environmental impact of coal fired power plants, however, implies that any addition of coal fired power plants has to be complemented with hydropower from Lao PDR in the medium-to-long term.

(iv) In its latest PDP, EGAT has planned to purchase additional 3,300MW from Lao PDR by the year 2008. At the same time, domestic consumption would increase by 12% per year and would require an additional 334MW between the year 2001 and 2009. According to the current Lao project pipeline to be exported to Thailand, the combined capacity would be around 2,681MW, excluding projects scheduled to export power to Vietnam.

(v) In current EGAT's fuel mix, hydropower accounts for 16.9% in capacity and 5.2% in energy, including hydropower import from Lao PDR. Based on Table 5.4.5, hydropower will not increase as fast as imported coal and gas. In the additional 4,500MW under the Yet-to-be-Determined category, EGAT basically has to choose between imported coal and imported hydropower, since natural gas and other fuel's availability are not yet clear.

Table 5.4.5 Power Capacity Increase in Thailand (1999-2011)

	Coal	Gas	Oil	Hydro	Yet-to-be-Determined
Addition Power (MW)	5,089	5,878	1,035	4,488	4,500
% of Total Addition	24.2%	28%	4.9%	21.4%	21.4%

Source: EGAT, PDP 99-01, January 1999

(vi) Therefore, to maintain the existing share of hydropower in the whole power mix and to mitigate negative environmental affect of thermal power, Thailand needs to continue, and possibly, expand its current commitment of power purchase from Lao PDR.

5.4.4 REASSESSMENT OF ECONOMIC GROWTH IN WAKE OF CURRENCY CRISIS

(1) Recovery of Thai Economy

Slightly more than two years have passed since the Asian currency crisis in later 1997, and the countries of Southeast Asia are recovering more rapidly than expected. The recovery in Thailand has been particularly striking since the start of 1999. NESDB announced that Thailand had a growth rate of 0.8% in the first quarter of 1999 when compared to the same quarter of the previous year. This was followed by a 3.5% growth rate in the second quarter and a 7.7% growth rate in the third quarter. According to estimates by the Bank of Thailand, the country had negative growth of 1.8% in 1997 and negative growth of 10% in 1998. In contrast real GDP grew 4.0% in 1999 and has been expected to continue at the same rate in 2000. However, at the end of January 2000, the focussed GDP in 2000 was changed upward from 4.0% to 4.4%.

The rapid pace of Thailand's economic recovery occurred because of structural reforms put in place both by the government and by the private sector, to address a crisis which was far worse

than that faced by Japan. In the short term the government of Thailand worked to stabilize the country's economy and to achieve reliable economic growth. For long term programs the government put in place fiscal stimulus measures, as well as policies to address structural issues. The policies involving structural issues included economic reforms such as (i) financial sector reform, (ii) industrial restructuring, (iii) improvement of competitiveness and efficiency and (iv) implementing a variety of legal regulations concerning economic reform, as well as (v) political reform through enactment of a new constitution, (vi) reform of the public sector to improve efficiency and transparency, and (vii) educational reform. Although these measures will take time, they constitute a commitment by the government to take action in order to achieve future success. The country has succeeded in recovering economic stability, and restoring some trust in its economy. Most key economic indicators such as the budget balance, the manufacturing production index and the export growth rate are also showing improvement (see Table 5.3.6). Foreign reserves are increasing steadily, the exchange rate has been stabilized, and inflation has been held to an acceptable level.

With increased stability in the economy, the Thai government has turned its attention to stimulation to restore economic growth as soon as possible, and to building a foundation for sustainable growth in the economy. The government determined two economic stimulus packages in 1999. In March the government announced an important package that consisted of three elements, an increase of 5.3 billion Bahts in government spending, tax incentives consisting of a reduction in value added tax rates and cuts in personal income taxes, and a program to reduce energy prices. The government targeted the timing for this first package to coincide with the bottoming out of the economy, and the package made a very substantial contribution to subsequent economic recovery. It was therefore well received as a program which gave support to allowing the economy to recover self-sufficiency. In August the Thai government announced their second package, which consisted of assistance to the manufacturing sector and an additional economic stimulus measures. Component programs included reduction of import duties levied on machinery and raw materials, credit assistances, a recovery program for the real estate industry, and a financial restructuring program for SMEs.

On December 30, 1999, the Bank of Thailand made its monthly economic report and announced projections for the year 2000, at which time the bank predicted that GDP growth in 2000 would be 4.0% or almost the same as that estimated for 1999. Continued growth in exports would be the driving force for the economy, and new loans from banks also implied substantial improvement, particularly among SMEs. While it is still not clear whether or not the country is developing a strong economic base, the economic recovery appears to be well on its way.

Even though the Thai economy has begun to recover, however, time is still required for a true economic recovery to occur. Recovery began first in certain sectors of the economy, and there are substantial differences in the extent of the recovery depending on the sector. Nevertheless the economy is steadily expanding, and employment and consumption can be expected to improve, although one cannot expect the high growth that occurred during the bubble period. The World Bank and the IMF estimate that the economic growth rates will not be more than 5% during the next 4 to 5 years in the countries of Southeast Asia who experienced the economic crisis, including Thailand. The main challenge is to maintain the economic recovery and to achieve balanced and stable growth within the Thai economy. The Government of Thailand has made a firm commitment to meeting this challenge, and thus new development in the Thai economy can be expected as we move into the next millennium.

(2) Recovery of Electricity Consumption in Thailand

The economy of Thailand has shown strong signs of recovery since the middle of 1999. Beginning with the industrial sector business activity has grown in almost all sectors of the economy. With these developments energy consumption also began to increase from the mid-1999. During 1998 energy consumption fell by 2.2% below the previous year. Energy consumption continued to show negative growth from January through July 1999, but in August changed to positive growth of 5.9%, followed by growth of 7.2% in September, 5.3% in October, and 7.8% in November. Consequently, the energy consumption in 1999 is expected to exceed 1998 levels, and the energy consumption in 2000 is also expected to increase 11.24% from the last year's consumption.

