บริษัท โกลว์ พลังงาน จำกัด (มหาชน)

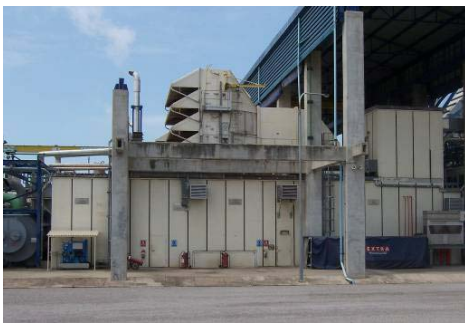
เอกสารแนบ 5

รายงานวิเคราะห์ลักษณะทางเทคนิคของ
โรงงานผลิตสาธารณูปโภคด้านอุตสาหกรรมในกลุ่มบริษัท

Executive Summary

ENERGY BUSINESS GROUP

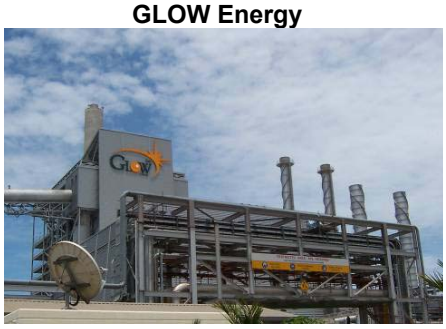
February 20, 2005



GLOW SPP 1

GLOW Energy

GLOW SPP 2



GLOW SPP 3

GLOW DEMIN

GLOW IPP

Tractebel Asia Co., Ltd

Independent Technical Consultant's Report on Glow Group

ELECTROWATT-EKONO
Jaakko Pöyry Group

Notice

It is the good faith and belief of Electrowatt-Ekono that the information, estimates and conclusions contained in this report are reliable. However, Electrowatt-Ekono does not warrant or guarantee their accuracy. Use of the report and its estimates shall, therefore, be at the user's sole risk. Such use shall constitute a release of Electrowatt-Ekono from and against any liability in connection with such use, whether liable for special, indirect or consequential damages, whether such liability is asserted to arise in contract, negligence, strict liability or other theory of law.

EXECUTIVE SUMMARY

1 Introduction

1.1 This Report

The following is a summary of the technical due diligence report, dated 6 August 2004, prepared by Electrowatt-Ekono (Thailand) Ltd., the Independent Technical Consultant (the "**ITC**") appointed by Tractebel Asia Co., Ltd. in connection with the initial public offering of Glow Energy.

However, since the technical due diligence, the data tables, the status of the expansion projects and the status of the disputes with EGAT have been updated by the ITC to reflect the status as of the end of January 2005.

1.2 Independent Technical Consultant

1.2.1 Introduction of Electrowatt-Ekono

Electrowatt-Ekono, the energy sector arm of Jaakko Poyry Group, is one of the leading power sector consulting and engineering firms of its kind in the world, ranked by the Engineering News Record ("ENR", USA) as the 6th largest International Design Firm in Power Sector. The company is recognised as an independent firm of consultants by all major international institutions. The company is independent from equipment suppliers and power companies, and is thus able to provide fully independent advice for all of its clients.

Electrowatt-Ekono has good experience in technical due diligence work for power generation and distribution assets, similar to this project. We have conducted technical due diligences or related technical advisory work for more than 100 thermal and hydro power plants within the last 10 years alone. In terms of megawatts, the combined capacity of these power plants totals over 35,000 MW, and the plant capacities have ranged from a few megawatts to 2,400 MW. A good example of our technical due diligence work is the on-going over USD 1 billion BLCP 1,400 MW coal-fired power plant project in Thailand, for which we have performed technical due diligence and are currently the Independent Engineer for the project lenders.

Independence of Electrowatt-Ekono

This independent technical due diligence report was prepared by Electrowatt-Ekono (Thailand) Ltd. for Tractebel Asia Co., Ltd.

Electrowatt-Ekono will receive professional fees for the preparation of this report. However, none of the Electrowatt-Ekono directors or staff who contributed to this report has any interest in:

- Tractebel or any of the other shareholders of Glow Group companies
- Glow Group companies
- The generation or distribution assets subject to this report
- The outcome of the initial public offering

Unrelated to this technical due diligence, Electrowatt-Ekono (Thailand) Ltd. is currently working for Glow Group as the Owner's Engineer for Glow Energy Phase IV Stage 1&2 power plant expansion.

Drafts of this report were provided to Tractebel and Glow and their advisors, but only for the purpose of confirming the accuracy of factual material relied upon in the report.

1.3 Technical Due Diligence

1.3.1 Scope of Work

This technical due diligence report has been prepared expressly for the purpose of providing an objective and independent technical assessment of Glow Group's operating power, steam and water assets. The report is provided for incorporation in any public information document to be issued as part of the initial public share offering in respect of these assets.

1.3.2 Sources of Information

This report is based on information and documents supplied by Glow Group during the due diligence assignment, as well as discussions with a number of Glow Group's directors and staff.

It is the belief of Electrowatt-Ekono that the information, estimates and conclusions contained in this report are reliable. However, as the report is based on information received by Electrowatt-Ekono in bona fide from Glow Group, no representation or warranty is made by Electrowatt-Ekono as to the accuracy and completeness of any of the information contained in the report. Unless specifically stated otherwise in this report, Electrowatt-Ekono has not attempted to verify or validate any of the information provided to it.

We have prepared this report as an independent third-party analysis of the industrial utilities-generating facilities of the Glow Group. In our report, we have chosen to use certain measurements of technical characteristics of Glow's facilities which we believe are common in the industry but are not universally used or, if used, may be measured, calculated or defined in different ways. In particular, it is worth noting that Glow Group itself uses different measurements than those which we present in this report or calculates or defines these criteria differently than we do herein. These discrepancies are normal, and to some extent to be expected, in an industry involving precise measurements of complex machinery, with the result that there is always an element of subjectivity in any set of figures presented. Nothing in this report should be construed to suggest that one particular set of figures or measurements of these technical capacities of the Glow Group's facilities is correct or incorrect.

1.3.3 Conduct of Due Diligence

The technical due diligence was conducted by a team of experts with good experience of similar work for gas and coal-fired power plants, water treatment plants and power and steam distribution systems, similar to Glow Group's assets. The team included a total of five experts covering the mechanical, electrical, C&I, O&M, environmental, contractual and other aspects of the plants and their distribution systems. Two of the experts also had previous experience of hybrid coal- and gas-fired power plants, similar to the Glow SPP 2&3 plant.

The initial technical due diligence was performed over a period of about three weeks, from 23rd June to 12th July, 2004, and included review of project contracts and documents in the data room and visits for all the plants. Site visits for each plant covered review of technical documentation and operating records, discussions with plant management, as well as operation and maintenance personnel, and visual inspections of the plant and equipment. Site visits had a typical duration of 1.5 days per plant. Based on the initial due diligence, more information was requested on certain issues and the due diligence was completed by August 6, 2004.

However, since the technical due diligence, the data tables, the status of the expansion projects and the status of the disputes with EGAT have been updated by the ITC to reflect the status as of the end of January 2005.

