Chapter 8

Suggestion for Promotion of the Nam Ngiep-I HEPP

8.1 Power Sales Approach Long-Term PPA vs. Pool Bidding (Advantages and Disadvantages)

For the power purchase from Lao PDR, EGAT has entered into the MOU or PPA with existing two developers and is now under negotiation of the PPA with the Nam Theun 2 Project Developer. New projects after Nam Theun 2 will be invited to participate in direct bidding of the Power Pool. There will be introduced measures to eliminate any additional stranded costs to the electrical system in the long run and to allow the tariff fluctuated upon the condition of electricity demand and supply of the whole market. However, this policy has not been firmly settled and is subject to review by the Thai Government.

In conclusion, PPA is more advantageous when viewed from all prospects, because of its firmness of tariff. As mentioned earlier, the power pool operation will be delayed for 5-6 years from 2003 to 2008 due to transmission system constraints as stated by the EGAT's deputy governor.

However, the future PPAs will be different from the existing ones which were executed between the project developers and the government. Due to the voluntary nature of the Thai power pool, the project developers may be able to agree on the PPAs with the PPA trader who in turn will bid into the power pool.

8.1.1 Trading Mechanism in the Power Pool

Since the generation, transmission and distribution of electricity have unique operational characteristics and conditions and storage of electric energy for sale when the demand arises is not cost-effective or not economically feasible, the amount of electrical energy produced has to be in balance with the demand. The unique characteristics of electricity make it different from other ordinary commodities. Therefore, rules and covenants governing the Power Pool trading (**Market Rules**) have to be established so that the pool operation will be most similar to that of other commodities. The Market Rules include the procedures of price offering by generators and the pool price determination to ensure adequate production of energy to meet the demand. The pool price may change hourly or daily depending on the established covenants.

The market operation will be in the form of both forward market and real time operation, which can be on an hourly or a half-hourly basis. A forward market will allow generators to bid their prices in the pool and the GridCo to report the conditions of the grid system prior to the actual operation. However, since the conditions of the grid and

generation systems may change prior to the real dispatch time, reports on the changing conditions must be made to the ISO until the actual operation takes place. The ISO will then use the latest available information as a base for issuing a dispatch instruction to power plants.

The overview of the Power Pool process can be summarized as follows:

Prior to the hour of real time operations, the GridCo will inform the ISO of the expected condition of the grid system prior to the actual dispatch. At the same time, Gencos will provide the ISO with their offered prices and the amount of capacity they want to operate in that hour while the ISO will forecast the demand during a given purchasing period.

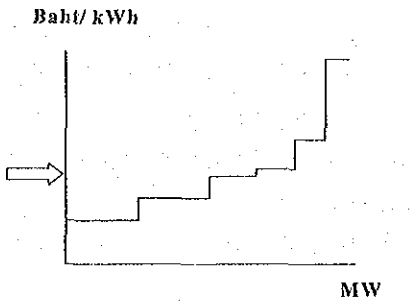
Then, the Power Pool will use the available information to determine a set of operating schedules – for both generation and transmission systems – and issue the instructions to the GridCo and GenCos prior to the hour so that they can plan their individual operations. Meanwhile, the ISO will monitor developments and keep the GridCo, GenCos and buyers in the pool informed of any changes in the system conditions.

At the real-time spot market, the GridCo, GenCos and Retailers will report the most updated information on the system conditions and forecasted demand to the ISO. Based on the latest information, the ISO will send final instructions for generators to commence or to reduce their physical operations. Then, in compliance with these instructions, the GridCo and GenCos will generate and transmit energy to meet the demand or the operating schedules, which may differ from the initial forecast.

The MO will determine the market price for each particular hour and notify the SA and market participants of the purchase quantities. The ISO will record the metered actual purchase quantities and notify the SA so that the latter could proceed with the billing and settlements accordingly.

As illustrated in Figures 8-1 and 8-2, GenCo A with the lowest price will be given the first priority by the ISO to operate and produce energy into the system, followed by the next lowest offers (GenCos B and C) respectively until the production meets the demand in each particular period (11,000 MW). Generally, the offered price of the generator with the highest price bid, which has received the dispatch order, will be considered as the **System Marginal Price (SMP).** In this example, the SMP is 1.1 Baht/kWh and this will be the purchasing price (the pool price or P_{pool}) for all generators selected to generate electricity in that given period.

