Attachment 1

Proposal for The Construction of Power Plant Using Non-marketable Coals

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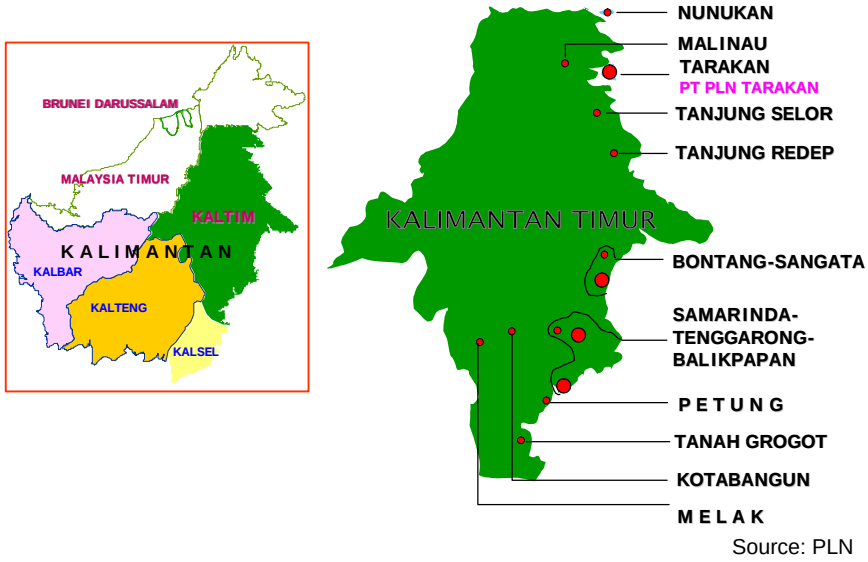
1 Survey on Power Infrastructure in the Province of East Kalimantan

East Kalimantan has a large land area of 210,000 km^2 compared to its population of only 2.8 million. The population is concentrated in a few locations such as the cities of Balikpapan and Samarinda. Historically, electric power infrastructure comprising power generation and distribution systems has been developed regionally and independently. A 150 kV power transmission line (the Mahakam System) has been installed to link between Samarinda and Balikpapan, and further extension is planned in order to deliver stable power to isolated areas.



Source: PLN

Fig. 1 Service Area of PT. PLN (PERSERO) wil. KALTIM

The stable supply of power in the Mahakam System is one of the most imminent issues to be solved.

In 2006, Total power generation capacity in the Mahakam System was 203 MW and dependable peak capacity was 180 MW. Of those 203 MW, 76 MW comes from gas turbine based power generators and the remaining 127 MW comes from diesel engine generators. Due to a scarcity of gas supply, gas turbine generators should rely on diesel oil used as a back up for the gas.

NO.	UNIT	CAPABILITY (MW)	PEAK CAPACITY (MW)
PLN			
1	TJ BATU CCPP	56	51.5
	GT (2 x 20 MW)		
	ST (1 x 16 MW)		
2	PLTD KR ASAM DIESSEL PP	28	24.2
	SWD (6 x 3 MW)		
	Sulzer (2 X 5 MW)		
3	PLTD KLEDANG DIESSEL PP	31	26.3
	Mirless (2 x 4 MW)		
	Pielsteick (2 X 4 MW)		
	Sulzer (3 X 5 MW)		
4	PLTD BATAKAN DIESSEL PP	26	16.1
	GMT (4 X 4 MW)		
	IHI (2 X 5 MW)		
5	PLTD GN MALANG DIESSEL P	18	18.3
	SWD (6 x 3 MW)		
RENT (IPP)			
1	PLTD KALTIMEX BPP	12	11
2	PLTD PEMKOT BPP	4	4.1
3	PLTG MENAMAS TJ BATU	20	21.3
4	PLTD KUKAR	8	7.3
	TOTAL	203	180

Source: PLN

Table 1 Existing Power Generators Power Supply

Although the area is known for gas production, local use of gas for power generation started only recently. Initially committed natural gas supply was 20 MMscfd; however, actual gas supply is limited to only 3-5 MMscfd. Supply of gas is suspended occasionally due to unstable production and production facility operation. During those outages, power plants continue to operate using diesel oil as a back up.

Operating pressure of the gas gathering system which connects gas production well heads is 40 psig. The gathered gas is transferred to the central processing station where the gas is processed and the pressure is raised to 600 psig via diesel engine driven reciprocating compressors. The treated gas is transferred to the PLN Tanjung Batu Natural Gas Power Plant and to the Menamas IPP Gas Power Plant via pipelines.

Specific gravity of the gas is 0.7121 with a heating value of 1,048 BTU/scf. It contains 86% methane, 9% of carbon dioxide, 2% ethane, and 3% propane and heavier, and more importantly no H_2S.

Electricity Tariff in East Kalimantan States in 2004 was Rp 612/kWh. Due to an upheaval of crude oil price after 2005, imported oil prices also soared. Domestic oil supply prices have been subsidized by the government, however, soaring import prices started to take up a significant portion of the national treasury. In October 2005, it was decided to lift all of the subsidies in principle, with some exceptions. The Price for diesel oil for power generation has risen significantly and in July 2006 was Rp 6,150 per liter. Diesel engine generators consume 0.25

liter of diesel oil to generate one kWh of power. This corresponds to Rp 1,537 per kWh just for fuel cost, and is two and one half times the electricity tariff in the region. Budget deficit is accumulating minute by minute by operating the diesel power plants.

Table 2 Tariff 2004

TARIFF	Rp/kWh
RESIDENTIAL	564
BUSINESS	706
INDUSTRIAL	610
PUBLIC	679
AVERAGE	612
Fuel Cost	**1,537**

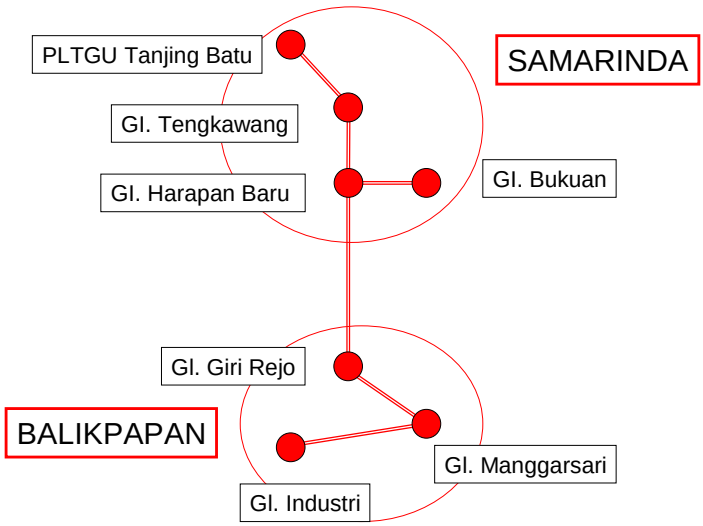
PLN can not recover even fuel (Diesel) cost from the tariff

Note :
Diesel Generator 0.25 L/kWh = 6150 x 0.25 Rp/kWh
= 1,537 Rp/kWh

9

Source: PLN

A 150 kV transmission line between Balikpapan City and Samarinda City has been installed as a major electricity transmission infrastructure. Present total power cable length installed for 150 kV systems is 269 km, 20 kV systems are 4,094 km, and 400 V systems are 4,226 km. Following is a simplified schematic drawing of the Mahakam System showing the 150 kV transmission lines.



Source: PLN

Fig. 2 Mahakam 150 kV Transmission System 2006

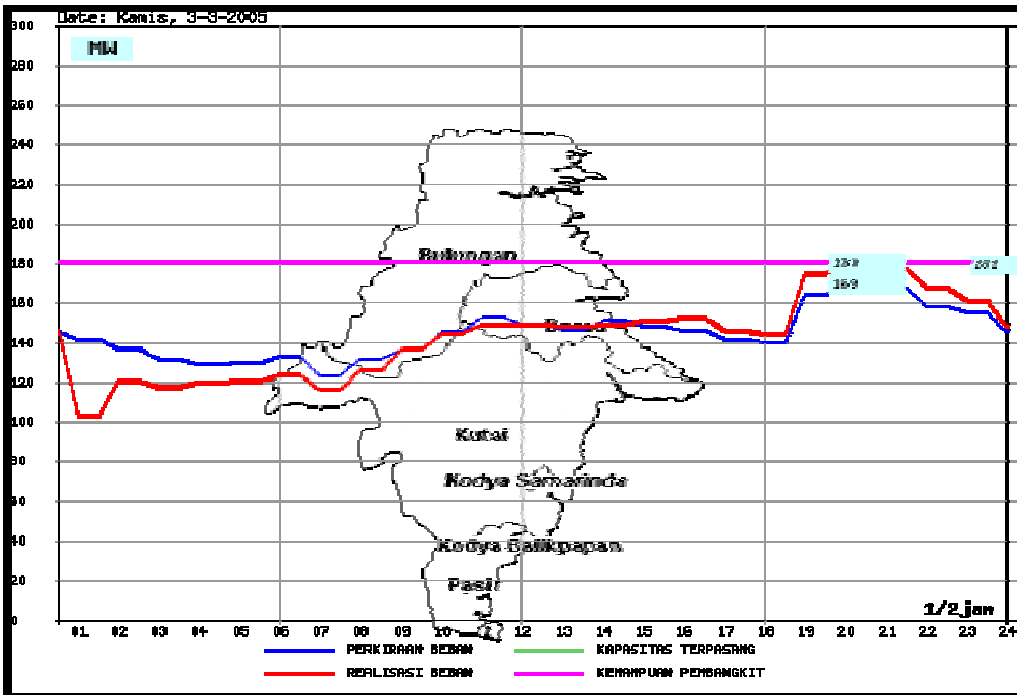
Electricity demand in the Province of East Kalimantan is growing at a rate of 7% per annum. The Mahakam System supplies power to 440,000 customers with the total contractual supply capacity of 678 MVA. However, 45,000 new customers, with 114 MVA of contract capacity are wait listed.

Table 3 Power Demands 2006 June

CONSUMER			WAITING LIST	
RESIDENTIAL	**401.086**	**365,6 MVA**	**28.865**	**29.150 MVA**
COMERCIAL	**25.643**	**175,8 MVA**	**15.139**	**60.562 MVA**
INDUSTRIAL	**239**	**58 MVA**	**435**	**4.580 MVA**
PUBLIC	**12.095**	**73,5 MVA**	**690**	**20.083 MVA**
TOTAL	**439.063**	**672,9 MVA**	**45.129**	**114.375 MVA**

Source: PLN

Mahakam System has a relatively small variation between peak and bottom power load in a day. Peak time is limited to a few hours in the evening. This profile shows that industrial users are not using Mahakam System and may be relying on their own power generation facilities. Once stable power supply is established, the number of industrial customers will increase and peak load might shift from night to day time and power demand would increase greatly.



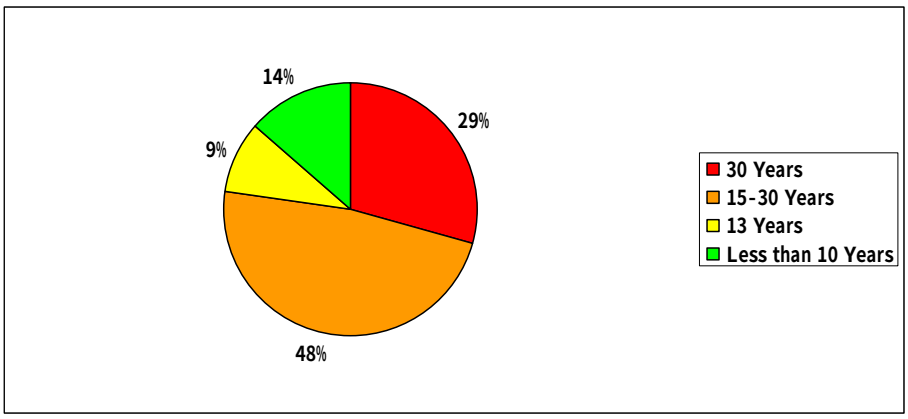
Source: PLN

Fig. 3 Daily Curve of System Mahakam March 3rd 2005

2 Power Supply and Demand

Present total power supply capacity is only 203 MW and dependable power supply capacity is 180 MW, and this just covers present peak load in the system. In general, maintenance cost, including parts replacement cost for diesel engine generators increases with the aging of the engine. General life time of the engine is 15 years, and it become increasingly difficult to obtain spare parts after 15 years of service time.

A total of 87% of the diesel engine generators used presently are more than 15 years old already and among these, 29% are engines older than 15 years. In addition to the upheaval in the diesel oil price, higher maintenance cost has become a heavy burden for PLN in East Kalimantan.

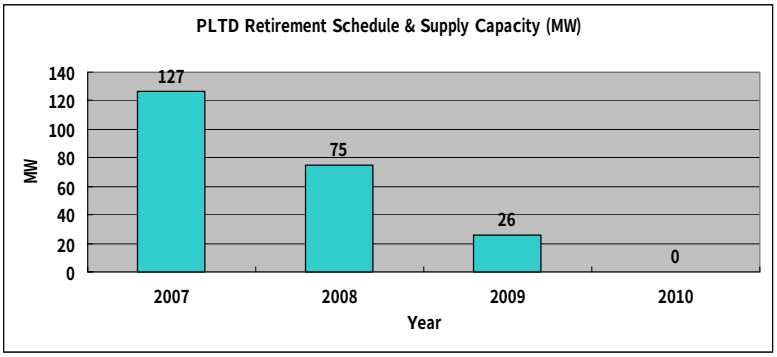


Source: PLN

Fig. 4 Aging of Diesel Power Generator Mahakam Systems

The operation of diesel engine generators will be phased out starting in 2007 and completing in 2010, as shown below.

At present, PLN is trying to develop new power plants in the form of IPPs (Independent Power Producers) in order to make up for the phased out diesel capacity and still meet the increasing demand.



UNIT	CAPABILITY (MW)	RETIREMENT (Year)
PLTD KR ASAM DIESSEL PP	28	2008
PLTD KALTIMEX BPP	12	2008
PLTD KUKAR	8	2008
PLTD PEMKOT BPP	4	2008
PLTD KLEDANG DIESSEL PP	31	2009
PLTD GN MALANG DIESSEL P	18	2009
PLTD BATAKAN DIESSEL PP	26	2010
TOTAL	127	

Source: PLN

Fig. 5 Diesel Generator Retirement Program Mahakam System

PLN is planning to install new power plants to supplement the retired diesel engine generators and also to meet the increasing power demands in the system.
Following is the 10 year power supply plan presented in 2006 by PLN.

Table 4 PLN Power Supply Plan (10 Years) 2006

Project	Fuel	Location	Capacity (MW)		Year
			Unit	Total	
PLTU TJ Batu	Coal	TJ Batu	2 X 25	50	2007/08
PLTG Menamas	Gas	TJ Batu	1 X 20	20	2008
PLTU Kaltim	Coal	TJ Batu	2 X 60	120	2008/09
PLTU Mulut Tambang	Coal	Bukuan	2 X 25	50	2008/09
PLTG Balikpapan	Gas	Senipah	2 x 40	80	2009
PLTGU Bontang	Gas	Bontang	2 X 75	150	2009/10
PLTU Biomass	Biomass	Kuaro	2 X 15	30	2010
PLTGU	Gas			100	2013
PLTG	Gas			50	2015
PLTU	Coal			65	2015

Source: PLN

Among these listed projects, two 25 MW installations for PLTU Tanjung Batu were scheduled to be commissioned in the end 2005. However, the construction work is suspended due to a delay of financial closure. According to recent information, the facilities are rescheduled to complete one unit in 2007 and 2008 for the second unit.

The No. 1 Unit of the PLTG Menamas using a 20 MW gas turbine generator has already been completed and is operational. Because of a shortage in natural gas supply, however, diesel fuel is used for power generation. The No. 2 Unit is scheduled to start operation in 2008, and supply of natural gas should be secured.

Two 60 MW units for PLTU Kaltim are planned near the existing Embalut Substation in Tanjung Batu. Further power plant construction plans until 2010 include PLTU Mulut Tambang, PLTG Balikpapan, PLTGU Bontang, and PLTU Biomass. However these projects will depend also on the schedule for the construction of the new power transmission lines.

The power project development plans for the period after 2010 rely on the utilization of natural gas. In view of the gas supply security in terms of price and supply reliability, it will be more advantageous to utilize coals in the area. In recognition of this situation, PLN is considering to change direction in future electric power development in favor of coal-based power plants.

In this survey, the above 10-year plan was examined through Load Flow Analysis. Since the majority of new projects are located in the north part of the Mahakam System, it may not be feasible to implement the 10-year plan as it was planned. They would necessitate a major expansion of the existing substations and a large capacitor to accommodate a voltage reduction in the southern districts around Balikpapan.

In discussion with PLN Balikpapan, it was revealed that the 10-year plan has been reviewed. The PLTU Kaltim 2x60 MW units of TJ Batu will be moved to Penajam and the PLTU Mulut Tambang 2x25 MW units of Bukuan to Samboja. This would result in a dramatic improvement in the power balance between the south and north. It would also make it possible to build a 100 MW power plant near Samarinda in 2012.
To increase the transmission capacity and also improve the transmission stability, a loop configuration is also recommended by installing a 47 km transmission line between Bukuan and Senipha.

Table 5 shows the results of the study conducted jointly with PLN Balikpapan.

Table 5 PLN Power Supply Plan (10 Years) Reviewed Dec.2006

Project	Fuel	Location	Capacity (MW)		Year
			Unit	Total	
PLTU TJ Batu	Coal	TJ Batu	2 X 25	50	2007/08
PLTG Menamas	Gas	TJ Batu	1 X 20	20	2008
PLTU Kaltim	Coal	**Penajam**	2 X 60	120	2008/09
PLTU Mulut Tambang	Coal	**Samboja**	2 X 25	50	2008/09
PLTG Balikpapan	Gas	Senipah	2 x 40	80	2009
PLTGU Bontang	Gas	Bontang	2 X 75	150	2009/10
PLTU Biomass	Biomass	Kuaro	2 X 15	30	2010
PLTU Unit 1	**Coal**	**Samarinda**	**50**	**50**	**2012**
PLTU Unit 2	**Coal**	**Samarinda**	**50**	**50**	**2012**
PLTU	Coal			65	2015

Source: PLN

In line with the construction of new power projects, construction of new transmission systems should also be implemented.

Acquisition of the land for the construction of transmission lines in East Kalimantan is relatively easy and accomplished at low cost. This differs from other parts of the country. It is also advisable to acquire land for future transmission lines if possible to eliminate various future problems.

Transmission line expansion plan by PLN is shown in Table 6.

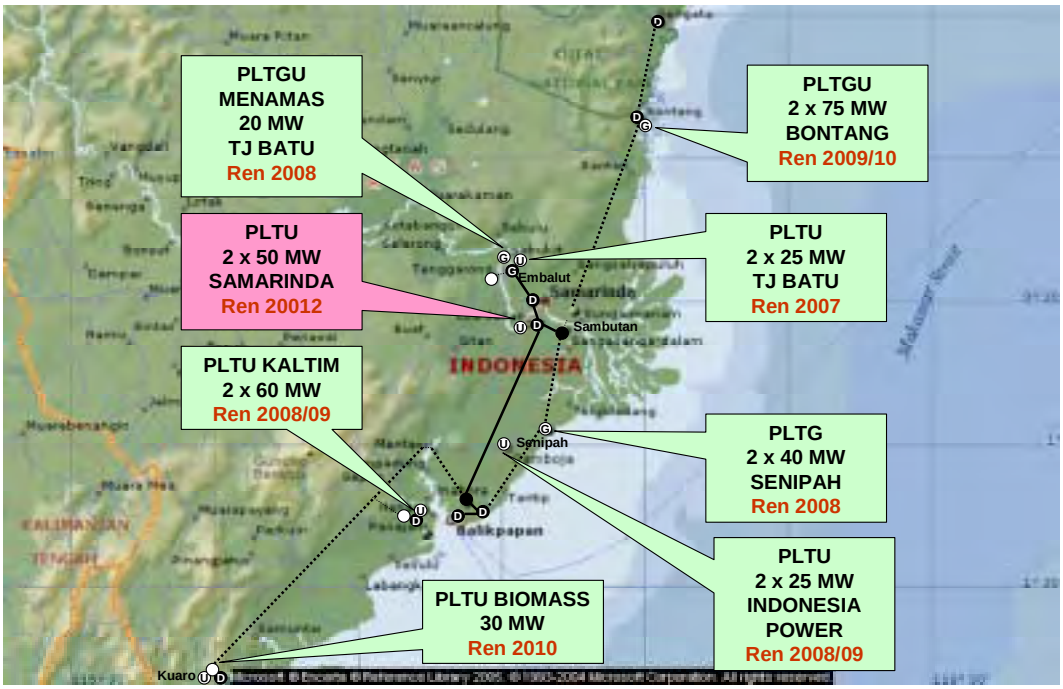
Table 6 Transmission Grid Extension Plan

	From	To	Length (km)	KV	Circuit	Year
1	Embalut	Tenggarong	20	150	1	2007
2	Embalut	PLTU TJ Batu	2	150	1	2007
3	Embalut	PLTU Kaltim	2	150	1	2008
4	Bukuan	Sambutan	20	150	2	2008
5	Sambutan	Bontang	90	150	2	2009
6	Karang Joang	Kuaro	155	150	2	2009
7	Kuaro	Kalsel (South Kalimantan)	93	150	2	2009
8	Manggar Sari	Senipah	50	150	1	2009
9	Kuaro	PLTU Biomass	10	150	1	2010
10	Bontang	Sangata	65	150	2	2011

Source: PLN

New power projects rely on the construction or expansion of the transmission lines, except for the projects around the Embalut Substation.

Fig. 6 below shows the locations of the new power plants that were reconsidered in December 2006.



Source: PLN

Fig. 6 Locations of New Power Plants

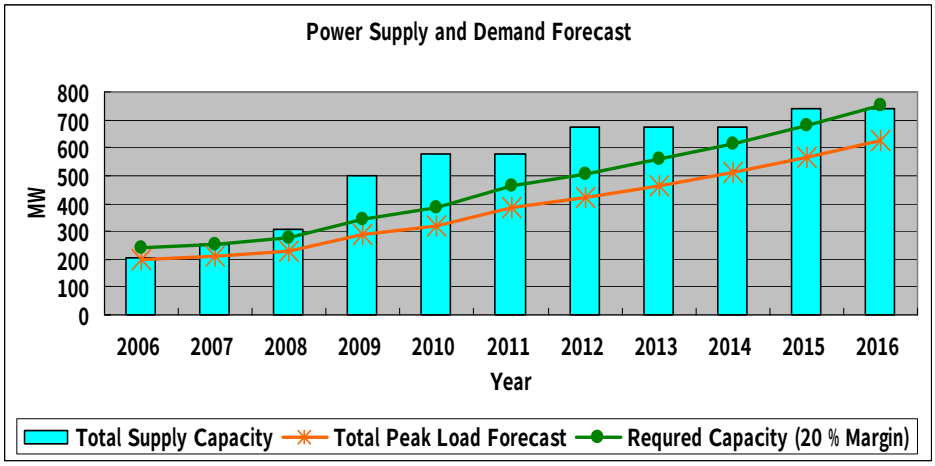
Table 7 shows the power supply and demand forecast for the Mahakam System, including expansion of the power supply area and new power projects.

Table 7 Power Supply and Demand Forecast

No.	NAMA	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Demand												
1	Mahakam System 2006	200	203	205	223	249	281	309	340	375	414	456
2	Mahakam System Extention	0	9	24	62	70	104	115	126	139	154	169
3	Total Peak Load Forecast	200	213	229	286	319	385	423	466	514	567	625
4	Requred Capacity (20 % Margin)	239	255	274	343	383	462	508	559	616	680	750
Supply												
1	Existing	203	203	203	151	102	76	76	76	76	76	76
2	PLTD Retirement	0	0	-52	-49	-26	0	0	0	0	0	0
3	Existing Total	203	203	151	102	76	76	76	76	76	76	76
4	Scheduled Future Project											
	PLTU TJ Batu		50	50	50	50	50	50	50	50	50	50
	PLTG Menamas			20	20	20	20	20	20	20	20	20
	PLTU Kaltim			60	120	120	120	120	120	120	120	120
	PLTU Mulut Tambang			25	50	50	50	50	50	50	50	50
	PLTG Balikpapan				80	80	80	80	80	80	80	80
	PLTGU Bontang				75	150	150	150	150	150	150	150
	PLTU Biomass					30	30	30	30	30	30	30
	PLTU Samarinda Proposed							100	100	100	100	100
	PLTU										65	65
6	Total Supply Capacity	203	253	306	497	576	576	676	676	676	741	741

Source: PLN

Fig. 7 shows the total power supply capacity, peak load and the required capacity.



Source: PLN

Fig. 7 Power Supply and Demand Forecast

It is clear that the addition of 100-150 MW new power capacity will be required in the Mahakam System in 2012-2015.

3 Review of Fuel for Power Generation

Proposed Power Plants should be designed to fully utilize non-marketable fine coals and dirty coals. These coals are known as pollutants of the river environment and need to be eliminated.

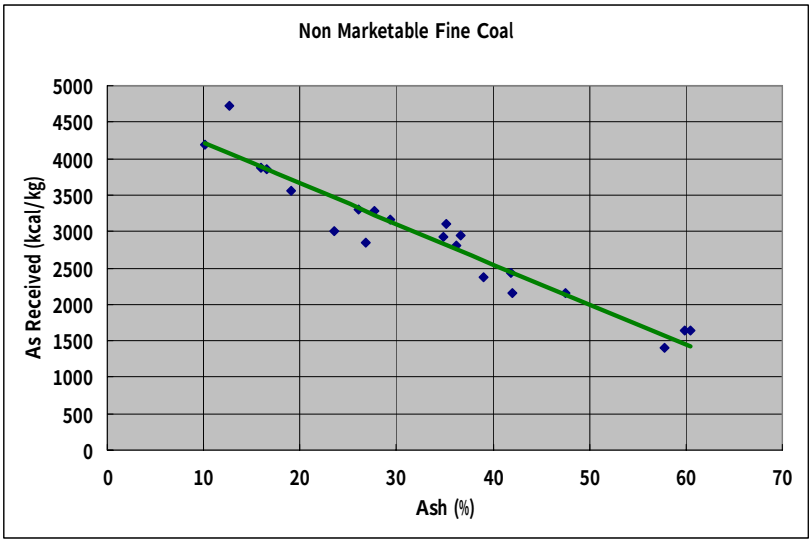
Non-marketable fine coal is currently generated on a scale of 400,000 tons per annum. Although the definite quantities have not been confirmed yet because of the closure of coalmines and the opening of new coal mines in the future, it can be forecast that the minimum amount at the present is around 100,000 tons per annum. Dirty coal output is estimated to amount to 5- 10% of total coal production and is likely to be produced in large quantities. Since non-marketable fine coal is essentially a serious factor of environmental pollution, the dirty coal usage quantities will be determined on the premise that the entire amount of fine coals are utilized at that time.

The physical properties of the non-marketable coal as a fuel (calorific content, ash content, sulfur content, etc.) vary significantly. While, even for the same non-marketable coal, there are variations according the locations from which the non-marketable coal comes, the ash tends to have a low melting point. In contrast, the ash of dirty coal tends to have a high melting point. One of the most important factors in the design of power plants is the heating value of the coal, and this may vary between 1,500 kcal/kg and 6,000 kcal/kg. It is therefore necessary to adjust the total heating value using a reference coal with known properties (for supplemental combustion adjustment) for stable power generation and incinerating these non marketable coals.

(1) Non-marketable fine coal

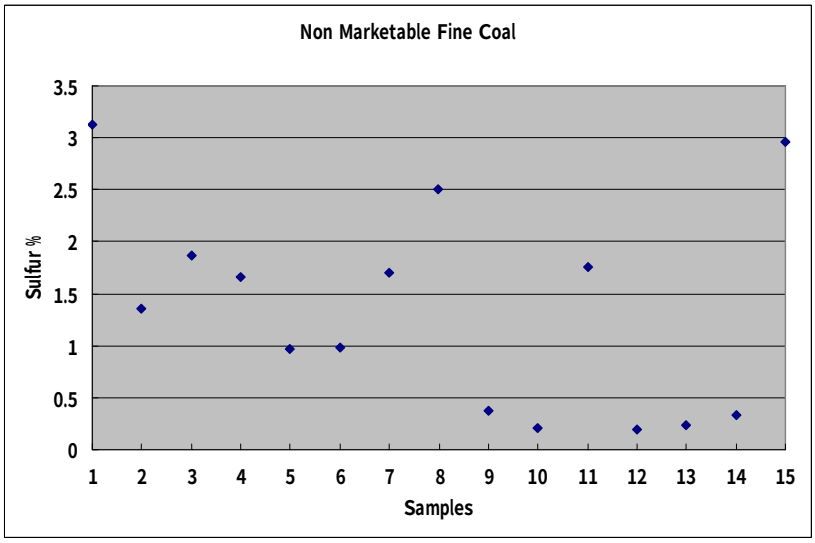
The results of analysis of non-marketable fine coal have shown that the heating value may vary significantly from 1,500 kcal/kg to 4,500 kcal/kg. Presuming, however, that the coal has a regular distribution, the average calorific value is 2,920 kcal/kg (AR). The average ash content is 24.7% (AR). The type of sulfur is actually divided into combustible sulfur and incombustible sulfur compounds. In these calculations, the total sulfur content is used as the basis and the average sulfur content becomes 1% (AR). As ash has a low fusion temperature, caution is required in the operation.

Fig. 8 shows the relationship between the ash content and the heating value (AR) based on non-marketable fine coal sample tests. Fig. 9 shows the sulfur content of each sample. Table 8 gives the average physical properties of non-marketable fine coal.



Source: PLN

Fig. 8 Non Marketable Fine Coal Ash Contents



Source: PLN

Fig. 9 Non Marketable Fine Coal Sulfur Contents

Table 8 Average Physical Properties of Non-marketable Fine Coal

Non Marketable Fine Coal			
HHV (kcal/kg)		ADB	3935
HHV (kcal/kg)		AR	2920
Total Moisture (%)		AR	31
Prox. Analysis	Inherent Moisture (%)	ADB	7.90
	Ash (%)	ADB	33.30
	Volatile (%)	ADB	29.90
	Fixed Carbon	ADB	30.50
	Fuel Ratio (%)	ADB	1.02
	Total Sulfur (%)	ADB	1.35
Ultimate Analysis	Carbon (%)	DB	48.00
	Hydrogen (%)	DB	3.45
	Nitrogen (%)	DB	1.13
	Oxygen	DB	12.63
	Total Sulfur (%)	DB	1.40
	Combustible Sulfur (%)	DB	0.60
	Non-Combustible Sulfur (%)	DB	0.80
	Chloride	DB	0.01 and less
sh Analysi	SiO2 (%)	DB	61.50
	Al2O3 (%)	DB	12.90
	Fe2O3 (%)	DB	6.74
	CaO (%)	DB	8.44
	MgO (%)	DB	1.39
	Na2O (%)	DB	0.97
	K2O (%)	DB	1.25
	TiO2 (%)	DB	0.75
	SO3 (%)	DB	3.22
	P2O5	DB	0.12
Ash Fusibility Temperature	Oxidizing Condition		
	Initial Deformation Temp. (Deg C)		1135
	Softening Temp. (Deg C)		1140
	Hemispherical Temp. (Deg C)		1220
	Fluid Temp. (Deg C)		1490
	Reducing Condition		
	Initial Deformation Temp. (Deg C)		1070
	Softening Temp. (Deg C)		1090
	Hemispherical Temp. (Deg C)		1140
	Fluid Temp. (Deg C)		1450

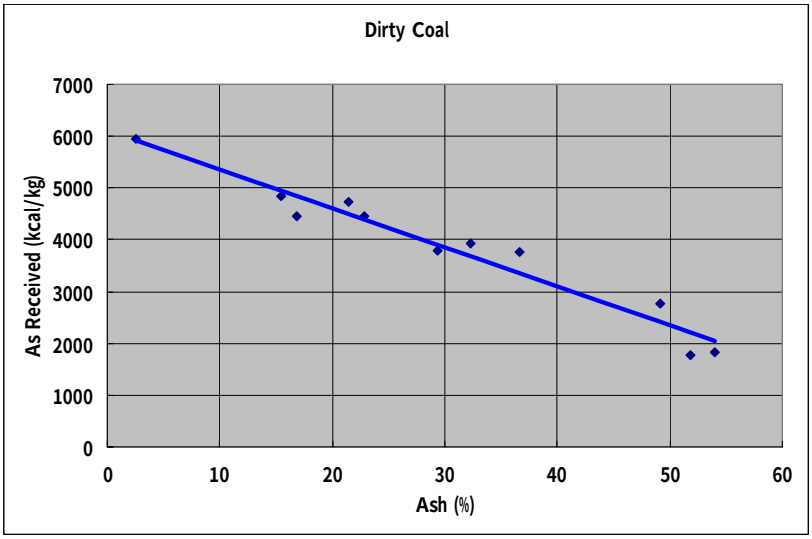
Source: PLN

(2) Dirty Coal

Result of the analysis of dirty coal samples have shown that the heating value varies significantly from 2,000 kcal/kg to 6,000 kcal/kg. Presuming, however, that the coal has a regular distribution, the average calorific value is 3,840 kcal/kg (AR). The average ash content is 20.7% (AR). As stated in the previous section, total sulfur content is used as the basis and the average sulfur content is 0.67% (AR). In contrast to non-marketable fine coal, non-marketable dirty coal is characterized as having a higher ash fusion temperature.

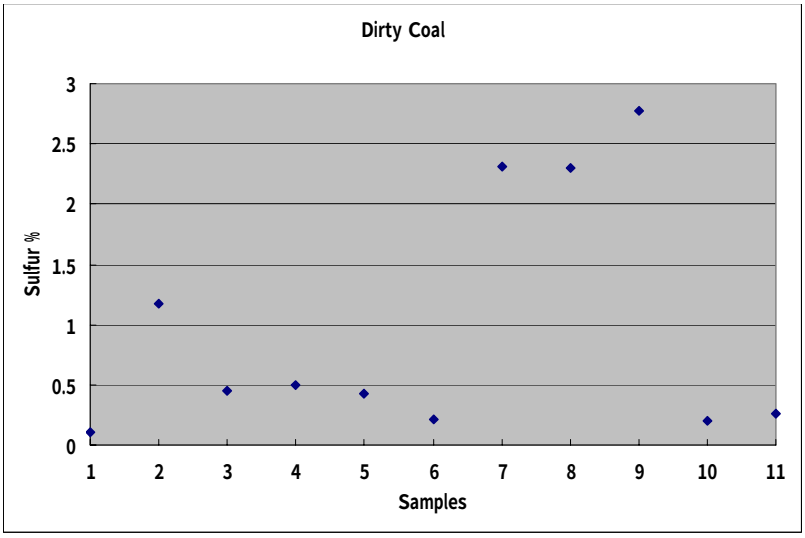
Fig. 10 shows the relationship between the ash content and the heating value (AR) based on non-marketable dirty coal samples analysis. Fig. 9 shows the sulfur content of each sample.

Table 9 gives the average physical properties of non-marketable dirty coal.



Source: PLN

Fig. 10 Non Marketable Dirty Coal Ash Contents



Source: PLN

Fig. 11 Non Marketable Dirty Coal Sulfur Contents

Table 9 Average Physical Properties of Dirty Coal

Non Marketable Dirty Coal			
HHV (kcal/kg)		ADB	5601
HHV (kcal/kg)		AR	3840
Total Moisture (%)		AR	20
Prox. Analysis	Inherent Moisture (%)	ADB	10.00
	Ash (%)	ADB	30.20
	Volatile (%)	ADB	29.80
	Fixed Carbon	ADB	30.50
	Fuel Ratio (%)	ADB	1.02
	Total Sulfur (%)	ADB	0.97
Ultimate Analysis	Carbon (%)	DB	48.00
	Hydrogen (%)	DB	3.45
	Nitrogen (%)	DB	1.13
	Oxygen	DB	12.63
	Total Sulfur (%)	DB	1.10
	Combustible Sulfur (%)	DB	0.50
	Non-Combustible Sulfur (%)	DB	0.60
	Chloride	DB	0.01 and less
sh Analysi	SiO2 (%)	DB	64.52
	Al2O3 (%)	DB	20.35
	Fe2O3 (%)	DB	3.29
	CaO (%)	DB	1.50
	MgO (%)	DB	1.62
	Na2O (%)	DB	1.48
	K2O (%)	DB	2.22
	TiO2 (%)	DB	0.88
	SO3 (%)	DB	0.85
	P2O5	DB	2.32
Ash Fusibility Temperature	Oxidizing Condition		
	Initial Deformation Temp. (Deg C)		
	Softening Temp. (Deg C)		
	Hemispherical Temp. (Deg C)		
	Fluid Temp. (Deg C)		
	Reducing Condition		
	Initial Deformation Temp. (Deg C)		1380
	Softening Temp. (Deg C)		1420
	Hemispherical Temp. (Deg C)		1450
	Fluid Temp. (Deg C)		1500

Source: PLN

(3) Supplement Coal

Supplemental Coal with known physical properties should be utilized to achieve steady combustion when using a coal with unstable properties. For the purpose of power generation, about half of the heating output has to be supplied by a supplement coal. In this Project, it is proposed to utilize low rank coals as supplement coal as it is available abundantly in the project area.

Table 10 shows the physical properties of the coal that can be used as the supplement coal.

Table 10 Typical Supplement Coal Properties

Supplement Coal			
HHV (kcal/kg)		ADB	5600
HHV (kcal/kg)		AR	5000
Total Moisture (%)		AR	25
Prox. Analysis	Inherent Moisture (%)	ADB	17
	Ash (%)	ADB	5
	Volatile (%)	ADB	39
	Fixed Carbon	ADB	39
	Fuel Ratio (%)	ADB	
	Total Sulfur (%)	ADB	0.6
Ultimate Analysis	Carbon (%)	DB	72.62
	Hydrogen (%)	DB	4.06
	Nitrogen (%)	DB	1.54
	Oxygen	DB	21
	Total Sulfur (%)	DB	0.78
	Combustible Sulfur (%)	DB	
	Non-Combustible Sulfur (%)	DB	
	Chloride	DB	
sh Analysi	SiO2 (%)	DB	34.31
	Al2O3 (%)	DB	27.9
	Fe2O3 (%)	DB	17.57
	CaO (%)	DB	9.02
	MgO (%)	DB	0.95
	Na2O (%)	DB	0.49
	K2O (%)	DB	0.8
	TiO2 (%)	DB	1.37
	SO3 (%)	DB	5.98
	P2O5	DB	0.94
Ash Fusibility Temperature	Oxidizing Condition		
	Initial Deformation Temp. (Deg C)		
	Softening Temp. (Deg C)		
	Hemispherical Temp. (Deg C)		
	Fluid Temp. (Deg C)		
	Reducing Condition		
	Initial Deformation Temp. (Deg C)		1200
	Softening Temp. (Deg C)		1220
	Hemispherical Temp. (Deg C)		1240
	Fluid Temp. (Deg C)		1250

Source: PLN

4 Selection of Power Plant Construction site

A power plant as a part of the energy infrastructure has an operational service life of over 30 years. It is therefore very important to study a range of different factors and aspects when selecting the construction site for a power plant as listed below.

- Fuel transport costs
- Access to plant site including fuel and material delivery
- Access to power transmission systems or substations
- Soil conditions and possibility of water (flood) damage
- Water availability (No possibility of ingress of sea water)
- Proximity to a center of power demand
- Land acquisition
- Ensuring recycling/reuse of coal ash or securing land for ash disposal
- Understanding and cooperation of local people

Present coal transportation uses river systems. Transportation of coal on public roads by trucks is prohibited by law. As a result, fuel transport depends primarily on river barges. For the ease of fuel delivery, the power plant location should therefore be accessible by river barges.

A site facing a river is also desirable for water pumping. Location of the water intake should be free from the risk of seawater back-flow in the river system.

The power plant should be connected to the existing power transmission network. The location of the construction site should be preferably near an existing substation. If the location of the power plant is distant from any substations, it may take more time and money to acquire the land for the power transmission lines, and may impact the overall construction schedule.

It is also important to take the stability of the system and future expandability fully into account in the design of the transmission systems. It is not desirable to connect a large scale power plant into branch lines in which multiple power plants are already connected.

A location adjacent to a river is prone to the risk of flooding. Construction in a location liable to flood damage should be avoided, since the power plant is required to run even under emergency or abnormal conditions.

It is also important to select a location where soil is solid and hard and capable of supporting heavy rotary machinery. River side locations tend to necessitate the long pipes through the soft alluvial layers to reach the bed rock. The soil condition has a major impact on the construction costs and schedule.

Land acquisition is a tedious problem. Public land without any future plan is preferable. If public land is not available, the land with clear and simple ownership is desirable.

It is also necessary to resolve the issue of ash handling and disposal from coal-fired power plants. Coal ash is widely used as a material for cement or as an aggregate by the construction industry. By cooperating with the cement industry, it will be possible to achieve the Zero-Emission Concept from a Coal Power Plant. When it is not possible to enlist the cooperation with the cement industry the only alternative is to acquire landfills for ash disposal as an industrial waste. In this case, a statutory duty for the management and operation of the landfill will persist for 30 years after the power plant has been taken out of operation. At present, BPPT and the Indonesia Cement Association are carrying out a detailed survey on ash utilization. Generally, the ash of Indonesian coal has very low heavy metals content and not reachable. It is believed that it would not become an environmental or health hazard. At present, there is a great demand for coal ash and it is expected that the project will be able to achieve the Zero Emission goal.

The most important factor is to enlist the understanding and cooperation of the local people around the construction site.

As shown in Fig. 12 five candidate locations were surveyed under this Study.

(1) Old ferry terminal site (Owned by Samarinda City)
(2) Land owned by Daya Desar Corporation (Samarinda acting as mediator)
(3) Land owned by Kiyani Lestari Corporation (Samarinda acting as mediator)
(4) Land privately owned by Balik Buaya (Samarinda acting as mediator)
(5) Bukit Baiduri Coalmine (Owned by the Provincial government and leased to the Coalmine)

Source: PLN

Fig. 12 Power Plant Site Selection

(1) Old ferry terminal site (Owned by Samarinda City)

The Samarinda City-owned old ferry terminal is the old landing place for the ferry crossing the Mahakam River. This ferry terminal was used before the Mahakam Bridge was built. At present, the interior part is an empty plot/football ground, and the riverbanks flanking the Balikpapan – Samarinda Road are used as a mooring area for the ships and barges, and partly as a timber storage yard for the nearby plywood factory. Because the land is owned by the City of Samarinda the acquisition of the land will not be a problem. On the other hand, however, the ground area is only about 5 ha and this is a little too small for a power plant construction site. The residential area has extended around the land and therefore the site will not be a candidate for the construction of the power station.

(2) Land owned by Daya Desar Corporation (Samarinda City acting as mediator)

The land is owned by Daya Desar Corporation, and the size of the area is 17 ha. Presumably, the company purchased this plot to build a new factory but has not started the construction work yet. At present, it is rented out as farming land. The City of Samarinda can act as proxy in the negotiations for the acquisition of the land. Furthermore, the plot adjoins P.T. Semen Tunasa, which is a cement-packaging factory. Considering the potential for synergy with the cement factory, it does seem an ideal choice. Yet, the ground is unfavorable. When the cement-packaging factory was built, more than 50m of piles were necessary.

(3) Land owned by Kiyani Lestari Corporation(Samarinda acting as mediator)

The land plot owned by PT. Kiyani Lestari Corporation was a plywood production plant that stopped operation in 2004. Because the factory equipment and the land were used as collateral for raising the loan on the property from the bank, all assets are now entrusted to the courts. It

would be possible for the City of Samarinda to act as proxy in the land purchasing negotiations (auction sale, etc.). The size of the plot is 20 ha. It is located near the Samarinda Container Port, and its position is not so unfavorable but the shape of the plot is long and narrow, with the part facing the river being rather narrow. Also, the pump station of the Samarinda Water Works is positioned in the part facing the river. The reliance on river transport may cause a problem. There are also land access problems as it is necessary for land transport to pass through the residential housing estate to access the site.