2 Glow Group

2.1 Summary of the Assets

Glow Group's power, steam and water production assets in Thailand are presented in the table below:[1]

Plant	Plant Type/Fuels	Nominal Power Capacity [MW]	Nominal Steam Capacity [t/h]	Nominal Demineralised Water Capacity [m^3/h]	Nominal Clarified Water Capacity [m^3/h]
Glow SPP 1	Combined Cycle Cogeneration / Gas and Diesel	117	90	70	-
Glow SPP 3 Phase 1	Steam Boilers and Gas Engines / Natural Gas	3[2]	250	230	1,110
Glow Energy	Combined Cycle Cogeneration / Gas and Diesel	281	300	280	900
Glow SPP 2	Gas Turbines and HRSGs / Gas and Diesel	513	200	150	-
Glow SPP 3	Boilers and Steam Turbines of the Hybrid Blocks/ Coal				
Glow IPP	Combined Cycle / Gas and Diesel	713[3]	-	-	-
Glow Demin Water	Demineralised Water Plant	-	-	80	-
Total Capacity		1,627	840	810	2,010

1 The ITC wants to emphasise that the actual electrical capacity of a cogeneration plant, like the ones owned by Glow, depends on steam output at the time and vice versa; thus electrical and steam capacities are always dependant on each other. In case the steam output is less, then more electricity can usually be produced by the cogeneration plants. In case the steam output is higher, then less electricity can usually be produced. Besides steam output, the capacity of a cogeneration combined cycle power plant also depends on i) prevailing ambient air temperature and humidity, ii) condensate return percentage and temperature, iii) amount of steam extracted at various steam pressure levels, iv) what part of the major maintenance cycle the gas turbines are at the time, and v) gas turbine compressor washing. Because the capacities cannot be considered definite, the ITC has determined the capacities presented in this table as follows: for steam, typical maximum steam load is used as "capacity", for electricity, the approximate electrical net capacity corresponding to this steam load is considered as the plant's capacity. This way, the plant capacities are realistic in a way that they refer to steam and power outputs that the plants can achieve at the same time.

2 It should be noted that the gas engines that produce electricity at Glow SPP 3 Phase 1 have not been operated for some time; therefore it is not known if they can still reach their nominal capacity of 3 MW. Glow does not normally include the gas engines in their capacity figures.

3 713 MW cannot currently be achieved under normal operating conditions; however, this capacity should be able to be achieved after the planned fogging system has been installed in 2005.

The general conclusion of the due diligence is that all of the Glow Group's assets are based on modern technology and design; the plants are ≤10 years old. The major equipment have been supplied by reputable and experienced suppliers. The quality of plant design and construction is comparable to what can be found in developed countries. The condition of the assets is good and while some further improvements can always be made, the ITC did not find any major concerns during the due diligence.

The individual assets are discussed in more detail in the following sections.

2.2 Plant Locations

With the exception of Glow IPP, all the other Glow Group's plants are located in Map Ta Phut Industrial Estate or its close proximity, as shown in the figure below. Map Ta Phut is Thailand's largest industrial estate, mainly catering for petrochemical industries. The fact that the Glow Group's cogeneration plants are all located close to each other allows Glow the possibility to reduce its operating costs compared to totally separate assets by optimising its steam, power and water supply to the industrial customers between the various plants.

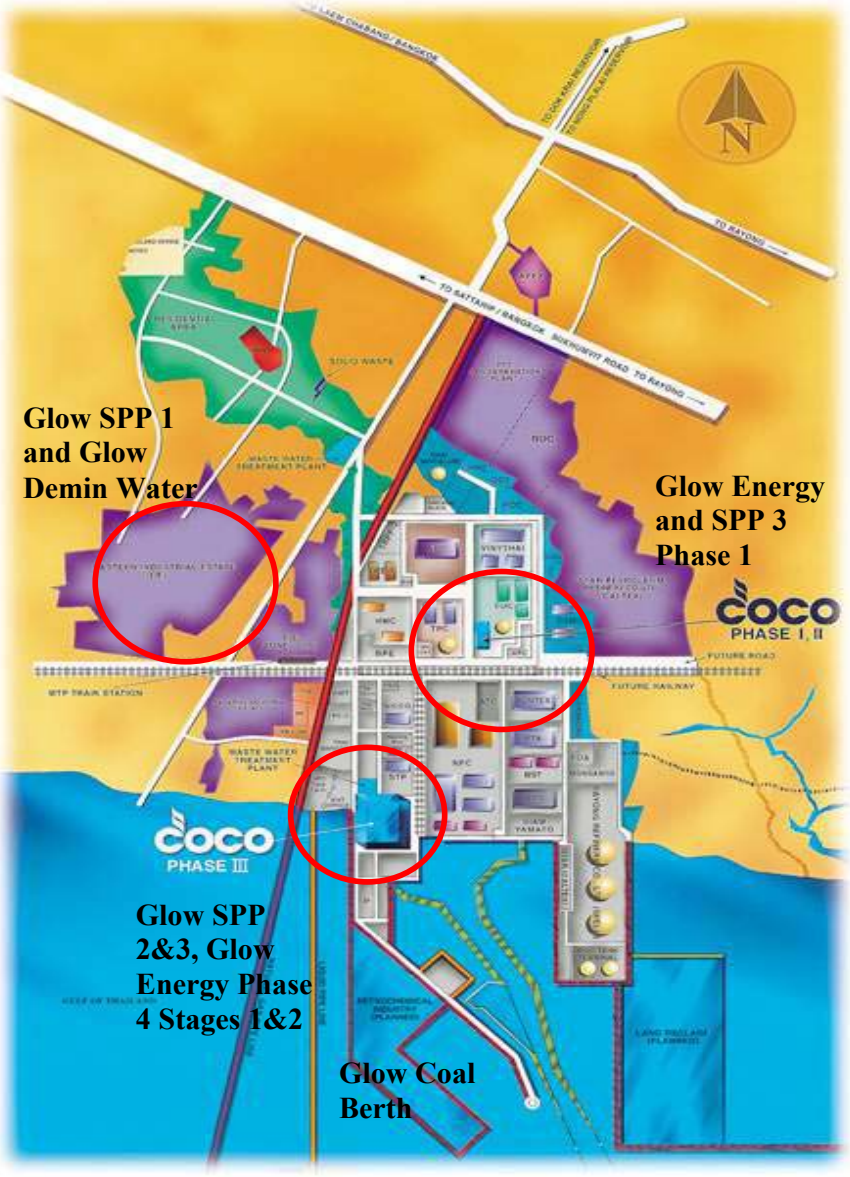


Figure: Glow Group Assets in Map Ta Phut Area

Besides having an excellent location regarding power, steam and water sales to major industrial customers, the locations of the Glow Group's plants offer the following advantages:

- Glow owns a coal berth at Map Ta Phut Industrial Estate, next to its SPP 2&3 power plant. This coal berth is big enough for Panamax-sized vessels and has enough capacity to supply coal also for future plant expansions
- All the Glow plants, including Glow IPP in Chonburi, are located very close to main natural gas transmission pipeline.
- All the Glow plants are located close to Thailand's high voltage transmission network
- There is an extensive network of water reservoirs, such as Dok Krai, Nong Khor and Nong Plalai with potential for water run-off of 20,000 million cubic meters per year, and water distribution system in place to serve the Map Ta Phut Industrial Estate area.

It can be concluded that the area has all the necessary infrastructure in place and the plant locations are well selected regarding fuel and water supply.

3 Asset Description

3.1 Glow SPP 1

The Glow SPP 1 cogeneration plant consists of two identical single-shaft combined cycle power plant blocks. The plant is a cogeneration plant producing power to EGAT and a number of industrial customers, as well as steam for industrial customers. The two blocks started their commercial operation in February and September 1998.

Each block consists of an ABB GT8C gas turbine, which drives a generator. At the other side of the generator an extraction - condensing steam turbine is connected to the generator via a clutch. The exhaust gases of the gas turbine are directed into a vertical Heat Recovery Steam Generator (HRSG), which produces steam at two pressure levels. Steam from both the pressure levels is then led to the steam turbine, where it expands and produces electricity. Process steam is extracted from the steam turbine and led to the industrial consumers. The plant also includes a 30 t/h gas-fired auxiliary steam boiler.