GenCo	Supply Offer (MW)	Price (Baht/kWh)
A	5000	0.6
B	5000	0.9
C	2000	1.1
D	1500	1.2
E	1000	1.6
F	500	3.0



Aggregated Price and Supply Offers

Figure 8-1 Example of Price and Supply Offers

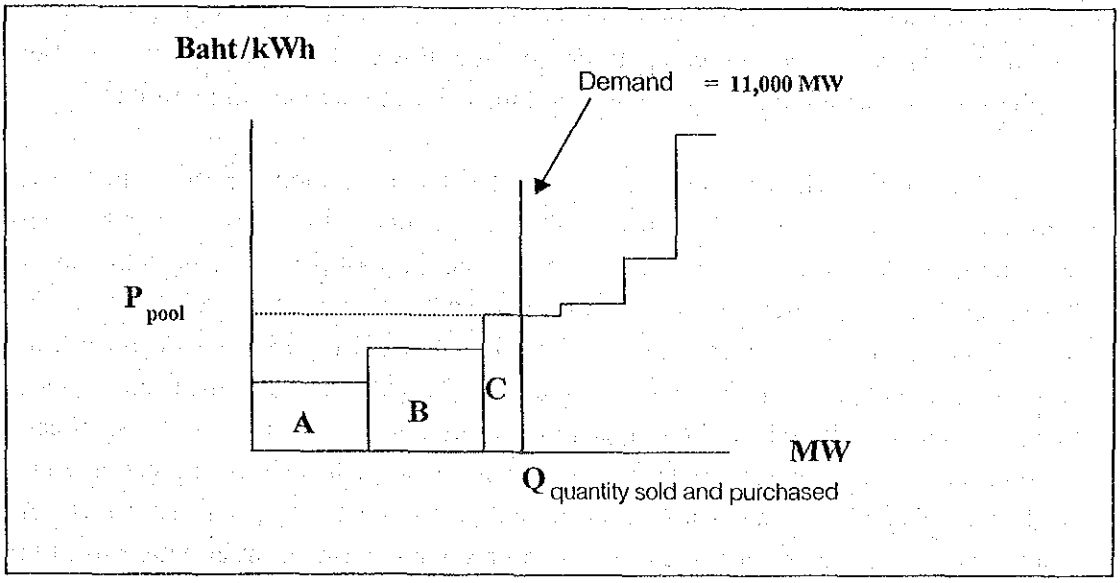


Figure 8-2 Determining Pool Prices

In the settlement process, the SA will be responsible for this function by compiling all information pertaining to the purchase in the pool, including contract quantities resulting from the "trade outside the pool (ToP)", and determining pool settlement amounts by deducting the ToP quantities. GenCos will receive payment for energy sold via the Power Pool (according to the metered actual quantities deducted by the ToP contract quantities and multiplied by the pool price); whereas wholesale traders will pay the SA for their purchase (according to the metered actual quantities deducted by the ToP contract quantities and multiplied by the pool price). As for the ToP, payments will be settled between concerned GenCos and wholesale traders according to their contract terms.

Under the Power Pool system, generators with low efficiency will not be able to compete with others in the bidding and hence will not get dispatched. When there is no operation, no revenue is generated. Therefore, the establishment of a power pool will encourage all generators, both existing ones and new ones, to improve their efficiency at all time; otherwise, they will have no chance to sell their production. For instance, given a situation where a power plant has been generating and selling electricity for 10 years, and later, another power plant with more efficiency enters the market, if the old one did not improve its efficiency, it would not be able to sell electricity and would have no income. Hence, increasing competition via the Power Pool and promoting power purchase from a large number of retailers will intensify the market competition.