(4) Land privately owned by Balik Buaya (Samarinda acting as mediator)
The land plot in the Balik Buaya area is in private ownership and has a size of about 10ha. It offers a possibility to secure a large ground area when the adjacent land is included. Among the candidate sites, it is located farthest downstream. The plot is currently a secondary forest. In 1997, saline water (seawater) back flowed to this point. There is no residential habitation in the vicinity.

(5) Bukit Baiduri Coalmine (Owned by the Provincial government and leased to the Coalmine)
PT. Bukit Baiduri is a coalmine company. The property rights of the land belong to the regional government, and the land is leased to this company. The property will be returned to the local government after termination of the coal mining in the area. The old coal shipping area of this land, now used as a coal storage yard, is considered as a candidate site. There are no problems with the land acquisition, water intake, soil condition and ash landfill, and it is considered to satisfy all conditions required for the selection of the site for the power plant. Fig. 13 is a photo of the Site.

Source: PLN

Fig. 13 Power Plant Site Selection-PT Bukit Baiduri

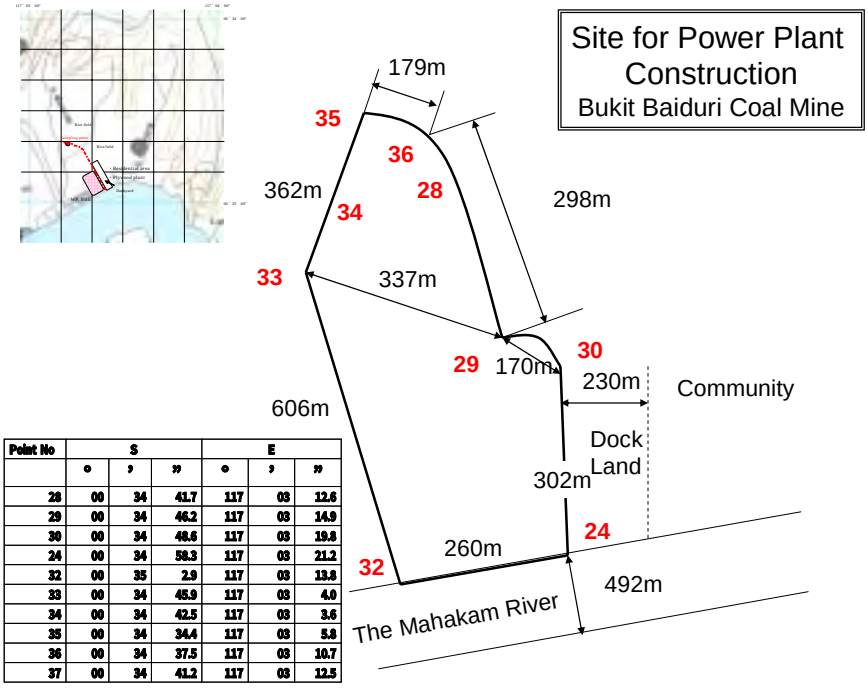
Table 11 shows the results of an overall assessment of the five candidate sites above.

Table 11 Power Plant Site Selection

No.	1	2	3	4	5
Name	Old Ferry Terminal	PT. Daya Besar	PT. Kiyani Lesari	Balik Buaya Area	PT. Bukit Baiduri
Land Acquisition	Ok	OK	OK	OK	OK, **Returned to the Local Government**
Water Intake	Ok	OK	OK	No Sea Water Problem	OK
Soil Condition	**Limited Land Space**	**Need to Investigate**	**Need to Investigate**	No	OK
Access by Road/River	OK	OK	No **Limited**	OK	OK
Substation	**Gl. Harapan Baru**	**Bukuan**	**Bukuan**	**Bukuan**	**Cross River, Gl. Harapan Baru**
Ash Land Fill Area	Need to find Outside	Ash Utilized by Tunasa Cement	Need to find Outside	Available at Adjacent Area	OK

Source: PLN

The Bukit Baiduri Coalmine is extensive. The candidate land is only a part of the old coal shipping area. The area can be used for the construction of a power plant. Fig.14 shows the configuration of the candidate site.



Point No	S			E		
	°	'	"	°	'	"
28	00	34	41.7	117	03	12.6
29	00	34	46.2	117	03	14.9
30	00	34	48.6	117	03	19.8
24	00	34	58.3	117	03	21.2
32	00	35	2.9	117	03	13.8
33	00	34	45.9	117	03	4.0
34	00	34	42.5	117	03	3.6
35	00	34	34.4	117	03	5.8
36	00	34	37.5	117	03	10.7
37	00	34	41.2	117	03	12.5

Source: PLN

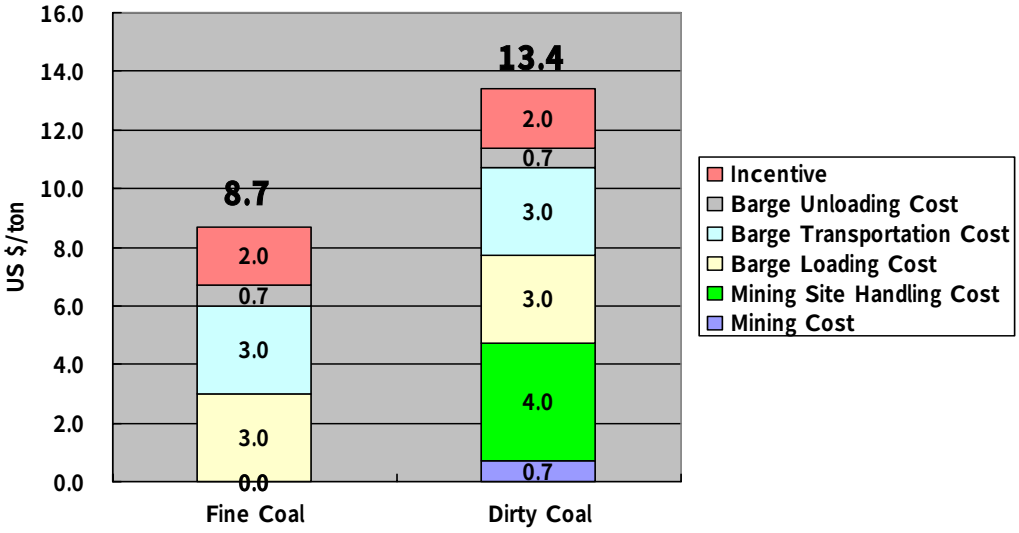
Fig. 14 Site for Power Plant Construction Bukit Baiduri Energi Coal Mine

5 Non-Marketable Coal Transportation Cost

Transportation of non-marketable coal is not permitted over public roads and it is delivered by river barge. Fine non-marketable coal is generated in the coal washery plants at the river side. It has been confirmed that this fine non-marketable coal can be transported by ordinary barges. An important factor to create a sustainable gathering system for this non-marketable coal is the introduction of incentive payments.

As shown in Fig. 15, the barge loading cost for fine non-marketable coal is 3 USD/ton, the barge transportation costs are 3 USD/ton and the barge unloading cost is 0.7 USD/ton. To ensure commercial sustainability, an incentive of 2 USD/ton is assumed to be necessary. Consequently, the delivery cost of fine non-marketable coal is 8.7 USD/ton.

Transportation of dirty coal starts from the mining site. The cost breakdown is shown below. In the case of dirty coal, the mining costs at the mining site are 0.7 USD/ton, transportation to the riverside and handling costs are 4 USD/ton. Barge loading and unloading cost are the same as for fine coal. Delivery cost of this dirty coal at the power plant site is 13.4 USD/ton, inclusive of 2.0 USD/ton of incentive.



Source: PLN

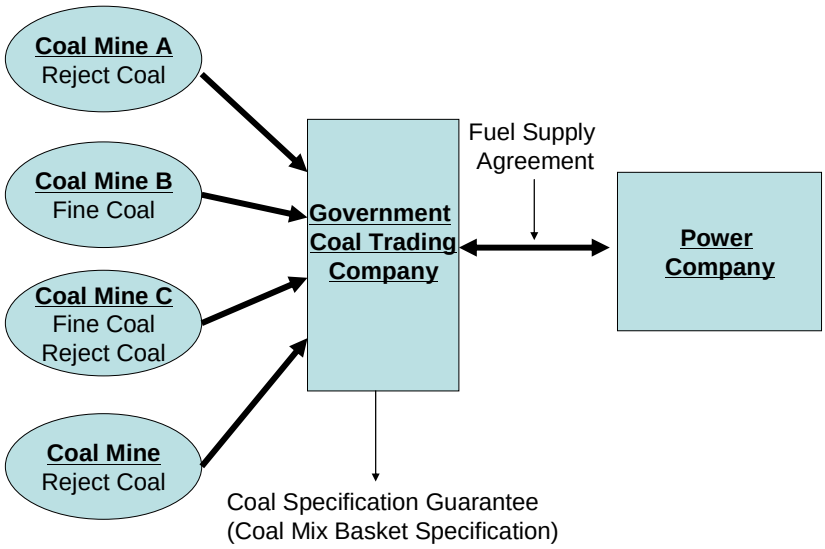
Fig. 15 Non Marketable Coal Gathering Cost

Once these non marketable coals are utilized for power generation, such non-marketable coals will be priced as stated above. In view of the coal purchasers or power plant operators, quality and price of such will be examined. Question of "what they paid for and who is the guarantor of the quality" should be answered. In the long run, coal supply terms and conditions should be documented in the form of a "Fuel Supply Agreement".

Non-marketable coal is generated by a number of coalmines, and the properties of non-marketable coal from these coalmines differ from each other. Quality control and handling of these coals will be a major burden for the power company.

Consequently, public institutions such as coal trading companies owned by The State Government should preferably intervene and take the role of supplying such non-marketable coal to the power company under a single Fuel Supply Agreement.

A basket specification may be introduced in the fuel supply agreements with the power company in which the minimum Heating Value is specified.
Fig. 16 shows the proposed fuel supply arrangement.



Source: PLN

Fig. 16 Proposed Fuel Supply System

6 Investigation of Power Generating Capacity

Following are the general steps to be taken in the decision making for optimum power generation capacity in a given grid system.

Power Supply and Demand Forecast
System Capacity and Stability via Load Flow Analysis
Non marketable coal availability and cost of delivery
Economics

In accordance with the power supply and demand forecast by PLN, 150 MW of new power supply capacity will be required in 2012-2015, and this requirement has been included in the 2006 Ten-Year Plan. This plan envisages the use of natural gas as the power fuel. However, considering the unstable supply of gas and unknown future gas price situation, a coal based power plant is a highly viable option and is considered to be a realistic choice.

Based on the original PLN Ten-Year Plan, a Load Flow Analysis was carried out assuming that new power generation capacity of 2x75 MW (150 MW, start of operation 2012-2015) is assumed in the Samarinda area. In this study, the computer program known as Power System Simulator for Engineers (PSS/E) version 29.4 was used, assisted by PLN JASER-SKT and BPPT.

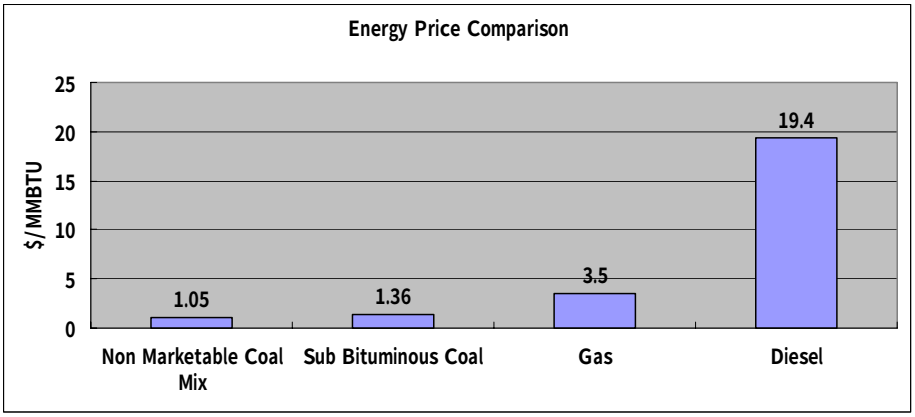
The result suggested that the Original Ten-Year Plan may not necessarily be feasible in view of transmission capacity and power balance. The first investigation results were submitted to PLN Balikpapan in October 2006. PLN reviewed its power development plan based on the report and prepared a new power development plan in December 2006 without changing the framework of the original Ten-Year Plan.

After a series of trial and error modifications, significant improvement on the power generation plan and transmission system has been demonstrated. New power generating capacity of 2x50 MW is confirmed in the Samarinda area and transmission capacity and stability is improved significantly with a minimum investment cost. In the study, a loop configuration between Balikpapan and Samarinda is proposed by installing a 47 km long transmission line between the Bukuan and the Sehnipha substations. Economics in this study include the investment for this 47 km transmission line.

Access to the power fuel is an important factor of the power plant economics. The fuel availability or supply capacity and delivery price are important factors to decide the power capacity and economics. As a result of investigation, enough fuel to support 100 MW or 150 MW power plant is confirmed in the Samarinda area, at the lowest cost.

In terms of economics, coal is the cheapest and lowest risk fuel among all other power fuels. Economics includes the investment segment; however, the sensitivity of the investment segment is smaller than the fuel cost in the long term. Note that fuel cost can be doubled but investment cost is not. In principle, lower fuel cost is economically advantageous and competitive. If power tariff at a level of 4 cents/kWh is expected, there is no other alternative but coal.

Fig.17 shows the energy price per unit calorific value (MMBTU), available in the Mahakam system. Price of natural gas is likely to be higher than 3.5 $/MMBTU in the future. Natural gas will not be a competitive power fuel. Non-marketable coal mix has a potential to be the lowest price fuel in the area and lower than the Low Rank Coal abundantly present in this area.



Note:

Diesel Price:	6150 Rp/L
Sub-Bituminous Coal, 5,000 kcal/kg:	27.0 $/ton
Non Marketable Coal Mix, 4,198 kcal/kg Avg.	17.4$/ton

Source: PLN

Fig. 17 Fuel Choices Available in East Kalimantan (2006 September)

7 Load Flow Analysis

The area of electrification is expanding and transmission lines are also being extended to cover the electrified area, and new power plants will be installed to meet the increasing demand. New power plants are subject to the Load Flow Analysis to confirm the accessibility to and influence on the existing transmission and distribution system.
Load Flow Analysis is carried out by constructing the power flow model in the computer and reviewing the power flow in the transmission system for various time periods, including emergency situations.

The following is a general overview of a model prepared by PLN based on the original Ten-Year Plan in 2006.

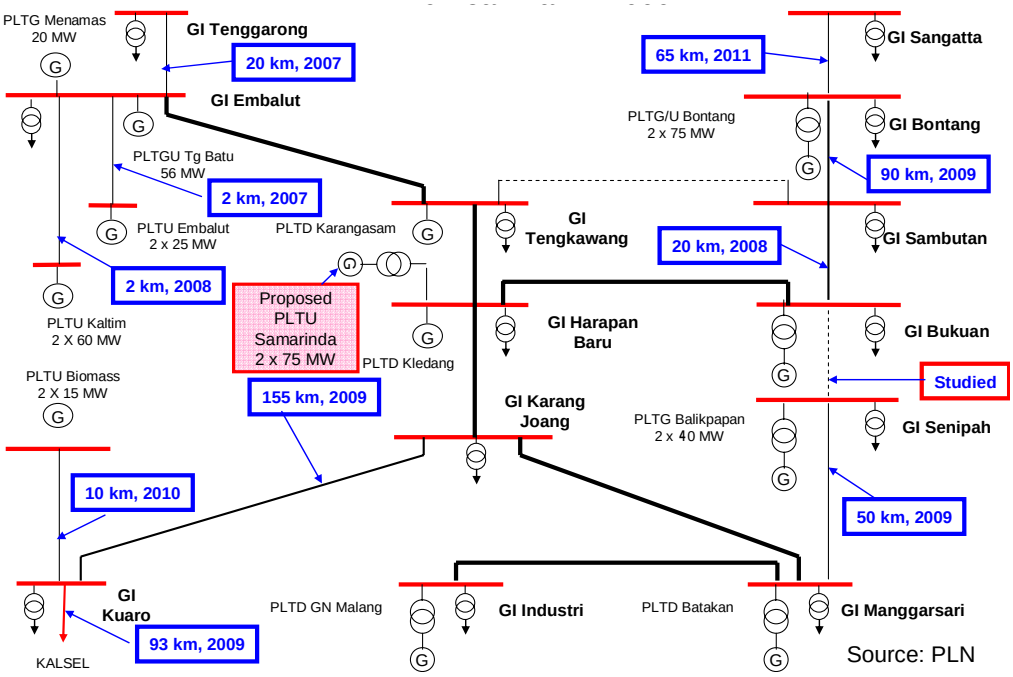


Fig. 18 Single Line Diagram System Mahakam Extension (10 Year Plan in 2006)

Samarinda area has three substations: Harapan Baru, Bukuhan, and Tengkawang. Each substation is connected to its own power generation plant. Kledang Power Station (diesel engine power plant) is connected to the Harapan Baru substation. The Karangasam Power Station (diesel engine power plant) is connected to the Tengkawang substation and from there the transmission line is further extended to the Embalut substation. The Embalut substation is connected to PLTGU TJ Batu (56 MW) and the PLTG Menamas (20 MW) power plants as of 2006. In 2007, the PLTU TJ Batu (Embalut) 2x25 MW power plant will be connected to this substation. In 2008, the PLTU Kaltim 2x60 MW power plant is due to be connected. Also in 2007, the system is to be extended to Tenggarong. The existing Mahakam System is to be

further extended from the Bakuan substation to Sambutan in 2008, to Bontang in 2009, and to Sangatta in 2011. In 2008/9, there are plans to build the PLTU Mulut Tambang 2x25 MW power plant around Sambutan and construct the PLTGU 2x75 MW power plant in Bontang in 2009.

Balikpapan also has three substations: Karang Joang, Manggarsari, and Industri. The Karang Joang substation is connected to the Harapan Baru substation of Samarinda via a 75 km long, 150 kV transmission line. The transmission line is due to be extended from Karang Joang to Kuaro in 2009 and further to the South Kalimantan System. Construction of a new transmission line from the Kuaro substation to the Kuaro PLTU Biomass 2x15 MW power plant via a 10 km transmission line is scheduled in 2010. The Industri substation is connected to the GN Malang Power Station (diesel engine power plant). Manggarsari substation is connected to the Batakan Power Station (diesel engine power plant). The transmission line is to be extended from Manggasari to Senipah where the new PLTG Balikpapan 2x40 MW power plant is planned for 2009.

As a result of the analysis, the Ten-Year Plan for 2006 will show the following problems by 2011, before introduction of new power capacity.

(1) The Samarinda Harapan Baru and Tengkawang substations will be over capacity
(2) The Balikpapan Manggasari and Industri substations will be over capacity.
(3) A 100 MVAR capacitor needs to be installed to restore the voltage at Balikpapan.
(4) There will be high transmission losses exceeding 2% of total power output.

The analysis suggested that even if the original Ten-Year Plan is implemented, it will still be physically difficult to accommodate additional new power capacity in the system after 2012. To stabilize and increase capacity of the Mahakam System, relocation of planned power projects and loop configuration of the transmission system were recommended.

PLN reexamined the entire system and improved the system as follows, after a series of trial and error redesigns and several trials of load flow analysis.

(1) The PLTU Kaltim 2x60 MW plant will be relocated from Embalut (TJ Batu) to Penajam in the southern parts of Balikpapan and will be connected to the Girirejo substation.
(2) The PLTU Mulut Tambang 2x25 MW plant will be relocated from Sanbutanor Bukuan to Samboja in the northern parts of Balikpapan and will be connected to the Girirejo substation.
(3) A new 47 km long transmission line between Senipha and Bukuan substation will be installed to form a loop configuration between Samarinda and Balikpapan.
(4) The Industri, Tengkawang, and Harapan Baru substation will be expanded.
(5) New capacity of 2x50 MW can be installed in 2012 and connected to the Samarinda Harapan Baru substation.

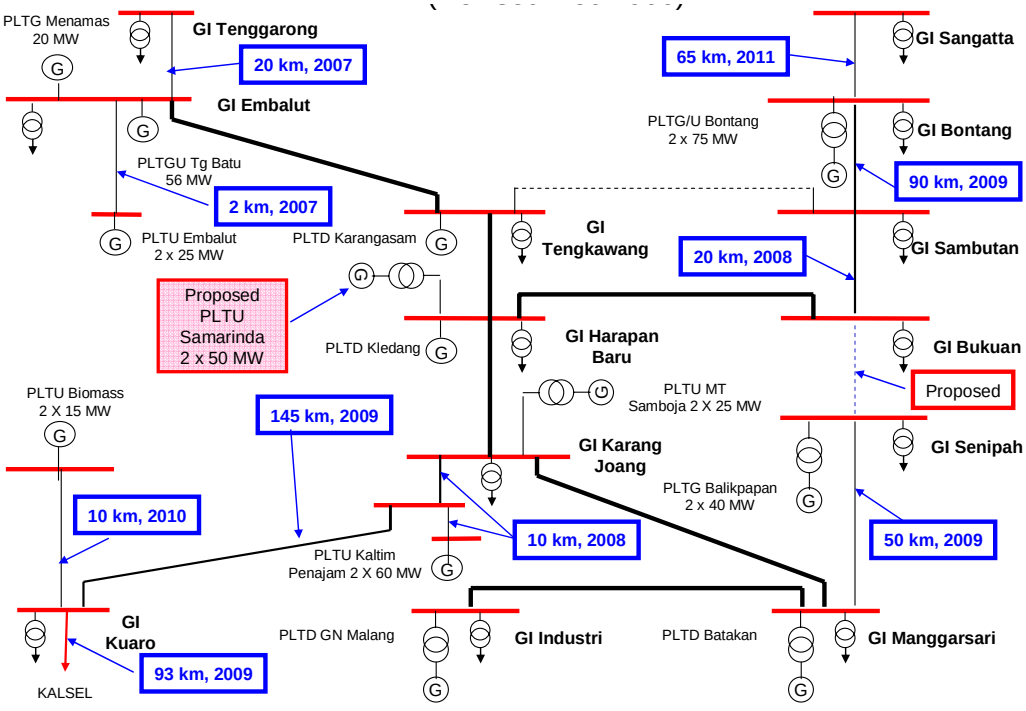
Analysis has demonstrated that the new Samarinda 2x50 MW power plant will harmonize with the power transmission system in 2012 with an operating margin of 20%. The existing substation will require expansion as shown in the Table 12.

Table 12 Substation Extension

Substation	Existing MVA	Estimated Load in 2012	New Transformenr
Industri	2x20 & 1x30 (70)	77.6 MW	2x30, & 1x60 (120)
Tengkawang	2x30	71.8 MW	1x60, & 1x30
Harapan Baru	2x30	58.2 MW	1x60, & 1x30

Source: PLN

Fig. 19 is a single-line circuit diagram showing the improved transmission system and the new power capacity.



Source: PLN

Fig. 19 Single-Line Diagram Mahakam System (Revised Ten Year Plan 2006)

Attachment 9 shows the results of the Load Flow Analysis in the form of computer input and output.

8 Coal Handling System

The coal to be used in this power plant consists of three types: non-marketable fine coal, dirty coal and supplemental fuel coal. These coals are delivered primarily by barges.
Physical properties of dirty coal and fine coal fluctuate significantly and careful handling management should be in place. Each coal is to be stored separately in separate yards. Storage capacity for each is designed at 10,000 ton (one month).

Operation will be as follows. Dirty coal and supplemental fuel coal are mixed in the storage yard for Heating Value adjustment. After this, the mixture is fed into a bin and hammer crusher to produce a grain size of 10mm and under. The product is then sent to two coalbunkers installed near the boiler. The bunker is sized for 20 hours of operation. The coal is withdrawn from the bunker and fed onto four weighing conveyors and then fed into the furnace on a screw conveyor.

The non-marketable fine coal is stored in a large concrete pit and transferred by bucket conveyer. The fine coal is transformed into a form of slurry and viscosity is adjusted and it is then injected into the furnace.

Quality and quantity of coals received should be monitored and analyzed by the Power Company. There are several options to control the heat input for the boiler. Appropriate system should be selected in the next phase of the study. A laboratory for this purpose may also be necessary.

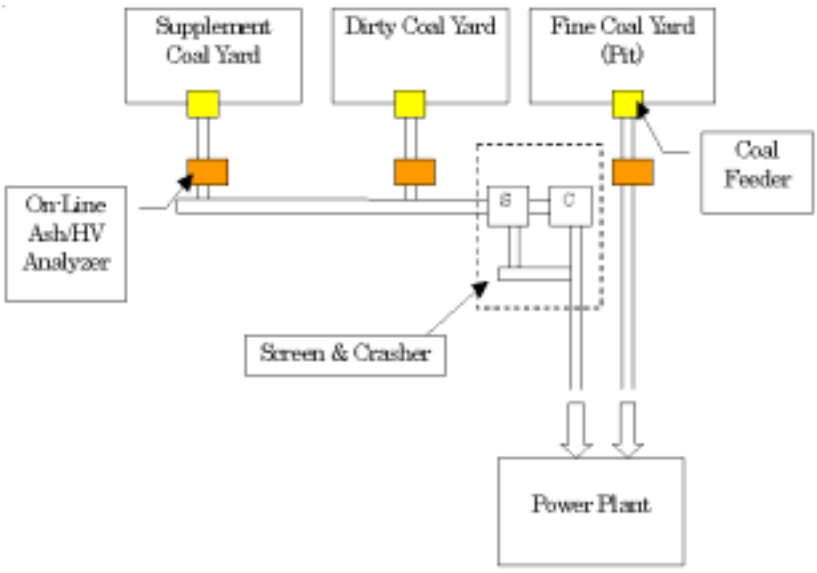


Fig. 20 Coal Handling System

9 Power Plant Concept

The concepts of the proposed power plant will be as follows.

- Capable of utilizing all types of coal fuel, including non-marketable coal.
- Environmentally friendly power generating system
- Supplying the electricity at the lowest cost

Since the properties of non-marketable fine/dirty coals, especially heating values, vary from lot to lot and site to site, combustion performance will not be stable if it is burned as it is. In order to stabilize the combustion performance, use of the higher and stable heating value coal, called supplemental coal, will be required. The supplemental coal can be a low-rank coal, which is abundantly present in the area. To ensure stable combustion in the furnace, feed rate of each fuel is controlled to meet the boiler performance. Non-marketable coal with a high water and ash content are difficult to burn and therefore require a longer combustion or reaction time.

For the environmental aspect, special care must be exercised to protect the riparian environment as the power facilities are built on the river side. Discharge of hot cooling water would impact the ecological system of the river. For this reason, a circulating cooling water system will be employed and no hot effluent water will be discharged to the river.

The proposed power plant is to be equipped with internal desulfurization (de-SOx) systems to minimize the SOx emission level. Limestone powder is injected in the furnace with the coals and the sulfur in the coal reacts with the limestone to form gypsum (calcium sulfate) and this is recovered as part of the coal ash. To reduce NOx emission levels, a relatively low combustion temperature will serve to lower the level of NOx generation.

The use of non-marketable fine coal and dirty coal will help reduce the fuel cost, and power generation cost can also be lowered.

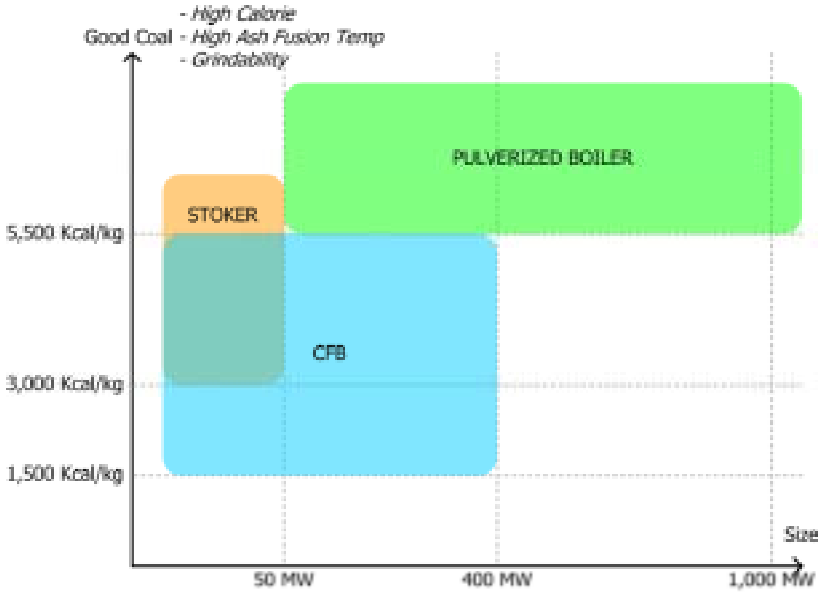
A CFB (Circulated Fluidized Bed Boiler) is recommended. It is suitable to combust low-heating value fuels in an efficient manner for complete combustion. There are two types of circulated fluidized-bed boilers: the internally circulating type or the externally circulating type. The internally circulating type is in general used for municipal waste incineration and waste heat can be recovered as electric power. Scale of the power generation is small. The scale of power generation is a maximum of around 10-30 MW.

The application field of the externally circulating system is wide. A variety of fuels, including biomass, lignite, and also industrial waste can be combusted in an efficient manner. In the burning process, unburned carbon is rejected and returned back to the combustion section until

complete combustion is achieved. Only Flue gas with fine fly ash can pass through the cyclone to the boiler section.
The largest CFB application is a lignite based power plant with 460 MW super critical boiler turbine generators in Europe.
CFB can control the combustion gas temperature. This feature serves to reduce the NOx formation and also avoids reaching ash fusion temperature. If the combustion gas temperature exceeds the ash fusion temperature, these ashes will cling to the surface of the tubes and boiler walls, and as a result, maintenance cost will be higher and reliability of the boiler will be lower.

Stoker type boiler is generally used for small scale power plant, however, this type will not be suitable for low caloric value coals or high ash content coals, which are difficult to combust. Pulverized boilers can combust high caloric value coals at a high efficiency and economically suitable for large scale power plant. In order to compete economically with a large scale pulverized coal boiler, small or middle scale boilers should use the combination of low priced coals, i.e, low calorie and high ash and sulfur coals, and CFBs.

General idea of the boiler selection is shown as follows:



Source: JICA Study Team

Fig. 21 General Idea of the Boiler Selection

10 Outline of Power Plant

This proposed power plant utilizes non-marketable fine coal and dirty coals as power generation fuels. These coals have a high ash content, high moisture, and therefore low heating value. These are not saleable on the market.

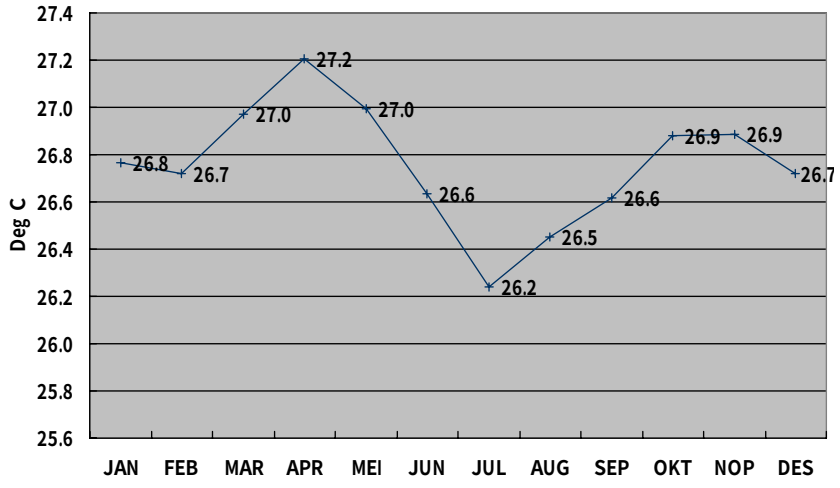
The type of the boiler proposed for this project is a CFB (circulated fluidized bed). This boiler is capable of combusting the above type of fuels in an efficient and stable manner to ensure steady steam generation. To achieve stable power generation from the use of these fuels, use of a stable coal with a little higher heating value, called supplemental coal, will be required. Use of low rank coal (lignite) is recommended for this purpose. Lignite is abundantly present around the proposed construction site. To meet the requirement of stable power supply, 50% of the total energy will be provided by the supplemental coal.

Attachment 4 is a process flow sheet showing the power generating system proposed for this project. Attachment 5 shows the fine coal injection system.

10.1 Investigation of the Climatic Conditions for Design

The climatic condition should be established to design the power station. The climatic data is provided by the meteorological station in Samarinda City. An accurate understanding of the climatic conditions at the construction site is very important for the optimization of the facility.

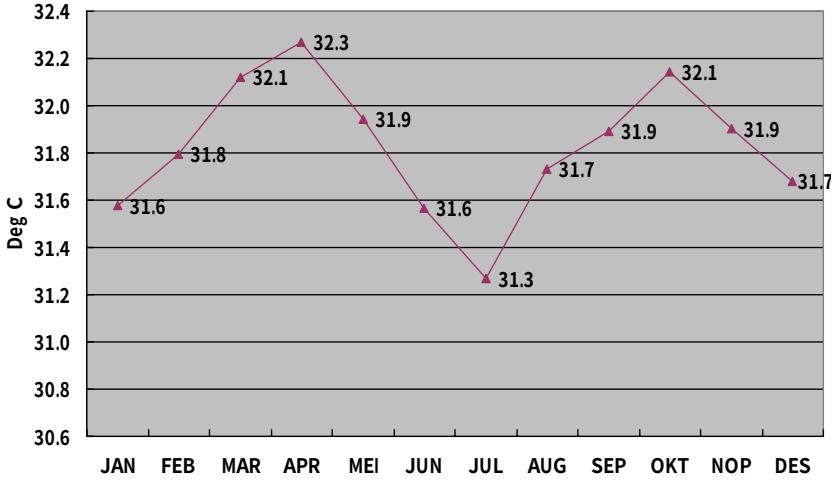
In accordance with the obtained data, the average ambient temperatures from 1982 to 2004 were as follows:



Source: PLN

Fig. 22 Average Ambient Temperature (1982-2004 Samarinda City)

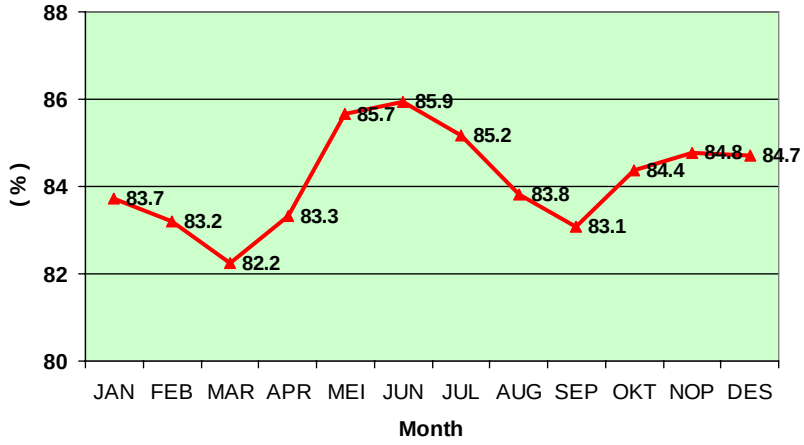
The maximum average temperatures from 1978 until 2005 are shown below.



Source: PLN

Fig. 23 Max. Ambient Temperature (1978-2005 Samarinda City)

Average relative humidities from 1982 until 2004 are shown below.



Source: PLN

Fig. 24 Average Relative Humidity SAMARINDA (1982-2004)

As a result of the review of climatic data, the Power Plant design conditions are as follows:

Ambient temperature (average)	27°C
Ambient temperature (maximum)	32°C
Humidity (average)	85%

Consequently, the design conditions for the cooling tower are set as follows:

Cooling water cooling tower inlet temperature	40°C

Cooling water cooling tower outlet temperature	30°C
Condenser pressure	8.7 kPA

10.2 Investigation of Coal Mixing

In order to combust three types of fuel with different specifications in a stable manner it is necessary to determine, in broad terms, their mixing ratio by taking into consideration the particular properties of each type of coal. It is also necessary to take the gathering or delivery costs of these fuels into account.

Table 13 shows the calculation results for the coal mix proportions for the base case of a 2x50 MW power plant. The capacity factor (availability) is assumed to be 75%.

Table 13 Coal Mixture Study (2x50 MW Units)

Item	Unit	Main		
Net Power Output	MWe	50		
Aux. Power Ratio	%	10		
Gross Power Output	MWe	55.6		
Turbine Plant Efficiency	%	39		
Boiler Efficiency	%	90		
Power Generation Efficiency	%	35		
Fuel Heat Input	MWth	158.3		
	10^6 kcal/h	136.1		
Item	**Unit**	**Fine Coal**	**Dirty Coal**	**Supplement Coal**
Heat Input per Fuel	%	15	35	50
	10^6 kcal/h	19.9	48.1	68.0
Fuel Heating Value, HHV-AR	kcal/kg	2,920	3,840	5,000
Fuel Heating Value, LHV-AR	kcal/kg	2,615	3,575	4,701
Rated Fuel Feed Rate	t/h	7.61	13.47	14.48
Operation (Capacity) Factor	%	75		
Operating Hours	h/y	8,000		
Average Boiler Load	%	82		
Average Fuel Feed Rate	t/h	6.25	11.06	11.89
Annual Fuel Consumption	t/y	50,000	88,481	95,101
No. of Unit	-	2	2	2
Total Annual Fuel Consumption	t/y	100,000	176,963	190,202

Source: PLN

The coal-mix ratio on a weight basis is: 21% non-marketable fine coal, 39% dirty coal, and 41% supplemental coal.

The utilization of this mix of these non-marketable coals also has economic advantages. The non-marketable fine coal has an average heating value of 2,920 kcal/kg. The gathering costs for this coal is 8.7 USD/ton, including the gathering incentive. Dirty coal has an average heating value of 3,840 kcal/kg and the gathering cost for this coal is 13.4 USD/ton. These are mixed

with the 5,000 kcal/kg heating value low-rank coal. Delivery price of this low rank coal at site is 27 USD/ton.

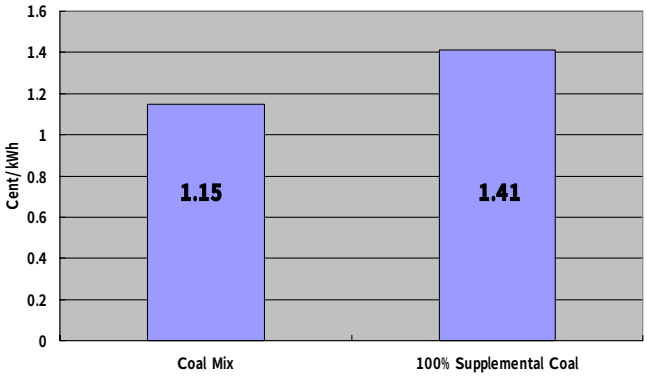
Table 14 shows the summary of the coal mix. Average heating value of the coal mix is 4,198 kcal/kg and the price is 17.4 USD/ton.

Table 14 Comparison of prices of the different fuels per unit power output

Coal Mix	Kcal/kg	$/ton	ton/year	wt %
Non Marketable Fine Coal	2,920	8.7	100,000	21.4
Non Marketable Dirty Coal	3,840	13.4	177,000	37.9
Supplement Low Rank Coal	5,000	27	190,000	40.7
Average	4,198	17.4	-	-

Source: PLN

Comparison of the fuel cost per unit power output (kWh) shows that a mixture of non-marketable coal, dirty coal, and supplemental coal will be able to offer electric power at 1.15 cent/kWh, the lowest fuel cost. On the other hand, low rank coal with 5,000 kcal/kg at 27 USD/ton corresponds to 1.41 US cents/kWh. This demonstrates that use of a coal mix will be economically more advantageous than the use of any other competing fuels.



Source: PLN

Fig. 25 Fuel Cost for Power Generation

10.3 Boiler Specifications

The coal that remains unburned in the combustion process is separated in a cyclone which is mounted at the boiler outlet (high-temperature duct inlet) and returned to the combustion section for complete combustion. Only flue gas and a fine fly-ash particulate pass through the cyclone and high temperature duct to the boiler section. This arrangement is ideal for the complete combustion of poor combustibility coals, i.e., high-ash or high-moisture coals. The boiler is

capable of generating 205 tons/h of steam and a power generating capacity of 50 MW (net output). Efficiency of the boiler is 90%. Make-up rate of the BFW (boiler feed water) is 1% of the circulated BFW. If the ash has a low fusion temperature, careful temperature control will be necessary and furnace exit gas temperature (FEGT) needs to be controlled to 870°C.

To control the temperature of the superheated steam, spray-type attenuators are installed in two locations. A steam soot blower is provided to clean the boiler tubes covered by ash and soot during operation, while water is used for cleaning the furnace wall.

Turndown ratio of the boiler is designed at 50% of the boiler maximum continuous rating (BMCR). The table below shows the specifications of the 50 MW boiler (Base Case).

Table 15 Preliminary Boiler Sizing (50 MW Unit)

Item	Unit	Main
Thermal Output	MWth	142.45
	10^6 kcal/h	122.5
Main Steam Flow	ton/h	206
Main Steam Pressure	kg/cm^{2}g	130
Main Steam Temperature	deg-C	540
Main Steam Enthalpy	kcal//kg	822.8
Feedwater Pressure	kg/cm^{2}g	150
Feedwaer Temperature	deg-C	223
Feedwater Enthalpy	kcal//kg	229.6
Enthalpy Difference	kcal//kg	593.2

Source: PLN

10.4 Review of Combustion System

Each boiler has two coalbunkers. The dirty coal and the supplemental coal are mixed together for heating value adjustment and stored in the bunkers. The mixed coal is weighed by four dose feeders and supplied to the furnace via a screw conveyor.

A feed system is also provided for the non-marketable fine coals. The fine coal in the storage yard is in the forms of slurries and sludge. And therefore a special feed system is required. After adjustment to the specified water concentration i.e., water content of 37%, the sludge is injected via special pumps. Feed rate is maintained at 15% on total heat input in the furnace.
By using the coal mix, operating condition will achieve the Boiler's Maximum Continuous Rating (BMCR). The anticipated NOx emission will be in the range of 150 to 200 ppm (6% O_2 basis), while the maximum allowable by the relevant regulation is 333 ppm (680 mg/Nm^3).

The plant also has one limestone bunker. This is used for desulphurization of the flue gas within

the furnace. This is called “internal desulphurization”. The design de-SOx rate is 90%. Limestone is preferably supplied from a cement manufacturing company. A synergy with the cement company should also be given consideration. A cement company may be able to supply limestone with a size of 1mm and under, in return for fly ash generated in the power plant. The power plant will benefit from the saving of investment for the limestone storage, crusher and cost for limestone handling. The cement company will benefit from the increased product volume by the use of fly ash. The feed rate of limestone is on a molar ratio of Ca/S = 3.

Fuel oil is used for boiler start up and emergency conditions. The design therefore provides a fuel oil system and oil burner.

Table 16 shows the material balance for the combustion system of the 50 MW boiler (Base Case).