Table 5.4.6 Key Economical Indicators in Thailand

No.	Key Economic Indicators	1998 Actual	1999 Estimate	2000 Forecast	1999 1st Half	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1.	Real GDP (% change from last year)	▲10.4%	4.0%	4.4%	1Q:0.8% 2Q:3.5%	3Q:7.7%			-	-	-
2.	Budget Balance (% of GDP)	▲3.0%	▲5.5%	▲5.0%	-	-	-	-	-	-	-
3.	Manufacturing Production Index (% change from last year)	▲10.0%	-	-	6.5%	14.6%	17.3%	15.4%	14.2%	20.6%	-
4.	Private Invest. Index (% of change from last year)	▲23.6%	-	-	▲14.5%	▲10.9%	▲9.0%	▲7.0%	▲5.0%	▲3.0%	-
5.	CPI (% change from last year)	8.1%	0.3%	2.4%	1.1%	▲1.1%	▲1.1%	▲0.8%	▲0.5%	0.0%	0.7%
6.	Balance of Payment		(Unit: Bil.US$)								
6-1	Export	52.9	56.6	-	26.38	4.88	4.86	4.95	5.33	5.15	-
	(% change from last year)	▲6.8%	7.0%	7.4%	0.7%	7.2%	15.0%	10.8%	18.7%	17.6%	-
6-2	Import	40.6	47.4	-	21.59	3.92	4.12	4.29	4.48	4.68	-
	(% change from last year)	▲33.8%	16.7%	16.7%	5.4%	9.1%	25.0%	33.1%	31.7%	40.1%	-
6-3	Trade Balance	12.2	9.2	-	4.79	0.96	0.74	0.64	0.85	0.47	-
6-4	Current Account	14.3	11.3	7.9	6.01	1.19	0.90	0.71	1.02	0.57	-
6-5	Capital Account	▲9.6	▲10-▲12	-	▲2.97	▲0.96	▲0.83	▲1.13	▲-0.95		-
6-6	Overall Balance	1.7	4.3	-	2.43	0.07	0.02	-0.19	0.02	0.32	-
6-7	Foreign Reserves	29.5	32~34	-	31.4	31.9	32.2	32.4	32.4	32.8	-
6-8	External Debt	86.1	75.6	-	-	80.3	80.0	-	-	-	-

Source: Bank of Thailand

5.5 POWER MARKET IN VIETNAM

5.5.1 GENERAL

Vietnam occupies an S-shaped ribbon of land that runs down the eastern coast of Indochina. It covers a land area of 330,000km^2 and has a 3,400km coastline on to the South China Sea and the

Gulf of Thailand. To the northern Vietnam shares a 1,280km border with China while to the west it borders Lao PDR for 1,560km and Cambodia for 980km. From north to south the country measures 1,650km.

The country is divided into two broad regions, one to the north and the other to the south, joined by a narrow strip in the centre. To the north is the delta of the Red River which flows from China through Vietnam to the sea. The capital, Hanoi, lies in the heart of the delta. To the south is the Mekong delta, and in its midst lies Ho Chi Minh City (formerly Saigon).

The two delta regions are heavily cultivated but elsewhere the country is hilly or mountainous. Natural resources include phosphates, manganese, bauxite and chromate. There is also coal and offshore oil and gas.

The population of Vietnam was 75.5 million in 1998 and the annual average growth rate was 1.66% (1994-98). Between 85% and 90% of the people are Vietnamese. The remainders are Chinese, Thai, Meo, Khmer, Hmong and Cham. Religious beliefs are equally diverse, including Buddhist, Taoist, Christian and Moslem.

Vietnam is a communist state and is divided into 57 provinces and 4 urban authorities. The head of state is the president and the Prime Minister heads the government. The cabinet is proposed by the Prime Minister and approved by the President. There is a single house national assembly comprising 450 seats. All members belong to, or are approved by the Vietnam Communist party, the only political party in the country.

Vietnam started to move away from a centrally planned economy and towards a market-based system in 1986. Since then growth has been significant. The process was accelerated in 1989 with the devaluation of the dong and the decontrolling of most prices. In 1994 the US lifted its embargo, freeing trade further.

As a result, the economy has sprung to life, with growth of 8 to 9% from 1992 to 1997. The economy growth slowed down to 5.8% in 1998 and 5% in 1999 due to Asian economy crisis. However it will recover to 6.0% in 2000 and onward as investment picks up and neighboring Asian economies gain strength. The per capita GDP in 1998 was US$360.

The Vietnamese economy has depended heavily on three products, namely, textiles/garment, oil and rice, which together accounted for nearly 40% of export earnings in 1998. However, the industrial sector is still dominated by uncompetitive state owned enterprises, although smaller companies, growing up in the south around Ho Chi Minh City, are doing better.

The government intends to develop both oil and gas industries, with plans to build major refineries and gas processing plants. It is trying to develop the electricity industry with the help of foreign investment and private sector participation.

However, institutional factors remain a handicap. Vietnam has also joined ASEAN, bringing it into much closer contact with Thailand, Singapore, Malaysia, Indonesia, the Philippines and Brunei.

5.5.2 STRUCTURE OF POWER SECTOR

The energy sector in Vietnam is under government control and in the 1980s the Ministry of Energy was the key government agency in charge of electricity. It oversaw three power companies, Power Company No 1, No 2 and No 3, operating in the three regions (north, central and south) of Vietnam.

Traditionally these power companies operated as government departments but in 1991 they were given greater autonomy. The government strategy is eventually to corporatise them so that they can operate along commercial lines.

In a further move to reform the institutional nature of the electricity industry, the power sector was restructured in 1995 with the help of the World Bank. As a result Electricity of Vietnam (EVN) was established on April 1, 1995. EVN is a government agency but not part of the Ministry of Energy and much of the work formerly carried out by the ministry is now devolved to EVN. With this change the Ministry of Energy disappeared and the Ministry of Industry (MOI) took over supervisory function of EVN.

EVN is responsible for five power companies: the three established organizations in Hanoi, Ho Chi Minh City and Danang, and two new companies, the Power Company of Hanoi and the Power Company of Ho Chi Minh city. It also oversees four power construction companies (Nos 1, 2, 3, and 4) and four transmission companies. In addition, EVN has taken responsibility for 12 power stations.

By early 2000, the power sector will be evolved to the situation where EVN is autonomous, under the eye of a regulatory commission. The reform plan envisages EVN as the sole or key buyer of power generation over the short and medium term. Competition will be encouraged in upstream generation, with a 20% target for private generation over the medium term. Transmission will remain the responsibility of EVN but will be regulated by an independent agency. EVN's distribution functions will gradually be equitized through diversified ownership of assets. Transmission and distribution will be separated as profit centers, and balance sheets will be independently audited. For implementing the reform an electricity law is required.