Pool prices will change in line with the demand/supply relationship. Certain consumer categories, especially industrial factories, which can rapidly reduce their power consumption, will be able to respond to the fluctuating pool prices. This helps speed up the restoration of the demand and supply balance. For example, suppose there is an operational failure of a power plant, resulting in a substantial decrease of its generating capacity, the pool price will increase and such a signal will be sent to those consumers. If they can immediately reduce their consumption, the balance in the power system can be restored in a shorter time. However, most consumers wish to have more stable prices while a number of generators also want to sell generated energy at fixed prices. As a result, generators and retailers may execute a power purchase contract with a fixed price in order to reduce risks and volatility for both parties. The contract terms may cover short-term or long-term power purchase. Such a contract form is called a **Contract for Differences (CfD)**.

A CfD is a contract made between a power seller (i.e. a generator or a retailer) and a power buyer (i.e. a retailer or a consumer). It is a financial contract that can be executed directly between the parties concerned without any involvement of the Power Pool or other power business operators.

Generally, a CfD will specify the amount of purchase, purchasing duration and price. If, during any period under the contract, the pool price is lower than the CfD price, the buyer will pay the seller for the difference. On the contrary, if the pool price is higher than the CfD price, the seller will have to pay the buyer for the difference, as shown in Figure 8-3. A CfD is, therefore, a form of hedge against risks for both sellers and buyers. Anyway, whether or not a CfD is made, the dispatch instructions will still be based on the economic merits of the price bid. Pool prices fluctuate in order to always maintain the demand and supply balance in the Power Pool. Notwithstanding, both power sellers and buyers can obtain stable prices as agreed under CfDs.

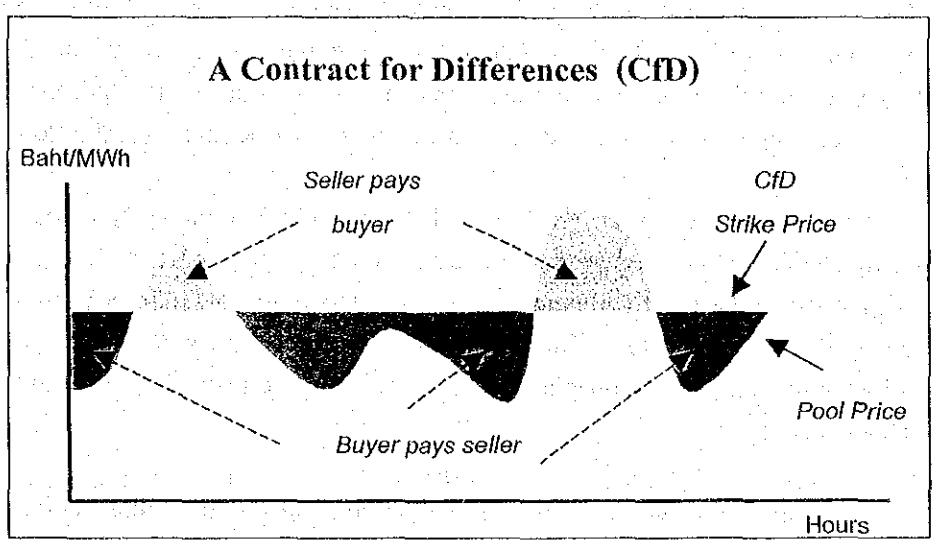


Figure 8-3 Contract for Differences (CFD)

In the case where the generation cost of a GenCo, contracted under a CfD, is high and hence its price bid is higher than the pool price, the Power Pool will not select the GenCo for dispatch but will look for other GenCos with lower generation costs. In this case, the contracted power buyer(s) will pay for electricity at the rate specified in the CfD whereas other GenCos that actually dispatch electricity will receive payment according to the pool price. The GenCo, with a CfD (but no power dispatch), will receive the difference between the CfD price and the pool price.

In addition, power sellers (generators) can directly trade with power buyers (retailers) under "**bilateral contracts**" or "**contracts outside the pool**". Under this mechanism, the buyers and sellers can determine the amount of purchase, subject to the system constraint, at a fixed price (similar to a PPA), giving both parties a stable price.