Table 16 Preliminary Material Balance (50 MW Unit)

Item	Unit	Fine-Slurry Coal	Dirty Coal	Supplement Coal
Heat Input per Fuel	%	15	35	50
Moisture Content	%	37.00	20.00	25.00
Fuel Heating Value, LHV-AR	kcal/kg	2,336	3,575	4,701
Fuel Feed Rate	t/h	8.72	13.29	14.44
Limestone (Ca/S Molar Raio 3)	t/h	2.58		
Fly Ash Flow (80% of Ash)	t/h	6.90		
Bottom Ash Flow (20% of Ash)	t/h	1.72		
Air Flow (Excess Air 20%)	Nm^3/h	176,070		
Gas Flow (Wet)	Nm^3/h	197,050		
CO_2	%	14.09		
N_2	%	68.60		
O_2	%	3.00		
H_2O	%	14.29		
SO_2 750mg/Nm^3	ppm O_2 6%	<263		
NO_x 680mg/Nm^3	ppm O_2 6%	<333		
Particulate	mg/Nm^3	<150		

Source: PLN

10.5 Air Supply System

The air used for combustion is supplied by two fans: a primary air fan and a secondary air fan. Air is heated from ambient temperature to around 200°C in the Gas Air Pre-heater by the effluent combustion gas from the Economizer. The preheated air is then sent to the air box at the bottom of the combustor for combustion and fluidizing the coals and ash in the furnace. The effluent combustion gases, in turn, are cooled down to about 145°C at the Gas Air Pre-heater outlet and are sent to an Electrostatic Precipitator.

If the temperature of the effluent combustion gas falls to 135°C or below, the temperature is raised by steam heaters installed at the outlets of the primary and secondary fans. In this manner, equipment corrosion due to the condensation of water/sulfur oxides can be avoided.

10.6 Combustion Gas Control

The temperature of the combustion effluent gases from the combustion furnace is controlled to 870°C. This temperature is lower than the ash fusion temperature and prevents the molten ash from clinging to boiler tubes and boiler walls. Controlling the combustion temperature also serves to minimize the formation of NOx. This temperature will promote the desulphurization reactions with the limestone to form gypsum in the furnace.

The combustion effluent gases pass through the steam generating section, the economizer section and the air heating section. In this process, they are cooled down to roughly 145°C. They are then sent to an Electrostatic Precipitator to remove the fly-ash particulate from the effluent gas. Recovery rate of the fly-ash is 99%. After EP, the gases are released to the atmosphere via a common exhaust stack.

The exhaust stack is shared by two boilers. It will have a height of 60 m and discharge velocity of 20 m/sec during 100% BMCR (Boiler Maximum Continuous Rating) operations.

The combustion effluent gas is desulfurized in the furnace. Limestone is fed into the combustion furnace together with the coals. Sulfur oxides formed in the combustion process are converted to gypsum for recovery as a bottom ash or fly ash.

10.7 Desulfurization in the Furnace

The limestone in the furnace reacts with the sulfur oxides formed from the sulfur in the coal in the combustion process in accordance with the following chemical reactions:

Calcinations of limestone

$CaCO_3 + \text{heat} \rightarrow CaO + CO_2$

Note that the amount of carbon dioxide generated in this reaction is very small in comparison with the total CO_2 emission volume.

Reaction with sulfur oxide

$CaO + 1/2O_2 + SO_2\ (Gas) \rightarrow CaSO_4\ (solid) + \text{heat}$

The calcium sulfate formed in this reaction is known as chemically stable gypsum. As the

reactions take place in a continuous manner, the limestone is continuously fed into the furnace together with the coal.

The reaction with sulfur oxides requires an excess of limestone. The required limestone feed rate depends on the sulfur oxide concentration, the properties of the limestone and the prevailing temperature conditions. In this case the limestone feed rate is controlled in such a manner that the molar ratio of Ca/S becomes 3. The ideal reaction temperature is 850-900°C.

The gypsum ($CaSO_4$) that is formed is recovered as bottom ash or fly-ash. The proportion of gypsum recovered as bottom ash usually tends to be higher than as fly-ash. In this case, however, equal amounts of gypsum in bottom ash and fly-ash are assumed.

10.8 Steam Turbine System

The proposed 50 MW steam turbine is a single casing type and has five condensate extraction nozzles. The amount of steam generation is 205 tons/h (without make-up it is 201.5 tons/h). The steam pressure is 131 kg/cm^{2}A and the steam temperature is 540°C. The turbine rotation speed is 3000rpm. The condenser is of the Shell & Tube type and operating pressure is 0.091 kg/cm^{2}A. Turbine efficiency is 39%, the highest efficiency achievable in this class.

10.9 Condenser System

The condenser is of the Shell & Tube type. A cleanliness factor of 85% is used for the design. Cooling water is used as a coolant. A closed circulating cooling water system with the use of a cooling tower is employed. The exhaust steam from the steam turbine is cooled in the condenser to form condensate water. Operating pressure of the condenser is 0.091 kg/cm^{2}A. The cooling water inlet temperature to the condenser is 30°C and outlet temperature is 40°C.

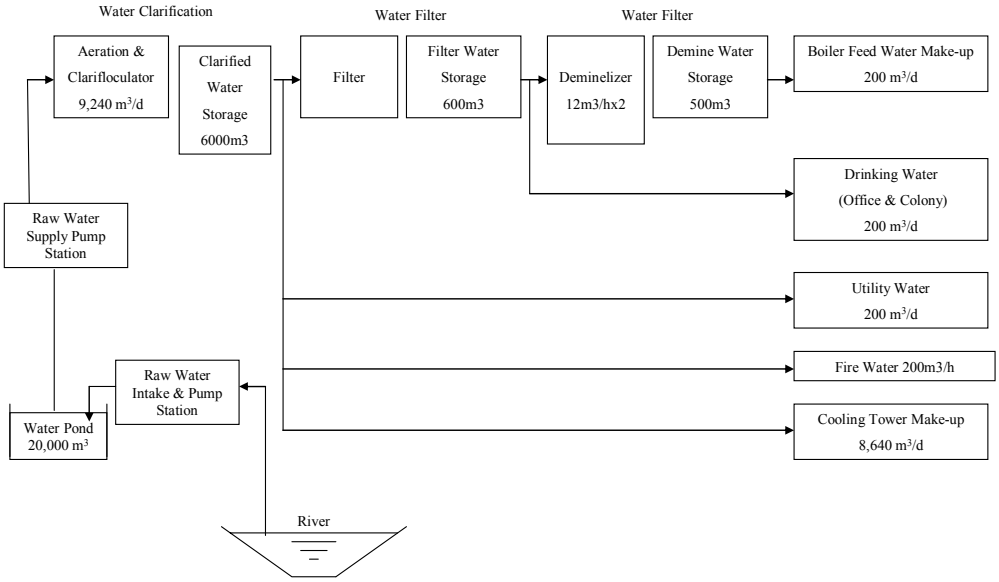
Condensate water from the steam is collected in a hot well with a capacity of 5 minutes resident time. The condensate is pumped from the hot well, by the condensate pump, via a low-pressure boiler feed water header to the deaerator. The condensate is heated by the steam extracted from the steam turbine before entering the deaerator. The condensate from the deaerator is pressurized by the boiler feed water (BFW) pump and heated further by the steam extract from the steam turbine and then sent to the economizer.

10.10 Generator and Single-line Drawing

The generator is a three-phase AC, excitation, synchronized type with a generating capacity of 55.6 MW. The output is 11 kV/50Hz. Attachment 6 shows a single-line circuit diagram.

10.11 Cooling Water System

Cooling water is used to cool the exhaust steam from the steam turbine and to cool the bearings of rotating equipment. The raw water is taken from the Mahakam River. It is stored in a water storage pond. The water from this water storage pond passes through a clarifloculator to remove sediments to produce a clear water. Most of this water is used for cooling of the condensers.



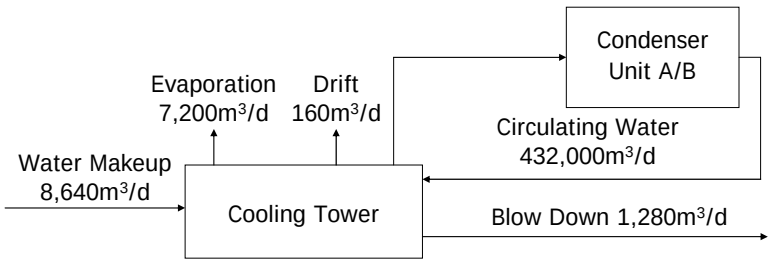
Source: JICA Study Team

Fig. 26 Water Supply System 2x50 MW Mahakam Project

For a 2x50 MW power generating system, 432,000 m^3/day of cooling water is circulated and serves to cool the condenser and the bearings of rotating equipment. Of this, 7,200 m^3/day of water is lost in the form of vapor and 160 m^3/day escapes to the atmosphere. In order to maintain the quality of the cooling water 1,280 m^3/day of water (concentrating rate is set at 6) is discharged as blow water.

The cooling water from the condenser is heated to 40°C. The cooling tower is a forced-draft type to provide flexibility in operation. The heated cooling water flows down from the top of the cooling tower through the packing to the cooling water basin. Hot cooling water is in contact with air. Part of the water is evaporated and extracts the latent heat from the hot water, and cools itself in this process. The water is cooled down to 30°C and collected in a cooling water basin and recycled to the condenser by a cooling water pump.

Fig. 25 shows the cooling water balance.



Source: JICA Study Team

Fig. 27 Cooling Tower Water Balance 2x50 MW

10.12 Limestone Feed System

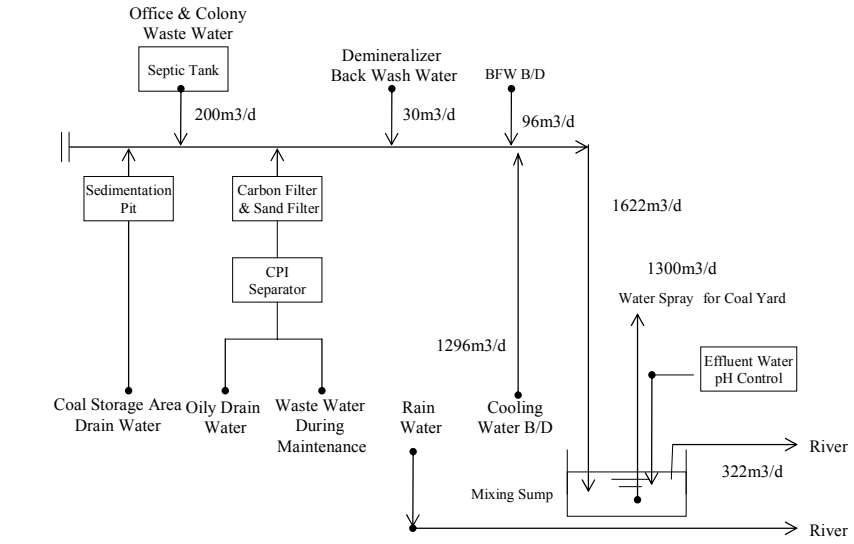
Limestone is fed into the furnace for the purpose of recovering the sulfur contained in the coal in a chemically stable form. The limestone with a grain size of 1 mm or under is supplied by a cement manufacturing company. The limestone particulates are transported by air and injected into the furnace. A high-pressure blower is used for the transportation. The feed rate is controlled to meet the specified ratio to react with the SOx to minimize the emissions.

10.13 Wastewater Treatment System

The most serious concern with regard to the discharge of wastewater from a coal-fired power plant is the releasing of hot cooling water to the river environment. Hot cooling water would have a serious impact on the riparian ecology. It is proposed to use a circulating cooling water system, which does not discharge hot cooling water to the environment. Most of the wastewater discharged from the power plant is rainwater from the coal yard, water from the water treatment system, and cooling water blow-down, as well as boiler feed water blow-down.

Oily water is treated in the CPI separator, and an activated carbon filter and sand filter. Waste water is gathered in the waste water basin and pH controlled, and released to the river if the waste water quality meets the relevant regulations and standards.

Fig. 26 is a waste water flow diagram proposed for this project.



Source: JICA Study Team

Fig. 28 Waste Water Treatment

The target water quality of this project is as follows:

Table 17 Target waste water quality proposed for the power plant

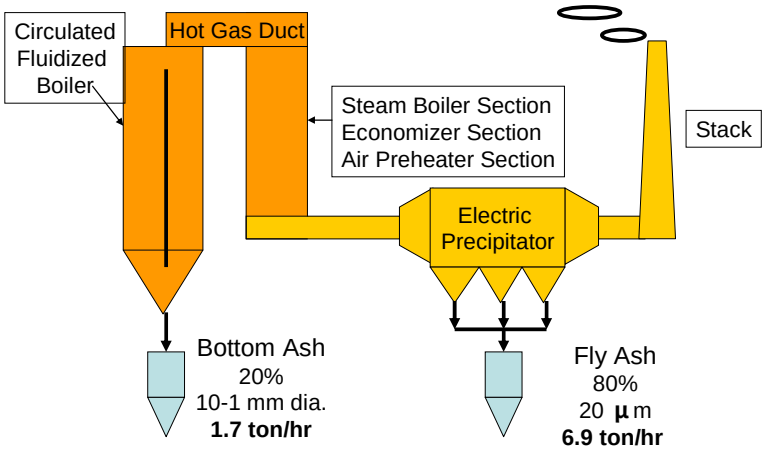
pH	5.0-9.0
COD	30 mg/L and less
Suspended Solid	13 mg/L and less
N	15 mg/L and less
P	1.5 mg/L and less
N-Hexane extract	5 mg/L and less
Colon Bacilli	3,000 numbers/cm^3 and less

Source: JICA Study Team

10.14 Ash Treatment System

The coal ash will be recovered from the power plant as a Bottom Ash or Fly Ash. Bottom Ash is recovered from the bottom of the combustion chamber and Fly Ash from the Electrostatic Precipitator. Coals are combusted together with limestone for sulfur removal in the flue gas. In this process gypsum and calcined limestone is also recovered as a part of Bottom Ash or Fly Ash. The Electrostatic Precipitator has a dust removal efficiency of 99%. The Ratio of Bottom Ash and Fly Ash needs to be confirmed through actual combustion tests. From the estimation based on the physical property of ash, the ratio of the Bottom Ash and Fly Ash is estimated at 1:4. The bottom ash is expected to be in the form of grain or gravel, ranging from 1mm to 10

mm. The Fly Ash is expected to be in the form of a particulate with the size of 20 μm.
The figure below shows a general ash recovery system arrangement.

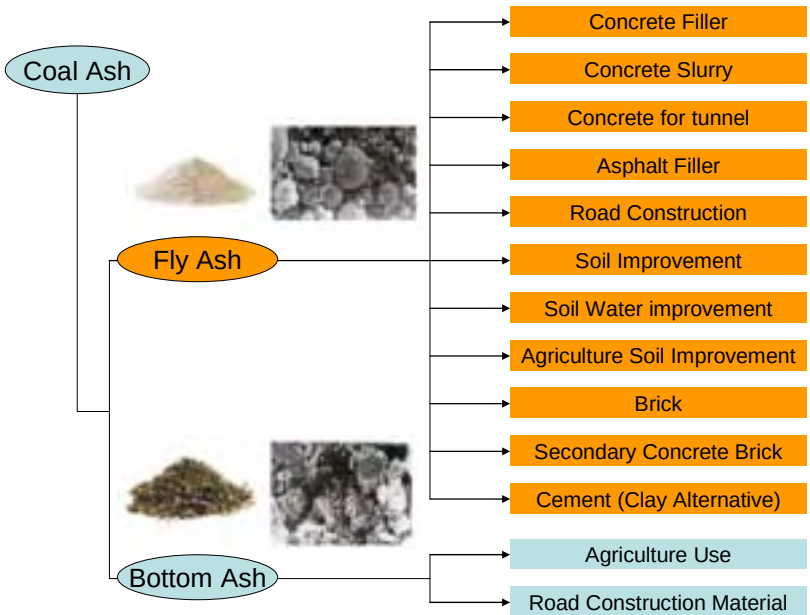


Source: PLN

Fig. 29 Circulated Fluidized Boiler 50 MW Ash Recovery

Behavior of the ash in the boiler system should be examined further by sample combustion testing to assist in the detail design of the boiler system and optimize the ash handling system capacity.

Ash recovered from the boiler should be reused. A separate study is shown in Attachment 10. Indonesian coal ash does not contain hazardous metals and a wide range of utilization should be considered. A general idea of the utilization is presented in Fig.28 as follows.



Source: JICA Study Team

Fig. 30 Coal Ash Utilization

Bottom Ash is used as a road construction material and for various applications in the agricultural industry. A major potential user of the Fly Ash is the Cement Manufacturing Industry. It is used in the cement manufacturing processes as a clay substitute.
There are three major raw material ingredients to manufacture cement: Limestone, Clay, and Silica. Coal Ash (Fly Ash) has similar properties to the clay and can be used as one of the cement ingredients.

Table 18 is a Comparison of the Cement Composition and Coal Ash (Fly Ash).

Table 18 Cement Composition Comparison

		Chemical Composition				
		SiO_2	Al_2O_3	Fe_2O_3	CaO	Na_2O_{eq}
Portland Cement Composition		20～23	3.8～5.8	2.5～3.6	63～65	0.3～0.7
Cement Ingredients	Lime Stone	～4	～2	～2	47～55	～0.2
	Clay	45～80	10～30	3～10	～5	2～6
	Silica	70～95	2～10	～5	～2	0.5～3.0
Coal Ash	Fly Ash	40～65	10～30	3～10	5～20	0.5～2.0

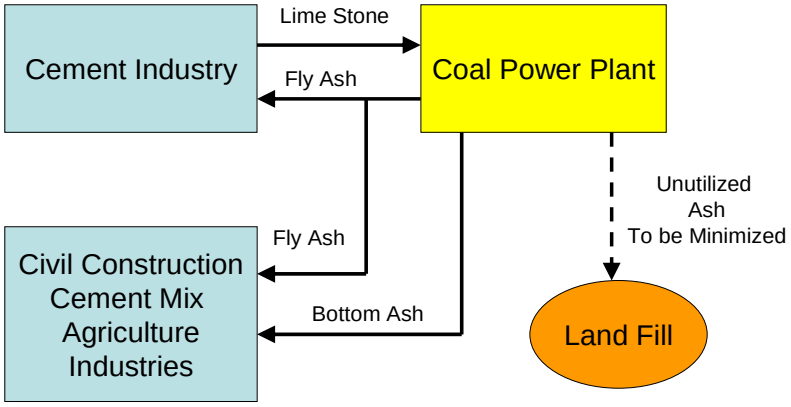
Source: Japan Cement Association

The advantage of using Fly Ash instead of Clay lies in the energy saving in the cement manufacturing. Clay requires a lot of energy to remove crystallized water but Crystallized water in the Fly Ash is already removed in the boiler.

This means that given the same input of energy, the cement production output will be increased if Fly Ash is used instead of Clay. A Cement Company can also manufacture Fly Ash mixed cement as one of the varieties of cement products. This type of cement is used for casting applications to construct large cement structures due to its higher fluidity.

Power plants require limestone (1 mm and under) in the desulphurization process of flue gas from the combustion furnace and this can be supplied by the Cement Manufacturing Company. And in return, the power plant supplies coal ash to the Cement Manufacturing Company. Good synergy between the Power Plant and the Cement Industry is expected as shown in Fig. 29

The following benefits are expected by the parties:
· The power plant can save the investment and handling cost to manufacture powder limestone (1 mm under)
· The cement industry can increase the cement production and manufacture a variety of cement products.



Source: PLN

Fig. 31 Synergy within Industries

Fly Ash can also be mixed directly with cement to improve the fluidity of the cement. This is not only effective in the construction of cast cement structures such as dams and large foundation construction but also be utilized for spray-on applications, such as rock stabilization in the construction of tunnels. Fly Ash can also be used as a soil-improvement agent.

10.15 Central Control Room and DCS System

This Project uses a Distributed Control System (DCS) to control the entire plant operation and monitor the environment and safety. This system is installed in the central control room and the operator controls each unit through an interface based on CTR. The central control room accommodates control panels for auxiliary equipment such as utilities. It is also equipped with panels for controlling soot blower systems that are independent of operation and safety-related equipment such as fire pumps or system panels related to environmental monitoring systems and furnace safeguards.

11 Investigation of Internal Power Consumption

As part of the preliminary design of the power plant, internal power consumption was investigated, based on the process flow of the proposed power plant. Boiler size and generator capacity is optimized by this investigation. The result is reflected in the economics of the power plant.

The investigation result shows that internal power consumption is about 11.2 MW (2x5.6 MW). And therefore the Gross Power Output of the proposed power plant is 2x55.6 MW and Net Power Output is 2x50 MW.

Table 19 summarizes the major power consumer of the proposed plant.

Table 19 Internal Power Consumption

Equipment	Unit Power (KW)	No of Unit	Total (KW)
1 Primary Air Fan	1,150	2	2,300
2 Secodary Air Fan	550	2	1,100
3 Induced Draft Fan	680	2	1,360
4 Boiler Feed Pump	1,500	2	3,000
5 Coal Crusher System	110	2	220
6 EP System	400	2	800
7 CWP	540	2	1,080
8 Condensate Pump	110	2	220
9 Cooling Tower Fan	150	2 x 2	600
10 Limestone Primary Crusher	55	1	Cement Company
11 Limestone Secondary Crusher	165	2	Cement Company
12 Coal Sludge Handling System	300	2	600
Total			11,200

Source: PLN

12 Heat Balance Analysis

A CFB (Circulated Fluidized Bed) system is proposed in this study. Based on the load flow analysis, the transmission system will be able to accommodate 2x50 MW power units in 2012. Through the design optimization process, gross power generation capacity is determined to be 2x55.6 MW.

With this capacity size, the casing type of the steam turbine will be a single casing. Five extracts are proposed to attain higher steam turbine efficiency. (Efficiency of a 3 extract steam turbine is 0.5 % points lower than that of 5 extracts.)

Optimized design pressure and temperature conditions are:

- The main steam condition will be set at 540°C and 131 kg/cm^{2}A at the boiler outlet.
- The boiler feed water supply condition will be at 223°C and 149 kg/cm^{2}A.
- Condenser pressure will be 0.09 kg/cm^{2}A.
- The main steam flow rate will be 2x205.1 ton/h.

The results of the heat balance analysis are shown in Attachment 3.

13 Power Plant Plot Plan

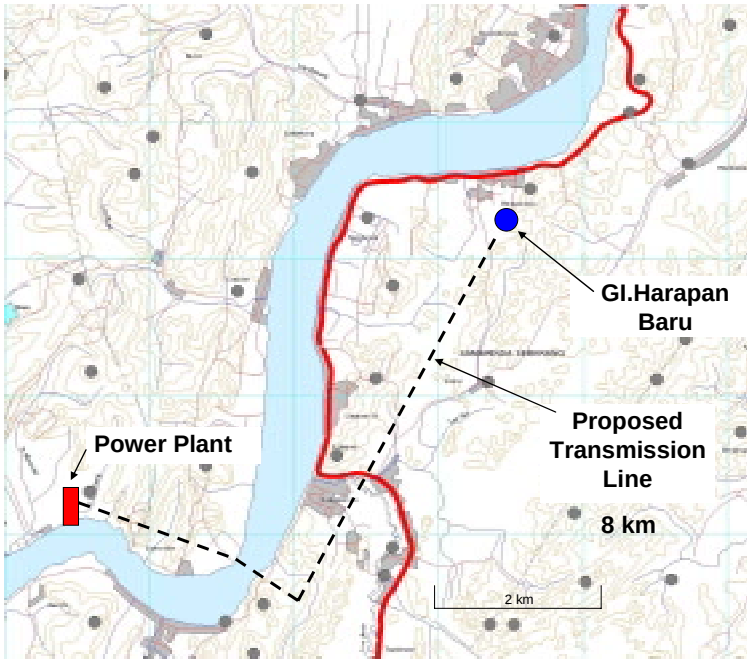
The power plant consists of various facilities. These include auxiliary equipment and offsite coal handling facilities as follows:

- Water intake pump station and water storage pond
- Coal yard and handling facilities
- Limestone handling facilities
- Boiler and steam turbine power generating facilities
- Flue gas discharge system including electrostatic precipitator
- Ash handling facilities
- Water clarifier and water treatment facility
- Cooling water system and cooling tower
- Wastewater treatment facility
- Switch yard and power transmission line, and associated substation
- Central control room
- Spare parts store and work shop
- Coal laboratory
- Offices
- Housing for employees

These facilities need to be logically laid out given the shape of the land.
Attachment 1 shows the overall Plot Plan and Attachment 2 presents the equipment layout.

14 Power Transmission Line Study

The power plant needs to be connected into the power transmission network. Transmission lines will be installed from the power plant and nearby existing substation.
In this Project, the Transmission lines will be connected to the Harapan Baru Substation.
The transmission line has to cross the River Mahakam. The narrowest section of the river should be selected as the crossing point. Fig. 30 shows the proposed transmission line route, and the overall length of the transmission lines is approximately 8 km.



Source: PLN

Fig. 32 Proposed Transmission Line Route

To increase the total transmission capacity and ensure system stability, new power transmission lines between Bukuan and Senipha with the approximate length of 47 km will be installed. According to PLN, the construction cost of the transmission lines is about Rp 1 billion per km (excluding the land purchase price). The land acquisition for the proposed route is said to be easier than in other parts of the country.

A field survey of the proposed transmission lie was carried out. From Bukuan through Sanga Sanga to Handir Dua is covered with secondary forest and large and/or small scale coal mine development areas. The proposed route should avoid crossing the estuary located south of Handir Dua. From there, the land becomes flat and mostly covered with swamps and secondary forest through to Senipha. No major obstacles for the installation of the transmission line were observed and access to construct the transmission line will not be difficult.

15 Economics of the Proposed Power Plant

According to the PLN plan of 2006, the existing diesel engine driven power generators, mostly owned by PLN, will be gradually taken out of service by 2010. PLN will therefore need to relay on the Independent Power Producers (IPP) for a significant part of the power generation. If, however, the system operators do not have dependable power generation facilities, the operation of the system might suffer from instability.

This study assumes that PLN has responsibility to expand the electrification area and supply stable power to the entire east Kalimantan area. To fulfill that responsibility, the existing power transmission system should be continuously extended and power stations should be constructed based on the appropriate power supply plan.

The proposed power plant construction plan therefore includes a transmission infrastructure reinforcement plan and the power plant is designed to operate more than 30 years as a center piece of the electric power infrastructure in the area. PLN is assumed to be an owner of the project and construction budget is assumed to be a soft loan or Official Development Assistance (ODA).

In this section, the ODA based power tariff was calculated. To compare the economics of the projects between the IPP case and the PLN case, IRR for both cases are calculated.

15.1 ODA-based Feasibility Study

The power tariff calculations are based on the following conditions.

·	Gross Power Generation Capacity (MW)	2x55.6 MW
·	Net Power Output (MW)	2x50 MW
·	Power Generation Efficiency (LVH)	35%
·	Internal Power Consumption	2x5.5 MW
·	Capacity Utilization Factor (availability) of power plant	80%
·	Construction Period	3 years
·	Total Operating Costs (% share of CAPEX)	4.0%
·	Grace Period of the Loan Repayment	3 years
·	Loan Length, including Grace Period	40 years
·	Depreciation (straight-line depreciation method)	40 years
·	Average Interest Rate (ODA Sub-lease)	6%
·	Exchange rate (Rp/USD)	9,000
·	Exchange rate (Yen/USD)	110
·	Mixed Coal Price	17.9 USD/ton

· Mixed Coal AR (HHV) 4,198 kcal/kg
· Mixed Coal AR (LVH) 3,998 kcal/kg

15.1.1 Construction Costs

The construction costs include all power generation equipment including auxiliary facilities, the infrastructure, and the construction costs for the transmission lines from the power plant to the neighboring substation, and the costs for the new transmission lines from Bukuan to Senipha (transmission line: 47 km) to reinforce the transmission system.

The initial cost estimate shows that the total project cost will be US$ 178 million, or 1,600 USD/kW, including a 15% contingency. This estimated cost is considered conservative but reasonable as a base to be used for an economics study.

Table 20 Project Cost (Preliminary Estimation)

Unit: MM $

	Item	Description	Total Cost	$/kW
100	**Coal & Lime Stone System**		4.5	40.5
10	Dirty/Supplement Coal Feed System			
20	Fine Coal Feed System			
30	Limestone Handling			
200	**Ash Handlin System**		3	27.0
	Ash Handling System			
300	**Boiler System**		79	710.4
10	Boiler System			
20	Draft Fan Unit			
30	Flue Gas Duct and Stack			
40	Electric Precipitator			
50	Auxiliary System			
400	**Steam Turbine Genersator System**		42	377.7
10	Boiler Feed Water System			
20	Steam Turbine System			
30	Generator/Main Transformer			
40	Auxiliary System			
500	**Coolin Water System**		1.9	17.1
10	Cooling Tower System			
20	Cooling Water Pump			
600	**Utility System**		4	36.0
10	Air Compressor Station			
20	Water Intake Pump Station			
30	Water Clarifier and Storage System			
40	Deminerizing and Tank System			
50	Oil Tankage			
60	Others			
700	**Fire Safty System**		1	9.0
10	Fire Pump Station			
20	Others			
800	**Electric Power Transmission System**		6.71	60.3
10	Emergency Generator/Transformer			
20	Switchyard			
30	Transmission Line Power Plant to Harapan Baru	10 km		
40	Transmission Line Bukuan to Senipha	47 km		
900	**DCS and Instrumentation**		4	36.0
10	DCS			
20	Others			
A100	**Temporary Facilities**		3	27.0
	Freight (Transship from Samarinda to Construction Site)		1	9.0
	EPC Total		150.11	1349.9
	Management and Engineering		5	45.0
	Contingency	15%	23	209.2
Total Cost Estimate			178	1604.1

Project Cost
Preliminary Estimation

Contingency : 15%
Project Cost : $ 178 MM
($ 1600/kW)
All Infrastructure Included
(Bukuan-Senipha Transmission Line)

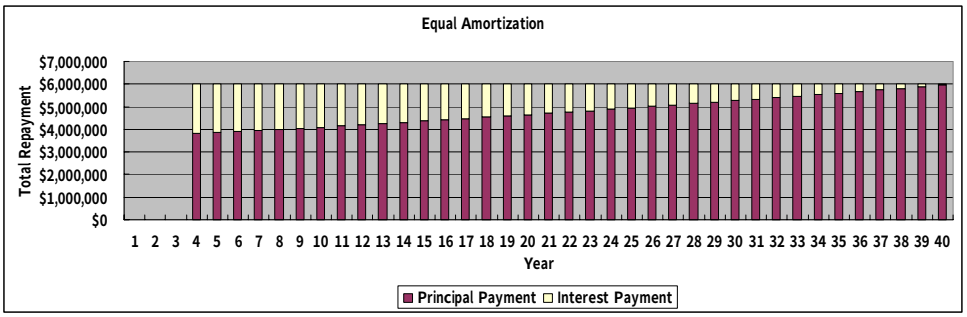
Source: PLN

15.1.2 Interest Rate and Principal Repayment

A soft ODA loan is assumed for the Proposed Power Project for a period of 40 years. Interest rate of the ODA Loan for environmental projects will be 0.75%. The loan will be subleased to government companies at a premium charge of 0.5 %. An interest rate of 1.25 % is assumed for this project.

The repayment for the state owned companies is to be completed over a 37-year period after the 3 years of grace period, i.e., during the construction period. Equal amortization will be used so that the total of principal and interest will remain equal. The calculation results are shown for the case that the project costs are considered as being USD 178 million. The annual repayment amount, including the principal and interest, is USD 6 million. For the power tariff calculations, this value is used to calculate the Capacity Charge.

Interest Rate :	1.25% (0.75% Environmental +0.5% Sublease)
Grace Period :	3 years
Total Loan Length :	40 years
Project Cost :	US $ 178 MM
Equal Amortization :	US $ 6 MM/Year



Source: PLN

Fig. 33 Equal Amortization Calculation (Principal Payment and Interest Payment)

15.1.3 Fuel Cost

Due to the effective use of non-marketable coal, the proposed fuel will be the lowest cost fuel in the area. Fuel cost is the most important element among the variable costs and it is influenced by the operating time. The price of the coal mix used in this Project has been calculated as USD 17.9 per ton. Since there is no market for coals such as non-marketable coals and low rank lignite, fuel price risk for the economics will be very small.

15.1.4 Operation and Maintenance Cost

The annual operation and maintenance costs for this Project are assumed to be 4.0% of the total Project Cost. This figure is a little on the high side compared to actual data from other projects in Indonesia. It will be necessary to investigate the operation and maintenance costs at the next stage of the project.

15.1.5 Power Tariff

The calculation results for the power tariff are shown in the Table 21, as follows: The project will be able to supply power at the price of 2.91 US cents/kWh, with the operation factor of 85 % for the next 37 years. Since the fuel cost and availability risk is very small, the power tariff will be very stable.

Table 21 Power Tariff Calculation

	US¢/kWh
Capacity Charge	0.81
Fuel Charge	1.15
Operation & Maintenance	0.96
Total	2.91

Note

Operation Factor :	85%
Capacity Charge :	Annual Loan Payment
Fuel Charge :	Coal Mix Price @ Plant Site
Operation & Maintenance:	4 % of Project Cost

15.2 IPP-based Economics Study

For comparison with the ODA case, the feasibility of the IPP case was studied. The project condition is the same as the ODA case and includes transmission reinforcement infrastructures.

15.2.1 IPP Economics Study Data

In order to secure investment funding from the private sector, considerable returns must be secured without cutting back the required expenses for operation and maintenance and environmental standards.

Economics conditions used for the study are shown below. 100% owner funding is considered to calculate the Project IRR. The overview below shows the economic feasibility study results. A long-term (10 year) interest rate of 10% for loans from private banks in Indonesia is assumed as a reference.

Project Life (Years)	30
Depreciation (Years)	15
Corporate Tax Rate (%)	30
Long Term Commercial Bank Interest (%)	10
Loan Period (Years)	10

15.2.2 Cash Flow

The cash flow calculation based on 7.0 US cents/kWh (630 Rp/kWh) is shown below. This level of tariff will be able to satisfy the potential investors.

Unit: million USD

Project Year		(3)	(2)	(1)	1	2	3	4	5	6	7	8	9	10
Power Sales Revenue	7.0 Cent/kWh	0	0	0	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12
Coal Fuel Cost					9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52
O & M Cost					7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11
	Operation Profit				35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49
Depreciation					11.85	11.85	11.85	11.85	11.85	11.85	11.85	11.85	11.85	11.85
	EBIT				23.64	23.64	23.64	23.64	23.64	23.64	23.64	23.64	23.64	23.64
	EBITDA				35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49
Tax					7.09	7.09	7.09	7.09	7.09	7.09	7.09	7.09	7.09	7.09
Capital Expenditure	177.78	35.56	71.11	71.11										
Free Cashflow		(35.56)	(71.11)	(71.11)	28.40	28.40	28.40	28.40	28.40	28.40	28.40	28.40	28.40	28.40
IRR on Investment														8.12%

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12
9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52
7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11
35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49
11.85	11.85	11.85	11.85	11.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23.64	23.64	23.64	23.64	23.64	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49
35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49
7.09	7.09	7.09	7.09	7.09	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65
28.40	28.40	28.40	28.40	28.40	24.84	24.84	24.84	24.84	24.84	24.84	24.84	24.84	24.84	24.84	24.84	24.84	24.84	24.84	24.84
									13.05%										13.82%

Source: JICA Study Team

Table 22 Cash Flow Based on IPP Financial Arrangement (F-IRR)

The result shows that with the power tariff of 7 US cents/kWh, the IRR for the IPP power development project will be 8% (10 years), 13% (20 years) and 13.8% (30 years). As the interest rate on long-term loans (10 years) is around 10% in Indonesia this may be within the feasible range, but tariff the would need to be 7.0 US cents/kWh.

15.2.3 Power Tariff Analysis in Case of an IPP Financial Arrangement

Provided that an IPP financial arrangement is used, the power tariff will include interest and dividends. These factors can be recouped as Capacity Charges together with the Depreciation Costs.

Under these economic conditions (investment amount and operating costs, etc.), the project will not be deemed as eligible for investors until the wholesale power tariff becomes 7.0 US cents/kWh (630 Rp/kWh).

PLN's average power tariff as of 2004 and after is 612 Rp/kWh. A wholesale power tariff of 7.0 US cents/kWh would thus exceed the average power tariff of PLN (612 Rp/kWh) and it would be difficult for PLN to accept the IPP deal.

The power tariff structure in case of an IPP financing arrangement is shown in the following table:

Table 23 Tariff Based on IPP Financial Arrangement

	US¢/kWh
Capacity Charge	4.89
Fuel Charge	1.15
Operation & Maintenance	0.96
Total	7.00

Note

Operation Factor :	85%
Capacity Charge :	Investment Recovery including Dividend
Fuel Charge :	Coal Mix Price @ Plant Site
Operation & Maintenance:	4 % of Project Cost

Source: PLN

15.3 Economic IRR (without Tax)

Cash flow of the IPP financial arrangement was compared with the cash flow without taking tax into consideration, called economic IRR (E-IRR) at the same tariff of 7.0 US cents/kWh (630 Rp/kWh).

The E-IRR cash flow is shown in Table 24.

Table 24 E-IRR Cash Flow (7.0 US Cent/kWh)

Unit: million USD

Project Year		(3)	(2)	(1)	1	2	3	4	5	6	7	8	9	10
Power Sales Revenue	7.0 Cent/kWh	0	0	0	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12
Coal Fuel Cost					9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52
O & M Cost					7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11
	Operation Profit				35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49
Depreciation					11.85	11.85	11.85	11.85	11.85	11.85	11.85	11.85	11.85	11.85
	EBIT				23.64	23.64	23.64	23.64	23.64	23.64	23.64	23.64	23.64	23.64
	EBITDA				35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49
Tax					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital Expenditure	177.78	35.56	71.11	71.11										
Free Cashflow		(35.56)	(71.11)	(71.11)	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49
IRR on Investment														12.54%

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12
9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52
7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11
35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49
11.85	11.85	11.85	11.85	11.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23.64	23.64	23.64	23.64	23.64	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49
35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49	35.49
									16.73%										17.30%

Source: JICA Study Team

The following table summarizes the result of the calculation between F-IRR and E-IRR based on the tariff of 7.0 US cents/kWh.

	F-IRR	E-IRR
10 Year (%)	8.12%	12.54%
20 Year (%)	13.05%	16.73%
30 Year (%)	13.82%	17.30%

As a side case, E-IRR was recalculated based on the tariff of 6.0 US cents/kWh (540 Rp/kWh), and 5.0 US cents/kWh (450 Rp/kWh)as follows:

Table 25 E-IRR Cash Flow (6.0 US Cents/kWh)

Unit: million USD

Project Year		(3)	(2)	(1)	1	2	3	4	5	6	7	8	9	10
Power Sales Revenue	6.0 Cent/kWh	0	0	0	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68
Coal Fuel Cost					9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52
O & M Cost					7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11
	Operation Profit				28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04
Depreciation					11.85	11.85	11.85	11.85	11.85	11.85	11.85	11.85	11.85	11.85
	EBIT				16.19	16.19	16.19	16.19	16.19	16.19	16.19	16.19	16.19	16.19
	EBITDA				28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04
Tax					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital Expenditure	177.78	35.56	71.11	71.11										
Free Cashflow		(35.56)	(71.11)	(71.11)	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04
IRR on Investment														7.88%

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68
9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52
7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11
28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04
11.85	11.85	11.85	11.85	11.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16.19	16.19	16.19	16.19	16.19	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04
28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04	28.04
									13.01%										13.86%

Source: JICA Study Team

Table 26 E-IRR Cash Flow (5.0 US Cents/kWh)

Unit: million USD

Project Year		(3)	(2)	(1)	1	2	3	4	5	6	7	8	9	10
Power Sales Revenue	5.0 Cent/kWh	0	0	0	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23
Coal Fuel Cost					9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52
O & M Cost					7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11
	Operation Profit				20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60
Depreciation					11.85	11.85	11.85	11.85	11.85	11.85	11.85	11.85	11.85	11.85
	EBIT				8.74	8.74	8.74	8.74	8.74	8.74	8.74	8.74	8.74	8.74
	EBITDA				20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60
Tax					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital Expenditure	177.78	35.56	71.11	71.11										
Free Cashflow		(35.56)	(71.11)	(71.11)	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60
IRR on Investment														2.40%

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23	37.23
9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52
7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11	7.11
20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60
11.85	11.85	11.85	11.85	11.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.74	8.74	8.74	8.74	8.74	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60
20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60	20.60
									8.81%										10.10%

Source: JICA Study Team

Resultant IRR is as follows:

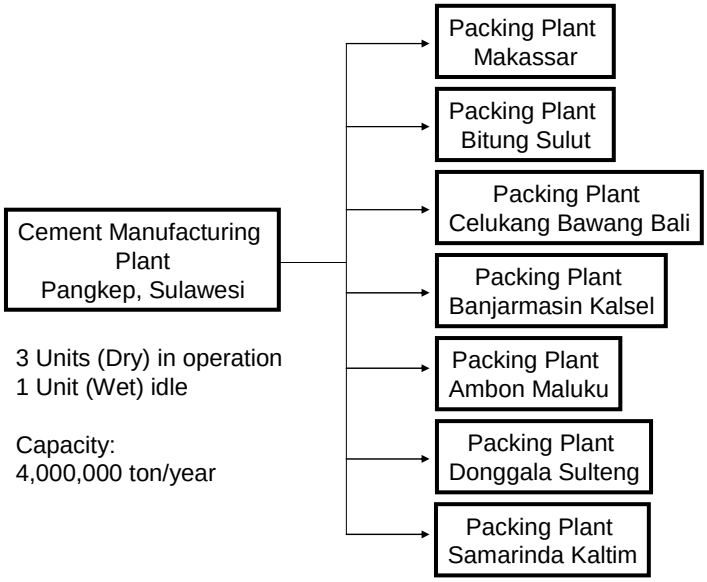
	E-IRR 6 US ¢/kWh	E-IRR 5 US ¢/kWh
10 Year (%)	7.86%	2.40%
20 Year (%)	13.01%	8.81%
30 Year (%)	13.86%	10.10%

As a conclusion, it may be difficult for the private sector to build and operate the same project as proposed herewith. It is recommended to use a soft ODA loan for this project.

16 Cement Market

At present, cement is supplied to East Kalimantan by the State run Tonasa Cement Corporation. Tonasa Cement manufactures their product in Pangkep, in the southern part of Surawesi Island, near a limestone mine. Their manufacturing plant has a total of four units: three units using a Dry Process and 1 unit using a Wet Process. Annual production capacity is 4 million tons. The cement products are distributed to the various regions through the cement-packaging plants. Locations of these cement packing plants include Makassar, Bitung, Bali, Banjarmasin, Ambon, Donggala and Samarinda.

The following provides an overview of the cement distribution system.



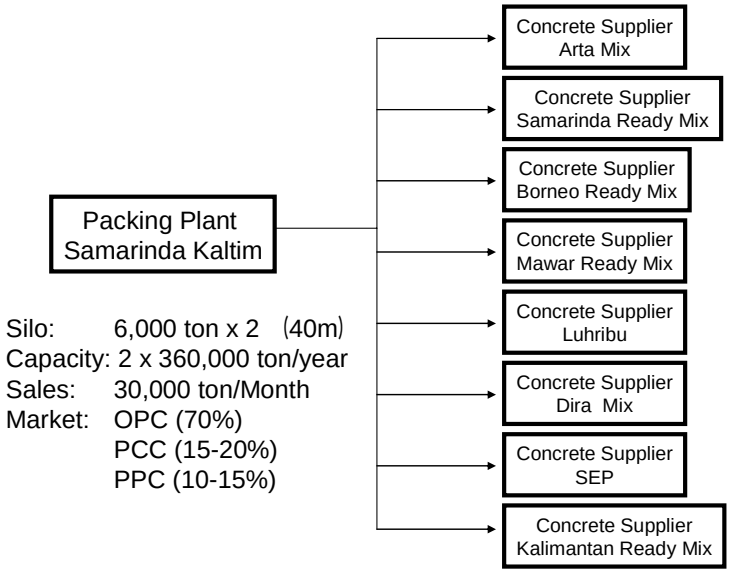
Source: PLN

Fig. 34 Tonasa Cement Supply System (Kalimantan /Surawesi Area)

Tonasa has four types of cement products. However, fly ash cement is not always marketed due to a shortage of the fly ash blend stocks in the area.