In mid-1996 the government began drafting an Electricity Law and supporting regulations. The draft law defines regulatory functions, functions of other government agencies, principles to guide the formation of a regulatory agency, procedures and requirements for licensing sector operations by function (generation, transmission, bulk supply, distribution, retail supply), rights and obligations of licensed operators, and principles for setting and approving tariffs. Detailed implementing regulations are being drafted in parallel. The law is expected to be passed in 2000. To supplement the law, secondary legislation will need to be drafted covering the scope and structure of the regulatory agency, procedures for setting and regulating tariffs, and administrative regulations and standards.

5.5.3 POTENTIAL OF POWER RESOURCES IN VIETNAM

Vietnam has significant energy resources. These include hydropower, coal, oil and gas. The government intends to exploit all four to increase the country's generating capacity.

(i) Hydropower

Vietnam has considerable hydropower potential; around 75% of the county is covered by hills and highlands and average rainfall is 1,500mm. According to an ADB study, gross theoretical hydropower reserves in the country amount to 300,000GWh/year. Divided between the regions, the north has 181,000GWh, the central region 89,000GWh and the south 30,000GWh.

Of this theoretical total, 82,000GWh is estimated to be economically exploitable. This equates to an installed generating capacity of 15,600MW. Out of them, a JICA study in 1993-95 ranked 18 projects with a combined capacity of 7,570MW.

(ii) Natural gas

Vietnam has potential non-associated gas reserves of more than 360 billion m^3. Proven associated gas reserves are on the order of 57 billion m^3. Though undeveloped, this resource has the potential to be the main fuel for Vietnam's power sector – avoiding excessive reliance on more polluting fossil fuels.

(iii) Coal

Vietnam's primary coal resource, anthracite, is concentrated in Quang Nihh Province, which has potential recoverable reserves of 7-8 billion tons – of which 600 million tons are shallow (within a depth of 100m). Anthracite coal is in demand by the metallurgical industry, and exports have reached 3.6 million tons a year, from 0.6 million tons in 1990. Vietnam now accounts for 40% of global exports of anthracite coal.

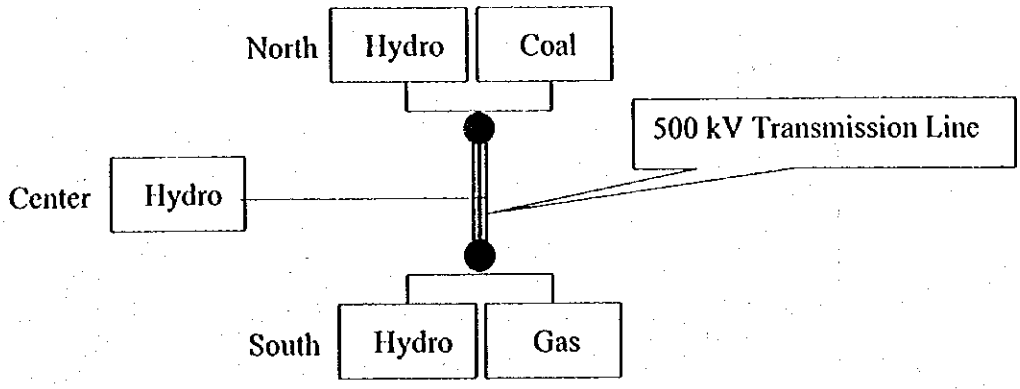
(iv) Petroleum

Potential crude oil reserves in the southern offshore area stand at about 270 million tons and are likely to increase substantially with continued exploration. Production is about 9 million tons.

With only 15% of Vietnam electrified in 1995, according to the World Bank, fuelwood inevitably plays a major role in energy supply. WEC figures suggest that the country has nearly 10m ha of productive forest and harvests 21,000m^3 of fuelwood each year.

The potential for solar power, wind power and geothermal power in Vietnam is unknown. However, geothermal resources are known to exist.

Vietnam's power sector has a regional character due to the geographic distribution of resources and the country's long, narrow shape (Fig. 5.5.1). In the north the system is dominated by hydropower, but there are also significant reserves of coal, the country's second most important fuel for power generation (Table 5.5.1). The fast-growing south has hydro capacity as well but also has had to rely on diesel-fired generation. However, the offshore gas fields of Bach Ho and Nam Con Son provide the south with a growing share of natural gas for power generation. The central region has the smallest population and limited installed capacity in hydro and diesel-fired generation; in the medium term it will increase its hydro generation and supply much of it to the south.



Source: World Bank

Fig 5.5.1 Characteristics of Vietnam's Power System

Table 5.5.1 Electricity generation by region, 1996

(Unit:1,000GWh)

No.	Type	North	Center	South	Total
1.	Hydro	7.7 (65%)	0.3 (3%)	3.8 (32%)	11.8 (100%)
2.	Thermal	2.4 (47%)	0.2 (4%)	2.5 (49%)	5.1 (100%)
3.	Net regional imports	-2.9 (Exp.)	0.9 (Imp.)	1.9 (Imp.)	0.0
	Total	7.2 (43%)	1.4 (8%)	8.2 (49%)	16.9 (100%)

Source: World Bank

5.5.4 POWER DEVELOPMENT PROGRAM IN VIETNAM

(1) Current Status of Electric Power System in Generation Facilities

The total installed capacity operated by EVN and IPPs is 5,134MW and 425MW respectively (as of end of 1999), with a total of 5,559MW (see Table 5.5.2). The available capacity is around 5,130MW of which 55% hydropower, 24% thermal power and 21% gas turbine & diesel. In 1999 the electricity generation was around 23,740Gwh, of which hydropower shared 51%, thermal 26% and gas turbine & diesel 23%. The location of major power station is shown in Figure 5.5.2.

Table 5.5.2 Vietnam's Existing Power Generation Facilities, 1999

(Unit: MW)

No.	Type	Name of Plant	Installed Capacity
1.	Hydropower	1.Hoa Binh	1,920
		2. Thac Ba	108
		3. Da Nhim	160
		4. Tri An	400
		5. Thac Mo	150
		6. Vinh Son	66
		7. Small Hydro	2,854
		Sub-total	2,854
2.	Thermal		
	Coal	1. Pha Lai	440
		2. Uong Bi	110
		3. Ninh Binh	100
	Oil	4. Thu Duc	165
		5. Can Tho	33
		6. Hiep Phnoc (IPP)	375
		Sub-total	1,223
3.	Gas Turbine	1. Ba Ria	271
		2. Phu My 2.1	568
		3. Thu Duc	128
		4. Can Tho	75
		Sub-total	1,042
4.	Diesel	1. EVN plants	390
		2. IPP (Nomura)	50
		Sub-total	440
Ground-total			5,559

Source: EVN Institute of Energy

The record of peak demand and electricity generation in the latest 5 years (1995-1999) is as shown in table 5.5.3. The annual average growth rates for this 5-year period were 10.9% for peak demand and 12.9% for electricity generation.