The generators will supply electricity to the buyers at the amount specified in the bilateral contracts and there is no need to bid their prices other than a zero price in the Power Pool. Nevertheless, the generators and the buyers will have to inform the Power Pool of their respective generation and consumption amounts so that the ISO can run a security check and the contract quantities could be deducted from the demand and supply in the Power Pool. For example : a generator has 100 MW of generating capacity and has its buyers in total of 20 MW, then the generator can bid up to 80 MW in the pool. Also, the generator can bid 0 (zero) MW, if the generator does not want to sell power in the pool for some reason. In supplying contracted purchases, the generators may generate electricity at an amount equal to or lower than that contracted. For example, in the case that there are constraints in the power network system or that the pool price is lower than their own generation costs, the generators may buy power from the Power Pool to delivery to the buyers as contracted instead of generating the purchase amount by themselves. In any case, however, all settlements must be made via the Power Pool.

Thailand Power Pool will be in the form of a Voluntary Net Pool. In this pool system, power business operators can carry out their power trades either via the Power Pool or outside the pool (bilateral contracts). However, all market participants have to abide by the Market Rules, with no exception to the submission of price bids, provision of information on generation plans, response to dispatch orders of the ISO, or payments for service charges.

Although the Market Rules must be mandatory, the rules will allow business operators to determine their own generation plans, within the system constraints, and to trade anyway they choose, including negotiation on purchasing prices with their customers without offering price bids via the Power Pool.

To make comparison of PPA option and Power Pool option, their advantages and disadvantage for the hydro power developer are summarized in the Table 8-1.

Table 8-1 Summary for Advantages and Disadvantages for PPA and Power Pool

PPA Option	Power Pool Option
1. The price is fixed. **(A)**	1. The price is depended on bidding. **(D)**
2. The definite amount of energy is purchased. **(A)**	2. The offered energy may be considered to buy. **(D)**
3. Only single buyer is in PPA. **(D)**	3. It has many buyers. **(A)**
4. There is no Marker Rules. **(D)**	4. It shall have Market Rules. **(A)**
5. The PPA has long term period to buy power. **(A)**	5. It is very short term to buy power, may be day by day or hour by hour. **(D)**
6. It has certain penalties if the generator does not generate power at the required time. **(D)**	6. It may not have penalty, if the producer does not offer to sell power. **(A)**
7. All power shall be sold to the single buyer. **(D)**	7. All power is not needed to sell for the single buyer. It can be several customers to buy for some generated power. **(A)**
8. It has specific time to begin operation of the plant. **(D)**	8. The time to operate the plant depends on offer for bidding and can be selected by the plant. **(A)**
9. It has many conditions during construction, which EGAT must inspect for every step. **(D)**	9. Commissioning of power plant is more flexible depending on the developer and construction period could be varied. **(A)**
10. It is easier for financing. **(A)**	10. It is expected to be harder for financing. **(D)**
11. EGAT (buyer) is the only one who does dispatch. **(D)**	11. Starting time, duration and capacity are decided by the plant and must be offered for bidding. **(A)**

Note: A in parenthesis means Advantage and **D** in parenthesis means Disadvantage.

8.2 Timing for Market Entry

Based on the information from the new PDP (unofficial PDP 2002), the suggested timing for import power from the neighboring countries of Thailand could be after year 2010. Starting from 2010 in which there will be a need of 700 MW from IPP (either domestic or import). Afterwards, the system will require addition purchases of at least 2,000 MW yearly. Accordingly, the Nam Ngiep-I can bid to supply the power to Thailand as one of the projects in the year 2011.

8.3 Supply Capacity and Operation Mode (Base or Peak)

With reference to the project descriptions shown in the Table on page 2-1 of the Feasibility Study of the projected prepared by JICA Study Team and Nipon Koei Co., Ltd., two options were considered, i.e., the medium-scale and the large-scale dams. For convenience, the referred table has been reproduced here, as shown in Table 8-2 below:

Table 8-2 Project Description of Nam Ngiep-I

Structure/ guideline	Items	Medium-scale Dam	1.3 Large-scale Dam
Reservoir	FSL (Full supply water level)	EL. 320.0 m	EL. 360.0 m
	Gross & effective storage capacity	2,279 mil.m^3 ; 1,779 mil. m^3	6,782 mil.m^3 ; 3,092 mil. m^3
	Reservoir area at FSL	73.9 km^2	148.2 km^2
Dam	Dam type	CFRD (concrete surfaced rockfill dam)	
	Dam height, crest length, dam volume	157 m, 524 m, 6.9 mil. m^3	197 m, 662 m, 12.7 mil. m^3
Power plant	Design discharge (annual mean runoff)	221.0 m^3/s (162.3 m^3/s)	224.0 m^3/s (162.3 m^3/s)
	Rated head	131.8 m	176.8 m
	Plant capacity & Annual output	240 MW ; 1,349 GWh	334 MW ; 1,905 GWh
Economic analysis	Total construction cost	US mil.$ 346 (1,442/kW)	US mil.$ 446 (1,389/kW)
	Economic/financial internal rate of return	17.2 % (12.8 %)	18.0 % (13.7 %)

Source : Feasibility Study on the Nam Ngiep-I Hydroelectric Power Project (Phase II) in the Lao People's Democratic Republic, JICA Study Team, Nippon Koei Co., Ltd.

The Feasibility Study Team has recommended the medium-scale dam as the optimum alternative for implementation. In the operational point of view, a power plant rated 240 MW generating energy of 1,349 GWH would run approximately 15 hours/day (about 64.16 % p.f.). A power plant operating in this range of plant factor would be regarded as a base-loaded plant.

If the Nam Ngiep-I is assumed to have an economic life of 50 years, the generation cost calculated from the annual energy of 1,349 GWh and the construction cost of 346 million US.$ will be 3.10 US cent/kWh.

The determination of the best installed capacity and operating hours for the project would require extensive analysis using computer software such as WASP-III. The hydrological data such as the monthly capacity and energy generation of the project must be required to conduct the study. This could be accomplished with a thorough investigation of the EGAT's PDP so that the calculation of the avoided costs for each possibility would be performed. The knowledge of the EGAT's power system would also be necessary, including plant data, demand forecast, load characteristics, scheduled maintenance of power plants, etc.

However, a preliminary analysis based on the available information at the moment can be performed. There is a technique known as "Screening Curve Analysis" which can be effectively used to help the generation system planner to determine the appropriate type of power plant to be incorporated into the Power Development Plan. The screening curve is a plot of the total expenses required to add one MW of capacity to the system against the various operating levels of the power plant. The expenses include the capacity cost, the fuel cost as well as the maintenance cost for each candidate power plant. The capacity cost will be annualized to reflect the yearly installment throughout the entire economic life of the power plant. The screening curves of different candidates will be plotted in the same graph. The vertical axis of the graph will be the annual expenses ($/kW-year) and the horizontal axis will represent the plant factors. The point where two curves intercept will indicate the plant factor at which the power plant with lower variable operating costs will be more economical to invest.