Portland cement Jenis 1 (OPC):	Ordinary cement
Portland composite cement (PCC):	15% fly-ash, 5% limestone
Portland Pozzolan cement (PPC):	10% fly-ash
Fly-ash cement (if ash is available):	40% fly-ash

In 2005, roughly 250,000 tons of cement products were sold in Samarinda City. A total of 27% is sold mainly to the private ready-mixed concrete firms and the remaining 73% is packaged in paper bags for supply to construction companies.



出典: PLN

Fig. 35 Tonasa Cement Distribution System in Samarinda Area

The amount of Fly Ash generation by this proposed project is estimated at 46,000 tons per annum. This figure corresponds to 2% of the Tonasa Cement production capacity.

The amount of Bottom Ash production is estimated at around 11,000 tons a year. At present, aggregate and gravels are delivered from South Kalimantan, Surawesi and even Malaysia. Bottom Ash will also be in a high demand under such circumstances.

In conclusion, Fly Ash and Bottom Ash demand is very high and the CFB boiler will be able to generate a quality of ash suitable for various applications.

17 Environmental Performance Data

The emissions from the proposed power plant are as follows:

1. Atmosphere:

   SOx, NOx, and Particulates

2. Water:

   Rain Water, Spray Water from Coal Yard, Boiler Feed Water Blow-down, Cooling Water Blow-down, Back Wash Water from the Demineralized Water System, and Office and Colony Waste Water

3. Solids:

   Coal Ash, Waste Water Treatment Sludge, Sludge from the Demineralizer, Fuel Oil Tank Bottom Sludge, and Wastes during Maintenance

4. Noise:

   Noise will be contained within the industrial noise regulation level.

The proposed power plant uses a Circulated Cooling System. It does not release hot cooling water to the river environment. Volume of effluent water is small and does not contain any toxic substances.

Coal ash is used by the Cement Industry, Construction Industries, and Agriculture for a soil improving agent.

With regard to air pollution, an internal Desulfurization system is used and SOx in the fuel is converted to Gypsum and recovered as a part of the coal ashes. A total of 90 % of the Sulfur will be removed. The relevant regulations limit SOx to 263 ppm and this can be achieved easily. NOx generation is also controlled by the CFB (circulated fluidized bed boiler) operation. The facility allows operation at a low combustion temperature and the level of NOx formation is also minimized to the range of 150-200 ppm. The regulations limit NOx to 333 ppm. With regard to particulate emissions, 99% of particulates will be removed by the Electric Precipitator. The regulation limit is 150 mg/Nm^3.

These impacts are to be studied in detail through an Environmental Impact Assessment (AMDAL) at a later stage.

18 Schedule

The proposed power plant construction schedule was also investigated. Based on the PLN Ten-Year Plan prepared in 2006, the timing for the startup will be January 2012, based on ODA financial arrangements.
Major milestones in the project execution are as follows:

(1) PLN Ten Year Plan listed (Reviewed in December 2006)
(2) Preparation stage for construction, including Basic Engineering and confirmation of the Feasibility
    FS
    AMDAL
    Power Purchase Agreement (If Applicable)
    Fuel Supply Agreement
    Preparation of Various Approval Documents
    Procedure of Funding Arrangement Process
    Selection of Consultants and/or Contractors
(3) Start of Detailed Design (May 2009)
(4) Construction (June 2009-December 2011)
(5) Commissioning and Commencement of the Commercial Operation (January 2012 or thereafter)

19 Further Works

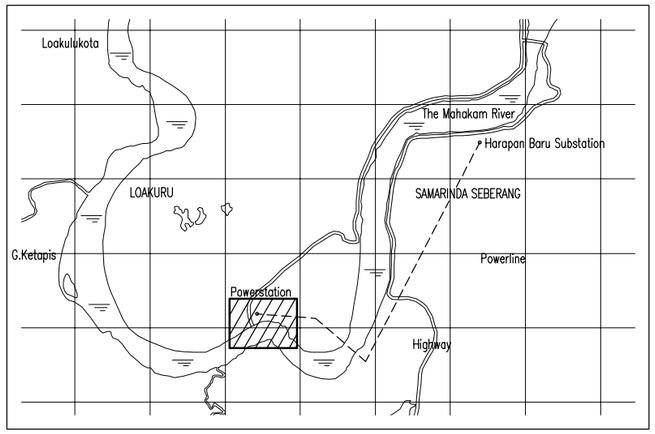
Further works to complete the Feasibility Study of the Project are listed as follows:

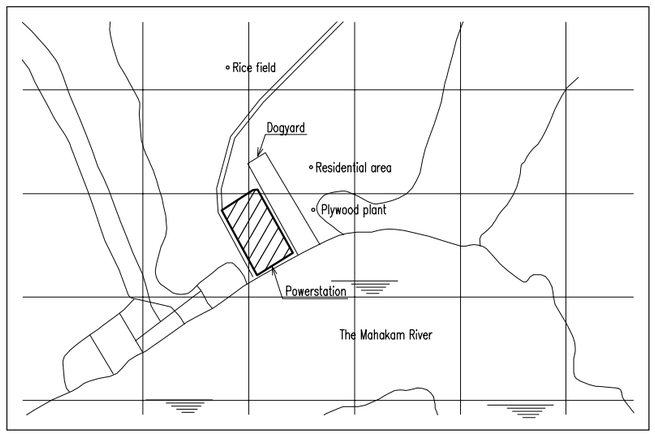
1. Local boring survey
2. Combustion tests using coal samples
3. Ash Sample Analysis
4. Prepare Equipment Specifications and Detailed Construction Cost Study
5. Review of the Construction Schedule

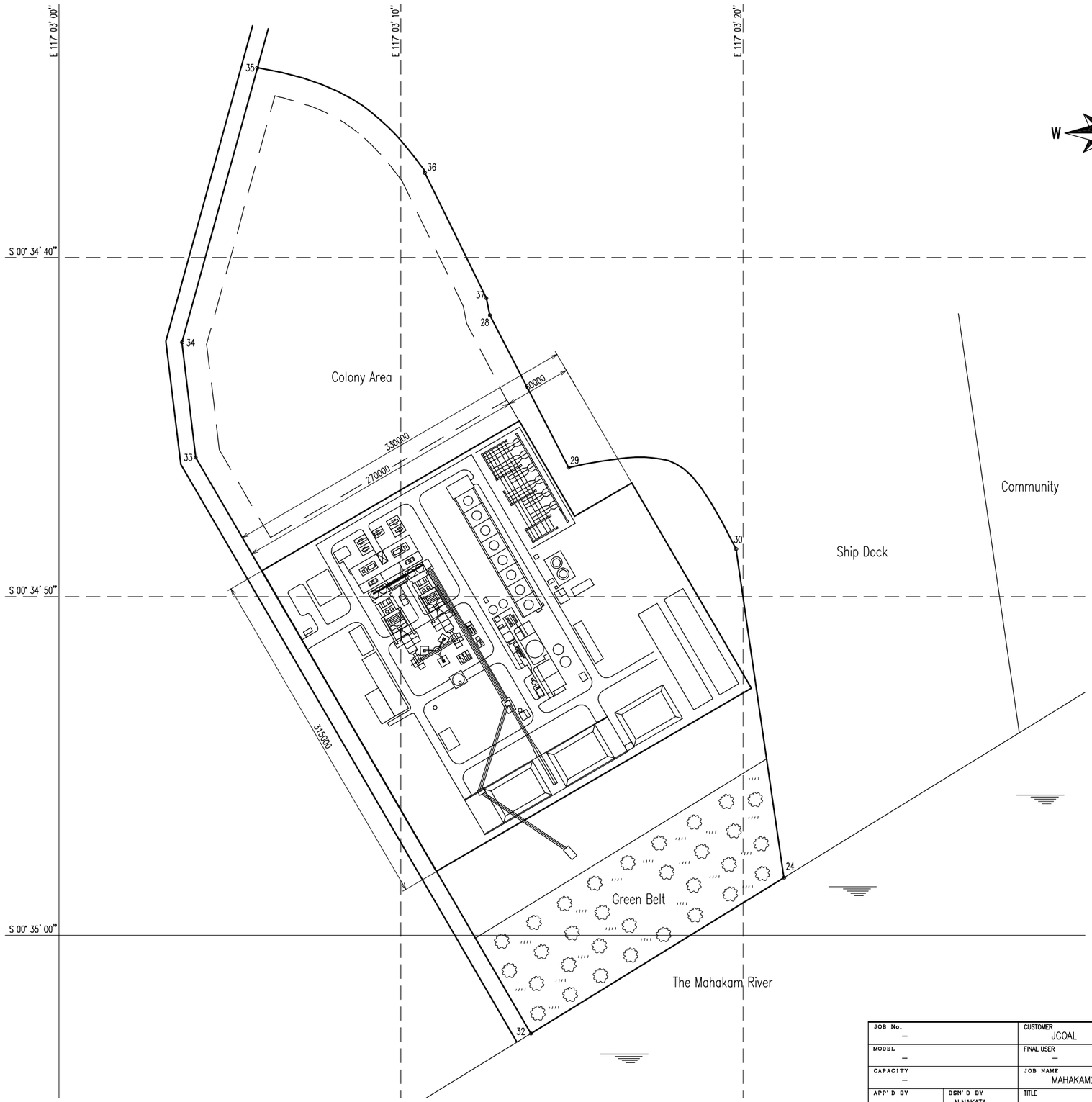
Attachments

Attachment 1: Overview of equipment arrangement
Attachment 2: Equipment Plot Plan
Attachment 3: Heat Balance Analysis
Attachment 4: Process Flow of the Proposed Power Plant
Attachment 5: Slurry Coal Supply System
Attachment 6: Single-line diagram of power plant
Attachment 7: Single-line diagram of Mahakam System
Attachment 8: Equipment List
Attachment 9: Load Flow Analysis Report
Attachment 10: Ash Study Report

ATTACHMENT 1







Point No.	S	E
28	00° 34' 41.7"	117° 03' 12.6"
29	00° 34' 46.2"	117° 03' 14.9"
30	00° 34' 48.6"	117° 03' 19.8"
24	00° 34' 58.3"	117° 03' 21.2"
32	00° 35' 02.9"	117° 03' 13.8"
33	00° 34' 45.9"	117° 03' 04.0"
34	00° 34' 42.5"	117° 03' 03.6"
35	00° 34' 34.4"	117° 03' 05.8"
36	00° 34' 37.5"	117° 03' 10.7"
37	00° 34' 41.2"	117° 03' 12.5"

0 50 100 150 200m

JOB No. –		CUSTOMER JCOAL	
MODEL –		FINAL USER –	
CAPACITY –		JOB NAME MAHAKAM2x50MW COAL-FIRED POWER PLANT	
APP'D BY –	DSN'D BY N.NAKATA	TITLE General Arrangement Plan	
APP'D BY –	DRW'N BY H.WATNABE		
		SIZE A1 / PROJ. / SCALE 1:2000	DWG. No. – / Rev. –

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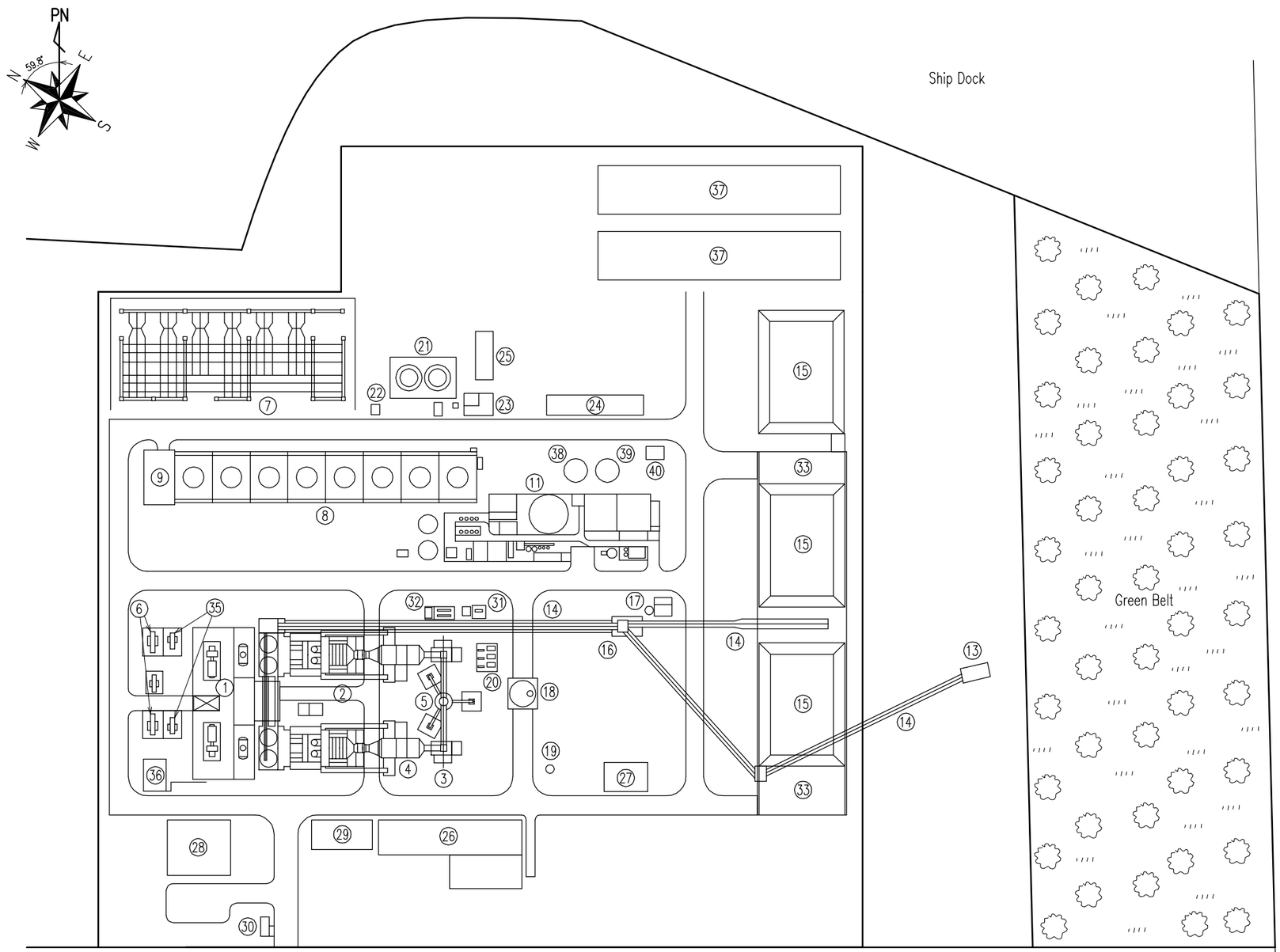
ATTACHMENT 2



No.	NAME
1	STG BUILDING
2	CFB BOILER
3	I.D FAN, P.A FAN, S.A FAN
4	EP
5	STACK
6	GENERATOR TRANSFORMER
7	SWITCHYARD
8	COOLING TOWER
9	CIRCULATING WATER PUMP HOUSE
10	DRY CHEMICAL TANK HOUSE
11	RAW WATER TREATMENT PLANT/ DEMINERALIZED WATER PLANT/ WASTE WATER TREATMENT PLANT
12	POTABLE WATER TANK
13	COAL RECEIVING POINT
14	COAL CONVEYOR
15	COAL STORAGE PILE
16	COAL CRUSHER STATION
17	COAL FEED CONTROL HOUSE
18	PLANT ASH STORAGE SILO
19	LIMESTONE BANKER
20	AIR COMPRESSION STATION
21	HEAVY FUEL OIL STORAGE AREA
22	LUBE OIL STORAGE TANK
23	HEAVY FUEL OIL PUMP HOUSE
24	MECHANICAL / ELECTRICAL WORKSHOP
25	MOBILE EQUIPMENT SHED
26	WARE HOUSE
27	CHEMICAL STORAGE HOUSE
28	ADMINISTRATION BUILDING
29	CIVIL WORKSHOP AND GARAGE
30	GATE HOUSE-MAIN
31	ASH ELECTRICAL HOUSE
32	EP ELECTRICAL HOUSE
33	COAL UNLOADING AREA
34	UNIT TRANSFORMER
35	STATION TRANSFORMER
36	EDG / AIR COMPRESSOR HOUSE
37	RAW WATER POND
38	DEMINERALIZED WATER TANK
39	PURE WATER TANK
40	WASTE WATER MIXING SUMP

JOB No. –		CUSTOMER JCOAL
MODEL –		FINAL USER –
CAPACITY –		JOB NAME MAHAKAM2x50MW COAL-FIRED POWER PLANT
APP'D BY –	DSN'D BY N.NAKATA	TITLE –
APP'D BY –	DRW'N BY H.WATNABE	General Arrangement Plan
		SIZE A1 / PROJ. / SCALE 1:1000 / DWG. No. – / Rev. –

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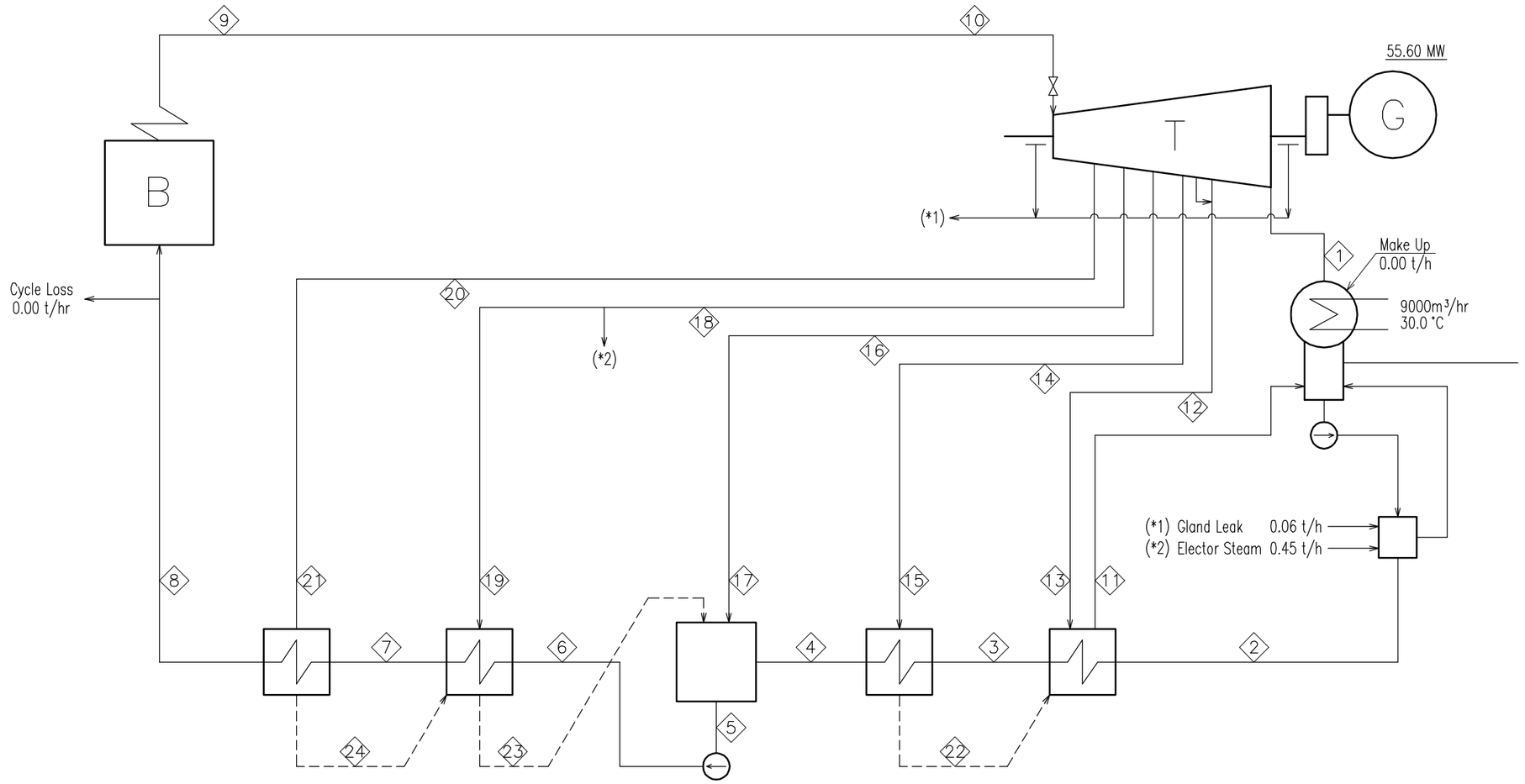
ATTACHMENT 3



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
kPA	8.9	–	–	784.5	590.4	14778.6	14690.4	14592.3	12846.7	12346.6	–	99.0	93.2	276.5	263.8
kJ	–	190.9	398.1	530.8	667.7	686.9	831.3	961.1	3444.3	3436.7	158.7	2857.8	2857.8	2659.4	2659.4
°C	43.5	45.4	94.9	126.3	168.2	160.8	194.0	223.0	540.0	535.0	97.8	89.5	89.7	97.2	97.3
t/hr	139.79	167.27	167.27	167.27	201.50	201.50	201.50	201.50	201.50	201.50	26.97	17.04	17.04	9.93	9.93

	16	17	18	19	20	21	22	23	24						
kPA	639.4	610.0	1529.8	1451.3	2687.0	2559.5	–	–	–						
kJ	2792.1	2792.1	2956.2	2956.2	3080.5	3080.5	422.4	704.9	851.9						
°C	175.9	175.0	264.3	263.2	331.4	330.2	100.8	166.7	199.8						
t/hr	10.35	10.35	12.59	12.14	11.75	11.75	9.93	23.88	11.75						

JOB No. –		CUSTOMER JCOAL
MODEL –		FINAL USER –
CAPACITY –		JOB NAME MAHAKAM2x50MW COAL-FIRED POWER PLANT
APP'D BY –	DSN'D BY K.NAKATA	TITLE – HEAT BALANCE DIAGRAM
APP'D BY –	DRW'N BY H.WATNABE	
		SIZE A2 / PROJ. / SCALE 1: NON / DWG. No. / Rev. –

PM752C

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ATTACHMENT 4

Coal
<200mm
BC1
BC2A
Bin
Crusher
<10mm
Receiving Hopper
BC2B
BC3A
BC3B
To Unit 2
BC4A
BC5A
Coal
Bunker
370m3
Coal
Bunker
370m3
Fine–Slurry 8.72 t/hr
Dirty Coal 13.29 t/hr
Assitant 14.44 t/hr
Fuel Heat Input 158.3 MW+hr

Foster Wheeler Compact CFB Boiler

Steam
Drum
Convection
Cage
Hot Gas Duct
Compact
Separator
SH2
SH3
SH1
ECO
GAH
Furnace
Wall Seal
BA Cooler
HP Blower
SAH
SAH
PA Fan
SA Fan
20 % EXCESS AIR
RH 85 %
176,070 Nm³/hr

Main Steam
130kg/cm2g
540 deg.C
205 t/hr
Auxiliary Steam

Turbine Generator
T
G
55.6MW
11kV
50Hz
Tr.
150kV
Turbine Bypass
Condenser
40°C
Cooling
Tower
CWP
30 °C
9000 t/hr
Water
Treatment
Plant
Demineralized
Water Plant
Dearator
HP Heater
BFP
LP Heater
CP
CTP

Fine Coal
Feed System
Coal 37t/hr
Coal Feed Screw
Coal
Weighing
Feeder

Heavy Fuel Oil Tank
2x300m3
Heater
Unloading Pump
Feed Pump
To Unit 2

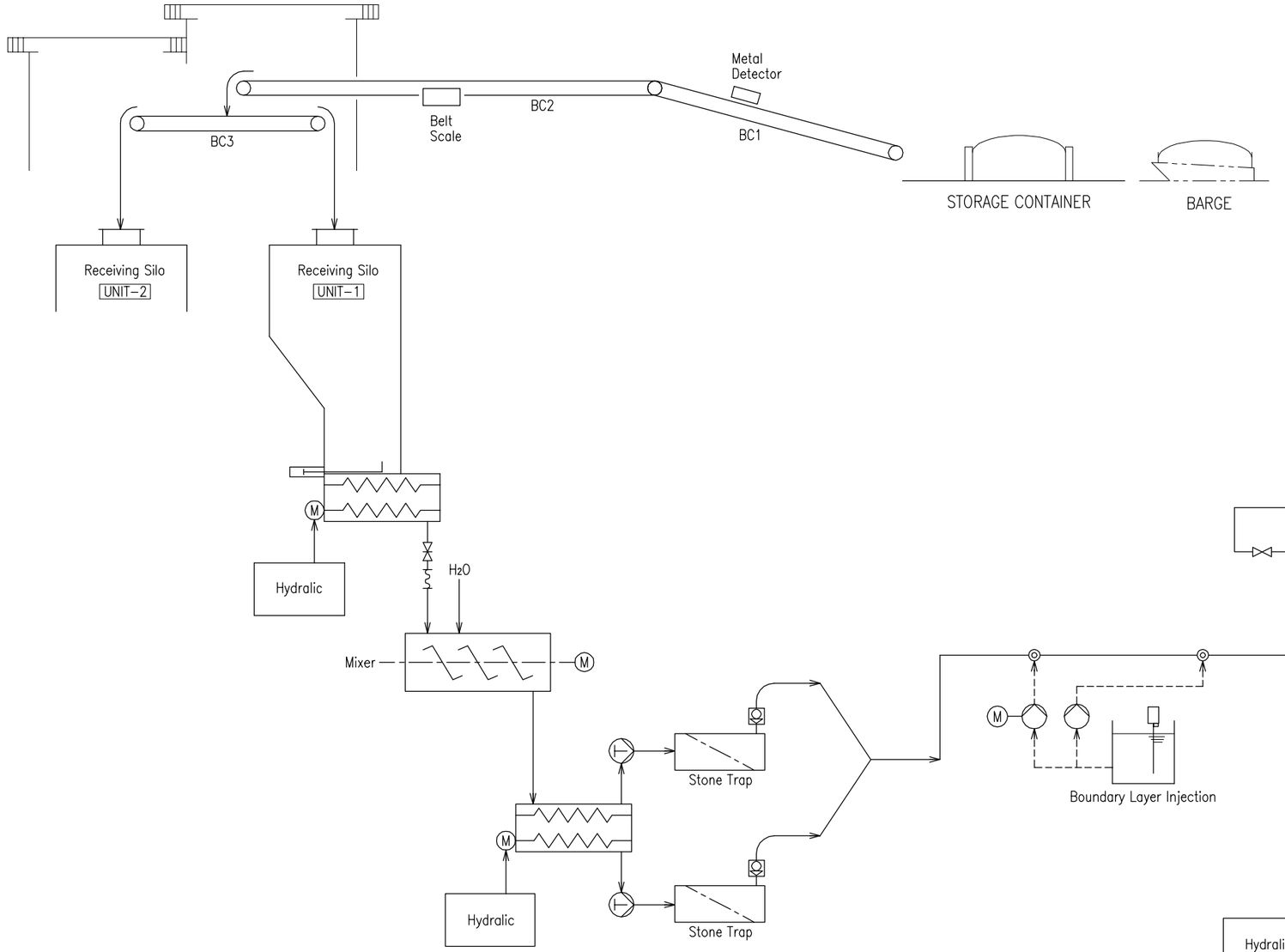
Electrostatic
Precipitator
145 °C
197,050 Nm³/hr
CO₂ : 14.1 %
N₂ : 68.6 %
O₂ : 3.0 %
H₂O : 14.3 %
Ash transporters
Fly Ash
6.9t/hr
From Unit 2
From Unit 2
From Unit 2
ID Fan
Stack
Fly
Ash
Silo
1500m3
LMS handling
BA handling
Stripper Cooler
Compressor
Station(6pcs)
Air Tank
Dry Ash Unloader
Ash Wet unloader

<40mm
Limestone
Receiving
Hopper
Limestone
Bunker
90m3
HP Blower
Limestone
2t/hr – 6t/hr
Bottom
Ash
6t/hr – 16t/hr
Sieve
50m3
Bottom
Ash
Bin
Wet & Dry unloader

JOB No. —		CUSTOMER JCOAL	
MODEL —		FINAL USER —	
CAPACITY —		JOB NAME MAHAKAM2x50MW COAL–FIRED POWER PLANT	
APP'D BY —	DSN'D BY K.NAKATA	TITLE —	
APP'D BY —	DRW'N BY H.WATNABE	PROCESS FLOW DIAGRAM	
		SIZE A2 / PROJ. / SCALE 1: NON / DWG. No. .	Rev. —

PM752C

ATTACHMENT 5



Remarks

This flow sheet shows one of the two identical Boiler units. UNIT-1 is shown here and UNIT-2 is abbreciated.

JOB No. —	CUSTOMER JCOAL
MODEL —	FINAL USER —
CAPACITY —	JOB NAME MAHAKAM2x50MW COAL-FIRED POWER PLANT
APP'D BY — / DSN'D BY K.NAKATA	TITLE —
APP'D BY — / DRW'N BY H.WATNABE	FINE SLURRY SYSTEM
	SIZE A2 / PROJ. / SCALE 1: NON / DWG. No. . / Rev. —

PM752C

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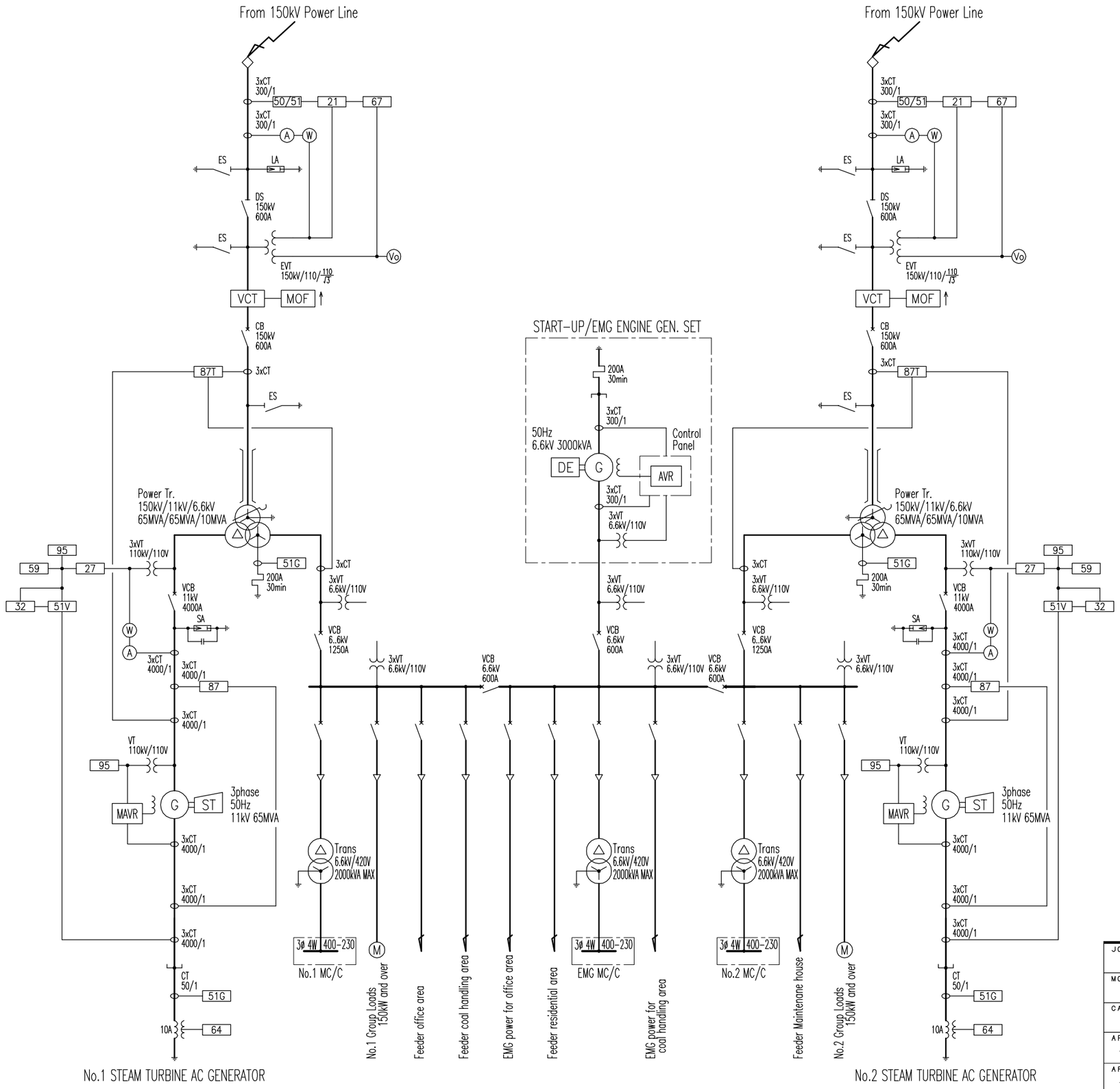
ATTACHMENT 6



Legend

- DS : Disconector
- ES : Earth switch
- CB : Circuit breaker
- LA : Lightning arrestor
- SA : Surge arrestor
- : Current transformer
- EVT, VT : Earth voltage transformer,voltage transformer
- MAVR : Manual/Auto voltage regulater
- G : AC alternator
- : Transformer with 3 windings
- : Load tapchanger
- ** : Protection relay

- 21 : Distance
- 50/51 : Over current(Instance/Inverse) (51V: with voltage element)
- 27/59 : Under/Over voltage
- 32 : Reverse power
- 67 : Directional over current
- 87 : Differential current
- 95 : Frequency Under/Over

NOTE

1. This dwg shows the preliminary outline power flow,the state capacity and voltages are tentative only.
2. The tie-in point at 150kV level and protection system, shall be incorporated with power company concered.
3. The start-up Gen set may disccuss on design stage.

JOB No. –		CUSTOMER JCOAL	
MODEL –		FINAL USER –	
CAPACITY –		JOB NAME MAHAKAM2x50MW COAL-FIRED POWER PLANT	
APP'D BY –	DSN'D BY K.TUKADA	TITLE –	
APP'D BY –	DRW'N BY H.WATNABE	SINGLE LINE DIAGRAM	
		SIZE A2 / PROJ. / SCALE 1: NON	DWG. No. . / Rev. –

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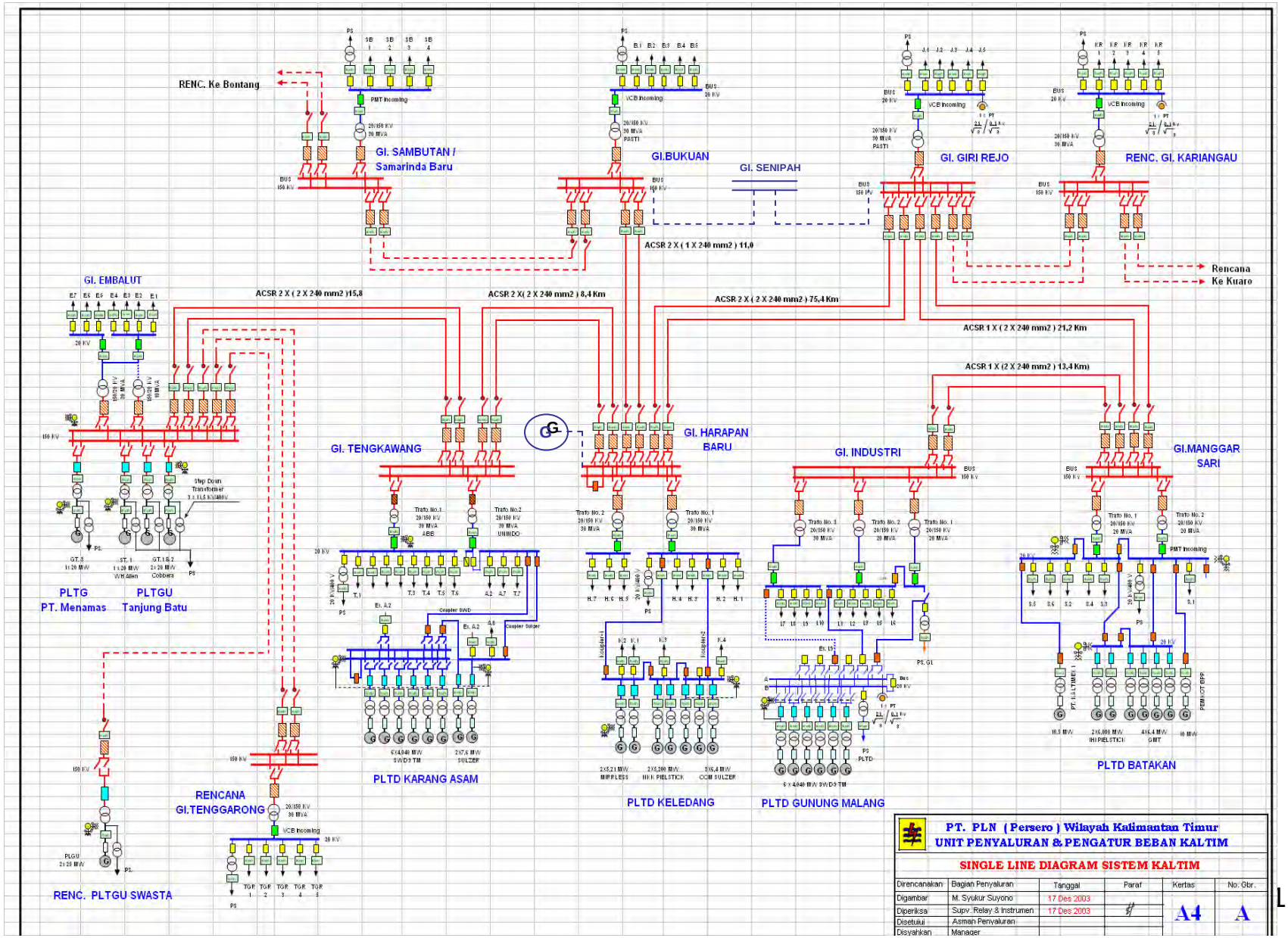
ATTACHMENT 7

SINGLE LINE DIAGRAM SISTEM MAHAKAM



Equipment List

Rev. No. 0

1000 Coal & Limestone Feed System

1100 Dirty/Supplement Coal Feed System

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
1100	Common	BC1101	Loading Belt Conveyor 1	1		<200mm							
1100	Common	V1101	Receiving Hopper	1									
1100	Common	CR1101	Hammer Crusher ABC	3	1	<10mm					110		
1100	1	BC1111	Belt Conveyor 1	1									
1100	1	BC1112	Belt Conveyor 2	1									
1100	1	BC1113	Belt Conveyor 3	1									
1100	1	BC1114	Belt Conveyor 4	1									
1100	1	V1111	Coal Bunker AB	2		$370m^3$							
1100	1	BW1111	Coal Weighting Feeder ABCD	4		10 ton/hr							
1100	1	BS1111	Coal Feed Screw ABCD	4		10 ton/hr							
1100	2	BC1121	Belt Conveyor 1	1									
1100	2	BC1122	Belt Conveyor 2	1									
1100	2	BC1123	Belt Conveyor 3	1									
1100	2	BC1124	Belt Conveyor 4	1									
1100	2	V1121	Coal Bunker AB	2		$370m^3$							
1100	2	BW1121	Coal Weighting Feeder ABCD	4		10 ton/hr							
1100	2	BS1121	Coal Feed Screw ABCD	4		10 ton/hr							

1200 Fine Coal Feed System

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
1200	Common	V1201	Fine Coal Storage Container	1			35	50	2.5			Concrete	7 days storage
1200	1	BC1211	Belt Conveyor 1	1									
1200	1	BC1212	Belt Conveyor 2	1									
1200	1	BC1213	Belt Conveyor 3	1									
1200	1	V1211	Receiving Silo A	1									
1200	1	P1211	Slurry Pumping System A	1							360		
1200	2	V1221	Receiving Silo B	1									
1200	2	P1221	Slurry Pumping System B	1							360		

1300 Limestone Handling

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
1300	Common	V1301	Lime Stone Storage Silo	1									
1300	Common	BC1301	Belt Conveyer System	1									
1300	1	V1311	Receiving Hopper	1									
1300	1	BU1311	Bucket Conveyer	1									
1300	1	V1312	Limestone Bunker	1									
1300	1	FN1311	HP Limestone Blower System ABC	3									
1300	2	V1321	Receiving Hopper	1									
1300	2	BU1321	Bucket Conveyer	1									
1300	2	V1322	Limestone Bunker	1									
1300	2	FN1321	HP Limestone Blower System ABC	3									

2000 Ash Handling System

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
2000	Common	V2001	Fly Ash Silo	1		1,500m^3							
2000	Common		Dry Ash Unloader	1									
2000	Common		Ash Wet Unloader	1									
2000	1		Bottom Ash Cooler A	2		6 ton/hr							
2000	1		Bottom Ash Conveyer A	1		12 ton/hr							
2000	1		Sieve A	1		12 ton/hr							
2000	1	BU2011	Bucket Conveyer A	1		12 ton/hr							
2000	1		Bottom Ash Bin & Handling System A	1		50m^3							
2000	1		Bottom Ash Wet & Dry Unloader A	1									
2000	1		Fly Ash Handling System A	1		10 ton/hr							
2000	2		Bottom Ash Cooler B	2		6 ton/hr							
2000	2		Bottom Ash Conveyer B	1		12 ton/hr							
2000	2		Sieve B	1		12 ton/hr							
2000	2	BU2021	Bucket Conveyer B										
2000	2		Bottom Ash Bin & Handling System B	1		50m^3							
2000	2		Bottom Ash Wet & Dry Unloader B	1									
2000	2		Fly Ash Handling System B	1		10 ton/hr							

3000 Boiler System

3100 Boiler System

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
3100	1	F3111	Boiler System	1		CFB, 500,365 MJ/hr, 205 ton/hr							
3100	1		Oil Burner	1									
3100	1	FN3111	HP Ash Blower ABC	3									
3100	2	F3121	Boiler System	1		CFB, 500,365 MJ/hr, 205 ton/hr							
3100	2		Oil Burner	1									
3100	2	FN3121	HP Ash Blower ABC	3									

3200 Draft Unit

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
3200	1	FN3211	Primary Air Fan	1		1612m3/mx3000m				motor,common bed	1150		
3200	1	FN3212	Secondary Air Fan	1		1612m3/mx600mm				motor,common bed	550		
3200	1	FN3213	Induced Draft Fan	1		5028m3/mx600mm				motor,common bed	680		
3200	2	FN3221	Primary Air Fan	1		1612m3/mx3000m				motor,common bed	1150		
3200	2	FN3222	Secondary Air Fan	1		1612m3/mx600mm				motor,common bed	550		
3200	2	FN3223	Induced Draft Fan	1		5028m3/mx600mm				motor,common bed	680		

3300 Flue Gas System

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
3300	1	EP3311	Electric Precipitator	1		400 kVA							
3300	2	EP3321	Electric Precipitator	1		400 kVA							
3300	Common		Stack	1		60 m, 20 m/s							

4000 Steam Turbine Generator System

4100 Boiler Feed Water System

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
4100	1	P4111	Condensate Pump A	2	1	167m3/hx120m					110		
4100	1	E4111	No1 LP Heater A	1		34,658 MJ/hr, 167.27 ton/hr							
4100	1	E4112	No2 LP Heater A	1		22,197 MJ/hr, 167.27 ton/hr							
4100	1	E4113	No1 HP Heater A	1		29,097 MJ/hr, 201.5 ton/hr							
4100	1	E4114	No2 HP Heater A	1		26,155 MJ/hr, 201.5 ton/hr							
4100	1	P4112	Boiler Feed Pump A	2	1	202m3/hx1400mx1					1500		
4100	1	D4111	Dearator A										
4100	2	P4121	Condensate Pump B	2	1	167m3/hx120m					110		
4100	2	E4121	No1 LP Heater B	1		34,659 MJ/hr, 167.27 ton/hr							
4100	2	E4122	No2 LP Heater B	1		22,198 MJ/hr, 167.27 ton/hr							
4100	2	E4123	No1 HP Heater B	1		29,098 MJ/hr, 201.5 ton/hr							
4100	2	E4124	No2 HP Heater B	1		26,156 MJ/hr, 201.5 ton/hr							
4100	2	P4122	Boiler Feed Pump B	2	1	202m3/hx1400mx1					1500		
4100	2	D4121	Dearator B										

4200 Steam Turbine System

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
4200	1	ST4211	Steam Turbine A	1		535 ℃, 12346.6 MPA, 201.5 ton/hr, 8.9 kPA@exhaust, 5 extracts							
4200	1	E4211	Condenser A	1									
4200	2	ST4221	Steam Turbine B	1		535 ℃, 12346.6 MPA, 201.5 ton/hr, 8.9 kPA@exhaust, 5 extracts							
4200	2	E4221	Condenser B	1									

5000 Cooling Water System

5100 Cooling Tower System

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
5100	1	CT5111	Cooling Tower	1		9000 t/hr, 30℃/40℃-25℃, 150 kW Fan x 4					600		
5100	2	CT5121	Cooling Tower	1		9000 t/hr, 30℃/40℃-25℃, 150 kW Fan x 4					600		

5200 Cooling Water Pump

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
5200	1	P5211	Cooling Water Pump	3	1	4500 m3/h x 18m					320		
5200	2	P5221	Cooling Water Pump	3	1	4500 m3/h x 18m					320		

6000 Utility System

6100 Air Compressor Station

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
6100	Common	AC6101	Air Compressor	3		26m3/m x 0.7MPaG					160		
6100	Common	D6101	Air Receiver Tank	3		10m3							
6100	Common		Air Distribution Piping	1									

6200 Water Treatment System

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
6200	Common	P6201	Water Intake Pump Station	2	1	385 ton/hr x 10m					22		
6200	Common		Water Pond	2		10,000 m3							
6200	Common	P6202	Raw Water Supply Pump	2	1	385 ton/hr x 20m					45		

6300 Water Clarifer and Storage System

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
6300	Common		Clarifloculator	2		190 ton/hr							
6300	Common		Clarified Water Storage	1		4550 m3							
6300	Common		Filter	2		10 ton/hr							
6300	Common		Filter Water Tank	1		400 m3							

6400 Deminerizing and Tank System

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
6400	Common		Deminerizer Package	2		5 ton/hr							
6400	Common		Deminerized Water Tank	1		200 m3							

6500 Water Supply Pump Station

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
6500	1	P6511	Boiler Freed Water Makeup Pump	2	1	2.1 m3/hr x 120m					2.2		
6500	1	P6512	Cooling Water Makeup Pump	2	1	180 m3/hr x 20m					18.5		
6500	2	P6521	Boiler Freed Water Makeup Pump	2	1	2.1 m3/hr x 120m					2.2		
6500	2	P6522	Cooling Water Makeup Pump	2	1	180 m3/hr x 20m					18.5		
6500	Common	P6503	Drinking Water Pump	2	0	10 m3/hr x 40m					2.2		
6500	Common	P6504	Utility Water Pump	3	1	400 m3/hr x 40m					55		

6600 Oil Tankage

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
6600	Common		Fuel Oil Tank	1									
6600	Common		Fuel Oil Heater	1									
6600	Common		Fuel Oil Pump	2	1	100L/mx0.6MPaG					11		
6600	Common		Diesel Oil Tank	1									

7000 Fire Pump Station

7100 Fire Pump Station

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
7100	Common		Fire Pump										
7100		P7101	Motor Driven	1		200m3/hr x 80m					90		
7100		P7102	Diesel Driven	1		200m3/hr x 80m					120PS		
7100		P7103	Pressurized Pump	1		10m3/hr x 80m					5.5		

8000 Electric Power Transmission System

8100 Generator/Transformer

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
8100	1		Electric Generator A	1		55.6 MW, 50 Hz, 11kV, 65 MVA							
8100	1		Main Transformer A	1		150 kV,65MVA/11kV, 65MVA/6.6 kV,10 MVA							
8100	1		Startup/Emergency Engine Generator Set A	1		50 Hz, 6.6kV, 3000kVA							
8100	2		Electric Generator B	1		55.6 MW, 50 Hz, 11kV, 66 MVA							
8100	2		Main Transformer B	1		150 kV,65MVA/11kV, 65MVA/6.6 kV,10 MVA							
8100	2		Startup/Emergency Engine Generator Set B	1		50 Hz, 6.6kV, 3000kVA							

8200 Switchyard and Transmission

EQUIPMENT LIST

Area No	Unit No	Equipment No.	Equipment Name	Total Q'ty	Spare	Description/Unit	Dimension(m)			Accessory	Motor/Unit kW	Material	Remarks
							W	L	H				
8200	Common		Switchyard	1		Open, 2 Circuits, 150 kV, 600A							
8200	Common		Transmission Line			10 km							

Attachment 9

REPORT

LOAD FLOW ANALYSIS
MAHAKAM SYSTEM, EAST KALIMANTAN

REVISION

11 December 2006

LOAD FLOW ANALYSIS
MAHAKAM SYSTEM, EAST KALIMANTAN

TABLE OF CONTENTS

REPORT OF LOAD FLOW ANALYSIS OF MAHAKAM SYSTEM, EAST KALIMANTAN

1. PREFACE

PT. Engrowth Indonesia and PT. PLN (Persero) Jasa Sertifikasi have conducted inspection and evaluation of Mahakam electrical system for the purpose of feasibility study for the construction of **PLTU (Coal Fired Power Plant) Mahakam 2 x 50 MW** located in **Kutai Kartanegara, east Kalimantan.**

Power flow analysis is the calculation of voltage, current, power and power factor or reactive power in several buses in an electrical network during normal operation whether it is still operating or future condition.