The assets also include 22 kV and 115 kV power distribution systems, as well as 27 bar and 18 bar steam distribution systems to customers in the industrial estate.

Total power generation capacity of the plant is about 117 MW and steam generating capacity 90 t/h, which includes the 30 t/h auxiliary boiler. Power generation can be increased to more than 125 MW at the expense of steam generation. Similarly, steam generation can be increased up to 130 t/h (including the 30 t/h auxiliary boiler) at the expense of power generation. In addition, the plant is capable of producing 70 m3/h of demineralised water. The power plant uses natural gas as primary fuel, with diesel oil as back-up.

The cogeneration plant is located in Eastern Industrial Estate in Rayong province. The site is compact but of sufficient size with part of the site reserved for future expansion of the plant with a third block.

Due to high demand of power and steam, the plant currently operates close to its full capacity during the day-time. At night-time, the demand for electricity is somewhat lower and also the plant operates at lower load, but still utilising both of the blocks.

3.2 Glow SPP 3 Phase 1

The Glow SPP 3 Phase 1 plant consists of two identical gas fired steam boilers supplying high-pressure steam to industrial customers. Commercial operation date of the plant was in July 1994.

Each gas fired steam boiler (Babcock DS 225/4 type manufactured by ABB) is rated to provide 125 t/h of steam at 47 bar(a) and 400ºC.

In addition to the auxiliary boilers, the plant includes three small gas engines of about 1.2 MW each, which are currently used for back-up purposes.

The plant also includes a water treatment facility capable of producing 1,110 m3/h of clarified water and 230 m3/h of demineralised water. The plant supplies both demineralised water and clarified water to industrial customers.

Natural gas is the plant's primary fuel, tail gas from nearby Thai Olefins Company (TOC) secondary fuel and diesel oil is used as back-up fuel.

The plant is located in Map Ta Phut Industrial Estate in Rayong province.

The auxiliary boilers are currently operated 24 h/d according to steam load of the customers. However, after the on-going Glow Energy IV Stage 1&2 expansions are in operation, it is expected that the operation of these auxiliary boilers can be considerably reduced or they can be fully shut down and kept only as reserve capacity.

3.3 Glow Energy

The Glow Energy power plant consists of two identical combined cycle power plant blocks. Total plant capacity is about 281 MW of electricity and 300 t/h of steam. The plant had its commercial operation date in October 1996.

Each of the blocks consists of:

- 3 x Frame 6B gas turbine generators, electrical output each about 35 MW (at site conditions)
- 3 x Heat recovery steam generators, rated steam output each 20 kg/s without supplementary firing and 26 kg/s with supplementary firing
- 1 x Steam turbine, electrical capacity about 55 MW
- Necessary auxiliary equipment

The plant is a cogeneration plant producing power to both EGAT and a number of industrial customers, as well as steam to industrial customers in high pressure (47 bar) and medium pressure (21 bar) levels. The assets also include extensive electrical (115 kV and 22 kV) and steam distribution networks in the Map Ta Phut and Padaeng Industrial Estates.

In addition, the plant includes demineralised water plant with capacity of about 280 m3/h and clarified water system with capacity of about 900 m3/h.

The plant uses a mixture of natural gas and tail gas from TOC as primary fuel, with diesel oil as back-up fuel.

The plant is located in Map Ta Phut Industrial Estate, next to Glow SPP 3 Phase 1 plant.

The Frame 6B gas turbine used at the plant (and at Glow SPP 2 plant and Glow Phase IV Stage 1&2 plants as well) is the most popular industrial gas turbine in the world with very good references from both Thailand and other parts of the world. The operational risks with Frame 6B gas turbines are considered to be low.

All the gas turbines are normally operated at full load during the day-time. During night-time, one of the gas turbines is typically shut down as electricity demand of EGAT reduces.

3.4 Glow SPP 2&3

Glow SPP 2 & 3 plant has a total capacity of about 513 MW of power and 200 t/h of steam. The plant is a cogeneration plant producing power to both EGAT and a number of industrial customers, as well as steam to industrial customers in high pressure and medium pressure levels.

The plant consists of:

- Two cogeneration blocks each including a Frame 6B gas turbine for electricity production and a heat recovery steam generator for process steam production
- Two hybrid blocks each including a coal fired Circulation Fluidized Bed (CFB) boiler and a steam turbine, two Frame 6B gas turbines, and two heat recovery units for steam reheat and condensate/feed water preheat

While the hybrid blocks are technically one plant, due to commercial reasons they have been divided into two entities: Glow SPP 2 (the four gas turbines, four heat recovery units, the two cogeneration blocks and the related auxiliaries) and Glow SPP 3 (the coal-fired boilers, steam turbines and the related auxiliaries). This is because SPP contracts with EGAT have a maximum contracted capacity of 90 MW only.

Each cogeneration block utilises a Frame 6B gas turbine with dual-fuel firing capability. The primary fuel is natural gas but the gas turbine also has diesel oil as a back-up fuel. The two cogeneration gas turbine units started their commercial operation in April 1997.

The hybrid blocks are considered hybrid because they combine a coal and gas-fired power plants into one entity, where the gas turbine exhaust gas is used for condensate and feed water heating (normally done in preheaters fed by steam turbine extraction steam) as well as steam reheating (normally done in the back pass of the CFB boiler). Live steam from the CFB boiler is fed to the steam turbine, expanded in the high pressure section of the turbine, then directed as cold reheat steam to the reheater section of the heat recovery unit. The heat recovery unit captures the exhaust heat from the gas turbine and reheats the steam, which is returned to the intermediate/low pressure section of the steam turbine. Expanding in the intermediate/low pressure section, the steam is exhausted into a seawater-cooled condenser.

The hybrid cycle combines fuel flexibility of both solid and gaseous fuels and good overall efficiency derived from the combined cycle portion of the hybrid cycle. However, due to the integration of the cycles, good efficiency is achieved only when all the main equipment are in operation. In other words, the efficiency advantage of the hybrid plant will be achieved when both the CFB boiler and the two gas turbines with heat recovery units are in service. Regardless of their complexity, once they have been designed properly and are operated with all components in service, hybrid plants provide fuel flexibility at high efficiency and good availability.

The four gas turbines of the two hybrid blocks started their operation in September (2 units) and October (2 units) 1997 in open cycle. The coal-fired boilers and steam turbines had their commercial operation dates in July 1999.

The assets also include electrical distribution and steam distribution (both high pressure and medium pressure) networks. Glow Energy and SPP 2&3 distribution networks are partly interconnected, which enables production optimisation between the plants.

The SPP 3 plant also includes its own coal berth, capable of receiving Panamax-size (about 60,000 t) vessels transporting coal. The coal berth has recently been upgraded to be able to receive various types of vessels and to unload coal at faster rate than before.

The plant is located in Map Ta Phut Industrial Estate. The site has been designed to be sufficient for future expansion, capable of locating several new power and steam generating units.

Normal operating regime is to run both the hybrid units and the cogen units at or close to full load. At night-time, one of the gas turbines is typically shut down as electricity demand of EGAT reduces.

The plant is based on modern design and it is the ITC's opinion that the plant is technically one of the best coal-fired power plants in Thailand.

3.5 Glow IPP

The Glow IPP plant is located in Chonburi Industrial Estate, Chonburi province, which is located between Bangkok and Rayong.

The power plant consists of two identical and independent single-shaft combined cycle power plant blocks. Both blocks consist of an ABB GT26B gas turbine, heat recovery steam generator, steam turbine and a common generator. The primary fuel at the plant is natural gas, diesel oil is used as a back-up fuel.