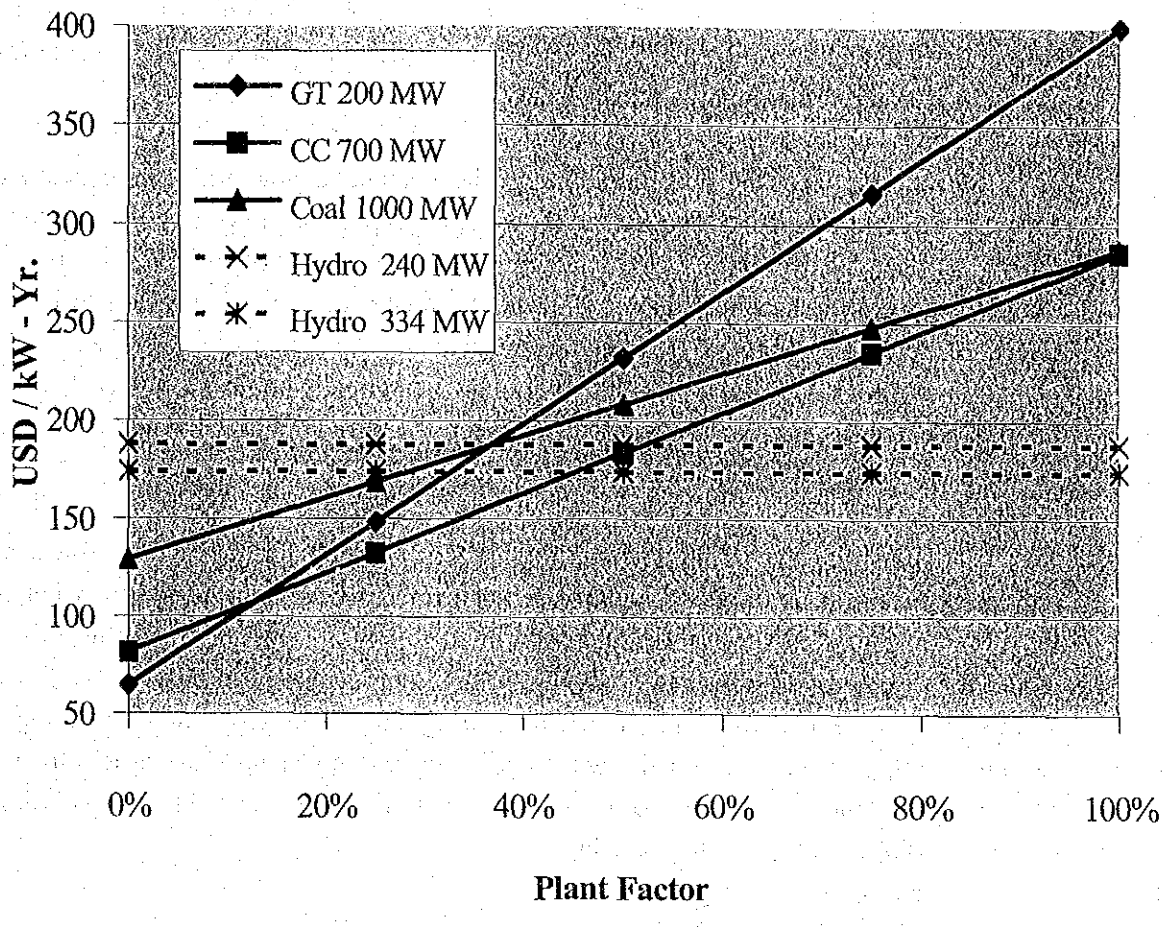
The capacity costs shown in Table 8-2 above are assumed to be the 2001 prices. The resulting screening curves prepared based on the data given in Table 8-3 are depicted in Figure 8-4.

Table 8-3 Screening Curve Analysis

Items	GT 200 MW	CC 700 MW	Coal 1000 MW	Hydro 240 MW	Hydro 334 MW
Capacity Cost (USD/kW)	349.3	453.46	727.12	1442	1335
Heat Rate (Btu/kWh)	11104	6673	9000		
Fuel Price (USD/MBtu)	3.41	3.41	1.9		
Annual Fixed Cost	64.51	81.49	129.23	188.02	174.15
(USD/kW-Yr)					
Annual Variable Cost	0.0382874	0.023368	0.0180977	0	0
(USD/kWh)					
Plant Life (years)	20	20	25	50	50
PF.	**GT 200 MW**	**CC 700 MW**	**Coal 1000 MW**	**Hydro 240 MW**	**Hydro 334 MW**
0%	64.510	81.490	129.230	188.017	174.149
25%	148.359	132.666	168.864	188.017	174.149
50%	232.209	183.842	208.498	188.017	174.149
75%	316.058	235.018	248.132	188.017	174.149
100%	399.908	286.194	287.766	188.017	174.149

Note: 1. A discount rate of 12% was used for this analysis.
2. Costs are expressed in 2001 price level

Figure 8-4 Screening Curve Analysis



Source : EGAT

As can be seen in the plots of the screening curve, both options of the Nam Ngiep-I project will be more economic if they are operated at the plant factor of approximately 50 %. Therefore, the Nam Ngiep I should be running as an intermediate power plant with the operating duration of about 12 hours per day. If the Nam Ngiep would be generating at the plant factor lower than 50 %, the combined cycle plant would be more economical and EGAT would rather buy the power from the combined cycle IPPs.