The assessment of these parameters is important due to the changes in the electrical system caused by load changes, generation schedule, and transmission line configuration changes. There are various calculation methods which are usually used in load flow analysis with the help of computer that will answer the following questions:

- How real and reactive power flow in a system at certain condition
- Whether the transmission line, power transformer and other equipment are still adequate to supply the required amount of electricity
- How the voltage level in every bus behaves

Hence, based on the above explanation, load flow analysis study has the following functions:

a. For the development planning of an electrical power system

b. To get a good pattern of electrical power system operation

c. To determine losses in an electrical power system

2. SCOPE OF WORK

The scope of work of this inspection and evaluation of Mahakam electrical system covers:

- Revision of Power System in year 2012 with the revised data as follows:
    - PLTU Kaltim 2 x 60 MW is connected to Substation Girirejo, before is Substation Embalut
    - PLTU Mulut Tambang 2 x 25 MW is connected to Substation Girirejo, before is Substation Sambutan
    - Proposed PLTU Mahakam 2 X 50 MW is connected to Substation Harapan Baru, before is Substation Bukuan

3. TECHNICAL DATA

The data used for this study are attached Attachment I as follows:

- Basic data such as generator data, transmission line data, transformer data, obtained from the data collection by PLN Balikpapan, East Kalimantan.
- Table of Mahakam load system.

4. JOB EXECUTION

4.1. EXISTING CONDITION OF MAHAKAM SYSTEM YEAR 2006

Base on table of Mahakam load system, peak load of Mahakam system in year 2006 is 199.53 MW, but total existing power generation is only 203 MW as shown in figure 1 below:

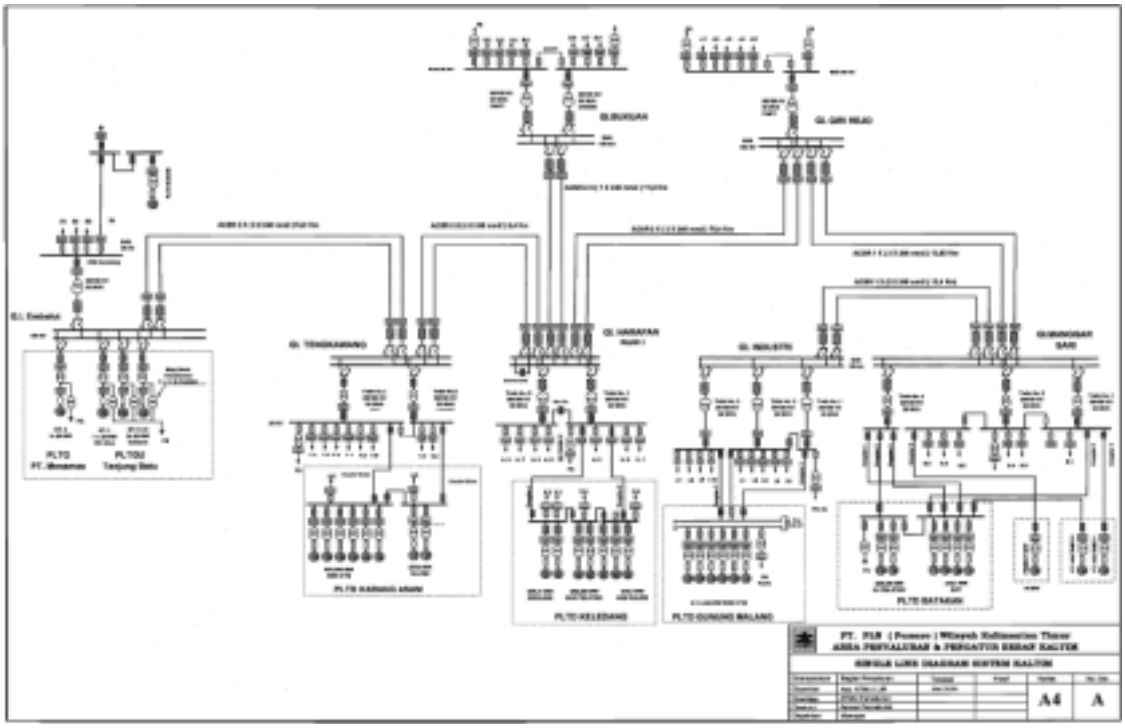


Figure 1. One line diagram of Mahakam system

At current time almost all generated power in Mahakam system is diesel generated power plant (PLTD).

To make the study much easier to analyze, the Mahakam System will be divided into a couple sub system areas, as follows:

- Area 1 ; sub system Samarinda
- Area 2 ; sub system Balikpapan

4.2. LOAD FLOW ANALYSIS OF MAHAKAM SYSTEM YEAR 2006

This Power flow analyze is needed to bring us a complete picture of the whole system condition before PLTU Mahakam integrated into the Mahakam system. It was planned that PLTU Mahakam will be implemented into the system in the year of 2012.

a. Power generation and Load System of Mahakam Year 2006.

Power flow analysis is carried out during the peak load condition, 199.53 MW. From the analysis and calculation is clearly stated that with 15 operating machines, a power of 200.2 MW is generated, see Table 1 below:

Table 1. Power generation and Load System of Mahakam Year 2006

```
--------------------------------------------------------------------------------

  LOAD FLOW SISTEM MAHAKAM
  LF2006MAX

    ************************  SUMMARY FOR COMPLETE SYSTEM  ************************

                                    SYSTEM SWING BUS SUMMARY
  X------ SWING BUS ------X X---- AREA -----X X---- ZONE -----X
    BUS# X-- NAME --X BASKV    # X-- NAME --X    # X-- NAME --X       MW       MVAR
MVABASE
    4005 TBATUGT1    11.500    1                 1                   25.2      11.8
24.0

     48 BUSES    15 PLANTS     15 MACHINES   15 LOADS  56 BRANCHES      30 TRANSFORMERS

                          X------ ACTUAL ------X X----- NOMINAL ------X
                                    MW        MVAR         MW        MVAR
  FROM GENERATION                 200.2      102.0       200.2      102.0
  TO CONSTANT POWER LOAD          199.5       96.6       199.5       96.6
  TO BUS SHUNT                      0.0        0.0         0.0        0.0
  TO LINE SHUNT                     0.0        0.0         0.0        0.0
  FROM LINE CHARGING                0.0       24.5         0.0       26.9
 ------------------------------------------------------------------------------

                               AREA TOTALS IN MW/MVAR

                  FROM      TO    TO BUS  TO LINE     FROM      TO           DESIRED
  X-- AREA --X GENERATION  LOAD    SHUNT    SHUNT CHARGING  NET INT   LOSSES  NET INT

     1           132.2    113.2      0.0      0.0      0.0    -25.2      0.4      0.0
                  67.4     54.8      0.0      0.0     19.6     -9.7     20.6

     2            68.0     86.3      0.0      0.0      0.0     25.2      0.3      0.0
                  34.6     41.8      0.0      0.0      4.8      9.7      9.2

  TOTALS          200.2    199.5      0.0      0.0      0.0      0.0      0.7      0.0
                  102.0     96.6      0.0      0.0     24.5      0.0     29.9
```

From table 1 above, it's stated that gas fired power generation (PLTG) Tj.Batu (No. Bus 4005) generates power of 25.2 MW, while the capacity of the PLTG is only 20 MW which means the Mahakam System is lacking a power of 5.2 MW. On the other hand, it's also clear that area 2 (subsystem Balikpapan) receives power of 25.2 MW from area 1.

b. Voltage profile

Voltage profile at condition of maximum load is still within the range voltage, namely +5 %, and -10 %, as shown at table 2 below;

Table 2. Voltage profile at maximum load

```
BUSES WITH VOLTAGE GREATER THAN 1.0500:
X---- BUS -----X AREA V(PU)  V(KV)  :     * NONE *

BUSES WITH VOLTAGE LESS THAN 0.9000 :
X----- BUS -----X AREA V(PU)  V(KV) :     * NONE *
```

c. Transmission line loadings

Condition of transmission line loading can be shown at table 3 below

Table 3. Transmission line loadings:

```
--------------------------------------------------------------------------------

  TRANSMISSION LINE LOADINGS ABOVE  25.0 % OF RATING SET A:

  X--------- FROM BUS ----------X X---------- TO BUS -----------X       CURRENT(MVA)
    BUS# X-- NAME --X BASKV  AREA   BUS# X-- NAME --X BASKV  AREA CKT LOADING  RATING
PERCENT
    3003 HARU_20A    20.000*    1   3005 KLDNG2      20.000     1  1     15.7    21.5
73.1
    5002 TKWG_20A    20.000     1   5004 KA1         20.000*    1  1     19.9    21.5
92.4
    6002 MSARI20A    20.000     1   6005 BTKAN_A     20.000*    1  1     18.9    21.5
88.1
    6003 MSARI20B    20.000*    1   6006 BTKAN_B     20.000     1  1      9.9    21.5
45.9
    6004 MSARI20C    20.000     1   6009 KMEX2       20.000*    1  1     13.1    21.5
60.9
    7002 INDTRI_A    20.000     1   7005 GMLNG       20.000*    1  1     12.5    21.5
58.1
    7003 INDTRI_B    20.000*    1   7005 GMLNG       20.000     1  1     19.9    21.5
92.7
    7004 INTRI_C     20.000     1   7005 GMLNG       20.000*    1  1     10.1    21.5
47.0
```

Table 3 above shows that there is no transmission line 150 KV (SUTT) which experience a load greater than 50 % except for cable 20 KV. However, the load is still far below 100%.

4.3. LOAD FLOW ANALYSIS OF MAHAKAM SYSTEM YEAR 2011

In year 2011 the system will change significantly. All new power supplies integrated into the system will give up to 500 MW of power. The total power produce by Mahakam System will then reach 576 MW, while the prediction of the peak load in 2011 is assumed around 385.324 MW

a. Power generation and Load System of Mahakam Year 2011.

Power flow analysis is carried out during the peak load condition, 385.324 MW. From the analysis and calculation is clearly stated that with 16 operating machines, a power of 390.9 MW is generated, see Table 4 below:

Table 4. Power generation and Load System of Mahakam Year 2011

```
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
  ************************  SUMMARY FOR COMPLETE SYSTEM  ************************

                                    SYSTEM SWING BUS SUMMARY
  X------ SWING BUS ------X X---- AREA -----X X---- ZONE -----X
    BUS# X-- NAME --X BASKV    # X-- NAME --X    # X-- NAME --X       MW       MVAR
MVABASE
    9021 PLTU KALTIM1 11.000    1               1                 -77.1      36.7
75.0

     58 BUSES         16 PLANTS            16 MACHINES      20 LOADS
     74 BRANCHES      44 TRANSFORMERS

                                  AREA TOTALS IN MW/MVAR

                  FROM      TO    TO BUS  TO LINE     FROM       TO           DESIRED
  X-- AREA --X GENERATION  LOAD    SHUNT    SHUNT CHARGING  NET INT   LOSSES  NET INT

     1           280.9    218.2      0.0      0.0      0.0     34.4      4.0      0.0
                 205.1    103.2      0.0      0.0     24.0     26.1     88.1

     2           110.0    167.3      0.0      0.0      0.0    -34.4      1.4      0.0
                  54.8     80.0      0.0      0.0     28.1    -26.1     40.7

  TOTALS         390.9    385.5      0.0      0.0      0.0      0.0      5.4      0.0
                 259.9    183.2      0.0      0.0     52.1      0.0    128.8
```

There is a power transmission of 34.4 MW from area 1 to area 2, at peak load, the total losses can reach 5.4 MW or 1.38 % from total generated power (Table 4).

Here, the swing bus receives -77.1 MW, while the capacity of PLTU kaltim1 (Bus 9021) is 60 MW, which results into an excess of power of 137.1 MW.

b. Voltage profile

Voltage profile at condition of maximum load is still within the range voltage, namely +5 %, and -10 %, as shown at table 5 below:

Table 5. Voltage profile at maximum load

```
BUSES WITH VOLTAGE GREATER THAN 1.0500:
X---- BUS -----X AREA V(PU)  V(KV)  :     * NONE *

BUSES WITH VOLTAGE LESS THAN 0.9000 :
X---- BUS -----X AREA V(PU)  V(KV)  :     * NONE *
```

c. Transmission line & Transformer loadings

Condition loading transmission line is shown at table 6 below:

Table 6. Transmission line & Transformer loadings:

```
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
  TRANSFORMER LOADINGS ABOVE  55.0 % OF RATING SET A:

  X--------- FROM BUS ----------X X---------- TO BUS ----------X       MVA      MVA
    BUS# X-- NAME --X BASKV  AREA   BUS# X-- NAME --X BASKV  AREA CKT LOADING  RATING
PERCENT
    1001 GREJO_15    150.00*    2   1002 GREJO_20    20.000     1  1     26.3    30.0
87.5
    3001 HARU_15     150.00*    1   3002 HARU_20     20.000     1  1     31.5    30.0
105.0
    3001 HARU_15     150.00*    1   3003 HARU_20A    20.000     1  1     31.5    30.0
105.0
    4001 EMLUT_15    150.00     1   4003 MMAS        11.500*    1  1     23.3    30.0
77.7
    4001 EMLUT_15    150.00     1   4003 MMAS        11.500*    1  2     23.3    30.0
77.7
    4001 EMLUT_15    150.00     1   4005 TBATUGT1    11.500*    1  1     23.3    30.0
77.7
    4001 EMLUT_15    150.00     1   4006 TBATUGT2    11.500*    1  1     21.6    30.0
72.1
    4001 EMLUT_15    150.00     1   4010 PLTUEMLUT   11.500*    1  1     27.7    37.0
74.9
    4001 EMLUT_15    150.00     1   4010 PLTUEMLUT   11.500*    1  2     27.7    37.0
74.9
    5001 TKWG_15     150.00*    1   5002 TKWG_20A    20.000     1  1     38.6    30.0
128.7
    5001 TKWG_15     150.00*    1   5003 TKWG_20B    20.000     1  1     38.5    30.0
128.4
    6001 MSARI_15    150.00*    2   6002 MSARI20A    20.000     2  1     21.3    20.0
106.6
    6001 MSARI_15    150.00*    2   6003 MSARI20B    20.000     2  1     21.3    20.0
106.6
    7001 INDTRI      150.00*    2   7002 INDTRI_A    20.000     2  1     24.6    20.0
122.9
    7001 INDTRI      150.00*    2   7003 INDTRI_B    20.000     2  1     37.9    20.0
189.4
    7001 INDTRI      150.00*    2   7004 INTRI_C     20.000     2  1     23.3    30.0
77.8
    8001 TENGGARONG  150.00*    1   8002 TGRRNG 2    20.000     1  1     16.6    30.0
55.5
    8050 SENIPAH     150.00     2   8052 PLTGBLKPPN  11.500*    2  1     44.7    50.0
89.4
    8050 SENIPAH     150.00     2   8052 PLTGBLKPPN  11.500*    2  2     44.7    50.0
89.4
    9010 MAHAKAM150   150.00     1   9020 PLTU KALTIM211.000*    1  1     67.1    82.0
81.8
    9050 SMBUTAN     150.00*    1   9051 SMBTN_20    20.000     1  1     22.7    30.0
75.6
    9050 SMBUTAN     150.00     1   9052 MULUT TBNG  11.000*    1  1     28.0    30.0
93.2
    9050 SMBUTAN     150.00     1   9052 MULUT TBNG  11.000*    1  2     28.0    30.0
93.2
    9060 BONTANG     150.00*    1   9061 BOTNG20     20.000     1  1     24.4    30.0
81.2
    9060 BONTANG     150.00     1   9062 PLTGBOTNG   11.000*    1  1     63.5   100.0
63.5
```

```
    9060 BONTANG     150.00     1   9062 PLTGBOTNG   11.000*    1  2     63.5   100.0
63.5
    9090 KUARO       150.00     2   9092 PLTUBIOMAS  11.000*    2  1     16.7    20.0
83.6
    9090 KUARO       150.00     2   9092 PLTUBIOMAS  11.000*    2  2     16.7    20.0
83.6
```

We can see here in table 6 that the transformer load in SS Industri, SS Manggarsari, SS Harapan Baru and SS Tengkawang is over 100% of their capacities.

To overcome the power flow problem, an action should be carried out:

- Replace the overload transformers or add more new transformers.

4.4. LOAD FLOW ANALYSIS OF MAHAKAM SYSTEM YEAR 2012

In year 2012, PLTU Samarinda 2 x 50 MW is planned to be integrated into Mahakam System connected with SS Harapan baru. Few things have been done in power flow analyze as follows:

1. Replacement of the overload transformers, like the transformers in SS Tengkawang, SS Harapan Baru, SS Industri.
2. SS Bukuan and SS Senipha is connedted by 150 KV transmission line to increase the system capacity and stability of the system

Table 7. Plan list of Power Trafo change

Substation	MVA old Trafo	Estimd. Load 2012	Loading (%)	MVA New Trafo
Industri	2x20, & 1x30 (70)	77.6 MW	> 120	2 x 30, & 1 x 60 (120)
Tengkawang	2 x 30	71.8 MW	142	1x60, & 1x30
Harapan baru	2 x 30	58.2 MW	116	1 x 60, & 1 x 30

a. Power generation and Load System of Mahakam Year 2012.

Power flow analysis is carried out during the peak load condition, 423.2 MW. From the analysis and calculation is clearly stated that with 18 operating machines, a power of 425.5 MW is generated, see Table 8 below:

Table 8. Power generation and Load System of Mahakam Year 2012

```
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------

      PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      MON, DEC 11 2006  10:46
  LOAD FLOW SISTEM KALTIM  LF2012MAX


  ************************  SUMMARY FOR COMPLETE SYSTEM  ************************

                                 SYSTEM SWING BUS SUMMARY
  X------ SWING BUS ------X X---- AREA -----X X---- ZONE -----X
    BUS# X-- NAME --X BASKV    # X-- NAME --X    # X-- NAME --X       MW       MVAR   MVABASE
    9021 PLTU KALTIM111.000    2                 1                  -73.5      33.3      75.0

     69 BUSES         21 PLANTS            18 MACHINES      20 LOADS
     89 BRANCHES      50 TRANSFORMERS       0 DC LINES       0 FACTS DEVICES

                          X------ ACTUAL ------X X----- NOMINAL ------X
                                  MW        MVAR         MW        MVAR
  FROM GENERATION              425.5       264.6       425.5       264.6
  TO CONSTANT POWER LOAD       423.2       205.0       423.2       205.0
  TO CONSTANT CURRENT            0.0         0.0         0.0         0.0
  TO CONSTANT ADMITTANCE         0.0         0.0         0.0         0.0
  TO BUS SHUNT                   0.0         0.0         0.0         0.0
  TO FACTS DEVICE SHUNT          0.0         0.0         0.0         0.0
  TO LINE SHUNT                  0.0         0.0         0.0         0.0
```

```
 FROM LINE CHARGING             0.0       56.3         0.0       60.4

  VOLTAGE       X----- LOSSES -----X   X-- LINE SHUNTS --X   CHARGING
  LEVEL BRANCHES       MW        MVAR        MW        MVAR       MVAR
  150.0     25       2.26        8.53        0.0        0.0       56.3
   20.0     35       0.12       55.83        0.0        0.0        0.0
   11.5     11       0.00       24.66        0.0        0.0        0.0
   11.0      8       0.00       26.57        0.0        0.0        0.0
    6.3     10       0.00        0.35        0.0        0.0        0.0
  TOTAL     89       2.38      115.94        0.0        0.0       56.3


                                                          AREA TOTALS
                                                          IN MW/MVAR

                 FROM      TO    TO BUS  TO LINE     FROM      TO            DESIRED
 X-- AREA --X GENERATION  LOAD    SHUNT    SHUNT CHARGING  NET INT   LOSSES  NET INT

    1           303.0    423.2      0.0      0.0      0.0     45.1      1.0       0.0
                140.6    205.0      0.0      0.0     24.6    -23.7     65.0

    2           122.5      0.0      0.0      0.0      0.0    -45.1      1.4       0.0
                123.9      0.0      0.0      0.0     31.7     23.7     51.0

 TOTALS         425.5    423.2      0.0      0.0      0.0      0.0      2.4       0.0
                264.6    205.0      0.0      0.0     56.3      0.0    115.9
--------------------------------------------------------------------------------
```

Table 8 shows that, area 1 sends power of 45.1 MW to area 2 with total losses of only 2.4 MW or 0.5 % from the total generated power.

Here, the swing bus receives -73.5 MW, while the capacity of PLTU kaltim1 (Bus 9021) is 60 MW, which results into an excess of power of 133, 5 MW.

b. Voltage profile

Voltage profile at condition of maximum load is still within the range voltage, namely +5 %, and -10 %, as shown at table 9 below:

Table 9. Voltage profile at maximum load

```
BUSES WITH VOLTAGE GREATER THAN 1.0500:
X---- BUS -----X AREA V(PU)  V(KV)  :     * NONE *

BUSES WITH VOLTAGE LESS THAN 0.9000:
X----- BUS -----X AREA V(PU)  V(KV):     * NONE *
```

c. Transmission line & Transformer loadings

Condition loading transmission line and transformer are shown at table 10 below:

Table 10. Transmission line & Transformer loadings:

```
TRANSFORMER LOADINGS ABOVE  40.0 % OF RATING SET A:

 X--------- FROM BUS ----------X X---------- TO BUS -----------X       MVA      MVA
   BUS# X-- NAME --X BASKV  AREA   BUS# X-- NAME --X BASKV  AREA CKT LOADING  RATING PERCENT
   1001 GREJO_15    150.00*    2   1002 GREJO_20    20.000     2  1    28.9    30.0    96.3
   1001 GREJO_15    150.00     2   9052 MULUT TBNG  11.000*    2  1    27.8    30.0    92.6
   1001 GREJO_15    150.00     2   9052 MULUT TBNG  11.000*    2  2    27.8    30.0    92.6
   2001 BKUAN_15    150.00*    1   2002 BKUAN20A    20.000     1  1    15.7    30.0    52.2
   2001 BKUAN_15    150.00*    1   2003 BKUAN20B    20.000     1  1    15.6    30.0    52.1
   3001 HARU_15     150.00*    1   3002 HARU_20     20.000     1  1    34.8    30.0   116.1
   3001 HARU_15     150.00*    1   3003 HARU_20A    20.000     1  1    34.8    30.0   116.1
   3001 HARU_15     150.00     1   9086 PLTUPROPOSED11.500*    1  1    55.4    60.0    92.3
   3001 HARU_15     150.00     1   9086 PLTUPROPOSED11.500*    1  2    55.4    60.0    92.3
   4001 EMLUT_15    150.00     1   4003 MMAS        11.500*    1  1    22.3    30.0    74.2
```

4001	EMLUT_15	150.00	1	4003	MMAS	11.500*	1	2	22.3	30.0	74.2
4001	EMLUT_15	150.00	1	4005	TBATUGT1	11.500*	1	1	22.3	30.0	74.2
4001	EMLUT_15	150.00	1	4006	TBATUGT2	11.500*	1	1	20.4	30.0	68.1
4001	EMLUT_15	150.00	1	4010	PLTUEMLUT	11.500*	1	1	27.2	37.0	73.5
4001	EMLUT_15	150.00	1	4010	PLTUEMLUT	11.500*	1	2	27.2	37.0	73.5
5001	TKWG_15	150.00*	1	5002	TKWG_20A	20.000	1	1	42.8	30.0	142.6
5001	TKWG_15	150.00*	1	5003	TKWG_20B	20.000	1	1	42.7	30.0	142.3
6001	MSARI_15	150.00*	2	6002	MSARI20A	20.000	2	1	13.6	20.0	67.9
6001	MSARI_15	150.00*	2	6003	MSARI20B	20.000	2	1	14.9	20.0	74.4
6005	BTKAN_A	20.000	2	6010	STICKBTK	6.3000*	2	1	17.2	32.0	53.7
7001	INDTRI	150.00*	2	7002	INDTRI_A	20.000	2	1	27.9	20.0	139.3
7001	INDTRI	150.00*	2	7003	INDTRI_B	20.000	2	1	28.7	20.0	143.7
7001	INDTRI	150.00*	2	7004	INTRI_C	20.000	2	1	36.5	30.0	121.7
8001	TENGGARONG	150.00*	1	8002	TGRRNG 2	20.000	1	1	18.4	30.0	61.3
8050	SENIPAH	150.00*	2	8051	SNPH20	20.000	1	1	17.6	30.0	58.7
8050	SENIPAH	150.00	2	8052	PLTGBLKPPN	11.500*	2	1	22.4	50.0	44.7
8050	SENIPAH	150.00	2	8052	PLTGBLKPPN	11.500*	2	2	22.4	50.0	44.7
9010	KALTIM150	150.00	2	9020	PLTU KALTIM2	11.000*	2	1	67.1	82.0	81.8
9010	KALTIM150	150.00	2	9021	PLTU KALTIM1	11.000*	2	1	80.7	82.0	98.4
9050	SMBUTAN	150.00*	1	9051	SMBTN_20	20.000	1	1	25.1	30.0	83.7
9060	BONTANG	150.00*	1	9061	BOTNG20	20.000	1	1	27.0	30.0	90.0
9060	BONTANG	150.00	1	9062	PLTGBOTNG	11.000*	1	1	40.9	100.0	40.9
9060	BONTANG	150.00	1	9062	PLTGBOTNG	11.000*	1	2	40.9	100.0	40.9
9070	SANGATA	150.00*	1	9071	SNGATA 20	20.000	1	1	16.6	30.0	55.3
9080	PETUNG	150.00*	2	9081	PTNG20	20.000	2	1	16.0	30.0	53.4
9090	KUARO	150.00	2	9092	PLTUBIOMAS	11.000*	2	1	15.8	20.0	79.2
9090	KUARO	150.00	2	9092	PLTUBIOMAS	11.000*	2	2	15.8	20.0	79.2

TRANSMISSION LINE LOADINGS ABOVE 40.0 % OF RATING SET A:

X--------- FROM BUS ----------X				X---------- TO BUS ----------X					CURRENT(MVA)		
BUS#	X-- NAME --X	BASKV	AREA	BUS#	X-- NAME --X	BASKV	AREA	CKT	LOADING	RATING	PERCENT
6002	MSARI20A	20.000	2	6005	BTKAN_A	20.000*	2	1	17.2	21.5	79.9
7003	INDTRI_B	20.000	2	7005	GMLNG	20.000*	2	1	10.8	21.5	50.4
7004	INTRI_C	20.000	2	7005	GMLNG	20.000*	2	1	10.1	21.5	46.8

5. CONCLUSION

5.1 The total capacity of generator existed in year 2012 will reach 676 MW, while the peak load is predicted to be around 423.2 MW, so that the Mahakam System will have an excess of power of 133.5 MW, or 20 % capacity margin.

5.2 Loop configuration between Samarinda and Balikpapan by installing transmission line from SS Bukuan to Senipa will improve the system power capacity and improve the stability of the system.

5.3 Based on power flow analyze of year 2011, there will be a few Substation (SS) which experience an overload of Transformators until over 100% of their capacities, such as SS Industri, SS Manggarsari, SS Tengkawang and SS Harapan Baru. It should be replaced and installed new Trafo.

5.4 Integrating of PLTU Mahakam 2 x 50 MW to Substation Harapan Baru will bring an excellent configuration on the Mahakam Electrical System and stability of power flow.

ATTACHMENT : LOAD FLOW ANALYSIS OUTPUT RESULTS

Table 1. Power generation and Load System of Mahakam Year 2006

```
--------------------------------------------------------------------------------

  LOAD FLOW SISTEM MAHAKAM
  LF2006MAX

    ************************  SUMMARY FOR COMPLETE SYSTEM  ************************

                                    SYSTEM SWING BUS SUMMARY
  X------ SWING BUS ------X X---- AREA -----X X---- ZONE -----X
    BUS# X-- NAME --X BASKV    # X-- NAME --X    # X-- NAME --X       MW       MVAR
MVABASE
    4005 TBATUGT1    11.500    1                 1                   25.2      11.8
24.0

     48 BUSES    15 PLANTS     15 MACHINES   15 LOADS  56 BRANCHES      30 TRANSFORMERS

                          X------ ACTUAL ------X X----- NOMINAL ------X
                             MW        MVAR         MW        MVAR
  FROM GENERATION           200.2      102.0       200.2      102.0
  TO CONSTANT POWER LOAD    199.5       96.6       199.5       96.6
  TO BUS SHUNT                0.0        0.0         0.0        0.0
  TO LINE SHUNT               0.0        0.0         0.0        0.0
  FROM LINE CHARGING          0.0       24.5         0.0       26.9
 --------------------------------------------------------------------------------

                              AREA TOTALS IN MW/MVAR

                  FROM      TO    TO BUS  TO LINE     FROM      TO            DESIRED
  X-- AREA --X GENERATION  LOAD    SHUNT    SHUNT CHARGING  NET INT   LOSSES  NET INT

     1           132.2    113.2      0.0      0.0      0.0    -25.2      0.4      0.0
                  67.4     54.8      0.0      0.0     19.6     -9.7     20.6

     2            68.0     86.3      0.0      0.0      0.0     25.2      0.3      0.0
                  34.6     41.8      0.0      0.0      4.8      9.7      9.2

  TOTALS          200.2    199.5      0.0      0.0      0.0      0.0      0.7      0.0
                  102.0     96.6      0.0      0.0     24.5      0.0     29.9
```

Table 2. Voltage profile at maximum load year 2006

```
BUSES WITH VOLTAGE GREATER THAN 1.0500:
X---- BUS -----X AREA V(PU)  V(KV)  :     * NONE *

BUSES WITH VOLTAGE LESS THAN 0.9000 :
X----- BUS -----X AREA V(PU)  V(KV) :     * NONE *
```

Table 3. Transmission line loadings year 2006:

```
--------------------------------------------------------------------------------

  TRANSMISSION LINE LOADINGS ABOVE  25.0 % OF RATING SET A:

  X--------- FROM BUS ----------X X---------- TO BUS -----------X       CURRENT(MVA)
    BUS# X-- NAME --X BASKV  AREA   BUS# X-- NAME --X BASKV  AREA CKT LOADING  RATING
PERCENT
    3003 HARU_20A    20.000*    1   3005 KLDNG2      20.000     1  1     15.7    21.5
73.1
    5002 TKWG_20A    20.000     1   5004 KA1         20.000*    1  1     19.9    21.5
92.4
    6002 MSARI20A    20.000     1   6005 BTKAN_A     20.000*    1  1     18.9    21.5
88.1
    6003 MSARI20B    20.000*    1   6006 BTKAN_B     20.000     1  1      9.9    21.5
45.9
    6004 MSARI20C    20.000     1   6009 KMEX2       20.000*    1  1     13.1    21.5
60.9
```

```
    7002 INDTRI_A    20.000     1   7005 GMLNG       20.000*    1  1     12.5    21.5
58.1
    7003 INDTRI_B    20.000*    1   7005 GMLNG       20.000     1  1     19.9    21.5
92.7
    7004 INTRI_C     20.000     1   7005 GMLNG       20.000*    1  1     10.1    21.5
47.0
```

Table 4. Power generation and Load System of Mahakam Year 2011

```
------------------------------------------------------------------------------
------------------------------------------------------------------------------
  ************************  SUMMARY FOR COMPLETE SYSTEM  ************************

                                  SYSTEM SWING BUS SUMMARY
  X------ SWING BUS ------X X---- AREA -----X X---- ZONE -----X
    BUS# X-- NAME --X BASKV    # X-- NAME --X    # X-- NAME --X       MW       MVAR
MVABASE
    9021 PLTU KALTIM1 11.000    1               1                 -77.1      36.7
75.0

     58 BUSES         16 PLANTS            16 MACHINES      20 LOADS
     74 BRANCHES      44 TRANSFORMERS

                                AREA TOTALS IN MW/MVAR

                  FROM      TO    TO BUS  TO LINE     FROM      TO           DESIRED
  X-- AREA --X GENERATION  LOAD    SHUNT    SHUNT CHARGING  NET INT   LOSSES  NET INT

     1           280.9    218.2      0.0      0.0      0.0     34.4      4.0      0.0
                 205.1    103.2      0.0      0.0     24.0     26.1     88.1

     2           110.0    167.3      0.0      0.0      0.0    -34.4      1.4      0.0
                  54.8     80.0      0.0      0.0     28.1    -26.1     40.7

  TOTALS         390.9    385.5      0.0      0.0      0.0      0.0      5.4      0.0
                 259.9    183.2      0.0      0.0     52.1      0.0    128.8
```

Table 5. Voltage profile at maximum load year 2011

```
BUSES WITH VOLTAGE GREATER THAN 1.0500:
X---- BUS -----X AREA V(PU)  V(KV)  :     * NONE *

BUSES WITH VOLTAGE LESS THAN 0.9000 :
X---- BUS -----X AREA V(PU)  V(KV)  :     * NONE *
```

Table 6. Transmission line & Transformer loadings year 2011:

TRANSFORMER LOADINGS ABOVE 55.0 % OF RATING SET A:

FROM BUS BUS#	NAME	BASKV	AREA	TO BUS BUS#	NAME	BASKV	AREA	CKT	MVA LOADING	MVA RATING	PERCENT
1001	GREJO_15	150.00*	2	1002	GREJO_20	20.000	1	1	26.3	30.0	87.5
3001	HARU_15	150.00*	1	3002	HARU_20	20.000	1	1	31.5	30.0	105.0
3001	HARU_15	150.00*	1	3003	HARU_20A	20.000	1	1	31.5	30.0	105.0
4001	EMLUT_15	150.00	1	4003	MMAS	11.500*	1	1	23.3	30.0	77.7
4001	EMLUT_15	150.00	1	4003	MMAS	11.500*	1	2	23.3	30.0	77.7
4001	EMLUT_15	150.00	1	4005	TBATUGT1	11.500*	1	1	23.3	30.0	77.7
4001	EMLUT_15	150.00	1	4006	TBATUGT2	11.500*	1	1	21.6	30.0	72.1
4001	EMLUT_15	150.00	1	4010	PLTUEMLUT	11.500*	1	1	27.7	37.0	74.9
4001	EMLUT_15	150.00	1	4010	PLTUEMLUT	11.500*	1	2	27.7	37.0	74.9
5001	TKWG_15	150.00*	1	5002	TKWG_20A	20.000	1	1	38.6	30.0	128.7
5001	TKWG_15	150.00*	1	5003	TKWG_20B	20.000	1	1	38.5	30.0	128.4
6001	MSARI_15	150.00*	2	6002	MSARI20A	20.000	2	1	21.3	20.0	106.6
6001	MSARI_15	150.00*	2	6003	MSARI20B	20.000	2	1	21.3	20.0	106.6
7001	INDTRI	150.00*	2	7002	INDTRI_A	20.000	2	1	24.6	20.0	122.9
7001	INDTRI	150.00*	2	7003	INDTRI_B	20.000	2	1	37.9	20.0	189.4
7001	INDTRI	150.00*	2	7004	INTRI_C	20.000	2	1	23.3	30.0	77.8
8001	TENGGARONG	150.00*	1	8002	TGRRNG 2	20.000	1	1	16.6	30.0	55.5
8050	SENIPAH	150.00	2	8052	PLTGBLKPPN	11.500*	2	1	44.7	50.0	89.4
8050	SENIPAH	150.00	2	8052	PLTGBLKPPN	11.500*	2	2	44.7	50.0	89.4
9010	MAHAKAM150	150.00	1	9020	PLTU KALTIM2	11.000*	1	1	67.1	82.0	81.8
9050	SMBUTAN	150.00*	1	9051	SMBTN_20	20.000	1	1	22.7	30.0	75.6
9050	SMBUTAN	150.00	1	9052	MULUT TBNG	11.000*	1	1	28.0	30.0	93.2
9050	SMBUTAN	150.00	1	9052	MULUT TBNG	11.000*	1	2	28.0	30.0	93.2
9060	BONTANG	150.00*	1	9061	BOTNG20	20.000	1	1	24.4	30.0	81.2
9060	BONTANG	150.00	1	9062	PLTGBOTNG	11.000*	1	1	63.5	100.0	63.5
9060	BONTANG	150.00	1	9062	PLTGBOTNG	11.000*	1	2	63.5	100.0	63.5
9090	KUARO	150.00	2	9092	PLTUBIOMAS	11.000*	2	1	16.7	20.0	83.6
9090	KUARO	150.00	2	9092	PLTUBIOMAS	11.000*	2	2	16.7	20.0	83.6

Table 7. Power generation and Load System of Mahakam Year 2012

```
      PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      MON, DEC 11 2006  10:46
 LOAD FLOW SISTEM KALTIM  LF2012MAX


 ************************  SUMMARY FOR COMPLETE SYSTEM  ************************

                                 SYSTEM SWING BUS SUMMARY
X------ SWING BUS ------X X---- AREA -----X X---- ZONE -----X
  BUS# X-- NAME --X BASKV    # X-- NAME --X    # X-- NAME --X       MW       MVAR   MVABASE
  9021 PLTU KALTIM111.000    2                 1                  -73.5      33.3      75.0

   69 BUSES         21 PLANTS            18 MACHINES      20 LOADS
   89 BRANCHES      50 TRANSFORMERS       0 DC LINES       0 FACTS DEVICES

                       X------ ACTUAL ------X X----- NOMINAL ------X
                               MW        MVAR         MW        MVAR
FROM GENERATION             425.5      264.6       425.5      264.6
TO CONSTANT POWER LOAD      423.2      205.0       423.2      205.0
TO CONSTANT CURRENT           0.0        0.0         0.0        0.0
TO CONSTANT ADMITTANCE        0.0        0.0         0.0        0.0
TO BUS SHUNT                  0.0        0.0         0.0        0.0
TO FACTS DEVICE SHUNT         0.0        0.0         0.0        0.0
TO LINE SHUNT                 0.0        0.0         0.0        0.0
FROM LINE CHARGING            0.0       56.3         0.0       60.4

 VOLTAGE       X----- LOSSES -----X   X-- LINE SHUNTS --X   CHARGING
 LEVEL BRANCHES      MW        MVAR        MW        MVAR       MVAR
 150.0     25       2.26       8.53        0.0        0.0       56.3
  20.0     35       0.12      55.83        0.0        0.0        0.0
  11.5     11       0.00      24.66        0.0        0.0        0.0
  11.0      8       0.00      26.57        0.0        0.0        0.0
   6.3     10       0.00       0.35        0.0        0.0        0.0
 TOTAL     89       2.38     115.94        0.0        0.0       56.3


                                                          AREA TOTALS
                                                          IN MW/MVAR

                FROM      TO    TO BUS  TO LINE     FROM       TO            DESIRED
X-- AREA --X GENERATION  LOAD    SHUNT    SHUNT CHARGING  NET INT   LOSSES  NET INT

    1           303.0    423.2      0.0      0.0      0.0     45.1      1.0      0.0
                140.6    205.0      0.0      0.0     24.6    -23.7     65.0

    2           122.5      0.0      0.0      0.0      0.0    -45.1      1.4      0.0
                123.9      0.0      0.0      0.0     31.7     23.7     51.0

 TOTALS         425.5    423.2      0.0      0.0      0.0      0.0      2.4      0.0
                264.6    205.0      0.0      0.0     56.3      0.0    115.9
--------------------------------------------------------------------------------
```