The plant sells its electrical output to EGAT at 230 kV under Thailand's IPP program. Nominal net capacity of the power plant is 713 MW.

The Commercial Operation Date (COD) of the power plant was January 31, 2003 and the plant is still under warranty from Alstom (previously ABB).

The two combined cycle blocks operate according to EGAT's dispatch instructions. EGAT usually dispatches both the units at daytime around 10% below their maximum capacity in order to maintain spinning reserve capacity. At night-times, EGAT often reduces the dispatch to about 280-300 MW per block.

3.6 Glow Demin Water

The Glow Demin Water plant is located in the Eastern Industrial Estate, in Rayong province, just across the road from the Glow SPP 1 cogeneration plant.

The plant has demineralised water production capacity of about 80 m3/h. The plant has been supplied by Salcon Limited, which is a well-known demineralised water plant supplier. Commercial operation date of the plant was in November 1999.

The plant supplies demineralised water to two industrial customers in the industrial estate through pipelines. In addition, the plant includes a tanker truck loading facility capable of

handling two trucks at the same time. This is used for spot sales when the long-term customers do not use all the capacity available.

3.7 Electricity, Steam and Water Distribution Networks in Rayong

Glow Group has extensive distribution networks in the Map Ta Phut area in Rayong for power and steam, and to a lesser extent also for water.

All electricity networks serving the industrial customers use underground cables, which are more expensive but also have better availability compared to overhead lines. According to the available network maps, the power distribution networks include a total of 46.1 circuit-kilometers of 115 kV distribution networks and 22.4 circuit-kilometers of 22 kV distribution networks and extend to the following industrial estates:

- Map Ta Phut Industrial Estate
- Padaeng Industrial Estate
- Eastern Industrial Estate
- Asia Industrial Estate

This is an area of about 7x4 km.

Steam distribution networks cover the same industrial estates, with the exception of the Asia Industrial Estate. The steam networks in the Eastern Industrial Estate are separate from the steam networks in the Map Ta Phut and Padaeng Industrial Estates, and are served by Glow SPP 1. The steam piping system is above ground and the pipes are built either on piperacks or pipebridges along with other pipelines transporting various petrochemical products, water and other utilities.

Demineralised water networks extend to Map Ta Phut, Padaeng and Eastern Industrial Estates. The network in the Eastern Industrial Estate is a separate one served by Glow Demin Water. Clarified water network extends only to Map Ta Phut and Padaeng Industrial Estates.

The investment already made for the distribution networks is considerable. As the existing substations can be easily extended to serve new customers and most of the steam pipelines still have excess capacity, it is reasonably easy for Glow Group to connect new customers to the existing networks at low marginal cost.

4 Fuel and Water Supply

Most of the Glow Group's power plants use natural gas as their primary fuel with diesel oil as back-up. Natural gas to the plants is supplied by Petroleum Authority of Thailand (PTT), Thailand's national oil and gas company. Natural gas comes from the off-shore gas fields in Gulf of Thailand, from where it is piped to Rayong and further inland through two parallel transmission pipelines.

Based on the ITC's experience, the gas supply security in Thailand has been excellent and there have been no major supply interruptions. In case of a supply interruption, Glow SPP 1, Glow Energy, SPP 2 and IPP plants can change to use diesel oil, and the plants have adequate facilities and storage systems in place for this. As diesel oil is more expensive fuel than natural gas, it is normally only used in case of gas supply interruptions and its long-term use is avoided.

Glow SPP 3 Phase 1 and Glow Energy. also use tail gas from TOC as supplementary fuel. This tail gas is quite close to natural gas in terms of chemical content and heating value, and the ITC considers the use of the current small amounts of tail gas to be safe and harmless.

Glow SPP 3 uses coal from Indonesia as its primary fuel. Coal is delivered by Panamax-size vessels to Glow's own coal berth at Map Ta Phut Industrial Estate, from where it is conveyed to the coal yard and further to the boilers. The coal used is of good quality with high heating value and low sulphur content. The coal storage arrangements at the plant are sufficient to keep the plant running at full load for more than 45 days in case of a possible problem with one coal shipment (which are scheduled to arrive every 20 days). The ITC has reviewed the coal supply, transport and storage arrangements, which all seem to be adequate, designed to mitigate risks related to coal supply.

Of the total fuel usage of Glow Group, about 80.6% is based on natural gas (in MMBTU's), 17.6% on coal, 1.6% on tail gas and 0.2% on diesel oil, according to year 2003 figures.

Water to the plants is supplied by the industrial estates, who in turn receive water from Eastern Water. The quality and quantity of water supplied has been sufficient and all the plants have water storage tanks or ponds, which can be utilised in case of short-term supply interruptions. Only Glow IPP has experienced any water supply interruption worth mentioning; the longest of the three interruptions experienced by the plant lasted for 10 hours. As the plant has two big water ponds capable of storing water for three days operation at full load, these supply interruptions have not affected plant operation. According to the ITC's experience, water supply interruptions in these industrial estates are quite rare and this is not considered to be a major risk for the Glow Group.

5 Plant Performance

Some of the main performance indicators for power and cogeneration plants, such as the ones owned by Glow Group, are capacity utilisation, operating efficiency, plant availability and product availability to customers. These are discussed in turn.

5.1 Capacity Factors

The capacity factors calculated by the ITC for the Glow Group's plants are presented in the table below.[4]

	2001	2002	2003	2004
Electricity				
Glow SPP 1	68.0%	72.2%	70.1%	76.5%
Glow Energy	83.6%	86.8%	91.3%	88.1%
Glow SPP 2	74.0%	81.2%	78.7%	81.6%
Glow SPP 3	61.3%	77.4%	78.5%	78.7%
Glow IPP	-	-	67.6%	83.3%
Total Glow Group	72.0%	80.5%	75.3%	82.6%

[4] As discussed earlier, capacity of a cogeneration plant is not definite but depends on the operating conditions. The same plant capacities as presented in Section 2 re used also as a basis for this calculation. Capacity factor equals to annual average load of the plant divided by its nominal capacity. It should, however, be noted that besides actual power, steam and water sales, Glow Group also gets revenues from availability payments without actually producing energy. Therefore capacity factor alone will provide only a partial picture of the revenue flows.

	2001	2002	2003	2004
Steam				
Glow SPP 1	44.3%	50.2%	58.4%	60.4%
- Power Blocks	54.6%	68.8%	82.1%	86.4%
- Aux. Boiler	23.7%	13.1%	11.1%	8.2%
Glow SPP 3 Phase 1	6.3%	7.7%	13.0%	34.4%
Glow Energy	91.8%	88.5%	98.6%	97.1%
Glow SPP 2	74.8%	78.4%	75.4%	83.0%
Glow SPP 3 (Phase 3)	87.2%	96.2%	145.0%	162.6%
Total Glow Group	57.9%	59.0%	67.4%	75.8%
- Power Blocks	82.8%	84.4%	94.8%	98.0%
- Aux. Boilers[5]	8.1%	8.3%	12.8%	31.6%

The following comments and interpretations can be made based on the calculated capacity factors:

- The fact that the auxiliary boilers have low capacity factor is good, since the most feasible option is to use auxiliary boilers (which have relatively high operating costs but low capital costs) only for back-up and peaking purposes, and to use the cogeneration plants for base load operation. In case of Glow Group, the auxiliary boilers have had capacity factors of around 10% which shows that the auxiliary boilers are used in the most feasible way. In 2004 the capacity factor for the auxiliary boilers (Glow SPP 3 Phase 1) has increased due to increasing steam loads, but the capacity factor will again reduce when the Glow Energy Phase IV Stage 1 HRSG becomes online in early 2005.