Since the average GDP growth rate during the period was 8.0%, the resulting elasticity of electricity generation to GDP growth rate was 1.61.

Table 5.5.3 Electricity Demand for 1995-1999

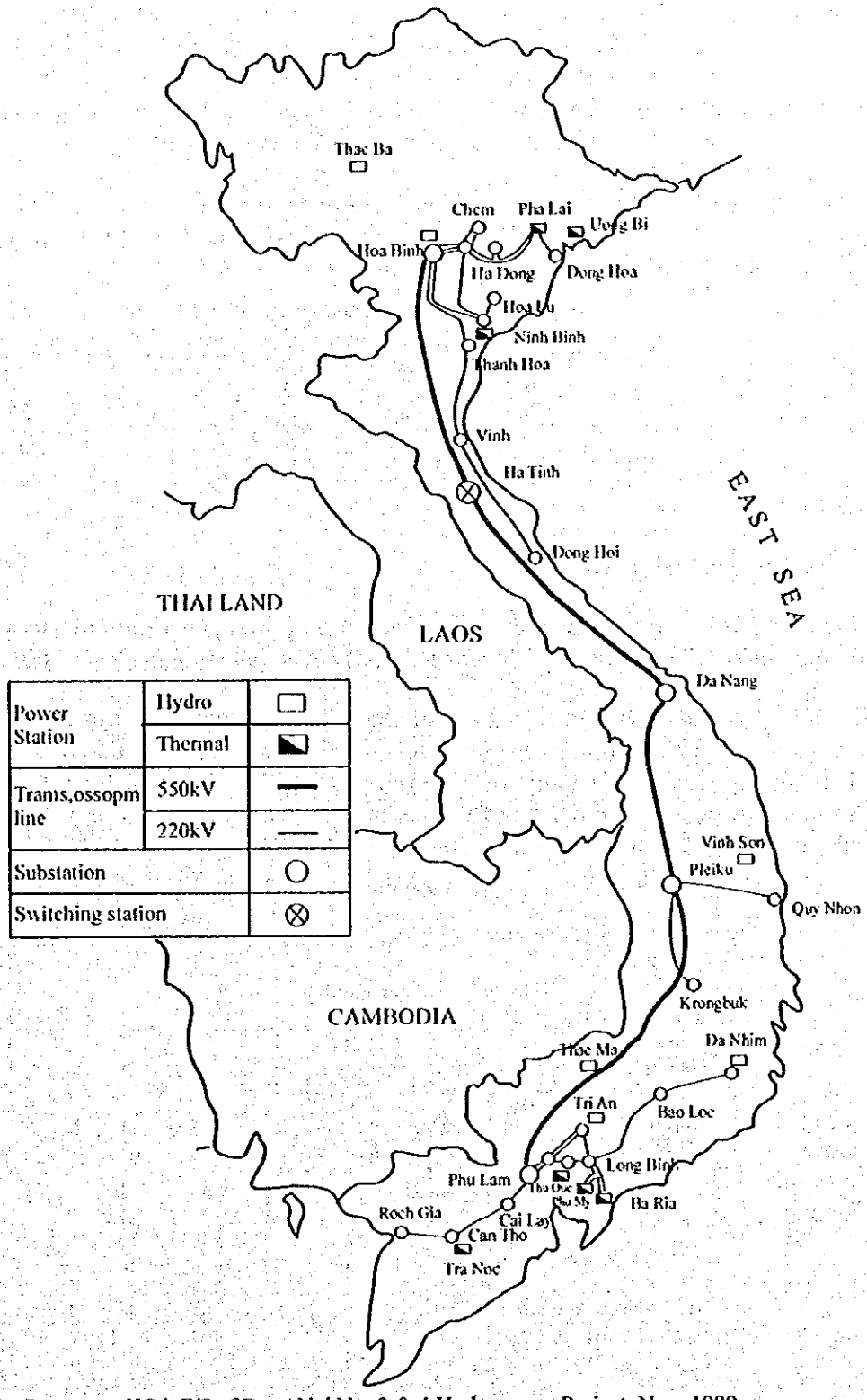
Electricity Demand	Unit	1995	1996	1997	1998	1999	Annual Growth Rate (%)
Electricity Consumption	GWh	11,186	13,374	15,305	17,739	19,592	15.0
Electricity Generation	GWh	14,636	16,960	19,151	21,654	23,740	12.9
Peak Demand	MW	2,774	3,177	3,582	3,875	4,200	10.9

(2) Transmission and Distribution Facilities

Transmission voltages in the National Power Grid of Vietnam comprise 500kV, 220kV, 110kV and 66kV, which would be upgraded to 110kV in near future.

The North-South 500kV transmission system which interconnects three regional power systems (northern, central and southern power system was completed by the middle of 1994. Its transmission capacity is around 500MW.

The location map of the 500 and 220kV systems of the National Grid in Vietnam is shown in Figure 5.5.2.



Source: Interim Report on JICA F/S of Dong Nai No. 3 & 4 Hydropower Project, Nov. 1999

Fig. 5.5.2 Location Map of Existing Power Station and Transmission Line System (As of December, 1998)From difference in history of development, various types of distribution system with

different medium voltage classes are in operation in the country. In the Northern system, the distribution network has been formulated based on medium voltage 35kV and 10kV or 6kV. In the central and southern system, the main distribution voltage is 15kV. In 1994 Ministry of Energy decided to adopt 22kV as the future standard medium tension voltage covering the whole country, except the mountainous, highland and remote areas, where 35kV could be applied depending on economic feasibility of installation.

According the EVN, at the present the National Power Grid has reached all of provinces, about 95% of districts and more than 75% of communes. The total amount of existing transmission and distribution network in the country is given in Table 5.5.4.

Table 5.5.4 Transmission and Distribution Facilities

No.	Voltage level (kV)	Length of lines (km)	Capacity of Transformer (MVA)
1.	500	1,489	2,850
2.	220	3,388	4,504
3.	66-110	7,493	6,283
4.	Medium-Low	50,464	-

Source: EVN

(3) Power Demand forecast

EVN Institute of Energy is now preparing a long-term power generation master plan (Year 2000-2020) to be incorporated into the 5th year national development plan (Year 2001-2005).

In the draft plan, three demand scenarios for electricity (low growth, base case, and high growth) were worked out for future power source development purposes, the demand was forecasted by elasticity method using elasticity of electricity sales to GDP for three sectors (agriculture, industry and services). The results of the demand forecast are shown in Table 5.5.5. The GDP growth rates under the three scenarios are given in Table 5.5.6.