Furthermore, if the consideration on the demand characteristics are taken into account, the intermediate or base load power plants will be more appropriate for the EGAT system due to its high load factor. The annual load factor for FY 2011, for example, is projected to be 72.8 %. The daily load factor can be expected to be even higher. Referring to Figure 3.1, it can be seen that the base laod power plants in the system on the peak day of the year 2001 could be theoretically about 13,000 MW whereas the peak demand is 16,126.4 MW. In this respect, the base load plants could be about 80 % of the total generating capacity.

To illustrate the terms and conditions of a contract for the hydro project with regulating reservoir as the Nam Ngiep-I project, reference is made to the PPA between EGAT and Houay Ho Power Company Limited (HHPC), which is now the only one model for storage hydropower project. HHPC shall during the Term provide Availability at the Delivery Point for each Weekday during the Term from and including the Commercial Operation Date for not less than 10 hours at a Capacity of not less than 126 MW. Weekday means any day from Monday to Saturday (inclusive) in any week during the Term. EGAT shall provide to HHPC:

- a monthly operating program;
- a weekly operating program; and
- a daily generation program;
- in each case, in such form and manner as is provided in the Grid Code and, in the case of any Unit, after Commissioned Date or, in the case of the Facility, after the Commercial Operations Date.

Each such program shall be determined in accordance with the Grid Code to show the proposed distribution of Dispatch of the Declared Availability for the relevant period and Provided that;

- in the case of any daily generation program or weekly operating program EGAT may schedule Dispatch up to but not exceeding the Declared Capacity of any Unit or the Facility (as the case may be) specified in the Availability Declaration for the relevant day or week (as the case may be);
- in any monthly operating programme EGAT may schedule Dispatch to utilize in Net Electrical Output the aggregate Availability specified (in MWh) in the Availability Declaration for the relevant month; and

- subject to above paragraphs, in the case of any daily generation program or weekly operating program issued after the Commercial Operation Date, EGAT may schedule Dispatch for such period or periods of time during the relevant day or week as EGAT may require and as shall utilize a quantity of electrical energy up to but not exceeding the Declared Availability for the month in which the relevant day or week shall fall;
- each program shall be consistent with the Registered Operating Characteristics or Declared Operating Characteristics (if any) of the Facility or the relevant Unit (as the case may be) for the time being; and
- each program shall make due provision for any HHPC Maintenance Outage or HHPC Planned Outage notified to EGAT prior to the issue of the relevant program and comprised in the period of such program.

HHPC shall control and operate each Unit and the Facility. HHPC shall comply with all Dispatch instructions received from EGAT in any period which are consistent with and, if not, only to the extent that such instructions are consistent with the next paragraph. EGAT shall use reasonable endeavors to Dispatch 100 per cent of Available Output for any month provided that nothing herein shall oblige EGAT to Dispatch Available Output other than in accordance with Prudent Utility Practice. For the avoidance of doubt, Prudent Utility shall exclude consideration of Economic Dispatch.

EGAT shall have right to Dispatch any Unit after its Commissioned Date and the Facility after the Commercial Operation Date provided that:

- all Dispatch instructions shall be issued in accordance with the Grid Code;
- without prejudice to EGAT's obligation to pay for Net Electrical Output and Deem Net Electrical Output, the level and scheduling of actual Dispatch shall be determined by EGAT's operational requirements and may be different from any prior operating or generation program provided as described above and provided that actual Dispatch shall not exceed the limitations on schedule Dispatch in the daily generation program and in the weekly and monthly operating program.
- EGAT shall have due regard in the scheduling of Dispatch (including, without limitation, as to the level and periods of Dispatch) to any HHPC System Outage as previously notified to EGAT.

HHPC shall at all times comply with the procedures specified in the Grid Code in the operation and maintenance of the HHPC System and (for the avoidance of doubt) shall comply with any all changes or variations of the Grid Code at such time or times as may be required by EGAT. If any time there is any conflict or inconsistency between the Grid Code ant the terms of the PPA, then the Grid Code shall prevail.