- While Glow SPP 2 produces both electricity and steam, the supplementary firing used in the cogeneration blocks of Glow SPP 2 is used to produce only steam. The best use of supplementary firing is to use it to cover the intermediate and peak steam loads, and as reserve capacity; this explains why it is not used so much and why the capacity factor for steam at Glow SPP 2 is lower than in the other plants.

- Glow SPP 3 has during the last two years produced more steam than before, which shows in the statistics so that the capacity factor for steam is more than 100%. The plant has been designed so that it can be operated this way and there is no reason to be alarmed; this just means that less electricity is actually available than the nominal electrical capacity as long as steam load is this high, resulting in slightly lower capacity factor for electricity.

- The capacity factors for the power blocks (=Glow Group excluding the auxiliary boilers) are high, 82.6% for electricity and 98.0% for steam in 2004. More importantly, the capacity factors have increased over time, showing that the power and steam loads are increasing, increasing also the net sales.

[5] Glow SPP 3 Phase 1 and Glow SPP 1 Auxiliary Boiler

- It should be noted that capacity factors of 100% are not possible due to the fact that i) power and steam loads of industries and EGAT have typical load factors of around 65-85%, and ii) every power plant needs annual maintenance shutdown and also has some forced outages, typically reducing the annual availability to about 90-95%. Compared to other similar plants, the capacity factors of Glow Group can be considered high.

5.2 Efficiency

The plant efficiency figures calculated by the ITC for the Glow Group's plants are presented in the table below.

	2001	2002	2003	2004
Net Electrical Efficiency (LHV)[6]				
IPP	-	-	54.6%	55.0%
Overall Net Efficiency (LHV)[7]				
SPP 1 Power Blocks	N.A.	53.4%	55.2%	57.3%
Glow Energy	N.A.	63.7%	66.0%	64.8%
SPP 2 Cogen Blocks	N.A.	71.3%	70.0%	71.5%
SPP 2&3 Hybrid Blocks	N.A.	43.4	42.2%	43.9%
Heat to Power Ratio[8]				
SPP 1 Power Blocks	N.A.	36.4%	44.6%	43.5%
Glow Energy	N.A.	86.5%	91.7%	94.2%
SPP 2 Cogen Blocks	N.A.	149.2%	150.8%	152.6%
SPP 2&3 Hybrid Blocks	N.A.	11.4%	14.8%	17.8%

The efficiencies of all the plants are good, especially in case of Glow IPP, Glow Energy and SPP 2 Cogen Blocks. Because of their hybrid nature, the efficiency of Glow SPP 2&3 Hybrid Blocks is lower than the efficiency of combined cycle power plants; this is normal and is compensated by the lower cost of coal as compared with natural gas.

Based on the figures above and observations made during the site visit, the performance of the plants is as expected, with degradation of gas and steam turbines in a normal range, or even better than expected like in the case of Glow IPP.

The Frame 6B gas turbines at Glow Energy and SPP 2&3 plants have already been uprated once, which has improved their net heat rate about 1.0-1.6%. Another uprate is due to start in March 2005, which will further improve the heat rate of these plants.

The Glow IPP uses ABB GT26B gas turbines. As a company, ABB (now Alstom Power) is one of the largest suppliers of industrial gas turbines in the world. However, their GT 24/26 series has been facing some problems since their launch in 1995, including the units at Glow IPP.

6 Net Electrical Efficiency = Power Export / Fuel Consumption (LHV); as Net Electrical Efficiency is meaningless for cogeneration plants where part of the fuel energy goes to steam production, this figure has been presented only for Glow IPP

7 Overall Net Efficiency = (Power Export + Heat Export – Heat Import) / Fuel Consumption (LHV), where Heat Import includes the heat of condensate return and make-up water

8 Heat to Power Ratio = (Heat Export – Heat Import) / Power Export; this figure gives an idea of how much heat (steam) compared to power the plant produces

Despite of the modifications made on the gas turbines, the actual performance (power output and efficiency at base load) is still somewhat lower than originally guaranteed by ABB. This means that under most operating conditions Glow IPP cannot fully meet the Contracted Capacity with EGAT but incurs availability penalties and thus reduced revenues each month; however, the amount of these penalties is not significant. Glow is now planning to install a fogging system in 2005, subject to final approval from the Glow IPP lenders, which should increase the capacity of the plant above the Contracted Capacity with EGAT and thus resolve this small problem.

The heat rate of Glow IPP plant is still better than used in the PPA, allowing Glow IPP to make a small profit on EGAT's energy payments. Compared to other gas turbines of the same capacity, the electrical heat rate of the ABB machines is good; the Glow IPP plant has had net efficiency of around 55% on annual average basis, and is thus one of the very best of all the power plants in Thailand in this respect. Due to the good contractual heat rate of the plant under the PPA, the plant is, and is likely to remain, high in EGAT's dispatch order.

The power and heat ratios presented above show that Glow uses Glow Energy and SPP 2 Cogen Blocks as the main process steam producers, while the other plants produce much less steam in relation to their power outputs.

5.3 Plant Availability

The historical availabilities of the Glow Group's plants are presented in the table below[9]:

	2001	2002	2003	2004
SPP 1				
Unscheduled Outages	1.20%	1.20%	7.22%	1.37%
Scheduled Outages	2.22%	4.09%	2.96%	4.01%
Availability	96.58%	94.71%	89.82%	94.62%
Glow Energy				
Unscheduled Outages	3.16%	1.88%	1.98%	1.84%
Scheduled Outages	1.08%	3.51%	1.03%	3.46%
Availability	95.76%	94.61%	96.99%	94.70%
SPP 2&3				
Unscheduled Outages				
- SPP 2	1.44%	3.68%	0.56%	1.05%
- SPP 3	5.55%	2.15%	2.44%	4.31%
Scheduled Outages				
- SPP 2	0.54%	1.02%	1.33%	0.67%
- SPP 3	8.52%	5.42%	5.48%	4.73%

[9] Availability factor for any given period is the number of hours in such period that a generating unit is available to generate energy, divided by the total number of hours in the period. Scheduled outage factor for any given period is the number of hours in such period that a generating unit is not available to generate due to scheduled maintenance divided by the total number of hours in the period. Unscheduled outage factor for any given period is the number of hours in such period that a generating unit is not generating for reasons, other than scheduled maintenance, such as equipment failures, divided by the total number of hours in the period. The availability and outage factors for plants consisting of several power generating units are based on arithmetic average of the availability and outage factors of those units. A high availability factor generally indicates that the facility is capable of generating during a large portion of the period measured, while a low unplanned outage factor generally indicates that the facilities are well maintained and reliable. Compared to Glow's reporting standard, the unscheduled outages as above refer to planned outages and unscheduled outages to the sum of maintenance and forced outages.

	2001	2002	2003	2004
Availability				
- SPP 2	98.02%	95.31%	98.11%	98.27%
- SPP 3	85.93%	92.43%	92.08%	90.97%
IPP				
Unscheduled Outages	-	-	3.81%	1.33%
Scheduled Outages	-	-	17.54%	1.99%
Availability	-	-	78.65%[10]	96.68%

Based on the ITC's experience, with very good modern equipment, proper plant design and excellent O&M practices average annual availability of 94-95% or higher is possible for combined cycle power plants and coal-fired power plants, such as the plants of Glow Group. For a well-run power plant with no major operational problems, unscheduled outages should generally be <2.0%. For the first 1-2 years of operation, somewhat higher outage factors are still satisfactory due to initial teething troubles. These are all long-term averages, as availabilities vary from year to year depending on the major maintenance schedules.