Table 5.5.5 Electricity Generation Demand Forecasts (2000-2020)

Year	Low-growth Scenario		Base-case Scenario		High-growth Scenario	
	Electricity Generation (GWH)	Peak Demand (MW)	Electricity Generation (GWH)	Peak Demand (MW)	Electricity Generation (GWH)	Peak Demand (MW)
2000	26,000	4,477	26,000	4,477	26,000	4,477
2005	42,409	7,141	44,230	7,447	46,554	7,838
2010	64,553	10,680	70,437	11,653	78,466	12,982
2015	96,906	15,803	109,439	17,847	126,949	20,703
2020	142,113	22,849	167,022	26,854	201,367	32,376
Ave. Growth Rate (%)	9.5%	8.5%	10.2%	9.4%	11.0%	10.4%

Source: EVN

Table 5.5.6 GDP Growth under the 3 Growth Scenarios

Growth Rate	Low-Growth Scenario			Base-Case Scenario			High-Growth Scenario		
	1996-2000	2001-2020	2011-2020	1996-2000	2001-2010	2011-2020	1996-2000	2001-2010	2011-2020
GDP	6.9	6.5	6.0	6.9	7.2	6.5	6.9	8.0	7.0
Agriculture	3.6	3.1	3.0	3.6	3.1	3.1	3.6	3.1	3.0
Industry	10.8	8.1	7.0	10.8	8.6	7.5	10.8	9.5	8.1
Service	5.7	6.6	6.0	5.7	7.8	6.6	5.7	8.8	7.0

Source: EVN

The base-case scenario indicates the annual average growth rates for the planning period year 2000-2020 are 10.2% for electricity generation and 9.4% for peak demand. In Vietnam there are three major growth centers demanding power loads:

(i) The economic triangle Hanoi-Haiphong-Quang Ninh in the North.

(ii) The Da Nang – Quang Nam – Quang Ngai with area Chu Lai-Ky Ha Open Economic Zone and Dzung Quat Industrial Zone in the Center.

(iii) The Eastern area including Ho Chi Minh city, Dong Nai, Binh Duong and Ba Ria Vung Tau provinces in the South.

(4) Power Generation Plan

Under the base-case scenario the required capacity of generation will be 9,160MW in 2005, 14,330MW in 2010, 21,950MW in 2015 and 33,030MW in 2020 to meet the peak load at each target year with a planned reserve margin rate of above 23%.

Since the present available capacity is 5,130MW, this will require new generating capacity of 4,040 MW from 2000 through 2005. New capacity of 5,170MW will be required between 2005 and 2010, followed by 7,620MW between 2010 and 2015, and 11,080MW in the 5- year from 2015 to 2020.

EVN states that the present power plan including the IPP will be sufficient to cover demand, and there is no need for a new IPP or for power purchases from abroad. Given fiscal constraints, however, EVN's new power capacity from 2005 will probably increase by only 800MW per year, or 4,000MW over 5 years, which will make purchases from external sources inevitable, including buying power from abroad.

EVN's Power Sector Master Plan projects the following sources of power for the estimated 29,400MW in new generating capacity that will be required by 2020. According to these projections 25,400MW will be produced within the country, and 4,000MW will be purchased from abroad.

Table 5.5.7 New Generating Source Capacity by 2020

No.	Power Sources	Capacity (MW)
1.	Domestic Source (including IPP)	(100%)
1-1	Hydropower(incl.Son La HEP: 3,600MW)	9,000 (35%)
1-2	Gas Thermal & Combined Cycle Plant	10,000 (39%)
1-3	Coal Thermal	5,000 (20%)
1-4	Nuclear Power Plant	1,200 (5%)
1-5	Geothermal, etc.	200 (1%)
	Sub-total	25,400 (86%)
2.	Purchase from Abroad	4,000 (14%)
	Grand-Total	29,400 (100%)

5.5.5 POWER IMPORT PLAN OF VIETNAM

As stated above, Vietnam will require 4,000MW in power purchases from abroad in the year 2020. The main suppliers would be Lao PDR, Cambodia and China (Yunnan Province).

(1) Purchase from Lao PDR

Vietnam has expressed interest in purchasing electricity from Lao PDR. An MOU was signed in September 1995 between the two governments for the transfer of 1,500 to 2,000MW of power by 2010. Subsequently specific discussions were held concerning power purchases, in July 1998 and March 1999. In March 1999, the Laos Government listed three (3) plants as possibilities (Nam Mo HEPP, Nam Ngiep-1 HEPP and a generator in southern Laos), and requested that Vietnam promptly enter into a purchase commitment. Hydropower from the Nam Mo HEPP was later withdrawn from discussion because of delays in the relay hydropower generator in Vietnam (Bam Mai HEPP, 380MW) caused by a problem in relocating residents, and the feasibility of this plan has declined. The Vietnam side (MOI) has expressed desire to purchase power from the next candidate, Nam Ngiep-1 HEPP. According to the most recent information, planned purchases by Vietnam from Lao PDR are 1,000MW between 2005 and 2010, and 1,000MW between 2010 and 2015.

Consequently, the attractiveness and practicality of selling power from our Nam Ngiep-1 HEPP to Vietnam have increased. The deciding point would be the price, and MOI has commented that they would be prepared to negotiate at a border price of around 5¢/kWh (at 1999 prices) on a 20 levelized cost base. The transmission route from Lao PDR to Vietnam would be through two locations as shown in Figure 5.3.3:

(i) Transmission line (double circuit) from Nam Theun 2 HEPP in Central Laos to Ha Tinh 500kV substation in Northern Vietnam, and

(ii) Transmission line (double circuit) from Ban Sok 500kV substation in Southern Laos to Pleiku 500kV substation in Central Vietnam.

(2) Purchase from Cambodia

Vietnam and Cambodia have agreed to trade electricity between two countries in two main phases:

(i) In the first phase, from now to the year 2010, Vietnam will sale power to Cambodia by 110-220kV transmission lines, and

(ii) In the second phase, after 2010, when Cambodia developed large hydropower plants such as the Sambor HEPP, the Strung Treng HEPP, Vietnam could purchase electricity from Cambodia by 500kV transmission lines to the Southern Vietnam.

(3) Purchase from China (Yunnan Province)

The China Government has a plan to develop the great hydropower resources of the Lancang River (the Mekong River in China) in Yunnan Province for the regional market.