In summary, from the model PPA for HHPC, which is adopted to apply for other storage hydro power plant, EGAT shall have right to dispatch power from generators. The 10 hr does not mean continually of all 10 hr, it can stop for some period(s). Then EGAT can select any one or more to operate any period of time for his maximum benefit. The tariff for projects must be agreed before PPA negotiation will be started and must be lower than EGAT's system avoided cost. So, it is not necessary to operate the power plant on peaking period and will have a better price. It may not get more benefit to the investor who wants to install in a bigger generating capacity and operation on shorter daily period (expected for peaking load level) instated of a lower generating capacity but in the longer daily period of operation at the same amount of generated energy.

8.4 Price Setting and Benchmarking (Average Thai IPP Price, EGAT System Avoided Cost etc.)

At present, there are two domestic IPPs, i.e., the Independent Power Thailand (700 MW) and the Tri Energy (700 MW) in operation. EGAT buys power from both projects under the two-part tariff structure consisting of the availability payment (AP) and the energy charge. The AP for the Independent Power is currently 0.491 Baht/kWh and the energy charge is 1.087 Baht/kWh (totaling 3.54 cents/kWh). The Tri Energy receives the AP at 0.666 Baht/kWh and the energy charge at 1.064 Baht/kWh (totaling 3.88 cents/kWh).

Thailand is currently importing power from the Theun-Hinboun (187 MW) and the Houay Ho (126 MW) projects in Lao PDR. The purchase price from the Theun Hinboun is 1.734 Baht/kWh (3.88 cents/kWh) and from the Houay Ho is 2.0008 Baht/kWh (4.48 cents/kWh).

Basically, EGAT will purchase the power from IPPs or from Thailand neighboring countries based on the system avoided cost. The avoided cost is the expense that EGAT would incur if EGAT invested on the required capacity by itself instead of buying the power from the IPPs or importing the power. The average avoided cost for the required capacity during 2007-2008, when the power purchase from Lao PDR will be considered, at approximately 4.2 cents/kWh.

In particular, there was an analysis carried out by EGAT for the Nam Theun II project for the purpose of PPA negotiation. Since the developer for the Nam Theun II proposed two options for the project to operate either as a base load plant or an intermediate plant, EGAT prepared the estimation of the avoided costs for both modes of operation. The avoided cost for the base load plant was about 4.1 cent/kWh and the avoided cost for the intermediate load operation was around 5.4 cent/kWh for the primary energy and 4.0 cent/kWh for the secondary energy.

8.5 Impact and Consideration of ASEAN Power Grid System Development and Power Pool

The ASEAN Power Grid System development will require a huge amount of investments which is unlikely for any ASEAN country to support. Even if there is any country which is financially capable, the associated risks will prevent them from implementing the project. Furthermore, each country is now stick to the self-sufficient philosophy for the power system which will further hinder the full scale power interconnection in the region. At present, there are power system interconnections between Thailand and Malaysia and between Malaysia and Singapore. However, the purpose of having the interconnection is not for bulk power transfer. The interconnection will be used rather for emergency purpose.

The realization of the ASEAN Grid will take a lot more time probably over 20 years. Therefore, the project development in Lao PDR will be limited to supplying power to only Thailand with possibility for small scale power export to Vietnam. Even when the ASEAN Grid becomes reality, the transmission of power over the long distance will be associated with substantial losses which will not make it economic to wheel the power to Malaysia or Singapore.

In summary, the ASEAN Power Grid is viewed by the study team as having no impact on the Nam Ngiep-I project.

However, the introduction of power pool to the Thai electricity supply industry is another matter. Even though the Thai power pool will be voluntary, the PPA that the developer of the Nam Ngiep-I project can execute with the PPA trader will not cover the long period as those PPAs between the Theun Hinboun and the Houay Ho and the Thai government. The contract period of the PPAs made between the project developers and the Thai government normally covers the whole economic lives of the projects, which are normally 20 to 25 years. The bilateral agreement between the project developers and the PPA trader, on the other hand, will be only for 3-5 years. In this respect, project financing for the Nam Ngiep-I may become a difficult matter under the power pool condition.