It should be noted that the ITC's benchmarking is based on worldwide best practices; in many countries in Asia and the developing world plant availabilities of around or below 90% are common.

Based on the above, the ITC considers that the availabilities of SPP 1 and Glow Energy are very good (excluding the Oct '03 one-time event affecting SPP 1, see below), the availability of SPP 2 excellent and availability of SPP 3 is currently good/satisfactory. Excluding the spring outages in 2003 done to rectify the known problems with ABB GT26 gas turbines, the availability of Glow IPP has also been very good. The 2004 figures show already good availability and low amount of unscheduled outages for this plant.

The availability of SPP 1 was reduced in 2003 due to a one-time event resulting in a down-time of one of the gas turbines for 24 days. The availability of SPP 3 was reduced in 2001 due to some major modifications made to the CFB boilers. The availability of Glow IPP was reduced in 2003 due to some major modifications made to the GT26B gas turbines to improve the performance of the machines. These have all been one-time events which are not expected to occur again. The unscheduled outages of SPP 1 have been at reasonably high level due to frequent tube leakages in the heat recovery steam generators; as discussed later on, this problem has already been solved in case of one of the units at the plant and the same modifications will be implemented also for the other unit in November 2004.

In general, the availabilities of the Glow plants are good, well within the normal range for this kind of power plants and, importantly, have improved over time as the initial teething troubles have been resolved. Considering the good operating and maintenance practices in use at the plants, and the fact that several problems affecting plant operation during the previous years have been rectified, the ITC has no reason to expect that the availabilities would not remain good also in the future.

[10] 95.35% without the spring outages in 2003 that were used to do modifications on the gas turbines under the EPC contract

5.4 Product Availability

Actual availability of power and steam to the customers is different from the plant availability due to two reasons:

- The various plants partially back each others up; thus if one unit at one of the plants is down, another unit may be able to supply more power and steam to the customers. In addition, the auxiliary steam boilers and back-up power supply agreements with EGAT/PEA can be used to back-up part of the steam and power supply to industrial customers
- Supply of power and steam to the industrial customers is prioritised at the expense of EGAT; the industrial customers thus enjoy very high product availabilities (the guaranteed availability to EGAT is much lower than to the industrial customers)

Historical product availabilities for the Glow Group's industrial customers is presented in the table below.

	1999	2000	2001	2002	2003
Electricity:					
SPP 1 (115 kV)	99.970%	99.980%	99.990%	99.977%	100.00%
SPP 1 (22 kV)	-	-	-	-	100.00%
Energy, 2&3 (115 kV)	99.996%	100.00%	100.00%	100.00%	100.00%
Energy, 2&3 (22 kV)	99.995%	99.995%	99.947%	99.995%	99.992%
Steam:					
SPP 1 (MP)	99.940%	99.960%	99.980%	99.959%	100.00%
SPP 1 (LP)				99.991%	100.00%
Energy, 2&3 (HP)	99.952%	99.985%	100.00%	99.918%	100.00%
Energy, 2&3 (MP)	99.975%	99.999%	99.960%	99.999%	99.997%

The figures indicate very good availability of electricity and steam to the Glow Group's industrial customers. It is typically not possible to achieve 100% availability in longer run; over 99.95% is what the ITC considers a good long-term availability. The figures reported by Glow are above this, very close to 100%, showing very high product availabilities.

The product availabilities have also been higher than the guaranteed availabilities for the industrial customers. Glow has reportedly had to pay penalties for only one industrial customer due to lower than guaranteed product availability during 2001-2003, and this was for a customer to whom Glow had guaranteed 100% steam availability. Total amount of liquidated damages paid to this customer in 2001-2003 was THB 1.4 million, i.e. not significant.

6 Condition of the Assets

During the technical due diligence the current and historical operational problems and the current condition of the assets were assessed. Based on this, our conclusion is that the general condition of the assets is good, as can be expected as the plants are all relatively new. There are no major technical problems associated with the assets. The most significant of the problems found are briefly discussed in the following.

Glow SPP 1:

- After two years of operation, the availability of the plant started to be negatively influenced by frequent tube leakages in the bends of the HRSG evaporator sections. The reason for the tube leakages has already been identified and after the modifications for Unit 2 in 2003 the problem appears to have been solved for that unit. For Unit 1, which still suffers from the problem, the same modifications will be made in the next major shutdown in November 2004, and after that it is expected that the leakages will reduce to normal level and the problem has been fully solved.

- Unit 2 of the plant experienced a gas turbine failure in October 2003 as one of the fuel oil lances broke off and damaged the gas turbine blades. This resulted in a 24-day downtime. The cause of the damage was investigated and the remaining fuel oil lances were checked and replaced where necessary. This incident was thus successfully resolved and it is not expected to return or to have consequences for the life-time of the plant.

Glow SPP 3 Phase 1:

- No major problems have been identified.

Glow Energy:

- All the gas turbines have experienced trips during fuel changeovers. GE has tried to resolve this issue for some time, but while the success rate has clearly improved, the problem remains. Glow is actively trying to resolve the issue with GE and has changed the fuel changeover testing procedures so that testing is done just prior to a unit shutdown; this way a failed fuel changeover test does not affect the availability of the plant. The ITC would like to comment that quite many gas turbines around the world suffer from this problem, and as it is only experienced occassionally when the plant switches to use diesel oil the problem does not affect normal plant operation or its availability.

- Investigations have revealed that possibly due to earlier problems with restricted cooling, the paper insulation of the generator transformers is degrading. A program of replacement of all eight transformers is underway with the first due in November 2004 and the exercise is due to be completed by the end of 2005. Until the program is completed there is a somewhat higher than normal possibility of transformer failure leading to unit down-time, however, this is not a major concern and the problem does not otherwise impact the plant operation. In addition, should a failure occur, a spare transformer is available. The major part of the replacement cost is covered by Alstom, the original equipment manufacturer.

Glow SPP 2&3:

- As in Glow Energy (see above), all the gas turbines of SPP 2 have experienced trips during fuel changeovers. Based on the records, after February 2004 almost all the fuel changeover tests have already been successful. In any case, as discussed earlier, this issue is not significant considering normal plant operation.

- The two coal-fired CFB boilers have had a number of teething troubles since the start of operation. However, practically all of the major problems have already been resolved

by technical modifications (including installation of additional superheater surface to increase temperature of superheated steam and refractory replacements for the cyclones). Due to the problems, and the downtime required for the necessary modifications, the availability of the CFB boilers was poorer than what could be expected prior to year 2002. Since then, the availability of the CFB boilers has been reasonably good.

Glow IPP:

- The plant has experienced several trips due to unsuccessful fuel changeovers. Glow has identified the reason to be sticking valves and has started a program to exercise the valves during shutdowns. The success rate has since clearly improved and the last few fuel changeovers have already been successful. As discussed before, this issue is not a major concern for the plant operation or its availability.

- The plant has a potential problem with gas quality. When PTT's gas separation plant trips, the gas supplied to Glow IPP contains high amount of heavy hydrocarbons; in case the heavy hydrocarbon content was ≥15.6%, this would result in automatic shutdown of the SEV burners and 16 MW less power per unit until gas quality has returned to normal or the gas turbines switched to use diesel oil. So far this has not happened, although once due to the trip of the gas separation plant the heavy hydrocarbon content went all the way up to 15.4%. Glow IPP has a gas chromatograph which is used to track the gas quality on continuous basis. As PTT does not guarantee heavy hydrocarbon content, it cannot be held contractually responsible of this problem. This issue may in the worst case result in somewhat lower availability payments from EGAT, but as this has not yet happened in one and a half years time, the possibility can be considered reasonably low. As the gas quality in Thailand is scheduled to change during the next few years, it is the view of the ITC that also the risk related to this abnormally high heavy hydrocarbon content of gas will reduce in the future.