Table 8. Voltage profile at maximum load year 2012

```
BUSES WITH VOLTAGE GREATER THAN 1.0500:
X---- BUS -----X AREA V(PU)  V(KV)  :     * NONE *

BUSES WITH VOLTAGE LESS THAN 0.9000:
X----- BUS -----X AREA V(PU)  V(KV):     * NONE *
```

Table 9. Transmission line & Transformer loadings year 2012:

TRANSFORMER LOADINGS ABOVE 40.0 % OF RATING SET A:

FROM BUS BUS#	FROM BUS NAME	FROM BUS BASKV	FROM BUS AREA	TO BUS BUS#	TO BUS NAME	TO BUS BASKV	TO BUS AREA	CKT	MVA LOADING	MVA RATING	PERCENT
1001	GREJO_15	150.00*	2	1002	GREJO_20	20.000	2	1	28.9	30.0	96.3
1001	GREJO_15	150.00	2	9052	MULUT TBNG	11.000*	2	1	27.8	30.0	92.6
1001	GREJO_15	150.00	2	9052	MULUT TBNG	11.000*	2	2	27.8	30.0	92.6
2001	BKUAN_15	150.00*	1	2002	BKUAN20A	20.000	1	1	15.7	30.0	52.2
2001	BKUAN_15	150.00*	1	2003	BKUAN20B	20.000	1	1	15.6	30.0	52.1
3001	HARU_15	150.00*	1	3002	HARU_20	20.000	1	1	34.8	30.0	116.1
3001	HARU_15	150.00*	1	3003	HARU_20A	20.000	1	1	34.8	30.0	116.1
3001	HARU_15	150.00	1	9086	PLTUPROPOSED	11.500*	1	1	55.4	60.0	92.3
3001	HARU_15	150.00	1	9086	PLTUPROPOSED	11.500*	1	2	55.4	60.0	92.3
4001	EMLUT_15	150.00	1	4003	MMAS	11.500*	1	1	22.3	30.0	74.2
4001	EMLUT_15	150.00	1	4003	MMAS	11.500*	1	2	22.3	30.0	74.2
4001	EMLUT_15	150.00	1	4005	TBATUGT1	11.500*	1	1	22.3	30.0	74.2
4001	EMLUT_15	150.00	1	4006	TBATUGT2	11.500*	1	1	20.4	30.0	68.1
4001	EMLUT_15	150.00	1	4010	PLTUEMLUT	11.500*	1	1	27.2	37.0	73.5
4001	EMLUT_15	150.00	1	4010	PLTUEMLUT	11.500*	1	2	27.2	37.0	73.5
5001	TKWG_15	150.00*	1	5002	TKWG_20A	20.000	1	1	42.8	30.0	142.6
5001	TKWG_15	150.00*	1	5003	TKWG_20B	20.000	1	1	42.7	30.0	142.3
6001	MSARI_15	150.00*	2	6002	MSARI20A	20.000	2	1	13.6	20.0	67.9
6001	MSARI_15	150.00*	2	6003	MSARI20B	20.000	2	1	14.9	20.0	74.4
6005	BTKAN_A	20.000	2	6010	STICKBTK	6.3000*	2	1	17.2	32.0	53.7
7001	INDTRI	150.00*	2	7002	INDTRI_A	20.000	2	1	27.9	20.0	139.3
7001	INDTRI	150.00*	2	7003	INDTRI_B	20.000	2	1	28.7	20.0	143.7
7001	INDTRI	150.00*	2	7004	INTRI_C	20.000	2	1	36.5	30.0	121.7
8001	TENGGARONG	150.00*	1	8002	TGRRNG 2	20.000	1	1	18.4	30.0	61.3
8050	SENIPAH	150.00*	2	8051	SNPH20	20.000	1	1	17.6	30.0	58.7
8050	SENIPAH	150.00	2	8052	PLTGBLKPPN	11.500*	2	1	22.4	50.0	44.7
8050	SENIPAH	150.00	2	8052	PLTGBLKPPN	11.500*	2	2	22.4	50.0	44.7
9010	KALTIM150	150.00	2	9020	PLTU KALTIM2	11.000*	2	1	67.1	82.0	81.8
9010	KALTIM150	150.00	2	9021	PLTU KALTIM1	11.000*	2	1	80.7	82.0	98.4
9050	SMBUTAN	150.00*	1	9051	SMBTN_20	20.000	1	1	25.1	30.0	83.7
9060	BONTANG	150.00*	1	9061	BOTNG20	20.000	1	1	27.0	30.0	90.0
9060	BONTANG	150.00	1	9062	PLTGBOTNG	11.000*	1	1	40.9	100.0	40.9
9060	BONTANG	150.00	1	9062	PLTGBOTNG	11.000*	1	2	40.9	100.0	40.9
9070	SANGATA	150.00*	1	9071	SNGATA 20	20.000	1	1	16.6	30.0	55.3
9080	PETUNG	150.00*	2	9081	PTNG20	20.000	2	1	16.0	30.0	53.4
9090	KUARO	150.00	2	9092	PLTUBIOMAS	11.000*	2	1	15.8	20.0	79.2
9090	KUARO	150.00	2	9092	PLTUBIOMAS	11.000*	2	2	15.8	20.0	79.2

TRANSMISSION LINE LOADINGS ABOVE 40.0 % OF RATING SET A:

FROM BUS BUS#	FROM BUS NAME	FROM BUS BASKV	FROM BUS AREA	TO BUS BUS#	TO BUS NAME	TO BUS BASKV	TO BUS AREA	CKT	CURRENT(MVA) LOADING	CURRENT(MVA) RATING	PERCENT
6002	MSARI20A	20.000	2	6005	BTKAN_A	20.000*	2	1	17.2	21.5	79.9
7003	INDTRI_B	20.000	2	7005	GMLNG	20.000*	2	1	10.8	21.5	50.4
7004	INTRI_C	20.000	2	7005	GMLNG	20.000*	2	1	10.1	21.5	46.8

ATTACHMENT

PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E MON, DEC 11 2006 10:47
LOAD FLOW SISTEM KALTIM
LF2006MAX

FROM BUS BUS#	NAME	BASKV	AREA ZONE	VOLT PU/KV	ANGLE	GEN MW/MVAR	LOAD MW/MVAR	SHUNT MW/MVAR	TO BUS BUS#	NAME	BASKV	AREA	CKT	MW	MVAR	TRANSFORMER RATIO	TRANSFORMER ANGLE	RATING AMPS	RATING %I	RATING SET A
1001	GREJO_15	150.00	2	0.9597	35.8	0.0	0.0	0.0												
			1	143.96		0.0	0.0	0.0	1002	GREJO_20	20.000	2	1	24.7	15.0	0.925LK		116	100	30M
									3001	HARU_15	150.00	1	1	-30.0	2.2			121	15	816A
									3001	HARU_15	150.00	1	2	-30.0	2.2			121	15	816A
									6001	MSARI_15	150.00	2	1	38.6	27.9			191	23	816A
									6001	MSARI_15	150.00	2	2	38.6	27.9			191	23	816A
									9010	KALTIM150	150.00	2	1	13.5	-49.0			204	34	600A
									9052	MULUT TBNG	11.000	2	1	-25.0	-9.2	1.000LK	30.0LK	107	93	30M
									9052	MULUT TBNG	11.000	2	2	-25.0	-9.2	1.000LK	30.0LK	107	93	30M
									9080	PETUNG	150.00	2	1	-2.6	-3.9			19		
									9080	PETUNG	150.00	2	2	-2.6	-3.9			19		
1002	GREJO_20	20.000	2	0.9894	30.8	0.0	24.7	0.0												
			1	19.789		0.0	12.2	0.0	1001	GREJO_15	150.00	2	1	-24.7	-12.2	1.000UN		804	93	30M
2001	BKUAN_15	150.00	1	0.9596	37.7	0.0	0.0	0.0												
			1	143.94		0.0	0.0	0.0	2002	BKUAN20A	20.000	1	1	13.6	7.8	1.000LK		63	54	30M
									2003	BKUAN20B	20.000	1	1	13.6	7.8	1.000LK		63	54	30M
									3001	HARU_15	150.00	1	1	-5.6	-3.8			27	5	600A
									3001	HARU_15	150.00	1	2	-5.6	-3.8			27	5	600A
									9050	SMBUTAN	150.00	1	1	-7.9	-4.0			36	4	816A
									9050	SMBUTAN	150.00	1	2	-7.9	-4.0			36	4	816A
2002	BKUAN20A	20.000	1	0.9269	33.9	0.0	13.6	0.0												
			1	18.538		0.0	6.7	0.0	2001	BKUAN_15	150.00	1	1	-13.6	-6.7	1.000UN		471	54	30M
2003	BKUAN20B	20.000	1	0.9276	34.0	0.0	13.6	0.0												
			1	18.552		0.0	6.7	0.0	2001	BKUAN_15	150.00	1	1	-13.6	-6.7	1.000UN		470	54	30M
3001	HARU_15	150.00	1	0.9608	37.7	0.0	0.0	0.0												
			1	144.12		0.0	0.0	0.0	1001	GREJO_15	150.00	2	1	30.2	-7.5			125	15	816A
									1001	GREJO_15	150.00	2	2	30.2	-7.5			125	15	816A
									2001	BKUAN_15	150.00	1	1	5.6	3.2			26	4	600A
									2001	BKUAN_15	150.00	1	2	5.6	3.2			26	4	600A
									3002	HARU_20	20.000	1	1	29.1	19.1	0.925LK		139	121	30M
									3003	HARU_20A	20.000	1	1	29.1	19.1	0.925LK		139	121	30M
									5001	TKWG_15	150.00	1	1	-15.0	3.4			62	8	816A
									5001	TKWG_15	150.00	1	2	-15.0	3.4			62	8	816A
									9086	PLTUPROPOSED	11.500	1	1	-50.0	-18.2	1.000LK	30.0LK	213	92	60M
									9086	PLTUPROPOSED	11.500	1	2	-50.0	-18.2	1.000LK	30.0LK	213	92	60M
3002	HARU_20	20.000	1	0.9677	30.7	0.0	29.1	0.0												
			1	19.354		0.0	14.4	0.0	3001	HARU_15	150.00	1	1	-29.1	-14.4	1.000UN		968	112	30M
									3004	KLDNG1	20.000	1	1	0.0	0.0			0	0	621A
3003	HARU_20A	20.000	1	0.9677	30.7	0.0	29.1	0.0												
			1	19.354		0.0	14.4	0.0	3001	HARU_15	150.00	1	1	-29.1	-14.4	1.000UN		968	112	30M
									3005	KLDNG2	20.000	1	1	0.0	0.0			0	0	621A
3004	KLDNG1	20.000	1	0.9677	30.7	0.0	0.0	0.0												
			1	19.354		0.0	0.0	0.0	3002	HARU_20	20.000	1	1	0.0	0.0			0	0	621A
									3006	MLESS	6.3000	1	1	0.0	0.0	1.000LK	150.0LK	0	0	10M
3005	KLDNG2	20.000	1	0.9677	30.7	0.0	0.0	0.0												
			1	19.354		0.0	0.0	0.0	3003	HARU_20A	20.000	1	1	0.0	0.0			0	0	621A
									3007	PLSTICK	6.3000	1	1	0.0	0.0	1.000LK	150.0LK	0	0	10M

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                                                                      3008 CCMSLZR     6.3000    1  1     0.0    0.0 1.000LK 150.0LK    0   0    17M
3006  MLESS     6.3000    1 0.9677 -119.3    0.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 6.0966           0.0      0.0     0.0  3004 KLDNG1      20.000    1  1     0.0    0.0 1.000UN            0   0    10M

3007 PLSTICK    6.3000    1 0.9677 -119.3    0.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 6.0966           0.0      0.0     0.0  3005 KLDNG2      20.000    1  1     0.0    0.0 1.000UN            0   0    10M

3008 CCMSLZR    6.3000    1 0.9677 -119.3    0.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 6.0966           0.0      0.0     0.0  3005 KLDNG2      20.000    1  1     0.0    0.0 1.000UN            0   0    17M

4001 EMLUT_15   150.00    1 0.9687   38.8    0.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 145.30           0.0      0.0     0.0  4002 EMLUT_20    20.000    1  1     9.8    5.3 0.925LK           44  38    30M
                                                                   4003 MMAS        11.500    1  1   -20.0   -8.1 1.000LK  30.0LK   86  74    30M
                                                                   4003 MMAS        11.500    1  2   -20.0   -8.1 1.000LK  30.0LK   86  74    30M
                                                                   4004 TJBATUST    11.500    1  1     0.0    0.0 1.000LK  30.0LK    0   0    30M
                                                                   4005 TBATUGT1    11.500    1  1   -20.0   -8.1 1.000LK  30.0LK   86  74    30M
                                                                   4006 TBATUGT2    11.500    1  1   -18.0   -8.2 1.000LK  30.0LK   79  68    30M
                                                                   4010 PLTUEMLUT   11.500    1  1   -25.0   -8.3 1.000LK  30.0LK  105  73    37M
                                                                   4010 PLTUEMLUT   11.500    1  2   -25.0   -8.3 1.000LK  30.0LK  105  73    37M
                                                                   5001 TKWG_15     150.00    1  1    51.1   17.7                   215  26   816A
                                                                   5001 TKWG_15     150.00    1  2    51.1   17.7                   215  26   816A
                                                                   8001 TENGGARONG  150.00    1  1    16.0    8.3                    71  12   600A
4002 EMLUT_20   20.000    1 1.0247   36.4    0.0      9.8     0.0 --------------------------------------------------------------------------------
                          1 20.493           0.0      4.8     0.0  4001 EMLUT_15    150.00    1  1    -9.8   -4.8 1.000UN          307  35    30M
                                                                   4007 KUKAR       20.000    1  1     0.0    0.0                     0   0   621A
4003 MMAS       11.500    1 1.0000   12.8   40.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 11.500          19.6R     0.0     0.0  4001 EMLUT_15    150.00    1  1    20.0    9.8 1.000UN         1118  74    30M
                                                                   4001 EMLUT_15    150.00    1  2    20.0    9.8 1.000UN         1118  74    30M
4004 TJBATUST   11.500    1 0.9687    8.8    0.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 11.140           0.0      0.0     0.0  4001 EMLUT_15    150.00    1  1     0.0    0.0 1.000UN            0   0    30M

4005 TBATUGT1   11.500    1 1.0000   12.8   20.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 11.500           9.8R     0.0     0.0  4001 EMLUT_15    150.00    1  1    20.0    9.8 1.000UN         1118  74    30M

4006 TBATUGT2   11.500    1 1.0000   12.4   18.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 11.500           9.6R     0.0     0.0  4001 EMLUT_15    150.00    1  1    18.0    9.6 1.000UN         1025  68    30M

4007 KUKAR      20.000    1 1.0247   36.4    0.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 20.493           0.0      0.0     0.0  4002 EMLUT_20    20.000    1  1     0.0    0.0                     0   0   621A
                                                                   4008 PLTDKUKAR   6.3000    1  1     0.0    0.0 1.000LK 150.0LK    0   0    10M
4008 PLTDKUKAR  6.3000    1 1.0247 -113.6    0.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 6.4553           0.0      0.0     0.0  4007 KUKAR       20.000    1  1     0.0    0.0 1.000UN            0   0    10M

4010 PLTUEMLUT  11.500    1 1.0000   13.6   50.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 11.500          21.4R     0.0     0.0  4001 EMLUT_15    150.00    1  1    25.0   10.7 1.000UN         1365  73    37M
                                                                   4001 EMLUT_15    150.00    1  2    25.0   10.7 1.000UN         1365  73    37M
5001 TKWG_15    150.00    1 0.9602   38.1    0.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 144.03           0.0      0.0     0.0  3001 HARU_15     150.00    1  1    15.0   -5.5                    64   8   816A
                                                                   3001 HARU_15     150.00    1  2    15.0   -5.5                    64   8   816A
                                                                   4001 EMLUT_15    150.00    1  1   -50.9  -17.7                   216  26   816A
                                                                   4001 EMLUT_15    150.00    1  2   -50.9  -17.7                   216  26   816A
                                                                   5002 TKWG_20A    20.000    1  1    35.9   23.3 0.925LK          172 149    30M
                                                                   5003 TKWG_20B    20.000    1  1    35.9   23.1 0.925LK          171 148    30M
5002 TKWG_20A   20.000    1 0.9574   29.7    0.0     35.9     0.0 --------------------------------------------------------------------------------
                          1 19.148           0.0     16.4     0.0  5001 TKWG_15     150.00    1  1   -35.9  -16.4 1.000UN         1190 137    30M
                                                                   5004 KA1         20.000    1  1     0.0    0.0                     0   0   621A
5003 TKWG_20B   20.000    1 0.9599   29.9    0.0     35.9     0.0 --------------------------------------------------------------------------------
                          1 19.198           0.0     16.4     0.0  5001 TKWG_15     150.00    1  1   -35.9  -16.4 1.000UN         1187 137    30M
                                                                   5005 KA2         20.000    1  1     0.0    0.0                     0   0   621A
5004 KA1        20.000    1 0.9574   29.7    0.0      0.0     0.0 --------------------------------------------------------------------------------
                          1 19.148           0.0      0.0     0.0  5002 TKWG_20A    20.000    1  1     0.0    0.0                     0   0   621A
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                                                                  5006 SWD_KA      6.3000    1  1     0.0    0.0 1.000LK  30.0LK     0   0    15M
5005 KA2         20.000    1 0.9599   29.9     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 19.198            0.0      0.0     0.0   5003 TKWG_20B    20.000    1  1     0.0    0.0                       0   0   621A
                                                                  5007 SLZR1_KA    6.3000    1  1     0.0    0.0 1.000LK  30.0LK     0   0    20M
5006 SWD_KA      6.3000    1 0.9574   -0.3     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 6.0316            0.0      0.0     0.0   5004 KA1         20.000    1  1     0.0    0.0 1.000UN               0   0    15M

5007 SLZR1_KA    6.3000    1 0.9599   -0.1     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 6.0473            0.0      0.0     0.0   5005 KA2         20.000    1  1     0.0    0.0 1.000UN               0   0    20M

6001 MSARI_15    150.00    2 0.9490   35.2     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 142.35            0.0      0.0     0.0   1001 GREJO_15    150.00    2  1   -38.4  -29.0                     195  24   816A
                                                                  1001 GREJO_15    150.00    2  2   -38.4  -29.0                     195  24   816A
                                                                  6002 MSARI20A    20.000    2  1    11.3    7.5 0.925LK               55  72    20M
                                                                  6003 MSARI20B    20.000    2  1    12.3    8.4 0.925LK               60  78    20M
                                                                  6004 MSARI20C    20.000    2  1     0.0    0.0 0.925LK                0   0    30M
                                                                  7001 INDTRI      150.00    2  1    39.0   25.7                     189  32   600A
                                                                  7001 INDTRI      150.00    2  2    39.0   25.7                     189  32   600A
                                                                  8050 SENIPAH     150.00    2  1   -24.6   -9.3                     107  18   600A
6002 MSARI20A    20.000    2 0.9875   31.6     0.0     19.8     0.0 ------------------------------------------------------------------------------
                           1 19.749            0.0      9.7     0.0   6001 MSARI_15    150.00    2  1   -11.3   -6.5 1.000UN              382  66    20M
                                                                  6005 BTKAN_A     20.000    2  1   -15.9   -5.8                     496  80   621A
                                                                  6006 BTKAN_B     20.000    2  1     7.5    2.5                     232  37   621A
6003 MSARI20B    20.000    2 0.9826   31.3     0.0     19.8     0.0 ------------------------------------------------------------------------------
                           1 19.651            0.0      9.7     0.0   6001 MSARI_15    150.00    2  1   -12.3   -7.3 1.000UN              419  73    20M
                                                                  6006 BTKAN_B     20.000    2  1    -7.5   -2.5                     232  37   621A
                                                                  6007 PEMKOT20    20.000    2  1     0.0    0.0                       0   0   621A
6004 MSARI20C    20.000    2 1.0259   35.2     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 20.519            0.0      0.0     0.0   6001 MSARI_15    150.00    2  1     0.0    0.0 1.000UN               0   0    30M
                                                                  6009 KMEX2       20.000    2  1     0.0    0.0                       0   0   621A
6005 BTKAN_A     20.000    2 0.9929   31.9     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 19.858            0.0      0.0     0.0   6002 MSARI20A    20.000    2  1    16.0    5.9                     496  80   621A
                                                                  6010 STICKBTK    6.3000    2  1   -16.0   -5.9 1.000LK  30.0LK     496  54    32M
6006 BTKAN_B     20.000    2 0.9850   31.5     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 19.700            0.0      0.0     0.0   6002 MSARI20A    20.000    2  1    -7.5   -2.5                     232  37   621A
                                                                  6003 MSARI20B    20.000    2  1     7.5    2.5                     232  37   621A
                                                                  6008 KMEX1       20.000    2  1     0.0    0.0                       0   0   621A
                                                                  6011 GMTBTK      6.3000    2  1     0.0    0.0 1.000LK  30.0LK     0   0    15M
6007 PEMKOT20    20.000    2 0.9826   31.3     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 19.651            0.0      0.0     0.0   6003 MSARI20B    20.000    2  1     0.0    0.0                       0   0   621A

6008 KMEX1       20.000    2 0.9850   31.5     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 19.700            0.0      0.0     0.0   6006 BTKAN_B     20.000    2  1     0.0    0.0                       0   0   621A
                                                                  6014 KMEX_B      6.3000    2  1     0.0    0.0 1.000LK  30.0LK     0   0    10M
6009 KMEX2       20.000    2 1.0259   35.2     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 20.519            0.0      0.0     0.0   6004 MSARI20C    20.000    2  1     0.0    0.0                       0   0   621A

6010 STICKBTK    6.3000    2 1.0000    3.0    16.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 6.3000             6.2R     0.0     0.0   6005 BTKAN_A     20.000    2  1    16.0    6.2 1.000UN            1573  54    32M

6011 GMTBTK      6.3000    2 0.9850    1.5     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 6.2055            0.0      0.0     0.0   6006 BTKAN_B     20.000    2  1     0.0    0.0 1.000UN               0   0    15M

6014 KMEX_B      6.3000    2 0.9850    1.5     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 6.2055            0.0      0.0     0.0   6008 KMEX1       20.000    2  1     0.0    0.0 1.000UN               0   0    10M