In the future, Vietnam should consider purchasing power from this regional market through 500kV transmission lines to the Northern Vietnam.

5.6 IPP BUSINESS APPROACH

5.6.1 IPPS IN THAILAND

(1) General

The country's economic recession since mid 1997 until present has acutely affected the development of private and public sectors, stagnating and lagging substantial business growth particularly on large-scale capital intensive industries like power station. Similarly to the others, Independent Power Producer (IPP) and Small Power Producer (SPP) have also suffered by declining power demand in economic downturn following the previous closures of many industrial plants and business activities. In tandem with the hefty loan that partly borrowed from international financial institutions, IPPs experienced liquidity crunch driven by the exchange rate loss in their service repayment.

Carrying massive interest burden exacerbated by the lag of credit release of local financial institutes for large-scale project, new independent operators came under liquidity pressure that eventually turned down the projects or otherwise delayed their power plant construction. Meanwhile the private companies, which are presently supplying electric power to EGAT and other industrial plants, have to cut off their production capacity to suit the declined power demand.

Among IPPs and SPPs which have signed PPAs with EGAT's, those that the suffered most in the economic recession are IPPs and SPPs whose constructions have yet to be started or their constructions are being delayed, as they are plagued by seeking fund to finance their projects. Trailing next are developers whose construction are completed and are prepared to supply EGAT with electric power, but not exceeding 50% of their total installed capacity. These developers will face moderate risk from sharp contracting demand of private power consumption following the closure of many industrial plants. The developers who suffered the least are the ones whose construction are completed and who are prepared to supply EGAT with electric power ranging from 50% to 100% of their total capacity.

Nevertheless, it was predicted that there would no longer be new developers entering into the market over the next 3-5 years resulting from EGAT's power supply reduction policy in relative with the country's economic growth rate. Despite the above policy doubled by the construction abandonment of over 20 cash-strapped SPPs, the existing 40 suppliers are still able to produce enough electric power for power consumption demand in the next 5 years. The liquidity-stricken IPPs and SPPs, which carry losses at the present, simultaneously strive to keep their business afloat by offering to sell their interest to foreign partners.

(2) Trend of IPP Industry

Based on EGAT's adjustment plan which assumes a slow economic recovery, the economic growth rate has been revised for the period covering 2000 to 2004 to 2.9% per annum compared with 7.5% per annum formally targeted during the same period. In addition, it compared against 4.9% per annum originally targeted for the 9th development plan for the period covering 2005 to 2009, and 5.9% per annum originally targeted for the 10th development plan for the period covering 2010 to 2014, respectively. In a bid to comply with anticipated declining power consumption demand, EGAT has reduced its purchase from IPPs during Phase 2 (2006–2009) as

well as delayed additional purchase from SPPs. This resulted in some IPPs' business revocation and some SPPs' construction postponement. And it is estimated that the development for IPPs and SPPs would be sluggish over the next 3-5 years since there are 40 (500MW in total installed capacity) existing power stations which are enough for future supply in the next 5 years.

Furthermore, there is one (2,058MW in total capacity) power station. Electric Power Supply Co., Ltd. in addition to Independent Power Co., Ltd. will be put into operation in the coming year of 2000. The IPP Market still has high potential to grow in the long term attributed mainly to EGAT's privatization plan that will scale down its own production and turn to purchase more power from IPPs and SPPs. As a result of this market liberization program, their will be more market room to be shared among IPPs and SPPs. However, more market players means intense competition and downward pressure for energy sales price. In doing so, EGAT believes that consumers will enjoy the maximum benefit from the low prices despite minimum price guarantee to IPPs & SPPs by EGAT.

(3) IPP's Problems

(i) Higher Operation Cost

Power cost generally comprises of two significant cost elements which are (1) fixed costs, such as construction cost, loan repayment, fixed O&M cost (personnel and regular maintenance cost), (2) variable cost such as raw material (fuel), variable operating cost, tax and royalties. The recent crisis affected the loan repayment cost, fixed O&M cost (if salaries are denominated in foreign currencies) and variable O&M cost, if fuel and spare parts have to be imported with foreign curreincies. All of those cost rises will bring about adverse impacts on IPPs and SPPs.

(ii) Cash-Strapped Problem

Liquidity crunch is the crucial problem that IPPs & SPPs are encountering. Since large-scale power plant construction requires multi-billion bahts of working capital, the IPP operators have to go cap in hand with local and international financial institutions for syndicated loans. Because the recession has wiped out a large number of loss-ridden businesses which in turn increases the risks in non-performing loans. In this effect, several financial institutions have been reluctant to release credits to large-scale projects which is causing delay in IPP and SPPs' constructions. Moreover, developers who have suffered double injury of the interest rate hike and project completion delay project a lower rate of return on investment.

(iii) Private Sector's Contracting Demand

Besides selling power to EGAT, SPPs also sell power directly to large private consumers mostly located in Industrial Estates. However, the recent economic setback culminated in the closure of many industrial plants and drastically reduced SPP's sales volume. It is therefore estimated that SPP's direct sale to the private sector will continue to decline over the next 1-2 years until the economy recovers. On the above account, SPPs will be hit harder from this impact than IPPs that supply electric power only to EGAT.

(iv) Investment Risk

IPPs are big scale projects that generate electric power ranging from 90MW to 1,400MW. The projects are categorized as large-scale power stations with high production capacity using natural gas, coal, and bunker oil, etc. The plant construction costs are usually ten thousand million bahts

plus. So far, 5 IPPs out of 7 have called for the construction postponement mainly attributed to the current economic hardship that discourages large-sized investment. Currently, there is only one IPP that is still committed to supplying electric power to EGAT, namely Electric Power Supply Co., Ltd. (the subsidiary firm of EGAT).

There are a few IPPs available in today's market with power purchase agreements with EGAT. The promising trend after EGAT's privatization of its power stations (Rachaburi and Rayong power stations) will make these power stations switch their roles into IPPs selling power to EGAT. In this context, a larger number of power suppliers will enter the market. Undoubtedly, new IPP developers will encounter the disadvantages of bearing new investment costs while competing against those existing ones which have no such cost burden.

(v) Buying EGAT's Power Plant

It was predicted that the interested IPPs and SPPs could possibly turn to buying EGAT's existing power stations instead of building their own plants because the current macroeconomic environment is not favorable to new IPPs and SPPs. In the meantime, it is expected that EGAT will turn to purchase electrical power from the neighboring countries such as Malaysia, Lao PDR, Burma and China provided the demand increases. Another advantage of purchasing existing power stations from EGAT is that it could avoid oppositions from NGOs and local communities in the wake of intensified concerns over new power projects' impact on environment.