Glow Demin Water:

- No major problems have been identified.

It is emphasised by the ITC that it is normal for power plants to have some operational problems and the amount or severity of the problems occurred at the Glow plants do not raise any concerns. On the contrary, it is noted that the problems are properly investigated and addressed by Glow when they arise, and most of the problems during the last years have already been successfully resolved.

7 Environmental Issues

Most of the plants owned by Glow Group are natural gas-fired combined cycle power plants, which are well-known for their small environmental impact. The only significant gaseous emission from these plants is nitrogen oxides, and Glow has installed nitrogen oxide emission reduction systems at all of their combined cycle power plants, either based on water or steam injection, or dry Low-NOx combustion.

The coal-fired boilers at Glow SPP 3 plant are based on modern environmental technology, and thus represent a relatively environmentally friendly way of building coal-fired power generation facilities. While some other coal-fired power plants in Thailand have poor environmental reputation, the Glow SPP 3 plant includes the normal environmental protection

systems found in the modern installations in developed countries. Sulphur dioxide emissions are controlled in the circulating fluidised bed (CFB) boilers by injecting limestone in the furnace, which then captures most of the sulphur dioxide from flue gases. Nitrogen oxides are kept at low level due to the low combustion temperature of the CFB boilers (lower than in other kind of coal-fired boilers). Particulate emissions are at very low level due to the use of baghouse filters to separate particulates from the flue gases. Coal dusting is effectively controlled by using fully covered coal conveyors, spraying water on the active coal yard on a regular basis and having the passive coal yard covered by grass.

Coal ash is collected from the SPP 3 power plant by a third party under a long-term contract. Coal ash is then sold to cement industries and other users of ash in Thailand, and is thus disposed of in an environmentally friendly way. Glow does not dump any coal ash, which reduces environmental risks.

It is the ITC's view that the environmental risks associated with the coal-fired Glow SPP 3 plant are low and manageable.

Based on the measurements conducted on regular basis at all the plants, all the Glow plants currently meet the Thai standards for gaseous emissions. All the plants also meet the World Bank Guidelines regarding gaseous emissions from New Thermal Power Plants.

Review of the historical records shows that there have been some occassions when some of the units at SPP 2&3 have not met the stack emission limits mentioned in the EIA, for instance due to malfunction of valves controlling water injection for NOx emission control. These incidents are considered to be minor breaches and should not be a concern.

Waste water discharge from the Glow SPP 3, SPP 1 and Glow Demin Water has occasionally had some quality problems. Glow considers these to be mainly due to wrong measurement practices. These have been minor breaches and environmental authorities have not reportedly demanded any actions in this respect. Glow has since taken actions on its own to address the situation.

Due to the cooling water discharge from Glow SPP 3, the temperature increase of sea water has been around 3-4 oC, which is slighly higher than the permitted 3 oC. Again, this is a minor breach.

8 Operation and Maintenance

Glow Group has central organisation covering general management, strategic planning, project management, administration, sales, engineering, system optimisation etc., partly located in Bangkok and partly in Map Ta Phut. In addition, each of the power plants has their own operation and maintenance, as well as administrative staff.

Based on the ITC's review, the operation and maintenance of the plants is effective and the problems that arise are addressed in a systematic way. The manning levels and shift sizes are adequate and typical for this kind of power plants in Thailand. The skills level of the O&M staff is good and the staff appears well motivated. The ITC finds that the operation and maintenance of the Glow Group's power plants is better than in most other power plants in Thailand, and is at par with good European O&M practice.

The major maintenance programme in place generally follows the recommendations of the original equipment manufacturers. Also the ABB GT26B gas turbines at Glow IPP have already been released by Alstom to follow normal major maintenance cycle. For the gas

turbines at Glow Energy and SPP 2, Glow has a long-term service agreement in place with GE, which contract will be changed to be with Wood Group starting from January 2005. For the other power plants and other major equipment, Glow Group manages the major maintenance themselves by using the original equipment manufacturers or other reputable companies as contractors. The ITC considers that maintenance planning is adequate and its execution follows the best practices utilised around the world.

9 Technical Conformance with Contracts and Permits

9.1 EGAT SPP Contracts

Contracted Capacity

Glow Energy has achieved the commercial operation of its IV Stage 1 at Glow SPP 3 site. The commercial operation date of the gas turbine was in August 2004 and that of HRSG was in Jan 2005. In anticipation of the expansion, Glow has signed new power and steam supply contracts with industrial customers, some of which already receive power and steam from Glow. Because of this increased industrial load, the current capacity of the Glow Group's power plants in Rayong is not sufficient and Glow SPP 3 has to reduce its power export to EGAT by about 10 MW per block during peak period, for which it gets penalised. Once the Phase IV Stage 1 is commissioned, it is expected that Glow SPP 3 will again be capable of supplying the full contracted capacity to EGAT.

Thermal Efficiency and Ratio

The SPP contracts specify a certain "cogeneration criteria" that the SPP plants have to fulfil on an annual basis. This includes thermal efficiency and thermal ratio limits, of which thermal efficiency only applies for gas and oil-fired SPP power plants.

The figures reported by Glow to EGAT are presented in the table below.

Plant Block / EGAT Contract	Thermal Efficiency			Thermal Ratio		
	2002	2003	2004	2002	2003	2004
SPP 1 B1 / IP1	47.27	46.05	N.A.	30.34	34.05	N.A.
SPP 1 B2 / IP2	44.48	45.93	N.A.	25.33	32.69	N.A.
Glow Energy B1 / COCO1	49.88	51.56	N.A.	52.52	54.72	N.A.
Glow Energy B2 / COCO2	49.89	50.75	N.A.	48.40	52.54	N.A.
SPP 2 B1 / MTP1	50.47	51.11	N.A.	63.46	63.10	N.A.
SPP 2 B2 / MTP2	50.27	51.13	N.A.	63.25	63.10	N.A.
SPP 3 B1 / TCC1	1)	1)	1)	16.57	25.43	N.A.
SPP 3 B2 / TCC2	1)	1)	1)	17.39	22.74	N.A.
EGAT Cogeneration Criteria	>45%			>10%		

1) Not applicable for a coal-fired SPP power plant

In 2004, Glow had a dispute with EGAT on how to calculate the thermal efficiency and thermal ratio. This dispute was successfully resolved in late 2004 and Glow agreed to change the way these figures are calculated from 2005 onwards[11].

[11] The calculation method for 2001-2003 was different from the new calculation method agreed with EGAT in late 2004. The figures for 2001 and 2002 have been approved by EGAT, the figures for 2003 have not been officially approved

Glow also had a dispute with EGAT regarding whether heat and mass balances can be used when calculating the amount of heat supplied, or should the SPP plants install flow meters to measure all the outgoing process steam flows. This dispute has now been resolved and Glow has agreed to install new steam flow meters as required by EGAT.

Electrical Interconnections

Glow also had a dispute with EGAT about the way in which the Glow plants should be and can be permitted to be interconnected and operated under the terms of the SPP contracts. These disputes considered whether the electrical interconnections of the various Glow Group's plants in Rayong are allowed and whether each block with its own SPP contract should be separately connectable to EGAT under the SPP contracts. Under the agreement reached in late 2004, EGAT accepted the interconnections and Glow's way of operating, except for the interconnection of the SPP 2 cogeneration blocks and Glow Energy Phase IV blocks with the plants supplying power to EGAT; these are still under consideration by EGAT. The ITC considers that the present arrangements of Glow are technically satisfactory and seem to allow better supply security and operational flexibility than if these plants were not interconnected.