5.6.2 IPPS IN VIETNAM

(1) Status of IPPs

IPPs in Vietnam can be divided into the following two broad categories:

(i) private generation selling exclusively to businesses in export-processing and industrial zones, and

(ii) private generation selling exclusively to EVN on a 20-Year BOT basis.

Vietnam does not have an extensive history of IPP projects. The first such project was the IPP (Hiep Pluc) falling under the first category for an industrial park which opened in 1998. The next such project was Nomura Corporation's captive power generator (50MW diesel) for the Hai Phong Industrial plant. Currently these are the only two IPP projects operating.

Discussions for several IPPs to operate on a BOT basis started in 1997, beginning with the Wartsila (300MW). Table 5.6.1 summarizes the state of progress for each project as of December 31, 1999. The most promising project is Phu My 2.2. This is particularly true since the World Bank has said that a successful conclusion of Phu My 2.2 would set a benchmark for the power industry, and prove that complex BOT infrastructure deals were possible in Vietnam. Progress in Phu My 2.2 has thus attracted attention as a test case.

A local construction company is promoting the 72MW Can Don HEPP for development on a BOT basis. ADB is now conducting a feasibility study of Se San 3 (260MW). If as a result of the feasibility study Se San 3 is determined to have promise as a BOT project, it would be a focus for attention as the first thermal BOT project in Vietnam to make use of foreign capital.

Table 5.6.1 IPPs in Vietnam (as of end 1999)

No.	Project Name	Type	Fuel Type	Installed Capacity (MW)	Commi-ssioning Year	Developer	Status (as of end 1999)
	Existing Project						
1.	Hiep Phnoc	Thermal	Gas	375	1998	Taiwan Company	Operating
2.	Nomura	Thermal	Diesel	50	1999	Nomura Corp.	Operating
	Committed Project						
3.	Wartsila	Thermal	Diesel	120	2000	Wartsila, IFC	Under negotiation
4.	Oxbow	Thermal	Coal	300	-	Oxbow Energy USA)	Cancelled
5.	Phu My 2.2	Thermal	Gas	720	2002	EdF, Alstom, Sumitomo, TEPCO	Under negotiation
6.	Phu My 3	Thermal	Gas	700	n.a.	Statoil. BP., Tomen, Mitsui	To be negotiated
7	Can Don	Hydro	-	72	2002	Local company	Under negotiation
8.	Na Duong	Thermal	Coal	100	2003	Binacoal	Under negociation
9.	Cao Ngan	Thermal	Coal	100	2003	Binacoal	Under negociation
10.	Se San 3	Hydro	-	260	2005	n.a.	ADB conducting F/S

(Source) JICA Team hearing

(2) Issues on IPP

Potential investors in the power sector have expressed several concerns about the process of getting permission to enter the sector, including

(i) the need for many permits,

(ii) slow decision-making by the Government,

(iii) unclear decision-making processes,

(iv) corruption,

(v) the "underdevelopment" of the legal system-general lack of clarity and a belief that nothing is permitted unless positively provided for, and

(vi) under-estimation by the Government of the cost of capital.

They have also expressed concerns that the existing legal framework, while permitting private investment in principle, contains elements that discourage it, citing:

(i) difficulties in the application of international arbitration under international law,

(ii) limits on the security that lenders can take,

(iii) the non-transferability of land leases,

(iv) limits on the convertibility of the dong and associated problems such as limits on availability of dong, interest-rate caps on foreign-currency-denominated loans, and requirements to convert foreign currency into dong.

Most of the issues that concern investors are not specific to the power sector. Investors, potential investors, and their advisers also cite some power-specific factors that constrain entry by new private firms:

(i) The current rules for setting tariffs do not provide any assurance that the tariffs will cover costs – one of the reasons why EVN is considered a poor medium-term credit-risk,

(ii) The rules governing the operation of the gas sector – and, in particular, the pervasive role of Petro Vietnam – lead to long delays in the procurement of new gas supplies, and

(iii) EVN's role as both the purchaser of power from private power plants and a supplier of bulk power in potential competition with them may reduce its incentives to enter into PPAs with private power plants.

5.6.3 NEW IPP BUSINESS APPROACH AFTER ECONOMIC CRISIS

Under fiscal pressure and due to slowing GDP growth following the financial crisis of 1997, most Asian economies have embarked on wide-ranging reform programs. These programs are aimed at deregulating their energy sectors, privatizing large chunks of their state-owned utilities, and introducing real competition in their power markets. While the pace of the reform process will vary amongst countries and may, in some cases, also experience serious setbacks, power sector reforms present huge opportunities for new private investment. However, more competition will also mean that foreign developers, investors and lenders alike will have to shift their focus in assessing a project's success from the highest returns on investment towards a thorough analysis of the future demand and supply conditions. This will necessitate assigning competent market experts and researchers with projecting the entire relevant market as far into the future as possible. In competitive markets, the most important issues that will determine the viability of a project are:

(i) Is there a real market demand for the project?

(ii) What capacity additions can be expected in the future?

(iii) What is the project's cost competitiveness via-à-vis other existing and future plants (capital, fuel, O&M)?

(iv) Are there risks associated with tariff approvals?

(v) What will be the pace of reform, will it happen at all, and if so, what will be the resulting regulatory regime?

(vi) How creditworthy will be off-taker be in a competitive market?

(vii) What is the optimal plant technology (base or peak load) and size?

(viii) How close is the plant to the dispatch centre (transmission cost), and what is its proximity to alternative dispatchers;

(ix) What will be the plant's merit order in the dispatch queue?, and

(x) When is the optimal time for market entry?

Before the financial crisis, IPPs in virtually all Asian developing countries operated in quasi monopoly markets with government guaranteed returns on investment. Their prime goal was to negotiate the highest returns on investment and the best security package. After the crisis, the emerging competitive power industry will require a new IPP business approach, calling for in-depth pre-investment market research and the ability to compete with other market participants.

6. HYDROPOWER PLAN

6.1 GENERAL

Lao PDR has abundant hydroelectric resources totalling 23,000MW approximately, but because of a little incentive to increase domestic power demand, its potential has been developed only 1% up to the present. The country is, therefore, putting a high priority on the development of domestic hydroelectric resources to export electricity to Thailand and Vietnam.

The Nam Ngiep basin is straight from north to south. The Nam Ngiep River, the main stream having the total length of about 230km, collects water of the basin annually 210 to 160m^3/s on an average from its whole watershed of 4,510km^2 and drains it into the Mekong River.