9.2 EGAT IPP Contract

Although the Glow IPP plant never achieved its guaranteed net capacity and heat rate as specified in the EPC contract, the Dependable Contracted Capacity per unit according to the PPA is lower than the EPC contract guarantee and the PPA requirement of 356.5 MW per unit was successfully achieved by both the units in the pre-COD performance tests.

All the other contracted operating characteristics as per the PPA have been successfully met during the performance tests, except for the start-up time from cold for Unit 2, which was 10 minutes longer than the PPA requirement. This has not been a problem with EGAT; it appears that the only potential problem is that Glow IPP may face small penalties in case the plant is dispatched to start from cold and the plant fails to fulfil the dispatch order in due time.

In addition, there is a minor technical dispute with EGAT regarding the load where fuel changeover can be performed. Since this is an inherent characteristic of the GT 26B gas turbine and will thus affect also other IPP's using the same gas turbine (Bang Bo plant in Thailand and the planned Kaeng Khoi 2), it should be possible to resolve the matter by negotiation.

9.3 Industrial Power, Steam and Water Supply Agreements

The industrial power supply agreements typically guarantee availabilities of either 99.7% or 99.5% with total number of interruptions permitted in a calendar year either 2 or 3. This should be achievable with the current operating practices and plant configurations, as also the historical statistics show. In exceptional years these limits might be exceeded.

The industrial steam supply agreements typically guarantee 99.7% availability of steam and allow maximum of 3 interruptions in steam supply. This should be achievable by Glow, as also the historical statistics show. In exceptional years, e.g. if some major maintenance has to be performed for some part of the distribution system, these limits might be exceeded. This has already happened once in case of a customer to whom Glow has guaranteed 100% steam

due to the dispute; however, also the figures for 2003 have been indirectly approved by EGAT as EGAT has executed the settlement agreement on this matter. Because of the dispute with EGAT, no figures have been calculated for 2004 but it has been agreed with EGAT that the figures for year 2005 will apply also for 2004.

availability. However, as already discussed in Section 5.4, the liquidated damages in this case were not significant.

The power, steam and water quality specified in the agreements seem quite normal and should be achievable by Glow.

9.4 Fuel Supply Contracts

Glow SPP 3 has a long-term coal supply contract in place with Banpu. The contract adequately specifies the quantity and quality of coal to be supplied, with price adjustment formulas if actual coal quality differs from the reference coal.

On top of the coal supplied by Banpu, starting from this year Glow is planning to use some coal purchased on the spot market, should that have lower price.

The gas-fired Glow plants all have long-term gas supply contracts in place with PTT. These are of PTT's standard format and include standard specifications for gas quality and quantity to be supplied.

9.5 Other Contracts

Water supply contracts in place are of standard format of IEAT and the industrial estates authorities. These contracts are reasonably simple and do not always guarantee the amount or quality to be supplied. Based on the ITC's experience, this is not a concern as both the quality and supply reliability are very good in these industrial estates. Furthermore, as this is the standard contractual policy of IEAT, all the industrial plants and power plants located in these industrial estates face this same issue.

Glow SPP 3 has a long-term Ash Management Agreement with Edifice Engineering, who is responsible of collection and selling of all ash, and a Limestone Supply Agreement with Banpu. Glow also has Back-up Power Supply Agreements with EGAT/PEA. There are no technical concerns regarding any of these contracts.

9.6 Permits and Licenses

In general, Glow seems to be in technical compliance with the permits and licenses that it has for the facilities.

Some applications for power concessions regarding certain electricity customers are still under processing by the authorities although Glow already supplies power to them; because of this Glow pays some penalties until the power concessions have been officially received.

10 Commercial and Costs

10.1 Insurance

The ITC has reviewed the most important insurances in place. These include All Risks, Machinery Breakdown and Business Interruption insurances for all the plants.

The terms and conditions of the insurances appear to be standard. The retained liabilities for property damage and machinery breakdown are within typical range compared to other power plants of this capacity and replacement cost. The insured amounts are sufficient to cover the replacement cost of the plants in question, except in case of Glow IPP, whose replacement value is estimated by the ITC to be clearly higher than the sum insured. This has been brought to the attention of Glow and Glow has informed the ITC that they intend to amend the insurance policy to cover the full replacement cost of the plant in September 2004.

10.2 Operation and Maintenance Costs

The ITC has compared the level of historical and budgeted O&M costs of the Glow plants to the actual costs of other similar plants in Thailand and the region. Based on the review, the O&M costs are within typical range for similar plants with no major deviations. Also the administrative and sales costs are in line with other similar plants, however, the ITC expects that as Glow owns a number of similar plants in one country they may be able to achieve reduction in these cost items in longer run.

11 Expansion Plans and Potential

The locations of the Glow Group's plants at major industrial estates in Thailand offer good potential for the group to expand operations and gain new customers. Glow currently has customers in four major industrial estates in Rayong area: Map Ta Phut, Eastern Industrial Estate, Asia Industrial Estate and Padaeng Industrial Estate. Of these, Map Ta Phut and Padaeng Industrial Estates are reasonably full, but there is still some land available and the existing industrial companies also have on-going and planned expansion projects. Eastern Industrial Estate and Asia Industrial Estate have more land available for new locators and during the site visit it was observed that in Asia Industrial Estate construction work for a major industrial facility was on-going. In addition, Glow is targeting to supply electricity to a new private industrial estate, APEX, which is currently under development near Map Ta Phut.

Glow Group has currently three on-going expansion projects, as follows:

- Glow Phase IV Stage 1: This 38.2 MW gas-fired cogeneration plant, consisting of Frame 6B gas turbine and heat recovery steam generator, is currently under construction at the Glow SPP 3 site. The plant will supply power and steam to the already contracted industrial customers of Glow. The gas turbine entered into commercial operation in August 2004 and the steam cycle is expected to be completed in January 2005.

- Glow Phase IV Stage 2: This is a similar 38.2 MW gas-fired cogeneration plant as Stage 1. The new unit will have its commercial operation date in January 2006. The plant will supply power and steam to the industrial customers of Glow in Map Ta Phut.

- Construction of new water treatment plant at Glow SPP 3 site, which was completed in late 2004. The project includes new clarifier with capacity of 2x300 m3/h and 200 m3/h RO plant.

In addition to the above, Glow has also other expansion plans, as follows:

- Glow Phase IV Stage 3: Glow is currently studying the feasibility and optimum fuel and configuration for this expansion project, for which the infrastructure and some major auxiliaries already exist at Glow SPP 3 site. The plant capacity is likely to be about 100 MW. Glow already has an approved environmental impact assessment for a coal-fired expansion of about this capacity at this site.

- Glow SPP 1 Unit 3: The site at Glow SPP 1 has sufficient space for one more unit of about 50 MW. Environmental impact assessment for this unit has already been approved, however, the construction of the unit is waiting for new locators in Eastern Industrial Estate and Asia Industrial Estate.

- Besides the above, the Glow SPP 2&3 site offers sufficient space and good infrastructure to construct even more power and steam generating units based on either coal or gas. The coal berth, which can be used to supply coal for additional power plant units in the future, and the very short distance to the main gas transmission facilities are major benefits for Glow regarding possible plant expansions.

The ITC has reviewed the currently available basic information of the expansion plans and has not found any technical concerns in this respect. Considering the already available infrastructure at SPP 1 and SPP 3 sites, and the extensive distribution networks which can be extended to supply new industrial customers, it should be technically quite easy for Glow to expand its operations according to increasing energy and water demand, at low additional cost.