As of now, hydropower resources of the Nam Ngiep River basin remain totally unutilized. There are several studies made up to now on how to make use of its water resources, but among them, even the most updated study remains at Pre-F/S level, which was made with the financial assistance of the French Government in 1991 and revised in 1995.

The principal objective of this Study is to identify a viable hydroelectric scheme at the lower reach of the Nam Ngiep River, to propose it as an additional candidate project for electricity export to Thailand, and to provide it to the localities for regional development. The scheme is studied at the F/S level and also focuses on the environmental impact of the project implementation through the ecological assessment.

6.2 RESERVOIR OPERATION

6.2.1 PURPOSE OF RESERVOIR OPERATION STUDY

As the first step for optimization of the project development scale, reservoir operation has been carried out for the selected alternative scales by establishing a specific simulation model for the Project.

The main objectives of the reservoir operation study are as follows:

(i) Estimation of annual mean energy production,

(ii) Determination of optimum scale of the Project, and

(iii) Determination of optimum reservoir operation rule.

6.2.2 CONDITIONS FOR DETERMINATION OF OPTIMUM RESERVOIR OPERATION MODEL

(1) Basic Conditions

For the Nam Ngiep-1 HEPP, the optimum scale of the Project can be independently determined and no multi-reservoir operation is needed in the basin at the present stage.

Therefore, reservoir operation for the Project will be made for a single reservoir / single purpose (only for power generation) by giving the following basic (fixed) parameters for the respective alternative plan.

(i) dam heights,

(ii) draw-downs (FSL, MOL),

(iii) reservoir area-storage curve,

(iv) rated reservoir water levels (RWL),

(v) tail water rating curve,

(vi) head losses, and

(vii) efficiencies of turbine and generator.

(2) Minimum Operation Level (MOL)

The minimum operation level (MOL) of the reservoir will be determined to satisfy the following two conditions:

(i) The power intake sill is set on the design sediment level and MOL should be located at the elevation, which assures prevention of entrapping air in the tunnel system during operation, and

(ii) The ratio of the minimum water head to the maximum water head of the scheme should be more than 70% to avoid harmful effects to turbines.

(3) Reservoir Operation Model

The optimum operation rules will be obtained as the answer, which satisfies the following conditions set forth by EGAT:

(i) Power is to be generated daily for a 16-hr duration, and

(ii) EGAT will not buy energy from the Project on Sunday and Thai national holidays, thus the power plant will be stopped entirely on these days.

Note 1: Actual plant on day-off may be operated continuously for domestic power supply by running a small-scale generating unit to be separately provided, but such a sensitive operation is not taken into consideration in this study.

Note 2: In the next F/S, it should be noted of the necessity that Thailand will shift in the near future to the 8-hrs operation and calculate FIRR on an assumption that the tariff of power from Lao PDR will be increased matching to its kw-value from around 10 years later after commissioning. For such setting-out, further state of power demand in Thailand should be investigated and well background be consolidated.

6.2.3 SIMULATION OF RESERVOIR OPERATION

Input data and output for reservoir operation are as follows:

Table 6.2.1 Input and Output Data for Reservoir Operation

No.	Input Data	Output Data
1.	Monthly inflow data at dam site	Reservoir water levels
2.	Monthly mean evaporation from the reservoir surface	Plant discharges
3.	Initial reservoir water level	Evaporation losses
4.	-	Spill-out discharges
5.	-	Power outputs
6.	-	Energy outputs
Note	Release of water other than the discharge for power generation, such as riparian flow, etc. will not be made.	

Hydrological model used for reservoir simulation is as shown in Table 6.3.8 and Figure 6.3.8 hereinafter, which was assumed for 30 years in the Nam Theun-2 Alternative Study in 1998 as the monthly run-off data for the Nam Ngiep-1 dam site. These data are more conservative compared with those assumed in the Pre-F/S Study of the Nam Ngiep-1 HEPP.

Water balance in the reservoir is computed applying the following equation:

$$S_i = S_{i-1} + I_i - O_i - EV_i$$

Where, S_I : Reservoir water volume in the current day

S_{i-1} : Reservoir water volume in the previous day

I_I : Inflow into reservoir in the current day

O_I : Outflow from reservoir in the current day

Ev_I : Evaporation from reservoir in the current day

Simulation will repeat the following sequence for the period of 30 years:

(i) Be set initial reservoir level at FSL,

(ii) Deduct evaporation (depth) from the reservoir water level,

(iii) Release discharge for power generation up to the maximum plant discharge if reservoir level can be kept above MOL after release, or release possible maximum discharge if not so,

(iv) Add inflow,

(v) Spill-out excessive water if water level is above FSL, and

(vi) Return to Step 2 above and repeat the sequence for the next month.

6.2.4 COMPUTATION OF POWER OUTPUT

Power and energy outputs are computed applying the following equation:

$$P = 9.8 \times Q \times H \times \mu,$$

Where, P : Power output (kW)

Q : Discharge for power generation (m^3/s)

H : Effective head (m) = static water head - loss head

μ : Combined efficiency of generating unit

Note: Turbine efficiency due to water head variation is neglected.

$E = P \times t$

Where, E : Energy output (kWh)

t : Generating time (hr)

Since the present study is at the preliminary stage, specific conditions such as lowering reservoir level for a coming flood season, setting of minimum discharge for turbine, etc. were not given in this analysis. However, the maximum plant discharge for each development scheme was so determined that the annual energy for 95% of the total analyzed period (30 years) should not lower than 80% of the firm annual energy.

6.3 STUDY OF HYDROPOWER PLAN

6.3.1 BASIC CONSIDERATIONS FOR PROJECT POWER DEVELOPMENT

Through the Pre-F/S by the French government and this JICA Study being carried out since August 1998, the most downstream gorge of the Nam Ngiep River just downstream of the confluence of the Nam Katha River has been identified as a promising dam site of the Nam Ngiep-1 HEPP, where river flow is affluent and the dam site topography and geology are suitable for the construction of a high dam.

The Project will be developed in line with the Lao National Policy for increasing earnings from sales of residual electricity to abroad, and supplying clean without CO_2, stable and economic electricity to Thailand to meet the growing demand.

The Project will not only attain the conventional benefits of hydropower generation, but also contribute to the improvement of the downstream living standards. It is possible to develop a new irrigation scheme by using water to be released from the Project, to make rural electrification by a micro-power generation at the Project power station, to improve environmental conditions along the river corridor by regulating the discharge during flood, and to improve transportation between the upstream area of the reservoir and the dam site by using a boating system.