7001 INDTRI      150.00    2 0.9392   34.7     0.0      0.0     0.0 ------------------------------------------------------------------------------
                           1 140.89            0.0      0.0     0.0   6001 MSARI_15    150.00    2  1   -38.8  -25.8                     191  32   600A
                                                                  6001 MSARI_15    150.00    2  2   -38.8  -25.8                     191  32   600A
                                                                  7002 INDTRI_A    20.000    2  1    23.2   15.4 0.925LK              114 148    20M
                                                                  7003 INDTRI_B    20.000    2  1    23.7   16.2 0.925LK              118 153    20M
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							7004 INTRI_C	20.000	2	1	30.6	19.9	0.925LK		150 130	30M
7002 INDTRI_A	20.000	2 0.9397	26.9	0.0	22.6	0.0										
		1 18.793		0.0	10.8	0.0	7001 INDTRI	150.00	2	1	-23.2	-11.2	1.000UN		792 137	20M
							7005 GMLNG	20.000	2	1	0.6	0.4			22 4	621A
7003 INDTRI_B	20.000	2 0.9357	26.7	0.0	32.9	0.0										
		1 18.714		0.0	16.0	0.0	7001 INDTRI	150.00	2	1	-23.7	-11.8	1.000UN		817 142	20M
							7005 GMLNG	20.000	2	1	-9.2	-4.2			313 50	621A
7004 INTRI_C	20.000	2 0.9428	27.1	0.0	22.0	0.0										
		1 18.855		0.0	10.7	0.0	7001 INDTRI	150.00	2	1	-30.6	-14.6	1.000UN		1038 120	30M
							7005 GMLNG	20.000	2	1	8.7	3.9			291 47	621A
7005 GMLNG	20.000	2 0.9394	26.9	0.0	0.0	0.0										
		1 18.787		0.0	0.0	0.0	7002 INDTRI_A	20.000	2	1	-0.6	-0.4			22 4	621A
							7003 INDTRI_B	20.000	2	1	9.2	4.3			313 50	621A
							7004 INTRI_C	20.000	2	1	-8.6	-3.8			291 47	621A
							7006 GMLNG_B	6.3000	2	1	0.0	0.0	1.000LK	30.0LK	0 0	30M
7006 GMLNG_B	6.3000	2 0.9394	-3.1	0.0	0.0	0.0										
		1 5.9180		0.0	0.0	0.0	7005 GMLNG	20.000	2	1	0.0	0.0	1.000UN		0 0	30M
8001 TENGGARONG	150.00	1 0.9635	38.5	0.0	0.0	0.0										
		1 144.53		0.0	0.0	0.0	4001 EMLUT_15	150.00	1	1	-15.9	-9.2			73 12	600A
							8002 TGRRNG 2	20.000	1	1	15.9	9.2	1.000LK		73 64	30M
8002 TGRRNG 2	20.000	1 0.9299	34.7	0.0	15.9	0.0										
		1 18.598		0.0	7.9	0.0	8001 TENGGARONG	150.00	1	1	-15.9	-7.9	1.000UN		551 64	30M
8050 SENIPAH	150.00	2 0.9490	35.2	0.0	0.0	0.0										
		1 142.35		0.0	0.0	0.0	6001 MSARI_15	150.00	2	1	24.6	9.3			107 18	600A
							8051 SNPH20	20.000	1	1	15.4	8.6	0.900LO		71 62	30M
							8052 PLTGBLKPPN	11.500	2	1	-20.0	-9.0	1.000LK	30.0LK	89 46	50M
							8052 PLTGBLKPPN	11.500	2	2	-20.0	-9.0	1.000LK	30.0LK	89 46	50M
8051 SNPH20	20.000	1 1.0253	32.1	0.0	15.4	0.0										
		1 20.507		0.0	7.6	0.0	8050 SENIPAH	150.00	2	1	-15.4	-7.6	1.000UN		482 56	30M
8052 PLTGBLKPPN	11.500	2 0.9680	7.6	40.0	0.0	0.0										
		1 11.132		20.0H	0.0	0.0	8050 SENIPAH	150.00	2	1	20.0	10.0	1.000UN		1160 46	50M
							8050 SENIPAH	150.00	2	2	20.0	10.0	1.000UN		1160 46	50M
9010 KALTIM150	150.00	2 0.9614	35.7	0.0	0.0	0.0										
		1 144.21		0.0	0.0	0.0	1001 GREJO_15	150.00	2	1	-13.5	49.0			203 34	600A
							9020 PLTU KALTIM2	11.000	2	1	-60.0	-24.1	1.000LK	30.0LK	259 82	82M
							9021 PLTU KALTIM1	11.000	2	1	73.5	-24.9	1.000LK	30.0LK	310 98	82M
9020 PLTU KALTIM2	11.000	2 0.9973	10.4	60.0	0.0	0.0										
		1 10.971		30.0H	0.0	0.0	9010 KALTIM150	150.00	2	1	60.0	30.0	1.000UN		3530 82	82M
9021 PLTU KALTIM1	11.000	2 1.0000	0.0	-73.5	0.0	0.0										
		1 11.000		33.3H	0.0	0.0	9010 KALTIM150	150.00	2	1	-73.5	33.3	1.000UN		4234 98	82M
9050 SMBUTAN	150.00	1 0.9618	37.8	0.0	0.0	0.0										
		1 144.28		0.0	0.0	0.0	2001 BKUAN_15	150.00	1	1	7.9	3.0			34 4	816A
							2001 BKUAN_15	150.00	1	2	7.9	3.0			34 4	816A
							9051 SMBTN_20	20.000	1	1	21.3	13.3	1.000LK		100 87	30M
							9060 BONTANG	150.00	1	1	-18.6	-9.6			84 10	816A
							9060 BONTANG	150.00	1	2	-18.6	-9.6			84 10	816A
9051 SMBTN_20	20.000	1 0.9096	32.1	0.0	21.3	0.0										
		1 18.193		0.0	10.5	0.0	9050 SMBUTAN	150.00	1	1	-21.3	-10.5	1.000UN		754 87	30M
9052 MULUT TBNG	11.000	2 1.0000	11.3	50.0	0.0	0.0										
		1 11.000		24.2R	0.0	0.0	1001 GREJO_15	150.00	2	1	25.0	12.1	1.000UN		1457 93	30M
							1001 GREJO_15	150.00	2	2	25.0	12.1	1.000UN		1457 93	30M
9060 BONTANG	150.00	1 0.9814	39.2	0.0	0.0	0.0										
		1 147.21		0.0	0.0	0.0	9050 SMBUTAN	150.00	1	1	18.8	6.1			77 9	816A
							9050 SMBUTAN	150.00	1	2	18.8	6.1			77 9	816A
							9061 BOTNG20	20.000	1	1	23.1	14.1	1.000LK		106 92	30M

```
                                                                              9062 PLTGBOTNG   11.000    1  1   -37.5  -14.3 1.000LK  30.0LK   157  41   100M
                                                                              9062 PLTGBOTNG   11.000    1  2   -37.5  -14.3 1.000LK  30.0LK   157  41   100M
                                                                              9070 SANGATA     150.00    1  1     7.2    1.2                    29   4   816A
                                                                              9070 SANGATA     150.00    1  2     7.2    1.2                    29   4   816A
9061 BOTNG20      20.000    1 0.9321   33.8      0.0       23.1      0.0 -------------------------------------------------------------------------------------
                            1 18.642             0.0       11.2      0.0  9060 BONTANG     150.00    1  1   -23.1  -11.2 1.000UN           794  92    30M

9062 PLTGBOTNG    11.000    1 1.0000   11.8     75.0        0.0      0.0 -------------------------------------------------------------------------------------
                            1 11.000            32.7R       0.0      0.0  9060 BONTANG     150.00    1  1    37.5   16.3 1.000UN          2147  41   100M
                                                                          9060 BONTANG     150.00    1  2    37.5   16.3 1.000UN          2147  41   100M
9070 SANGATA      150.00    1 0.9764   38.8      0.0        0.0      0.0 -------------------------------------------------------------------------------------
                            1 146.46             0.0        0.0      0.0  9060 BONTANG     150.00    1  1    -7.2   -4.1                    33   4   816A
                                                                          9060 BONTANG     150.00    1  2    -7.2   -4.1                    33   4   816A
                                                                          9071 SNGATA 20   20.000    1  1    14.4    8.3 1.000LK            65  57    30M
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                            1 18.871             0.0        7.1      0.0  9070 SANGATA     150.00    1  1   -14.4   -7.1 1.000UN           491  57    30M

9080 PETUNG       150.00    2 0.9605   35.8      0.0        0.0      0.0 -------------------------------------------------------------------------------------
                            1 144.07             0.0        0.0      0.0  1001 GREJO_15    150.00    2  1     2.6    3.5                    17
                                                                          1001 GREJO_15    150.00    2  2     2.6    3.5                    17
                                                                          9081 PTNG20      20.000    2  1    13.9    7.9 1.000LK            64  56    30M
                                                                          9090 KUARO       150.00    2  1    -9.6   -7.4                    49   6   816A
                                                                          9090 KUARO       150.00    2  2    -9.6   -7.4                    49   6   816A
9081 PTNG20       20.000    2 0.9315   32.5      0.0       13.9      0.0 -------------------------------------------------------------------------------------
                            1 18.631             0.0        6.9      0.0  9080 PETUNG      150.00    2  1   -13.9   -6.9 1.000UN           482  56    30M

9086 PLTUPROPOSED11.500     1 1.0000   13.2    100.0        0.0      0.0 -------------------------------------------------------------------------------------
                            1 11.500            47.6R       0.0      0.0  3001 HARU_15     150.00    1  1    50.0   23.8 1.000UN          2780  92    60M
                                                                          3001 HARU_15     150.00    1  2    50.0   23.8 1.000UN          2780  92    60M
9090 KUARO        150.00    2 0.9774   36.9      0.0        0.0      0.0 -------------------------------------------------------------------------------------
                            1 146.61             0.0        0.0      0.0  9080 PETUNG      150.00    2  1     9.7    1.1                    38   5   816A
                                                                          9080 PETUNG      150.00    2  2     9.7    1.1                    38   5   816A
                                                                          9091 KUARO20     20.000    2  1    10.6    5.5 1.000LK            47  41    30M
                                                                          9092 PLTUBIOMAS  11.000    2  1   -15.0   -3.8 1.000LK  30.0LK    61  79    20M
                                                                          9092 PLTUBIOMAS  11.000    2  2   -15.0   -3.8 1.000LK  30.0LK    61  79    20M
9091 KUARO20      20.000    2 0.9576   34.5      0.0       10.6      0.0 -------------------------------------------------------------------------------------
                            1 19.152             0.0        4.9      0.0  9090 KUARO       150.00    2  1   -10.6   -4.9 1.000UN           353  41    30M

9092 PLTUBIOMAS   11.000    2 1.0000   11.3     30.0        0.0      0.0 -------------------------------------------------------------------------------------
                            1 11.000            10.2R       0.0      0.0  9090 KUARO       150.00    2  1    15.0    5.1 1.000UN           832  79    20M
                                                                          9090 KUARO       150.00    2  2    15.0    5.1 1.000UN           832  79    20M
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Attachment 10

ASH UTILIZATION STUDY IN INDONESIA

ASH UTILIZATION STUDY IN INDONESIA

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REPORT OF ASH UTILIZATION STUDY IN INDONESIA

I. PREFACE

PT. En-Growth Indonesia has conducted the study to investigate the potential of utilizing coal ash (bottom ash and fly ash) produced from combustion process in Indonesia. During the study continuous consultation meetings with relevant government institutions, industries such as coal miners, power generations, and cement industries have been conducted. In addition to that, PT. En-Growth Indonesia also conducted meetings with related industry associations, such as Cement Industry Association and Coal Mining Association to broaden its perspective.

Scopes of the study are:

1) Investigation on policy, law and regulation related to Ash handling and utilizing in Indonesia, and the procedure from ministry of environment for ash handling company
2) Investigation on the nature of some Indonesian coal ash and its possible utilization, potential demand of coal ash in some industries, and Ash Utilization Standard

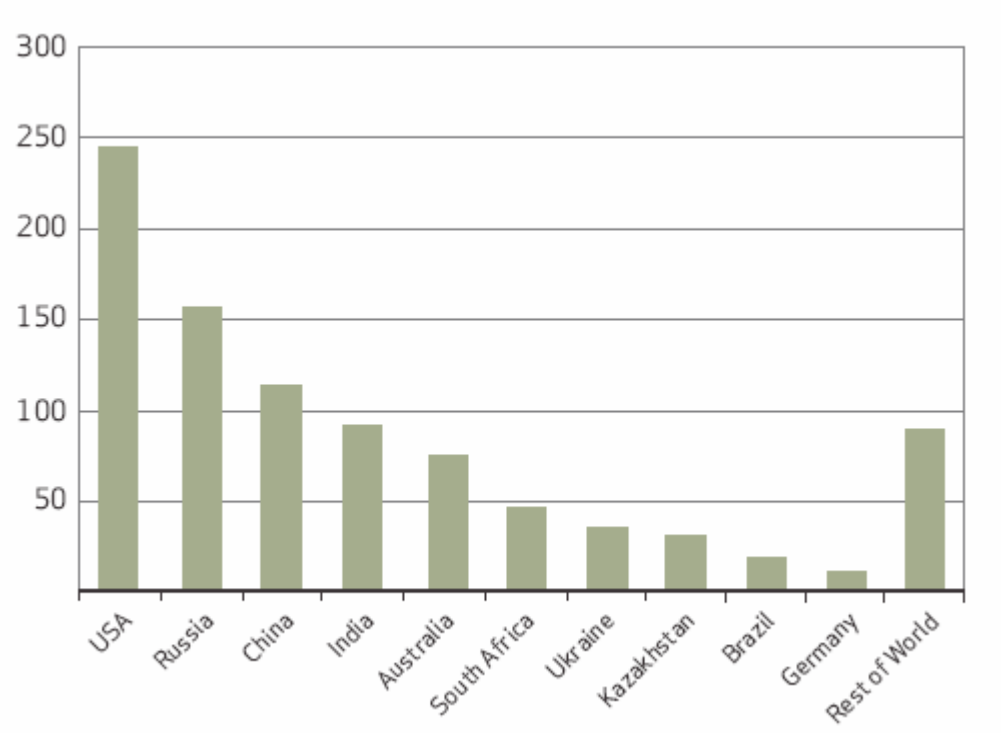
Coal Potential and its Mineable Reserves

It is perceived that more than 984 billion tons of proven coal reserves are found throughout the world where the biggest reserves are located in 70 countries. Assuming that the production rate of hard coal in 2004 was around 4.63 billion tons per year and 79 million per year for brown coal, then estimation of coal reserves can last around 164 years. Figure-1 shows the world coal reserves at end of 2005 (billion tons)

In Indonesia, most of its coal deposits are distributed mainly in Sumatra and Kalimantan islands. The location of coal deposit along with their mineable reserves and potential amount is shown in Table 1.

Figure-1: Global Coal Reserves at end 2005 (billion tons)

Source: BP 2006, London



New coal deposits have been found in Indonesia from time to time. Blueprint Energy 2005 shows Indonesia current coal resources has reached 58 billion ton with proven reserves of 19.3 billion ton. Compared with its significant amount of coal resources, Indonesia coal production capacity of 130 million ton in 2004 is relatively small. This means that ratio of coal production and its resources equals to 147. Thus, to utilize all Indonesia coal resources will need 147 years.

Table 1. Potential Reserves Of Coal

X 10^6 ton

	PROVINCE	Minable Reserves	Resources				
			Measured	Indicated	Inferred	Hypothetic	Total
1	Banten	0.00	0.00	0.00	13.75	0.00	0.00
2	Central Java	0.00	0.00	0.00	0.82	0.00	0.82
3	East Java	0.00	0.00	0.00	0.08	0.00	0.08
4	Nangroe Aceh Darusalam	0.00	90.40	13.40	346.35	0.00	450.15
5	North Sumatera	0.00	19.97	0.00	7.00	0.00	26.97
6	Riau	15.15	336.32	0.00	1,720.60	0.00	2,057.22
7	West Sumatra	36.07	181.24	42.72	475.94	19.19	719.09
8	Bengkulu	21.12	62.18	7.95	113.09	15.15	198.37
9	Jambi	9.00	94.22	36.32	1,462.03	0.00	1,592.57
10	South Sumatra	2,653.98	1,970.75	19,946.48	323.17	0.00	22.240.40
11	Lampung	0.00	0.00	0.00	106.95	0.00	106.95
12	West Kalimantan	0.00	1.48	1.32	482.60	42.12	527.52
13	Central Kalimantan	48.59	194.02	5.08	1,200.11	0.00	1,399.21
14	South Kalimantan	1,787.32	3,109.21	155.08	5,410.27	0.00	8,674.56
15	East Kalimantan	2,410.33	6,385.13	325.21	12,401.11	456.34	19,567.79
16	South Sulawesi	0.06	21.20	0.00	110.81	0.00	132.01
17	Central Sulawesi	0.00	0.00	0.00	0.00	0.00	0.00
18	Papua	0.00	0.00	0.00	138.30	0.00	138.30
TOTAL		**6,981.62**	**12,466.42**	**20,533.56**	**24,314.96**	**532.80**	**57,847.74**

Source : Indonesia Coal Resources, reserves, and calorific value, 2005

Coal Production and Future Projection

Coal production in Indonesia has greatly changed in the past 10 years as shown in Table 2. Previously most Indonesian coals produced are for exports, and only small amount is for domestic market. The low domestic consumption of coal has been predominantly due to low price of oil which make the industries preferred to use oil rather than coal which was not subsidized. Recently the government of Indonesia drastically reduced the

subsidy of oil, so that some industries began to look for less expensive fuel, mostly coal, to keep their industries survived.

Table 2. COAL PRODUCTION

(x 10^3 ton)

Year	State Owned Company	Contractor & Private	Total
1980	303.990	33.999	337.989
1981	350.350	48.420	398.770
1982	480.987	107.000	587.987
1983	485.699	162.610	648.309
1984	1,084.653	381.934	1,466.587
1985	1,491.052	508.807	1,999.859
1986	1,725.265	833.641	2,558.906
1987	1,907.432	1,192.063	3,099.495
1988	2,416.389	2,077.296	4,493.685
1989	4,015.069	4,685.936	8,701.005
1990	4,853.784	5,785.662	10,639.446
1991	5,768.000	8,157.000	13,925.000
1992	7,103.221	16,017.245	23,120.466
1993	7,374.039	19,794.265	27,168.304
1994	6,707.341	26,149.383	32,856.724
1995	7,979.244	33,862.348	41,841.592
1996	9,230.597	41,741.315	50,971.912
1997	9,965.250	45,009.780	54,822.000
1998	9,859.416	52,179.550	62,038.966
1999	11,207.140	62,570.,237	73,777.377
2000	10,746.024	66,389.133	77,135.157
2001	10,211.957	82,328.502	92,540.459
2002	9,482.311	93,926.829	103,409.140
2003	10,026.838	104,251.348	114,278.186
2004	8,707.166	123,644.858	132,352,024

Source:
- Indonesian Coal Mining Development & Company Profiles
- Indonesia Mineral and Coal Statistics

The coal production is divided into two categories, Mining Authorization (KP) and coal contractors (PKP2B). Mining authorization is comprised of state-owned coal company PTBA, several national private companies and cooperative units. Coal contractors are those companies who

has production sharing contract with the government, comprised of contractors from first to forth generation.

The production of mining authorization has not significantly increased within the last 5 years (2000 – 2005), only 3 million tons compared with those from coal contractors reaching 64 million tons. This significant increase is attributable to high demand of coal from Asian countries and this trend would continue to grow in the near future due to high rate of oil price. It is predicted that the total production of coal in 2009 would probably reach 181 million tons, dominated by contractor share 87% of the total.

Coal production of the contractors mainly comes from PT. Kaltim Prima Coal 40 million tons, PT. Adaro 30 million tons, PT. Arutmin Indonesia 20 million tons, PT. Kideco Jaya Agung 18 million tons and Berau Coal 12 million tons. These 5 big coal contractors are of the first generation companies.

There are hundreds of coal producers in Indonesia, particularly after the government issued autonomy bill few years ago, in which mining license is no longer issued by the central government, but regency or local government. Since then, the total annual production capacity has increased significantly from 27.8 million ton in 1993 to 114.3 million in 2003. About 30.7 million ton is used domestically, while the remaining is for export mainly to Asian countries such as Japan, Taiwan, Hong Kong, China, Korea, India, Thailand, Malaysia and so on. Major domestic coal users in Indonesia are power plant (74%), followed by cement industry (16%), pulp (3%), metallurgy (1%) and other industries (6%).

Coal Utilization in Indonesia

The fast growing of coal demand in Indonesia was mainly driven by the two largest coal consumers, i.e. power generation and cement industries, even though other industries such as pulp and paper, metallurgy,

briquette manufacturing etc. have also been consuming more coal. The amount of coal consumed by those industries is shown in Table 3.

Table 3. Coal Consumption by Industry

(X 103 tons)

	1998	1999	2000	2001	2002	2003	2004
Coal-fired Power Plant							
Asam-asam			127	488	568	568	554
Bukit Asam	1,200	1,231	1,192	1,154	1,058	1,143	1,091
Freeport Indonesia			-	646	558	669	594
Newmont Nusa Tenggara			376	406	-	480	483
Paiton II (Java Power)	2,152	3,369	2,457	6,276	8,300	9,016	9,310
Sijantang (Ombilin)	138	125	19	375	105	230	183
Suralaya	7,134	8,869	9,546	10,172	8,951	10,821	10,665
Sub-total	**10,623**	**13,594**	**10,718**	**19,517**	**19,540**	**22,996**	**22,882**
Cement Industries							
Bosowa Cement, PT	-	30	130	248	153	251	170
Indocement Tarjun, PT	67	456	167	342	119	270	368
Indocement Cibinong, PT	43	88	476	1,352	1,405	801	1,185
Indocement Cirebon, PT	8	81	-	380	303	313	386
Semen Andalas, PT	59	20	34	36	47	168	185
Semen Baturaja, PT	69	62	27	71	103	94	129
Semen Padang, PT	263	470	483	474	690	692	454
Semen Gresik, PT	76	100	NA	NA	NA	715	1,064
Semen Tonasa, PT	88	95	130	725	393	578	784
Semen Cibinong, PT	578	452	379	268	467	886	812
Semen Cilacap, PT			277	278	351		
Semen Cirebon, PT			72	157	76		
Semen Nusantara, PT	15	177	54	57			
Sub-total	**1,265**	**2,032**	**2,228**	**4,388**	**4,107**	**4,774**	**5,549**
Metalurgy Industries							
Antam Tbk, PT	33	21	-	14		62	46

The projection of domestic coal consumption investigated by BPPT (the Agency for the Assessment and Application of Technology) is shown in Table 4 with the assumption that the growth of electricity demand is 7% per year, while the growth of domestic cement demand is 7-8% per year.

From the table, one can see that coal consumption in industrial sector from 1998-2004 has increased continuously. In 2004, Indonesian coal production is 132.3 million tons, in which around 95.7 million tons (72%) is for export and 36.6 million tons (28%) is used domestically. The power industry accounts for about 63% of domestic coal consumption in 2004 (22.8 million tons), the cement industries consume 15% (5.5 million tons),

metallurgy and pulp industries require 1.3 million tons (3.5%), and around 18.5% is for other purposes such as briquette etc. This significant increase in coal consumption gives a very positive impact on coal mining development in Indonesia.

Table-4. Domestic Coal Consumption Projection (2005-2025)

(x 10^6 ton)

		2004	2005	2010	2015	2020	2025	Remarks
1	Power Plant	23.0	31.0	45.0	62.0	86.0	103.0	The growth of electricity demand 7% per year
2	Cement Industries	5.5	6.5	10.0	11.0	13.0	17.0	The growth of cement demand 7-8% per year
3	Metallurgical & Pulp Industries	1.3	1.5	7.0	10.0	11.0	12.0	
4	Other industries (textile, briquette, etc)	0.02	1.0	5.0	7.0	9.0	10.0	Direct use & coal briquette
5	UBC Product	-	-	5.0	10.0	20.0	30.0	Domestic use
6	Coal Liquid Product	-	-	3.0	6.0	11.0	22.0	
7	Others	6.8	-	-	-	-	-	
	Total	**36.6**	**40.0**	**74.0**	**106.0**	**150.0**	**194.0**	

Source: BPPT, 2005

Coal Fired Power Generation

The electricity generation sector began using coal in 1984 with the commissioning of the first coal-fired steam power plant located in Suralaya, West Java. In 1996 about 16% of the total electricity generating capacity had been generated from coal-fired steam power plant (SPP) and increased to 37% in 2003/2004 and will be increased to 49% in 2007/2008. In 2002, there are 9 coal-fired SPP with the total capacity of 6,943 MW in operation. They are located in Sumatra, Java, Lombok, Kalimantan and Papua. And in line with the power industry development, there will be more coal-fired Steam Power Plant (SPP) built in the near future.

Data from PLN shows that there are 9 (nine) large coal fired steam power plants (SPP) already in operation (see Table 5). Java as the most populous island, has the largest number in term of unit and installed capacity. There are 7 units coal-fired SPP in Suralaya, West Java, and

another 7 units in Paiton, East Java constitutes of approximately 5,800 MW installed capacity.

While data from the Department of Energy and Mineral Resources (2005) shows that Suralaya (PT Indonesia Power) is the biggest coal fired power plant in Indonesia, consumes around 10.7 million ton coal per year (2004) or 46.6% of the total coal consumption in power generation (22.9 million/year). The second biggest coal consumer is Paiton power (PT YTL East Java), consumes about 9.3 million ton coal/year. The remaining 12.7% is consumed by another five power generations

In Sumatra there are two coal-fired SPP located in Ombilin, West Sumatra and Bukit Asam, South Sumatra. Ombilin SPP has 2 x 100 MW Turbine Generator, while Bukit Asam has 2 x 65 MW generating units. Other coal fired SPP are in West Nusa Tenggara, Kalimantan, and Papua. The Newmont SPP in West Nusa Tenggara has installed capacity of 4 x 28 MW Turbine Generator, serving the Newmont mining complex in Lombok Island. In the Asam-Asam SPP, Banjarmasin, South Kalimantan 2 x 65 MW units is installed to serve the South Kalimantan PLN system. In Papua, the Freeport SPP operates 2 x 60 MW installed capacity to electrify mainly the Freeport mining complex.

Table 5. Coal-Fired Power Plant in Indonesia

No.	Power Station Name	Location	Operation Time	Generating Capacity (MW)	Generating Capacity (%)	Coal Annual Consumption (10^3 ton)	Description of Coal Used		
							Typical Quality	Name of Coal Reserve	Domestic/ Import
	Sumatra								
1	Bukit Asam	S-Sumatra	1987	2 x 65 = 130	36-38	1,153	Bituminous	Tanj. Enim	domestic
2	Ombilin	W-Sumatra	1996	2 x 100= 200	35-38	700	Bituminous	Ombilin	domestic
	Java								
3	Suralaya 1-4	W-Java	1984	4 x 400 =1600	30 – 35	5,100	Bituminous, Sub-bituminous	Bukit Asam (60%), Jorong, Berau, Kideco Arutmin	domestic
4	Suralaya 5-7	W-Java		3 x 600 =1800	35 - 38	5,070			

5	Paiton	E-Java	1994	2 x 600 =1200	37-39	3,138			
6	Paiton I (PEC)	E-Java		2 x 600 =1200	37-39	3,138	Sub-Bituminous	Adaro	Domestic
7	Paiton II (Jawa Power)	E-Java							
	Lombok – West Nusa Tenggara								
8	Newmount – Nusa Tenggara	Lombok		4x28 = 112	35-38	406	Sub-Bituminous	Adaro	Domestic
	Kalimantan								
9	**Banjarmasin** – Asam-Asam	S-Kalimantan	2000	2 x 65 = 130	35-37	488	Sub-bituminous	Asam-Asam	Domestic
	Papua								
10	Freeport	Papua		2 x 60 = 120	37-39	646	Bituminous	KPC	Domestic
	T O T A L			**6,492**		**19,839**			

According to 2002 statistics data the coal fired SPP produces around 35,000 GWH of electricity. In Java alone the Suralaya and Paiton SPP produce approximately 32,000 GWH constitutes of 35% of the total electricity production in the Java-Bali interconnected system. Such facts show that the role of coal-fired SPP in the Indonesian grid is and will remain important.

Table 6 shows coal-fired power plant planning in Indonesia and its fuel consumption. In Java, Suralaya and Paiton are the largest coal consumers that consume approximately 16.4 million tons coal annually, while in outside Java, SPPs consume only 3.5 million tons coal/year. Most of the SPPs are fueled by bituminous coal. Suralaya, Paiton, Power Gen, Newmont, and Asam-Asam, however, use Sub-Bituminous coal as their fuel too.

This table also shows generating efficiency of individual SPP, which ranges between 35 to 39% (2002). Data of Suralaya SPP provided by PT. Indonesia Power might serve as typical current SPP efficiency status. The data shows that in average Suralaya SPP units has thermal efficiency of 34.7%. The average heat rate efficiency of the units is 2,472.6 Kcal/kWh. The newer units, the higher efficiency will be.

The Power supply using coal as fuel not only produces electrical energy but also *coal ash*. When coal is burnt in the boilers this produces steam, hence able to move the turbines to produce electricity. The ash produced by burnt coal consists of *bottom ash* and *fly ash*. According to the Government Law of the Republic of Indonesia No. 18 Year 1999 coal ash is categorized as hazardous and poisonous waste (B3). This is the reason why PT Engrowth Indonesia is working together with BPPT, the Indonesian Cement Association, PT Semen Tonasa, Suralaya Steam Power Plant and the Indonesian Power Body to implement studies to utilize coal ash in Indonesia.

According to data derived from TekMIRA, the fly ash from coal ash waste will increase – Steam Power Plant year 2000 produced 1.66 million tons of waste, and it is estimated that year 2006 will accumulate to 2 million tons.

The coal burning system is usually divided into 2 systems: *fluidized bed* and *fixed bed* or *grate systems.* Aside from the three systems mentioned earlier, another system is also known as the *spouted bed system* or known as the *sprayed bed system.*

Fluidized bed is a system where air is blown from beneath using a blower so that the hard objects/elements on top will have a similar character like fluid. The fluidized technique is the most efficient technique to produce energy. Sand or corundum which acts as the heat medium is initially heated using kerosene/oil. After the sand's temperature reaches coal burning temperature ($300^{o}C$), coal will be induced. This system produces fly ash and bottom ash. The fluidized bed technology is commonly used at Steam Generated Power Plants. The weight composition of fly ash and bottom ash is (80 - 90%) compared to (10 - 20%).

Table 6. Coal Fired Power Plant Planning

No	Name	Location	Capacity (MW)	Operation Time	Coal Cons. (ton/y)	Coal Type	Coal Mining
1	PLTU Tanjung Jati B	Jepara-Central Java	1320	2005	4,162,752	Sub Bitumi-nous	East and S.Kalimantan
2	PLTU Cilacap	Cilacap-Central Java	450	2006	1,419,120	Sub Bitumi-nous	East and S.Kalimantan
3	PLTU Tarahan #1&2	Tarahan-Lampung	200	2007	770,880	Sub Bitumi-nous	Bengkulu, S. Sumatra,Riau
4	PLTU Tarahan #3&4	Tarahan-Lampung	200	2006	770,880	Sub Bitumi-nous	Bengkulu, S. Sumatra,Riau
5	PLTU Labuan Angin	Sibolga-N. Sumatra	230	2007	1,047,696	Lignite	Bengkulu, S. Sumatra,Riau
6	PLTU Amurang	Menado-N. Sulawesi	110	2006	346,896	Sub Bitumi-nous	E.Kalimantan, S.Kalimantan
7	PLTU Sibolga	Sibolga-Sumut	200	2006	630,720	Sub Bitumi-nous	Bengkulu, S. Sumatra,Riau
8	PLTU Cilegon	Cilegon-Banten	450	2008	1,419,120	Sub Bitumi-nous	S. Sumatra, S.Kalimantan, Bengkulu
9	PLTU MT Peranap	Riau	500	2007	2,277,600	Lignite	Riau
10	PLTU Banjarsari	South Sumatera	200	2007	911,040	Sub Bitumi-nous	South Sumatra
11	PLTU Lubuk Linggau	South Sumatera	130	2007	592,176	Sub Bitumi-nous	South Sumatra
12	PLTU Sarolangon	Jambi	14	2005	63,773	Sub Bitumi-nous	Jambi
13	PLTU Bangka	Bangka	30	2006	136,656	Sub Bitumi-nous	Riau
14	PLTU MT Lati	East Kalimantan	14	2003	68,678	Reject Coal	East Kalimantan
15	PLTU MT Sangata	East Kalimantan	14	2004	68,678	Reject Coal	East Kalimantan
16	PLTU Sintang	Central Kalimantan	14	2005	68,678	Reject Coal	South Kalimantan
17	PLTU Kupang	NTT	30	2005	136,656	Sub Bitumin ous	South Kalimantan
18	PLTU Palu	South East Sulawesi	30	2005	136,656	Sub Bitumin ous	East & South Kalimantan

Source : Coal Demand Projection for Electricity, 2003

The fixed bed system or grate system is a burning technique where coal is put on a conveyor belt or grate. This system is not that efficient since the coals do not burn thoroughly, carbon residue can still be found.

The ash – especially bottom ash, formed by this technique still has Calirific value around 3,000 kkal/kg. In China, bottom ash is used as fuel for iron smiths (the iron/metal industry). The fixed bed system technology is used by many textile industries as a steam generator. The weight composition of fly ash and bottom ash generated by this system is (15-25%) compared to (75-85%).

Coal fuel is mainly used for Steam Power Plants. This tendency today is caused by the rise of diesel fuel making many industries switching to coal as their fuel to produce steam with remnants of fly ash and bottom ash (5-10%). The percentage of fly ash and bottom ash produced is: fly ash (80-90%) and bottom ash (10-20%): [source: PJB Paiton]. The chemical composition of fly ash is usually as follows:

SiO_2	:	52. 00%
Al_2O_3	:	31. 86%
Fe_2O_3	:	4. 89%
CaO	:	2. 68%
MgO	:	4. 66%

Cement Industry

There are nine cement factories in Indonesia with total capacity of almost 47.5 million ton/year as shown at Table 7. The three biggest companies with total capacity of more than 37 million ton are located in Java; they are PT Semen Gresik, PT Indocement Tunggal Prakarsa, Tbk. and PT Semen Cibinong. Other three companies are located in Sumatra, namely PT Semen Padang, PT Semen Baturaja and PT Semen Andalas Indonesia; their total capacity is 8 million ton/year. The remaining are PT Semen Tonasa (3.48 million ton/year) in Pangkep, South Sulawesi, PT Semen Bosowa Maros (1.8 million ton/year) in South Sulawesi and PT Semen Kupang (570 thousand ton/year) in Kupang, East Nusa Tenggara. Attachment II Shows the production, consumption and export capacities of Cement in Indonesia

According to the Indonesia Cement and Concrete Institute, and the Indonesian Cement Association, cement demand per capita in Indonesia is very low, only about 125 kg/person/year, while in developed countries the demand per capita could reach around 1000 kg/person/year. Just for a comparison, cement demand per capita in Malaysia, before economy crisis in 1998 was already 600 kg/person/year. Cement in Indonesia is mainly used for the housing not for road/infrastructure facility. Concrete road is much cheaper than asphalt road especially when the oil price is very high and, now asphalt must be imported too, but fly ash can be used as asphalt filler.

As an energy intensive industry, cost of energy is very dominant for cement factory, so does distribution cost, particularly when cement must be transported across the sea. For this reason, cement is mostly sold for domestic market, very few is exported to Asian countries.

Total coal consumption in cement factories is around 5.5 million ton annually, with the major consumers are those factories located in Java. Coal is mainly supplied from PT Arutmin (Mulia Coal), PTBA and some other mining companies in South Kalimantan.

Table 7. Cement Industries Indonesia (2005)

No.	Power Station Name	Location	Operation Since	Plant Design Capacity (10^3 tons/yr)	Cement Production (2004) (10^3 tons/yr)	Coal Annual Consumption (10^3 ton)	Description of Coal Used		
							Typical Quality	Name of Coal Reserve	Domestic/ Imported
1	PT Semen Andalas Indonesia (SAI)	Lhok Nga, Nangroe Aceh Darussalam	1982	1,400	1,236	185			
2	PT Semen Padang (SP)	Indarung, West Sumatera	1910	5,440	4,600	454			
3	PT Semen Baturadja (SB)	Baturaja, South Sumatera Palembang, South Sumatera Panjang, Lampung	1980	1,250	914	129	Sub-Bituminous	Bukit Asam	Domestic
4	PT Indocement Tunggal Prakasa, Tbk (ITP)	Citeureup, West Java Palimanan, West Java Tarjun, South Kalimantan	1975	15,650	10,232	1,939			
5	PT Semen Cibinong, Tbk (SC)	Narogong, West Java Cilacap, Central Java	1975	9,700	5,410	812			
6	PT Semen Gresik, Tbk (SG)	Gresik, East Java Tuban, east Java	1957	8,200	7,193	1,064	Sub-Bituminous	Adaro Baramulti Lain2	Domestic
7	PT Semen Tonasa (ST)	Pangkep, South Sulawesi	1968	3,480	2,419	784			
8	PT Semen Bosowa Maros (SBM)	Maros, South Sulawesi	1999	1,800	1,132	170			
9	PT Semen Kupang (SK)	Kupang, East Nusa Tenggara	1984	570	92	-			
	T O T A L			**47,490**	**33,228**	**5,537**			

Source : Indonesia Cement Association

Typically, coal specification used in cement industry is as follows:

- Total Moisture 17% max
- Inherent moisture 8% max
- Ash 12% max
- Volatile matter 45%
- Fixed carbon by different
- Sulfur 1% max
- Size 10-50 mm
- Calorific value 5,800 kcal/kg
  (higher CV is preferable, e.g. 6,200-6,500 kcal/kg)

PT Cement Gresik consumes about 3,000 ton/day coal from different quality between 5,000 to 6,500 kcal/kg, while Narogong plant of PT Semen Cibinong consumes around 2,500 ton coal/day with calorific value of 4,500 kcal/kg up

PT Indocement Tunggal Perkasa Tbk, which currently has 3 factories in operation, consumes approximately 7,500 ton coal/day or 2.5 million ton/year from PT Bukit Asam, PT Adaro and some smaller coal producers in Kalimantan with calorific values vary between 5,000 - 6,500 kcal/kg. This coal is used for processing only, not for combustion in the factory. Data released by PT Indocement shows that for every ton cement produced, the factory requires around 150 kg coal and about 100 kw electricity.

Basically, cement factory can burn all kind of coal, the most important thing is that the quality must be kept constant, disregard to the amount of ash. The maximum ash in coal that can be accepted by cement factory is 25%.

Indocement is the only cement factory which owns its power generation that can supply 2/3 part of total electricity required or 120 MW. The remaining of 60 MW is supplied by PLN. Indocement has a factory

located near by mining area in Batulicin. Its coal consumption per year is 2.5 million ton (5,800 kcal/kg)

Coal price FOB barge supplied to Indocement are as follows:

From big miners: USD 25-30/ton

From small miners/cooperatives: USD 20-22/ton

Price FOB vessel is USD 4/ton higher than FOB barge.

For Indocement, Suralaya is the major fly-ash supplier, while cement Gresik gets fly-ash from Paiton power generation. Indocement also gets some small amount of ash from PT Indah Kiat. Total ash required by Indocement is about 10,000-15,000 ton/month with transportation cost of Rp 70,000/ton.

The Chairman of the Indonesia Cement Association concerns very much with the hiking of the world and domestic oil price that have serious negative impact to local industry, in particular those high intensive energy users. For cement industry, this sharp increase in energy price has caused considerable increase in production and distribution costs, which finally will push the price of cement up too.

Cement cannot be substituted; therefore cement industry must be kept sustained and profitable. Efforts to solve problems in cement industry have been made; among others is promoting regulation on power wastes utilization for cement production. Instead of purchasing ash with expensive price, wastes ash producer should pay money to cement factory for treatment. Such regulation has been applied in many countries, and should be applied in Indonesia too. This regulation can finally reduce the production cost of cement.

Industry has urged the government to provide incentive so that they could survive amid rising prices for fuel. If no help was given to industry,

many companies would have gone out of business, or would be on the brink of collapse, and finally thousands of people would lose their jobs.

Unfortunately, the government even had mentioned previously that fuel prices will be raised gradually to bring them in line with market prices between the end of 2006 and the end of 2007

II. INVESTIGATION OF POLICY, LAW AND REGULATION RELATED TO ASH HANDLING AND UTILIZATION IN INDONESIA

The Environment Minister is drafting 4(four) State Minister to the Environment Law which will evidently be used for implementing decentralization for B3 (Hazardous and Poisonous Waste) and B3 Waste Management. This regulation is meant to convey "guidance" for the regions, so B3 and B3 Waste management can be operated directly in regions.

The 4 (four) Minister Regulations being drafted are among others:

- Environment Minister Reg. on Technical Prerequisites to Store & Gather B3 Waste
- Environment Minister Reg. on Rules & Regulations and Technical Prerequisites to Store & Gather B3 Waste
- Environment Minister Reg. on License Mechanism for Activities to Store & Gather B3 Waste
- Environment Minister Reg. on Decisions of Funding Licenses to Manage B3 Waste for the Storing & Gathering Activities

The table of regulations for B3 Waste Management is:

1.	RI Gov. Reg. No.74 Year 2001	B3 Waste Management
2.	RI Gov. Reg. No.19 Year 1999	B3 Waste Management
3.	RI Gov. Reg. No.12 Year 1995	Gov. Reg. Change No.19/1994
4.	RI Gov. Reg. No.18 Year 1999	B3 Waste Management
5.	RI Gov. Reg. No.85 Year 1999	Gov. Reg. Change No.18/1999
6.	SE Bapedal 08/SE/02/97	Lubricating Oil Waste
7.	BAPEDAL Head Decision No. KEP-02/BAPEDAL/09/1995	B3 Waste Documents
8.	BAPEDAL Head Decision No. KEP-05/BAPEDAL/09/1995	Symbol & Label of B3 Waste
9.	BAPEDAL Head Decision No. KEP-01/BAPEDAL/1995	Regulations and Technical Prerequisites of Storage & Collecting B3 Waste

10.	BAPEDAL Head Decision No. KEP-03/BAPEDAL/1995	Technical Prerequisites of B3 Waste Management
11.	BAPEDAL Head Decision No.KEP-04/BAPEDAL/1995	Guidelines of Piling Prerequisites, Prerequisites for Waste Dump Location for B3 Waste
12.	BAPEDAL Head Decision No.KEP-68/BAPEDAL/1994	Guidelines to Acquire License, to Store, Collect, Operate Equipment to Manage the end result of B3 Waste Management & Piling
13.	BAPEDAL Head Decision No.KEP-255/BAPEDAL/1994	Storing & Piling Lubricating Oil Residue

Waste included in B3 Waste is waste that fulfills one or more of the following characteristics:

a. Easily explodes
b. Flammable
c. Reactive
d. Poisonous
e. Infectious
f. Corrosive, and
g. The other wastes, if tested with the toxic method is known to be one of the B3 Waste type;

Type B3 Waste includes:

a. B3 Waste is from a non-specific source
b. B3 Waste is from a specific source
c. B3 Waste is from expired, spilled, chemicals, retaining chemical packages, and thrown-out products that do not meet specifications;

The detailed definition of the Handlings are:

a. B3 Waste producers should implement B3 Waste Management;
b. B3 Waste producers unable to implement B3 Waste Management produced by them, should turn over the B3 Waste to the B3 Waste Manager/Operator;
c. If the B3 Waste Manager as defined in point b is not ready or is not up to standards to manage B3 Waste, the B3 Waste management will still be the responsibility of the said B3 Waste producer;
d. B3 Waste transferred by the producer as defined in point b can be implemented directly to the B3 Waste Operator or through collection/piling of B3 Waste;
e. The B3 Waste Collector should transfer the B3 Waste received from the producer to the B3 Waste Manager/Operator;
f. The Collector is prohibited to implement any collection activities if the B3 Waste manager is not ready yet;

A Ministry Decision draft about the Coal Ash Processing is currently being made, starting from initiating the technical guidelines which will commence on it being structured by the Ministry Decision (Coal Ash waste processing – Fly ash and bottom ash). The Ministry of Environment Law categorizes this product as B3 (dangerous) waste; but because of technical/environmental considerations where ash can still be seen as useful, therefore the Ministry of Environment has decided to make/issue the said Ministry of Environment Decision orientated to 3 elements which are **Reuse, Recovery** and **Recycle**. The Minister targets December 2006 for the Ministry of Environment Decision to be completed, but fact shows otherwise since the issuance experienced delays and was expected to be completed by January 2007.

The Ministry Environment Decision technical structure includes the use of fly/bottom ash as follows:

1. As a substitute for basic material for cement
2. As building construction material: paving block, cone-block roof tiles and secondary brick.
3. To substitute fuel. In this case, fly ash still containing unburned carbon (carbon remains resulting from incomplete burning) in quite a large quantity, which is usually from the textile industries which generally uses boilers made in China. Ash that still contains a lot of unburned carbon is called **coal combustion product** (CCP). The CCP calorie value is only 3,000 kcal/kg since it should be blended with raw coal that has a high calorie value of 6,500-6,800 kcal/kg if it is to be used as fuel for industry – for example, fuel for the cement industry.

   Meanwhile, the ash cannot be directly utilized as basic material for cement (cement mix) requesting <5% LOI (zero expectation is called for), since it does contain a considerable amount of carbon (LOI~25%; LOI = fixed carbon). Ash containing Silica (SiO_2) is the type that is mainly hoped for other contents like CaO, Fe_2O_3 and Al_2O_3 are also expected.

This Ministry Decision does not accommodate the use of ash for roads and fertilizer since slight internal disagreements between the researchers and officials are still found. Therefore, it was decided that the regulation will be implemented in stages; accommodating the 3 elements above and 2 other elements are still pending since deliberations have not yet been met.

Permit issues for companies that want to move in this business category are required to acquire license/permit from the Ministry of Environment since ash is still categorized as B3 waste (the Ministry of Environment is working together with the Department of Industry and the Joint Work MoU has been signed).

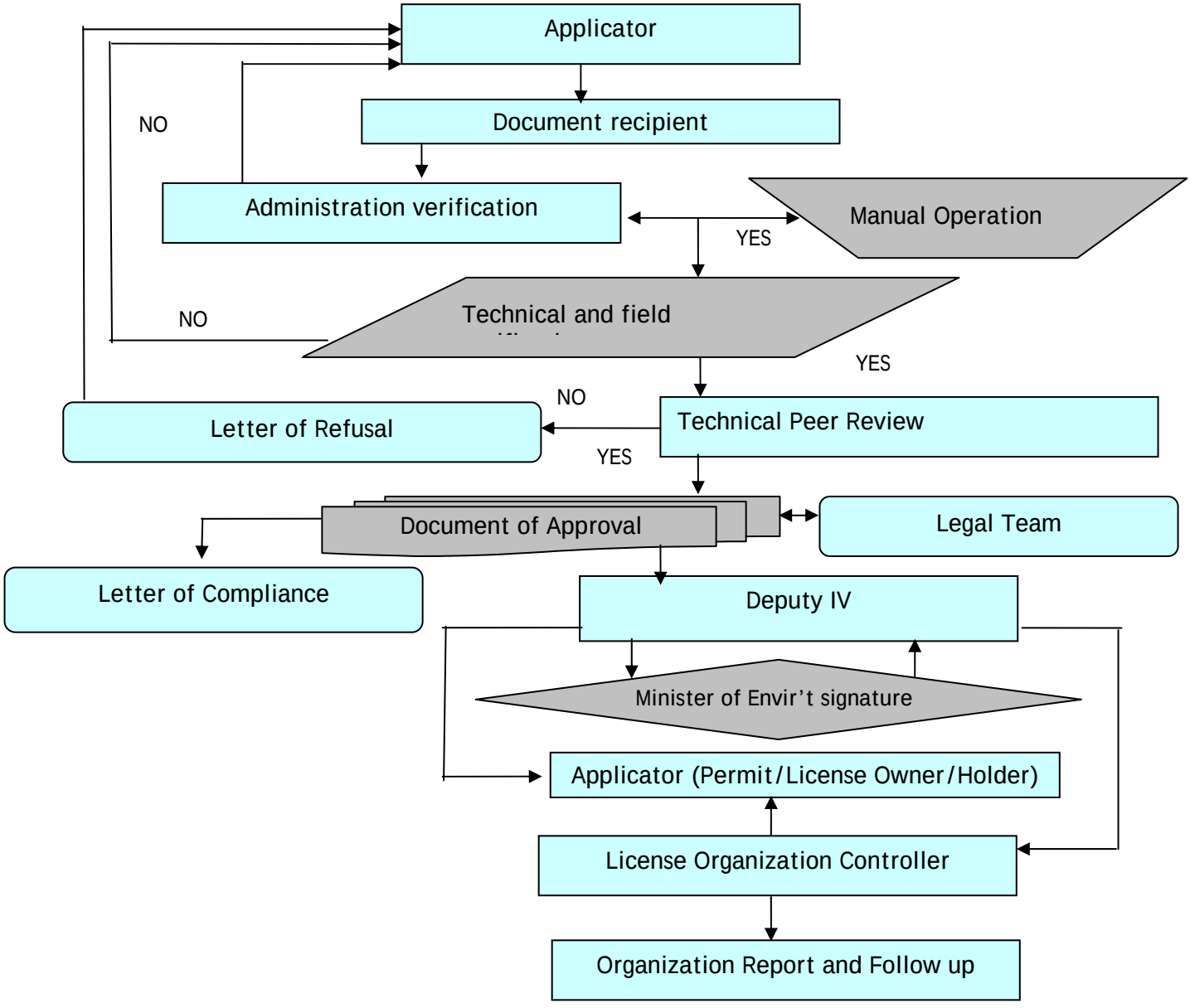
Basically, after the Ministry of Environment Decision is issued, then permit application and process for coal ash businesses will be much easier, or at least much easier than the former cases, for example, HOLCIM case, the company which has coal ash processing business. HOLCIM has applied for such a permit to manage and process coal ash waste and will be working together with PT Indocement to process ash waste from the textile industry to settle cases concerning ash from the industries to utilize it in the correct manner.

Most importantly, and the most difficult part is, according to the Ministry of Environment, control – so the focus is after the issuance of the Ministry of Environment Decision and not at the agreement level but control. If diversions should be met in the implementation of the Ministry of Environment Decision, then it should be reported to the Department of Industry that has issued such a work/business permit – therefore, this Department should also abolish the permit/license.

III. INVESTIGATION OF THE PROCEDURE FROM MINISTRY OF ENVIRONMENT FOR ASH HANDLING COMPANY

Applying for license to the Ministry of Environment can be seen in this diagram below:

LICENSE MECHANISM DIAGRAM



The division of B3 Waste Management License should be according to the issued license as follows:

- B3 Waste License
    - Storing
    - Collecting
    - Operating B3 Waste Management Equipment (incinerator, cleaning tank)
    - Piling
    - Utilizing
- Recommendation of B3 Waste Transportation
- Registration of B3 imports

The license application process through several stages, at the First Stage the applier fills in the form from the Ministry of Environment (attachment 1), should be provided with other required documents:

a. Company Act
b. Location Permit
c. Building Permit (IMB)
d. HO Permit (Business Location Disturbance)
e. Map of Activity Location
f. Definition of raw material and activity process
g. Definition on specifications of waste Management equipment
h. Definition of number and characteristic of hazardous and poisonous waste material

If the documents have been received, verified and approved, then the Second Stage is implemented, checking the location, to verify the Company's technical readiness and condition. The Third Stage is preparing documents for approval by attaching a Letter of Compliance to continue to the Deputy IV of the Ministry of Environment, and afterwards asking approval to the minister. The Fourth Stage is after License Approval where observation implementation of the B3 Waste Management begins.

IV. RECOMMENDATION BY MINISTRY OF ENVIRONMENT RELATED TO PERMIT OF ASH HANDLING COMPANY

License utilization fly/bottom ash prioritizing more to the cement producers or direct usage to mixed concrete, which has been prepared by Holcim cement. Recommendations provided should fulfill the criteria according to Gov. Reg. No.12 year 1995 with following articles:

Article 21

Clause (1)

Each Business Establishment that are doing the following activities:

a. Collect and/or manage B3 waste should own a license from the Body Head
b. Waste Impact Control. Transporting B3 Waste should own a license from the Ministry of Communications after acquiring recommendations from the Environmental Impact Agency Head
c. Use of B3 Waste should have a license from the related Government Supervisory Institution, after acquiring the recommendation from the Environmental Impact Agency Head

Clause (2)

The determination on regulations to acquire license as understood in clause (1) point a is determined by the Environmental Impact Agency Head, clause (1) point b Ministry of Communication Decision, and clause (1) point c related Government Supervisory Institution.

Clause (3)

Integrated B3 Waste Management activities with main responsibilities acquiring Management equipment operations and B3 Waste storage recommendation issued by the Environmental Impact Control Agency and implemented according to this Gov. Regulations Decision.

Clause (4)

The criteria to acquire license as understood in clause (1) point a and clause (2) is as follows:

1. Owning an Act of Establishment as a legal business establishment validated by an authorized institution.
2. The name and address of the business establishment applying for the license
3. The activities implemented
4. Activity location
5. Name and address of the body in charge/responsible of the activities
6. Raw material and activity process used – equipment specifications of waste Management operation
7. amount and characteristic of B3 Waste collected, transported or operated
8. Structure of waste canal/pipes, waste Management, and temporary storage of B3 waste before being processed and placed at the piling location after being processed
9. pollution prevention equipment for liquid waste, emission and processing of B3 waste

Article 22

Clause (1)

Location for B3 waste Process permit is given by the Regency/Municipality Land Office Head according to the organization plan after acquiring recommendation form the Environmental Impact Control Agency

Clause (2)

Recommendation as understood in clause (1) based o the study result of environmental impact and technical feasibility study like geo-hydraulic from the proposed location.

Article 23

Clause (1)

B3 Waste Management activities should make an environment impact analysis, environment Management plan, and environment observation plan

Clause (2)

The approved environment impact analysis, environment Management plan and environment observation plan documents are proposed with the operations permit application as mentioned in Article 21 to the Environment Impact Observation Body.

Clause (3)

The Decision approval upon the environment impact, environment Management plan and the environment observation plan analysis is issued by the Environment Impact Body.

Article 24

Clause (1)

The Decision on permit application as stated in Article 21 clause (2) should be submitted at least 30 (thirty) working days, starting from the approval of the environment Management plan and the environment observation plan by the authorized institution.

Clause (2)

Criteria and responsibility in the environment Management plan and the environment observation plan by the authorized institution is an inseparable part from the permit as understood in article 21.

Article 25

Clause (1)

If the B3 waste producer and utilizer also acts as the B3 waste processor and the processing location and the main activity location is in the same place,

then this should be made integrated with the analysis on the environment impact for main activities.

Clause (2)

If the B3 waste is processed by the producer and utilzer of the B3 waste at the main location, then only the environment Management plan and environment observation plan that has been approved by the related Supervisory Institution would be the one proposed to the Environment Impact control Agency Head together with the recommendation application as understood in Article 21 clause (3).

Clause (3)

The Decision on recommendation application as stated in clause (2) is issued by the Environment Impact Control Agency Head at least 30 (thirty) days since the receipt of the environment Management plan and the environment observation plan that has been approved by the related Supervisory Institution.

Clause (4)

The prerequisites and responsibilities in the environment Management plan and the environment observation plan as mentioned in clause (2) is an inseparable part from the recommendation mentioned in Article 21 clause (3).

Article 26

Clause (1)

When the producer and the utilizer of B3 waste that acts as the B3 waste Management and the processing location is different with the main activity, then the regulation for the B3 waste Management activity would be the validation of the Decision for the B3 Waste Management and this Gov. Regulation.

Clause (2)

For B3 waste utilizer activities, an analysis should be made on environment impact

Clause (3)

The analysis document on environment impact should be proposed to the Environment Impact Control Agency Head, and the approval on these documents should be issued/given b the Environment Impact Control Agency Head as well.

Clause (4)

The prerequisites and obligations stated in the environment Management plan and the environment observation plan as approved by the Environment Impact Control Agency Head becomes the criteria and obligation that should be stated in and by because it is inseparable from the permit as understood in Article 21 clause (1) point a.

V. NATURE OF SOME INDONESIAN COAL ASH AND ITS POSSIBLE UTILIZATION

The following table presents some Indonesian coal ash characteristics

Table-8: Some Indonesian coal ash characteristics

Ash Analysis by Tekmira

No.	Composition	Unit	Coal Power Plant					
			Paiton		Suralaya		Asam Asam	
			FA	BA	FA	BA	FA	BA
1	SiO2	%	41.30	51.10	51.30	62.20	44.40	87.80
2	Al2O3	%	29.50	17.94	34.60	25.50	27.00	4.43
3	Fe2O3	%	11.55	11.95	5.11	5.25	15.84	5.47
4	TiO2	%	1.25	1.36	0.13	0.13	1.44	0.27
5	CaO	%	9.13	4.78	4.48	2.37	3.49	0.15
6	MgO	%	2.46	1.98	1.81	1.20	2.32	0.30
7	K2O	%	1.14	2.83	0.48	0.33	0.68	0.36
8	Na2O	%	1.73	1.09	0.69	0.44	0.17	0.09
9	MnO2	%	0.04	0.08	0.20	0.18	0.22	0.05
10	SO3	%	0.82	0.25	tt	tt	0.67	0.09
11	P2O5	%	0.24	0.27	-	-	0.11	tt
12	LOI	%	0.62	6.22	0.45	2.16	3.43	0.69
13	Pb	ppm	80	40	tt	tt	19	7
14	Zn	ppm	230	130	90	30	896	61
15	As	ppm	-	-	-	-		
16	Ni	ppm	180	100	tt	tt	29.8	1.5
17	Cr	ppm	120	240	50	40	66	54
18	Co	ppm	130	240	50	40		
19	Cd	ppm	tt	-	90	70	5	1
20	Cu	ppm	0.009	870	-	-	523	63

- Current status of ash utilization in Indonesia

Fly/bottom ash is included in the Hazardous and Poisonous Waste category (B3) which is according to the Gov. regulation No.74/2001. Looking at the above situation and condition, we could say that the solution towards the availability of fly/bottom ash and its utilization related to security & safety towards the environment should be implemented according to the handling and management procedure for B3 waste in place, the solution that can be implemented is as follows:

1. Fly ash/bottom ash originating from the fluidized bed system can be used for:
    a. Anti acid cement mix
    b. Ready mix for asphalt and concrete (Asphalt / Concrete filler)
    c. Paving block/secondary brick mix
2. Fly ash originated form fixed bed system can be directly used for point 1.a, b, c. While the bottom ash which are still in chunks should go through the size reduction treatment before being used for other purposes.

The Fly ash/bottom ash produced by the fluidized bed system measuring 100-200 mesh (1 mesh = 1 hole/inch2). This size is relatively small and light, while the bottom ash measures 20-50 mesh. Generally, the fly ash/bottom ash size can directly be utilized in the cement industry/factory as a substituted for trass rock/chunks by incorporating it in the cement mill using the pneumatic system. Aside from using it in the cement industry, the fly/bottom ash can also be used as ready mix for asphalt, concrete and pressed as paving blocks or secondary brick. From an empiric study by the environment ministry, the best composition for ready mix paving blocks are as follows:

Lime	: 40%
Fly ash	: 10%
Sand	: 40%
Cement	: 10%

Too much ash may harm the strength of concrete or paving block.

The environment issues will rise from the bottom ash using the fixed bed or grate system. The chunks are big. The Bottom ash still contains fixed carbon (note: fixed carbon in coal with calories of 6500-6800 kkal/kg around 41-21%). If the bottom ash is directly dumped into the environment, then sooner or later it will turn to Methane gas (CH4) which will eventually go up in flames or explode by itself (self burning and self exploding). On the other hand, if the material is to be used for the cement industry, then it would

change the feeder design, so the cement industry will not be attracted to use bottom ash.

The cement industry needs fly ash used as a substitute for trass rocks having the character of pozzolanic for making anti acid cement (PPC). The use of fly ash in a typical cement factory is approximately between 4-6% weight of raw mill.

Chemical composition of fly ash as shown in the following table is similar to that of clay used in cement factory.

Table-9: Chemical composition of clay used in cement industry and fly ash

		Chemical Composition				
		SiO_2	Al_2O_3	Fe_2O_3	CaO	Na_2O_{eq}
Portland Cement Composition		20~23	3.8~5.8	2.5~3.6	63~65	0.3~0.7
Cement Ingredients	Lime Stone	~4	~2	~2	47~55	~2
	Clay	45~80	10~30	3~10	~5	2~6
	Silica	70~95	2~10	~5	~2	0.5~3.0
Coal Ash	Fly Ash	40~65	10~30	3~10	5~20	0.5~2.0

Source: Japan Cement Association

Cement as the cohesive element/material has been known since Early Egyptian era which is calcination of impure gypsum. While calcination of lime just started at Roman times. They used the material from Naples, Italy – the Pozzoalu region where the name Pozzolano was originated.

Portland cement is divided into 5 types: Porland Cement I to V. Each type has its specific mixture (according to the ASTM and SII standard – see attachment). Mixture means the difference in chemical composition and the cement's physics character that is formed. The chemical difference of several number of percent of calcium, silica, aluminum and iron as the main formula element for cement and the physics difference for instance, loss of ignition, strength of pressure, hydration heat, etcetera.

Generally, the composition of material forming PPC cement is:

- Clinker : 86%
- Gypsum : 4%
- Trass : 6%
- Fly ash : 4%

Based on the SNI 15-0302-1994 definition: PPC is hydraulic cement made of homogenous mixture between Portland cement and smooth pozzolan produced by mixing Portland cement clinker and pozzolan together with or evenly mixing Portland cement powder with pozzolan poweder or incorporating and grinding and also mixing where the pozzolan composition is 15 to 40% pozzolan Portland cement mass.

Based on the ASTM C 219 definition: PPC is hydraulic cement comprising of the mixture of Portland cement, blast furnace slag and pozzolan which is produced from mixing Portland cement clinker and pozzolan with mixing Portland cement or Portland cement blast furnace slag and separated refined pozzolan or a combination of grinding/mixing and mixture where the amount of ppozzolan is according to the required limit.

Based on the 2 (two) definition above, the difference between PPC and standard Portland cement (I to V) is the amount of trass or fly ash added with the mill finish process.

Adding fly ash would result to concrete structure as follows:

- Curing time (90 days) pace of pozzolanic reaction (tie Ca) will increase so the total of Ca (OH)2 that will interact with CO2 will decrease since the carbonization will be obstructed.
- Lowering concrete alkaline which is the cause of corrosion for iron concrete where the criteria will increase concrete durability towards oxidation caused by the environment which is acid in character (especially the swamp area).

- Possible Utilization

PT NNT Power Plant (Newmont Lesser Sunda Islands) produces around 580 tons of coal ash per month. While using coal ash that has been processed around 25 tons per month. And for this reason, many tests using coal ash for road pavement has been continuously conducted in the town of Town Site that totals 300 meters of road with satisfactory results.

One road in Townsite which was constructed by utilizing fly ash from buring coal

The suitability for ash utilization depends on several technical and economic factors such as:

- the chemical and physical properties of the ash;
- controlled variability of the ash properties;
- site specific factors, such as local land availability and local market for building materials;
- availability and quality of competing material and market structures;
- availability of waste lands or marginal lands which need rehabilitation;
- commercial experience in using the product.

Fly ash applications can be roughly categorized into low and high value added applications. Their main difference is that in the latter category the fly ash is either controlled or modified using advanced technologies, whereas in the first predominantly raw materials are directly used. Low value added applications mainly concern large scale use like land reclamation, whereas high value added applications mainly refer to building

materials. Table 10 presents an overview of available applications and methods.

Table-10. Listing of large and small scale fly ash applications

<table>
<tr><td colspan="4">Small scale application / building materials/high added value</td></tr>
<tr><td>Cement:
- Portland clinker
- Portland filler
- blast furnace cement filler
- slag filler
- slag preparation
- activated slag cement</td><td>Concrete:
- concrete mortar
- plaster mortar
- masonry mortar
- foam concrete
- dry mix
- fly ash sand
- concrete roads
- concrete products: flag-stone, paving stone, Kerb-stone, sewer pipe/pit, pile</td><td>Ceramics:
- paving stones
- bricks
- roof tiles
- porous tiles
- polysil tiles
- ceramic tiles & paver blocks</td><td>Civil engineering applications:
- asphalt filler
- road stabilization, sub-basis
- dikes
- banks
- industrial areas
- hydraulic engineering
- road construction: slopes, ramps, approach roads, concrete roads</td></tr>
<tr><td>Lime:
- sand-lime / calcium silicate brick
- insulation material
- cellular concrete
- gascon
- masonry mortar
- sewage sludge stabilizer</td><td>FGD Gypsum:
- indoor wall blocks
- cardboard/fiberboard self leveling floors retarding agent

Miscellaneous:
- zeolites
-</td><td>Synthetic artificial gravel:
- aardelite, a lime bound artificial gravel

lytag, a sintered light weight synthetic gravel</td><td>Upgrading techniques:
- calcining
- sintering
- wind shifting
- sieving, screening
- grinding, milling
- mixing, blending
- drying
- micronising</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="4">Large scale application/low added value</td></tr>
<tr><td colspan="4">- Use on agricultural land as fertilizer
- Land reclamation for agriculture and forestry
- Land reclamation for building
- Application in large infrastructure works
- Mine back filling (mine stowing)
- Rehabilitation of uncontrolled landfills</td></tr>
</table>

VI. POTENTIAL DEMAND OF COAL ASH

-Cement Industry

The data from the Department of Industry shows that national cement production in 2004 reached 33 million tons while domestic consumption totaled 29.3 tons. The 2005 consumption reached 32.2 million tons. The needs are still lower than the national cement production capacity that reached 47.49 million tons.

Table-11 below shows Indonesian cement production and the production capacity in year 2004 (Source : Indonesia Cement Association)

No.	Industry Name	Location	Operation Since	Plant Design Capacity (10^3 Tons/Yr)	Cement Production (2004) (10^3 Tons/Yr)	Coal annual Consumption (10^3 Ton)
1	PT Semen Andalas Indonesia	Lhok Nga, Aceh	1982	1,400	1,236	185
2	PT Semen Padang	Indarung, West Sumatra	1910	5,440	4,600	454
3	PT Semen Baturadja	Baturaja, South Sumatera	1980	1,250	914	129
4	PT Indocement Tunggal Prakasa	Citeureup, West Java	1975	15,650	10,232	1,939
5	PT Semen Cibinong	Narogong, West Java	1975	9,700	5,410	812
6	PT Semen Gresik	Gresik, East Java	1957	8,200	7,193	1,064
7	PT Semen Tonasa	Pangkep, South Sulawesi	1968	3,480	2,419	784
8	PT Semen Bosowa Maros	Maros, South Sulawesi	1999	1,800	1,132	170
9	PT Semen Kupang	Kupang, East Nusa tenggara	1984	570	92	-
	TOTAL			47,490	33,228	5,537

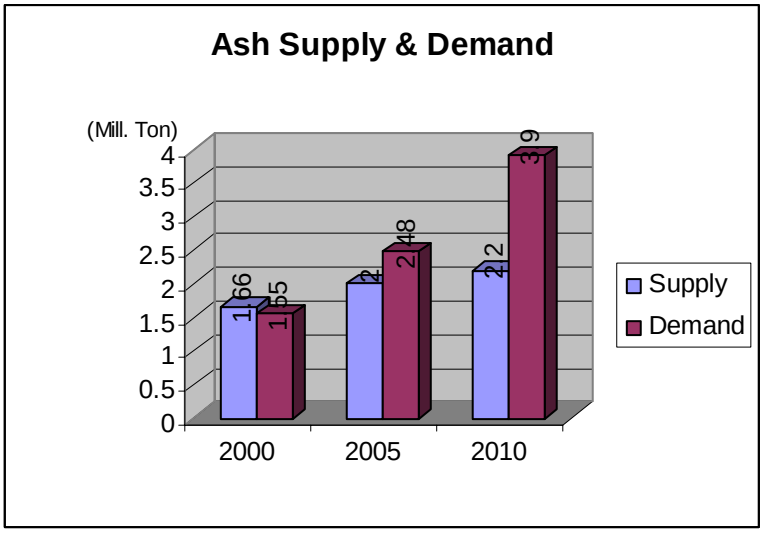
Table-12: Indonesia Cement Specification

No.	Type	Production (%)	Fly Ash (%)
1	Portland Cement Type 1 (OPC)	70	0
2	Portland Composite Cement (PCC), 5% limestone	15	15
3	Portland Pozzolan Cement (PPC)	15	10
4	Fly Ash Cement (if Ash is Available)	0	40

Note: Total cement production is 32.2 million Tons in year 2005

From the above table we can see that PCC and PPC cement production total 9.9 tons in 2005, while potential fly ash is utilized for cement production of the PCC and PPC type which totals 2.48 tons.

The data from the Chemical, Agro and Forest Yield Directorate General – Department of Industry assumes that average cement growth is 10%/year, therefore, the need for cement in year 2010 would rise to 52 million tons. This would mean the need for fly ash would increase to 3.9 million tons.



One of the most profitable characteristic and component of fly ash is its similarity to zeolite. The main component of coal fly ash is mullite ($3Al_2O$-$3.2SiO_2$), quartz (SiO_2), hematite (Fe_2O_3), magnetite (Fe_3O_4). Apart from the minerals mentioned, we also find other minerals but to a smaller amount, which enables fly ash to be the basic material of zeolite, which is a porous material that can be used for many things; which among others are

absorbent, as an ion replacement, molecule strainer, filler, fertilizer mix as a release agent, catalyst as well as a catalyst culture.

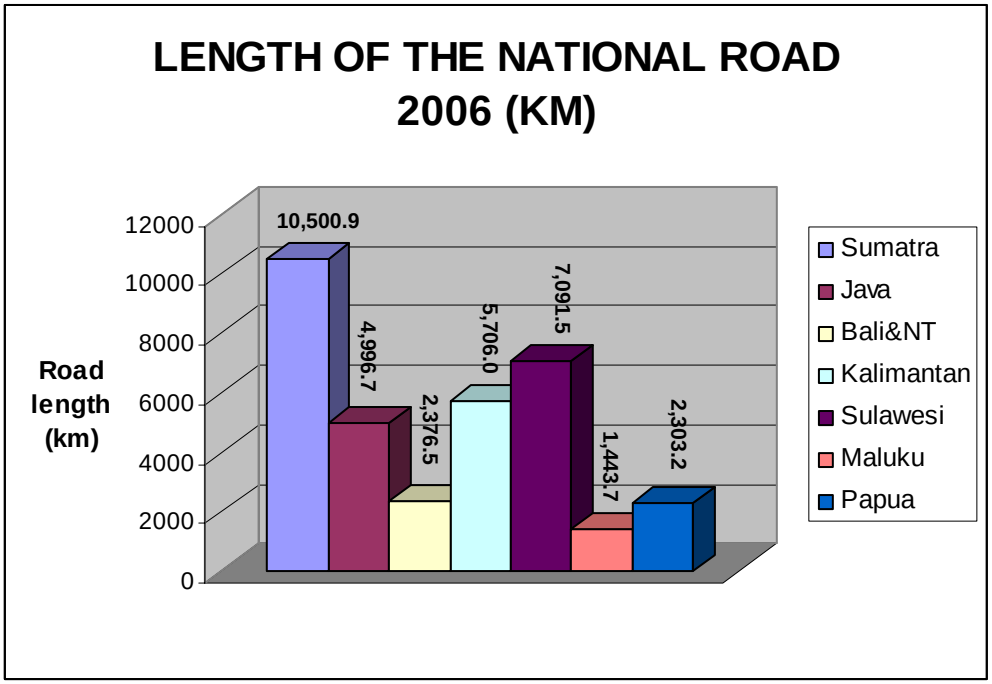
-Infrastructure

Fly ash is also beneficial for Material Admixture for concrete (concrete mix). Base on date from the Department of Public Works Year 2006, the national road network totals 34,506.5 Km.

Table-13: NATIONAL ROAD CONDITION 2006

NATIONAL ROAD CONDITION 2006 (STATUS PER 1 JANUARY 2006)								
BASED ON **IRI** CRITERIA								
No	Island / Nasional	Road length (KM)	ROAD CONDITION					
			Very good	Good	Moderate	Not good	Minor damage	Severely damage
1	Sumatra	10,588.9	9,352.9	5,309.4	4,043.5	1,236.1	734.6	501.4
2	Java	4,996.7	4,676.7	2,886.9	1,789.8	320.1	237.8	82.2
3	Bali & Nusa Tenggara	2,376.5	2,032.2	1,244.5	787.7	344.3	298.1	46.2
4	Kalimantan	5,706.0	3,770.8	2,501.2	1,269.6	1,935.1	541.9	1,393.2
5	Sulawesi	7,091.5	5,822.4	3,699.2	2,123.2	1,269.1	610.5	658.6
6	Maluku & Maluku Utara	1,443.7	825.6	644.2	181.4	618.1	201.0	417.1
7	Papua	2,303.2	880.4	549.9	330.5	1,422.8	343.6	1,079.2
Indonesia		34,506.5	27,360.9	16,835.4	10,525.5	7,145.5	2,967.6	4,178.0
Source: Directorate General Bina Marga-Department of Public Work								
Notes: excluded Jakarta								

According to the above data, severely damaged roads replaced with material using concrete admixture, and assuming that 10% of fly/bottom ash is mixed into this material, then approximately 250.68 m3 of fly/bottom ash is needed for a road 6 meters long. This need will increase if the roads in the provinces are also calculated.



The table 14 below shows the development of national roads and provinces 2000-2004:

Table-14: Data of roads Nationwide, Province and its development

No	Province	National			Province		
		2000 (Km)	2004 (Km)	Average Road development Per year (%)	2000 (Km)	2004 (Km)	Average Road development Per year (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Nanggroe Aceh D	1,144.02	1,782.78	11.73	1,701.82	1,701.82	0.00
2	North Sumatra	1,305.96	2,098.05	12.58	2,919.72	2,752.50	-1.46
3	West Sumatra	871.95	1,200.09	8.31	1,288.41	1,130.73	-3.21
4	Riau	838.56	1,126.11	7.65	2.162.82	1,795.92	-4.54
5	Jambi	853.27	820.40	-0.98	1,566.68	1,525.40	-0.67
6	Bengkulu	1,006.95	1,290.24	6.39	1,624.99	1,621.33	-0.06
7	South Sumatra	750.43	736.44	-0.47	1,500.29	1,356.57	-2.49
8	Lampung	851.26	1,004.16	4.22	2,369.97	2,355.09	-0.16
9	Bangka Belitung	0,00	530.65	#REFI	912.59	511.48	-13.48
10	DKI Jakarta	153.50	122.38	-5.51	1,328.99	1,124.51	-4.09
11	West Java	1,062.22	1,140.69	1.80	1,994.41	2,141.23	1.79
12	Central Java	1,215.46	1,297.63	1.65	2,525.55	2,550.21	0.24
13	D.I. Yogyakarta	158.34	168.81	1.61	690.25	690.25	0.00
14	East Java	1,783.49	1,899.21	1.58	1,439.18	1,439.18	0.00
15	Banten	0.00	490.40	#REFI	456.43	372.25	-4.97
16	Bali	405.93	501.64	5.44	673.40	839.88	5.68
17	Nusa Tenggara Barat	541.22	601.83	2.69	1,763.61	1,416.41	-5.33
18	Nusa Tenggara Timur	1,121.85	1,273.02	3.21	2,939.86	2,626.92	-2.77

19	West Kalimantan	1,006.62	1,575.32	11.85	1,788.96	627.64	-23.04
20	Central Kalimantan	1,707.53	1,714.95	0.11	1,059.26	771.56	-7.62
21	South Kalimantan	864.07	876.00	0.34	1,056.38	898.14	-3.98
22	East Kalimantan	1,226.21	1,539.70	5.86	1,640.07	1,442.07	-3.17
23	North Sulawesi	1,360.39	1,267.39	-1.75	1,310.52	740.57	-13.30
24	Central Sulawesi	1,592.99	1,806.46	3.19	2,037.06	1,976.81	-0.75
25	South Sulawesi	1,669.57	2,107.54	6.00	1,618.51	1,486.47	-2.11
26	South East Sulawesi	612.60	1,293.87	20.55	1,487.36	488.80	-24.29
27	Gorontalo	0.00	616.24	#REFI	468.22	284.22	-11.73
28	Maluku	464.68	985.46	20.68	1,611.87	997.7	-11.30
29	North Maluku	0.00	458.21	#REFI	688.93	586.74	-3.93
30	Papua	1,701.96	2,303.16	7.86	1,872.60	1,872.60	0.00
		26,271.03	**34,628.83**	**7.15**	**46,498.71**	**40,125.02**	**-3.62**

SOURCE :
- Length of National Road (2000): based on Kepmen PU No. 236A/KPTS/1997
- Length of National Road (2004): based on Kepmen Kimpraswil No. 376A/KPTS/2004

NOTES : Symbol #REFI: data is not available/the province was not exist yet
and data in collumms 5 & 8 were from the *Balai Literal Pusdatin*

The data above shows estimation for 2010, where an additional of 2,475.96 km of roads is needed nationwide, with the assumption of road construction using concrete admixture and 10% fly/bottom ash mix, therefore, the need for fly/bottom ash will reach up to 148. 55 m3 for additional road length of 6 meters.

This table below shows the percentage of type of road surface in Indonesia for year 2000:

Table-15: Type of National Road Network

Island	National Road			Provincial Road			Regency Road		
	Asphalt (%)	Not Aspal (%)	Total (%)	Asphalt (%)	Not Asphalt (%)	Total (%)	Asphalt (%)	Not Asphalt (%)	Total (%)
Sumatra	99,60	0,40	100	88,80	11,20	100	36,86	63,14	100
Java	100	0	100	99,40	0,60	100	61,05	38,95	100
Kalimantan	64,10	35,90	100	73,20	26,80	100	39,46	60,54	100
Sulawesi	93,80	6,20	100	91,10	8,90	100	39,57	60,43	100
Irian	41,40	58,60	100	65,50	34,50	100	17,34	82,66	100
Others	98	2	100	84,42	15,58	100	39,36	60,64	100
Indonesia	88,30	11,70	100	88,20	11,80	100	43,09	56,91	100

Source : IIRMA data year 2000

Assuming that the national and provincial roads are not yet using asphalt and concrete admix with 10% fly/bottom ash mix will be used, then the need for fly/bottom ash would total 513.02 m3 for additional road length of 6 meters.

-Agriculture

Up till now, coal ash has been significantly used for cement and concrete industries, fillers for mining material and digging material as well as other things. One of the benefits of coal ash which is being studied by TekMIRA is to treat tailing soil originating from gold producing activities in West Java. Tailing has characterization as basic compound and contains several heavy metals. By adding fly ash to the tailing soil, it would neutralize the heavy metal contents in soil. Eventually, the neutralized land can be used for plantation or agricultural estate.

-Land application with fly ash use as fertilizer

This type of application is considered an attractive alternative for disposal of fly ash compared to the current procedure of disposal. However, concern of trace element contamination has been one factor that has limited widespread land application. Another major limiting factor is the lack of macro nutrients (notably nitrogen) in the ash, which is consequently of little agronomic value. However, several studies has shown that the mixing of fly ash with an organic waste product such as paper mill water, sewage sludge or poultry litter can produce a balanced soil amendment with equivalent nutrient availability to conventional fertilizers. Moreover, addition of fly ash improves the water holding capacity and the structure of the soil.

-Land reclamation for forestry and agricultural development by covering the soil with a fly ash layer.

Recent studies have revealed that fly ash is very similar to volcanic ash from a morphological, physical and chemical point of view. Given enough time, both ash types are predisposed to transform into a fertile soil. This 'naturalization process' is enhanced by the action of vegetation. If properly

exploited and managed, these unique properties make fly ash a potential resource for forestry and agriculture. This last point is of special importance because some of the largest producers of coal fly ash (e.g. India and China) have the greatest need for fertile soil and renewable energy.

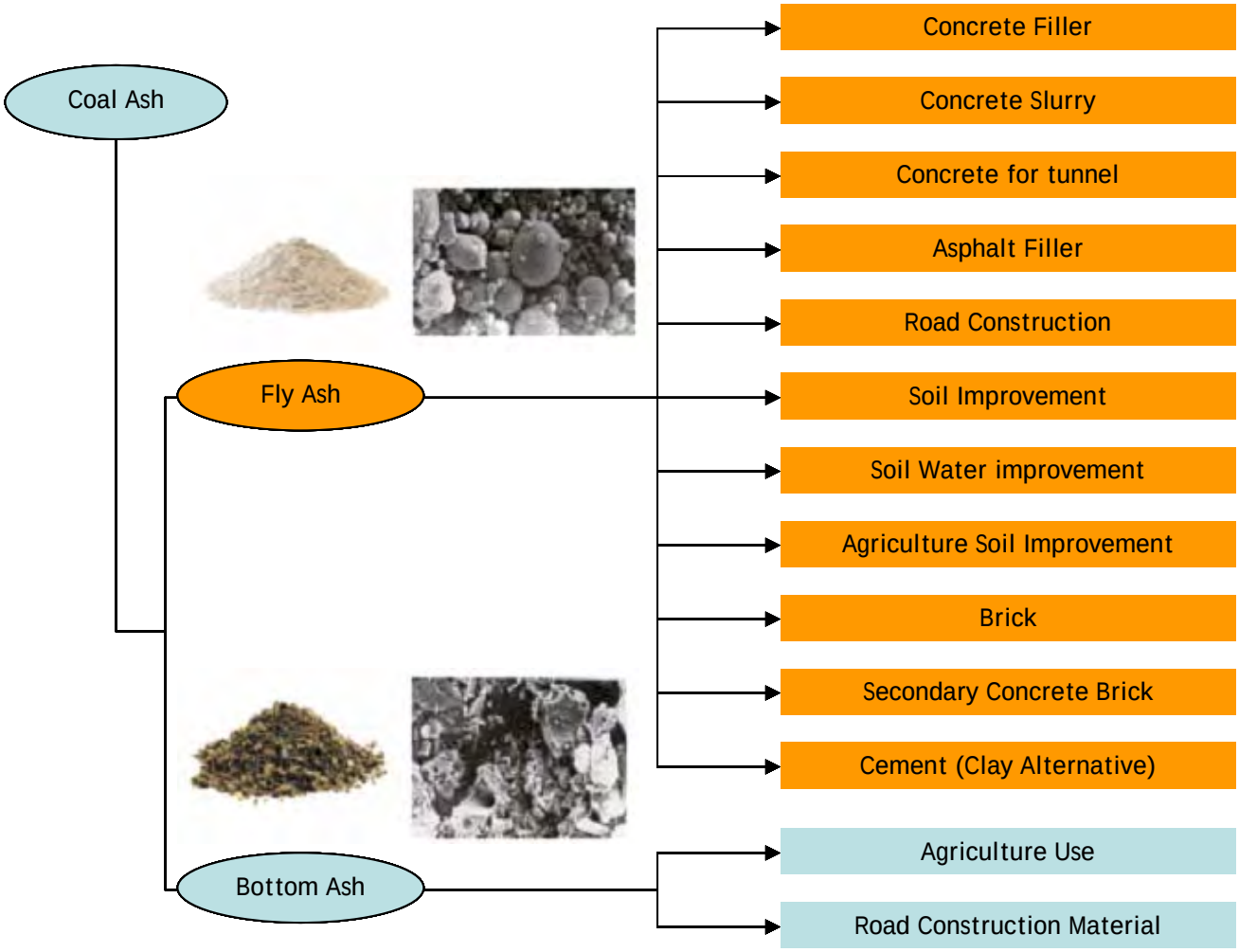
-Land reclamation for developing building areas.

Building areas require consolidated soils. Advanced pumping systems are now available which are able to transport low moisture fly ash over large distances. Application of low moisture fly ash provides stable consolidated soils in a relative short period of time.

-Mine back filling

Mine back filling has demonstrated to be an attractive option for those plants located near the coal mine. Back filling of underground mines is technically vulnerable and especially holds good potentials for those areas where sand is scarce. Open cast mine filling can again be considered as land reclamation.

VII. ASH UTILIZATION STANDARD



The table 16 below shows data of fly/bottom ash utilization in Japan in year 2000, the source is form the Japan Coal Energy Center (JCOAL).

Table-16: Effective coal ash utilization in Japan by sector in fiscal 2000

(Unit: thousand tons)

Item		Electric power utilities		General industries		Total	
Sector	**Contents**	**Amount**	**Ratio(%)**	**Amount**	**Ratio(%)**	**Amount**	**Ratio(%)**
Cement	Raw material	3,042	61.68	1,333	66.68	4,375	63.12
	Admixture	189	3.83	185	9.25	374	5.4
	Ready mixed	87	1.76	57	2.85	144	2.08
	total	**3,318**	**67.27**	**1,575**	**78.79**	**4,893**	**70.6**
Public works	Soil treatment	96	1.95	45	2.25	141	2.03
	Public works	121	2.45	24	1.2	145	2.09
	Public works for electric power	26	0.53	0	0	26	0.38
	Sub-grade stabilization	65	1.32	31	1.55	96	1.39
	Asphalt filler	3	0.06	0	0	3	0.04
	Backfilling in coal mines	291	5.9	0	0	291	4.2
	Total	**602**	**12.21**	**100**	**5**	**702**	**10.13**
Construction works	Construction board	198	4.01	109	5.45	307	4.43
	Lightweight aggregate	28	0.57	0	0	28	0.4
	Concrete product	27	0.55	2	0.1	29	0.42
	Others	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Agriculture, forestry & fisheries	Fertilizer	41	0.83	2	0.1	43	0.62
	Soil improvement	9	0.18	70	3.5	79	1.14
	Thawing material	0	0	22	1.1	22	0.32
	Total	50	1.01	94	4.7	144	2.08
	Sewage	2	0.04	1	0.05	3	0.04
	Iron manufacture	1	0.02	2	0.1	6	0.04
	Others	706	14.31	116	5.8	822	11.86
	Total	709	14.38	119	5.95	828	11.95
Grand total		**4,932**	**100**	**1,999**	**100**	**6,931**	**100**

- Ash Mix Standard

Table of Indonesia Cement Specification Standard (source: Tonasa Cement, Indocement)

Table-17: Cement Specification according to Indonesia Standard

No.	Type	Production (%)	Fly Ash (%)
1	Portland Cement Type 1 (OPC)	70	0
2	Portland Composite Cement (PCC), 5% limestone	15	15
3	Portland Pozzolan Cement (PPC)	15	10
4	Fly Ash Cement (if Ash is Available)	0	40

Source : Tonasa Cement, Indocement

VIII. POSSIBLE ORGANIZATION TO PROMOTE ASH UTILIZATION

As mentioned in Chapter II, a Ministry Decision draft about the Coal Ash Processing (concerning Fly ash and bottom ash) is currently being prepared. Since The Ministry of Environment Law categorizes that this product as B3 (dangerous) waste, therefore the Ministry of Environment has decided to issue the Ministry of Environment Decision orientated to 3 elements which are **Reuse, Recovery** and **Recycle**. Such decision has been made based on consideration that ash can still be seen as useful "wastes". Besides, Indonesia will requires huge amount of ash for the construction of roads, bridges, buildings and other infrastructure This Ministry of Environment Decision is expected to be completed very soon, in the earlier of 2007.

The Ministry Environment Decision covers the issues of utilizing fly/bottom ash as a substitute for basic material for cement, building construction material, and fuel subtitution. Unfortunately, this Ministry Decision does not accommodate the use of ash for roads and fertilizer.

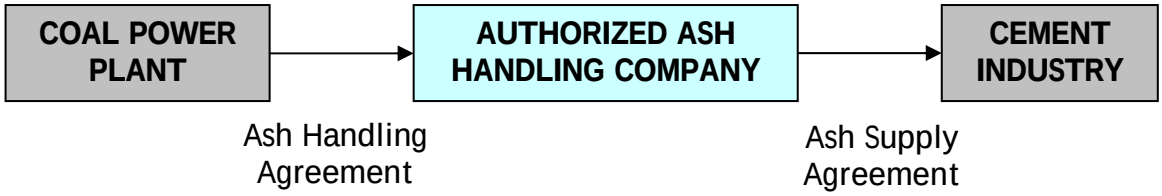
Permit issues for companies that want to move in this business category are required to acquire license/permit from the Ministry of Environment since ash is still categorized as B3 waste (the Ministry of Environment is working together with the Department of Industry and the Joint Work MoU has been signed).

At the moment the only company which has coal ash processing business in Indonesia is PT. HOLCIM Indonesia (cement factory) to process ash waste from the textile industry in cooperation with PT Indocement. The permit/lisence was issued as a special case which is urgently needed to settle cases concerning ash from the textile industries to utilize it in the correct manner, although the Ministry of Environment Decision about the Coal Ash Processing is not issued yet.

According to the Ministry of Environment, the most difficult part is how to control the quality of ash, which is the responsibility of the Ministry of Environment office and Bappedal to carry out ash verification and set an ash utilization standard for industry – so the major problem is after the issuance of the Decision is not at the agreement level but control.

The possible role of the ash handling company is to verify the ash quality and confirm that the ash is not reachable. The company should have a R&D laboratory for this purpose and set an industrial standard for ash utilization practice. The company can sell the ash to cement industry based on the standard, which most likely must be approved by the authority

If diversions should be met in the implementation, then it should be reported to the Department of Industry that has issued such a work/business permit – therefore, this Department should also abolish the permit/license.



Fly/bottom ash yielded by the Steam Power Supply Plant or Industries can only be managed and utilized by a business that owns a permit/license to manufacture B3 Waste, therefore contract agreement is needed between the Steam Power Plant/Industry with the company that produces fly/bottom ash.

ATTACHMENT 1

PERMIT APPLICATION FORM TO MANUFACTURE B3 WASTE

No…. To the Ministry of Environment
Attachment…. JAKARTA
Subject…..

With this letter we would like to apply a permit/license to stock/collect/operate equipment to manufacture/stock end result)* of B3 Waste with the following data:

I. DEFINITION OF APPLICATION:

1.Application
a. Name of applicator/authorized person:
b. Address
c. Phone/Fax
2. Company
a. Name of applicator/authorized person:
b. Address
c. Phone/Fax
d. Type of business
e. Establishment Notary Act
f. Principle Agreement No.
g.Tax No.
h..Permits/license already acquired (location, Construction, HO and AMDAL)

II. LOCATION DEFINITION

1.Width
2.Location
3.Village
4.Subdistrict

5.Regency/Manucipality

6.Province

III. B3 WASTE MANAGEMENT DEFINITION

1.Type of manufacture:
(stocking/ collecting/ processing and piling
end result)*

2.Specification of processor and equipment used

3.Amount, character of Waste being stocked/collected/processed/piled

4.Channel/pipe structure of B3 Waste Management

5.Prevention equipment for pollution of liquid waste and emission

6.Systems equipment for emergency cases

IV. PERMIT APPLICATION DOCUMENTS FOR THE MINISTRY OF ENVIRONMENT

1.Company Establishment Notary Act

2.Location permit

3.Construction permit

4.HO Permit

5. AMDAL approval

6.Location activity map

7.Definiton on raw materials and activity process

8.Definition on waste Management equipment

9.Definition on number and character of B3 waste

Jakarta,……..2007

Name and signature of applicator

Stamp duty

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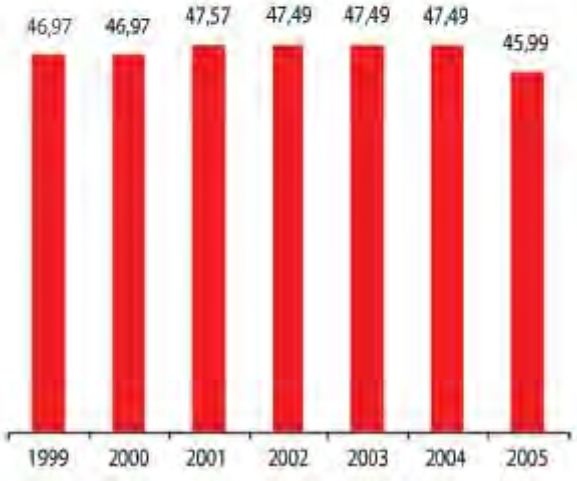
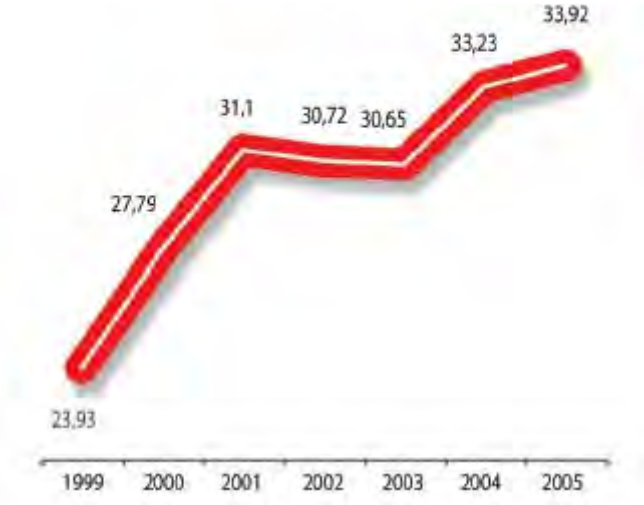
ATTACHMENT 2

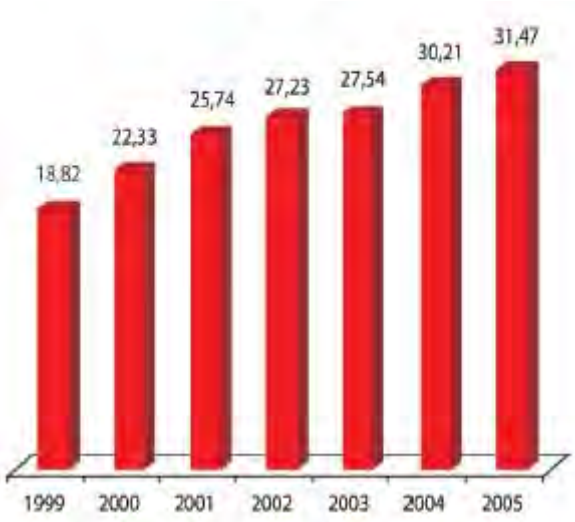
Production **Capacity** of Cement Industry in Indonesia
1999-2005 (million ton)



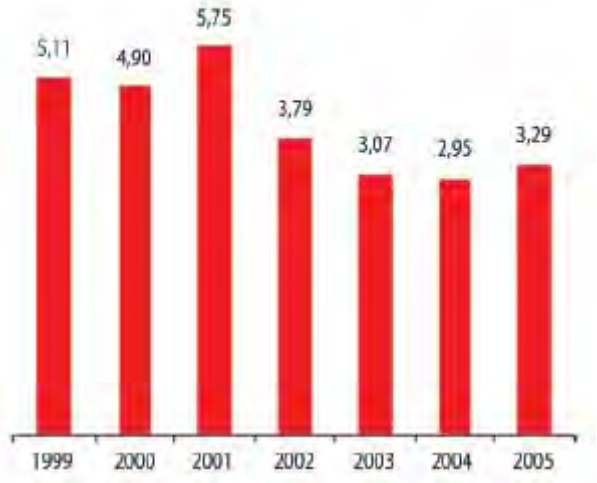
Cement Total Production in Indonesia
1999-2005 (million ton)



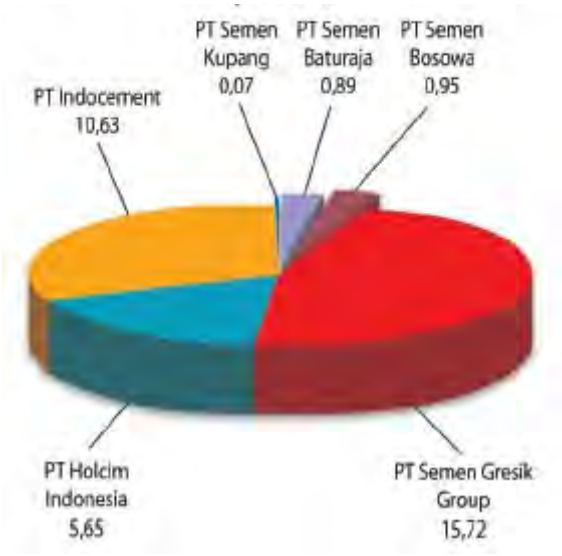
Cement Consumption in Indonesia
1999-2005 (million ton)



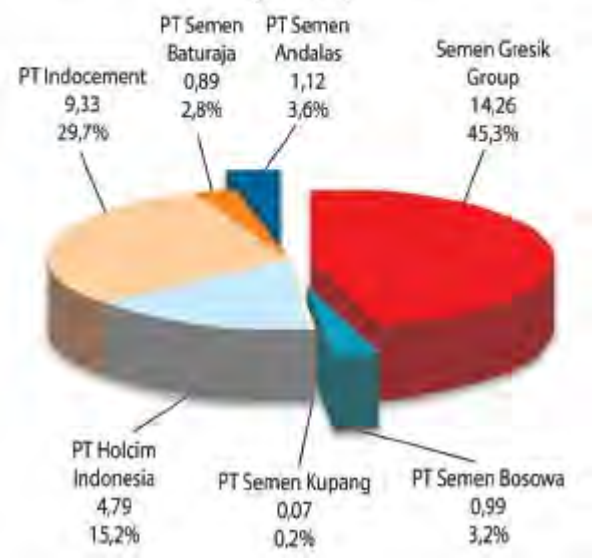
Indonesia Cement Export
1999-2005 (million ton)



Production Real of Cement Factory in 2005
(Million ton)



Total Sales of Indonesia Cement Factories
In 2005 (million ton)



Total Cement Consumption per Region
In 2005 (million ton)

Indonesia Cement Export in 2004 (million ton)

Attachment 2

Environmental and Social Considerations

for

Construction of the Power Plant

CONTENTS

LIST of TABLES

LIST of FIGURES

Chapter 1 Environmental and Social Considerations

1.1 Background

In the JICA development study "The Master Plan Study on Pollution Risk Mitigation Program for Sustainable Coal Mine Development in East Kalimantan Province in the Republic of Indonesia", an IEE was executed the construction of the coal power plant to use the unsalable coal effectively was assumed was proposed. The implementation of AMDAL is described in the specification of the JICA study. However, AMDAL in the law of Indonesia is an EIA. The IEE study was implemented in this study because there is no project owner and this is a masterplan study. The preliminary AMDAL study is referred as "AMDAL" in this chapter.

1.2 AMDAL Schedule

Table 1-1 AMDAL Schedule

Activities	2006					2007	
	8	9	10	11	12	1	2
Study of Legislations & Standard Regulations for AMDAL Study							
Stakeholder Meeting (AUDIENSI)							
Scoping							
AMDAL Study							
Collection & Analysis of Secondary data							
Collection & Analysis of Primary data							
Public Hearing							
Stakeholder Meeting (Public Consultansi)							
Evaluation of Environmental Impacts							
Draft Final Report							
Workshop (Jakarta & Samarinda)							
Final Report							

1.3 Legislations and Standard Regulations

This preliminary EIA study is backed up by the following legislations and regulations:

1.3.1 Legislations

Republic of Indonesia Law Number 5 Year 1960 on Basic Regulations of Agrarian Principles.
Republic of Indonesia Law Number 6 Year 1968 in-conjunction with Law Number 12 Year 1970 on Domestic Capital Investment (PMDN)
Republic of Indonesia Law Number 5 Year 1990 on Conservation of Living Natural Resource and its Ecosystem.

Republic of Indonesia Law Number 24 Year 1992 on Spatial Planning.
Republic of Indonesia Law Number 23 Year 1997 on Management of the Living Environment.
Republic of Indonesia Law Number 20 Year 2002 on Electric Power.
Republic of Indonesia Law Number 22 Year 1999 on Regional Government.

1.3.2 Government Regulations

Government Regulation Number 18 Year 1999, in-conjunction with Government Regulation Number 85 Year 1995, on Management of Dangerous and Poisonous Materials.
Government Regulation Number 41 Year 1999 on Air Pollution Control.
Government Regulation Number 27 Year 1999 on Preliminary Environmental Impact Assessment.
Government Regulation Number 82 Year 2001 on Management of Water Quality and Water Pollution Control.

1.3.3 Ministerial Decrees

State Minister for the Living Environment Decree Number 13 Year 1995 on Standard Quality of Emission of Stationary Source.
State Minister for the Living Environment Decree Number 48 Year 1996 on Noise Level Standard.
State Minister for the Living Environment Decree Number 49 Year 1996 on Standard Quality of Vibration Level.
State Minister for the Living Environment Decree Number 45 Year 1997 on Standard Index of Air Pollutant.
State Minister for the Living Environment Decree Number 17 Year 2001 on Types of Planned Business and/or Activity that Require Preliminary Environmental Impact Assessment Studies.
State Minister for the Living Environment Decree Number 37 Year 2003 on Surface Water Quality Analysis and Sampling Method.
Minister of Mining and energy Decree Number 0.1.P/47/PME/1992 on High Voltage Air Channel Open Space (SUTT) and Extra High Voltage Air Channel (SUTET) for Electric Power Distribution.
Minister of Public Works Regulation Number 63 Year 1993 on River Border Line, River Use Area, River Authority Area, and Former River.
Minister of Public Works Regulation Number 45 Year 1990 on Water Quality Control in Water Sources.
Minister of Public Works Regulation Number 48 Year 1990 on Management of Water and/or Water Source in River Regions.
Minister of Public Works Regulation Number 49 Year 1990 on Procedure and Requirements of the Water and/or Water Source Utilisation Permit.

1.3.4 Decrees of the Head of Environmental Impact Control Agency (BAPEDAL)

Head of BAPEDAL Decree Number Kep-056/BAPEDAL/1994 on Guideline for Determining the Magnitude of Significant Impact.
Head of BAPEDAL Decree Number Kep-299/BAPEDAL/11/1995 on Technical Guideline for the Study of Social Aspect in Compilation of Preliminary Environmental Impact Assessment.
Head of BAPEDAL Decree Number Kep-124/12/1997 on Guideline for the Study of Public Health Aspects in Compilation of Preliminary Environmental Impact Assessment.
Head of BAPEDAL Decree Number 08 Year 2000 on Community Involvement and Information Disclosure in Preliminary Environmental Impact Assessment Process.

1.3.5 Decree of Director General of Electricity

Director General of Electricity and New Energy Decree Number 75-12/008/600.2/95 on Directive for Implementation Supervision of Environmental Management and Monitoring in Electric Power.

1.3.6 Decrees of the Governor of East Kalimantan

Governor of East Kalimantan Regulation Number 339 Year 1988 on Standard Quality of Emission on East Kalimantan Province.
Governor of East Kalimantan Regulation Number 22 Year 1995 on Underground water limitation usage for industrial need on East Kalimantan Province.
Governor of East Kalimantan Regulation Number 660 Year 2000 on Environmental standard laboratories on East Kalimantan Province.

Chapter 2 SCOPE of EIA STUDY

2.1 The Extensive and Significant Impacts

Extensive and significant impacts analysed in this study were identified based upon the results of the scoping process discussed in EIA Regulations. Those impacts have been determined as probable impacts of the construction of the power plant and its associated transmission lines (**Table 2-1**) that need careful assessment. They were predicted to occur during the pre-construction, construction, operation and post-operation stages.

2.2 The Area of EIA Study

The boundary of the EIA Study for the Construction of 2x50 MW Coal-Fired Power Plant was dictated by the combination of the boundaries of the project sites, ecological boundary, social boundary and administrative boundary.

2.2.1 Project Boundary

The Project boundary was the boundary that encircles the area where the project will take place, i.e. within the power plant project site (total area 20 hectares), and along the transmission lines (total length 10 km).

2.2.2 Social Boundary

The social boundary was established based on the possibility of changes in the local community's social-cultural environment. The boundary was basically similar to the administrative boundary of village in the districts that were predicted to receive direct impact from the project. They were: Loa Janan, Harapan Baru and Samarinda.

2.2.3 Ecological Boundary

The source of impact was the power plant, the supporting facilities and the transmission lines, thus the ecological boundary was the maximum extent of air pollutant fallout within a 3 km radius of the power plant midpoint, and the maximum extent of corona noise in the transmission line corridor, i.e. about 120 m to the right and left of the corridor along the 10 km route.

2.2.4 Administrative Boundary

The administrative boundary of the project follows the government administrative boundaries, which includes Loa Duri Ulu village (in Loa Janan District) and Harapan baru district in Samarinda regency.

Table 2-1
Matrix of Impact Interaction

ACTIVITY PHASE / ENVIRONMENTAL COMPONENT	Preconstruction						Construction												Operation										Pasca Oprs		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1. Climate, Air Quality and Noisy																															
a. Micro climate										√																					
b. Air Quality										√										√	√		√	√	√	√			√		
C. Noise and Vibration						√		√	√	√	√	√	√	√	√	√	√					√	√				√				
2. Physiographic and Geology																															
a. Erotion										√																					
b. Land Stability										√					√																
c. Ground Water													√																		
3. Hidrology																															
a. Water Resources						√	√	√	√	√				√					√		√	√	√			√			√		
b. Water Resources Quality						√	√	√	√	√									√		√	√	√			√					
c. Sedimentation										√																					
d. Sediment Quality										√											√	√									
e. Flood Hazard										√																					
4. Space, Land and Soil																															
a. Land Quality				√						√																					
b. Land Using				√						√																					
c. Land Owner Status			√	√																											
d. Physical and Chemist Soil Characteristic										√																					
e. Land Scape				√			√			√																				√	
5. Biology																															
a. Secondary Forest Community										√													√								
b. Bushes Community										√													√								
c. Endemic Species																															
d. Man Made Ecosystem										√													√								
e. Wildlife Home Range										√													√								
f. Freshwater Biotic Composition						√		√	√	√												√									
g. Nekton						√		√	√	√												√									
6. Social, Economic and Culture																															
a. Demography					√		√											√													
b. Sex Ration					√		√											√													
c. Demography Dispersal					√		√											√													
d. Manpower			√	√	√		√											√	√												
e. Livelyhood			√		√		√											√	√												√
f. Traffic Hazard							√		√																						
g. Criminility							√											√													
h. Live Style				√			√											√													
i. Acceptibility							√																								
j. Perseption			√	√											√	√	√		√							√					
k. Aculturation							√																								
7. Health																															
a. Health Infrastructure							√																								
b. Sanitation Hazard							√																√				√				

Note

1. General Survey
2. Activity Planning Socialisation
3. Mapping
4. Planning
5. Land Aquisation
6. Manpower Recruitment
7. Jetty Construction
8. Manpower Mobilization
9. Loading Unloading
10. Equipment Mobilization
11. Land Clearing and Land Preparation
12. Land Preparation For PLTU
13. Installation Development
14. Freshwater Facility Installation
15. Infrastructure Installation
16. Tower Construction
17. Tower Setting
18. Cable Pulling and Setting
19. Release Manpower
20. Manpower Recruitment Operational Phase
21. Coal Delivery
22. Coal Pilling
23. Water Intake and Water Inlet
24. Coal Combustion
25. Fly-Ash Pilling
26. Coal Ash Delivery
27. Bottom-Ash Pilling
28. Power Distribution
29. Power Plant & Transmission Line Facilities Maintenance
30. Equipment and Material Maintenance
31. Asset Deliverieable
32. Manpower Release Operational Phase

Chapter 3 METHODS of EIA STUDY

3.1 Methods of Data Collection and Analysis

The collected data are primary and secondary data. They cover geophysics-chemical, biological, socio-economic and socio-cultural and public health aspects. Primary data were collected through direct observations, measurements and interviews in the field. While secondary data were gathered via literature studies and by collecting accessible documents from respective institutions or organizations. These secondary data included maps, district's notes and reports, city and regency statistics, and relevant laws and regulations.

The locations for direct observations and samples collection were selected by considering the following: (a) type of activities that were identified to cause possible impacts; (b) time of the implementation of the planned activities; (c) time interval of activities; (d) location and distribution of activities; and (e) representation of environmental characteristics in the study area.

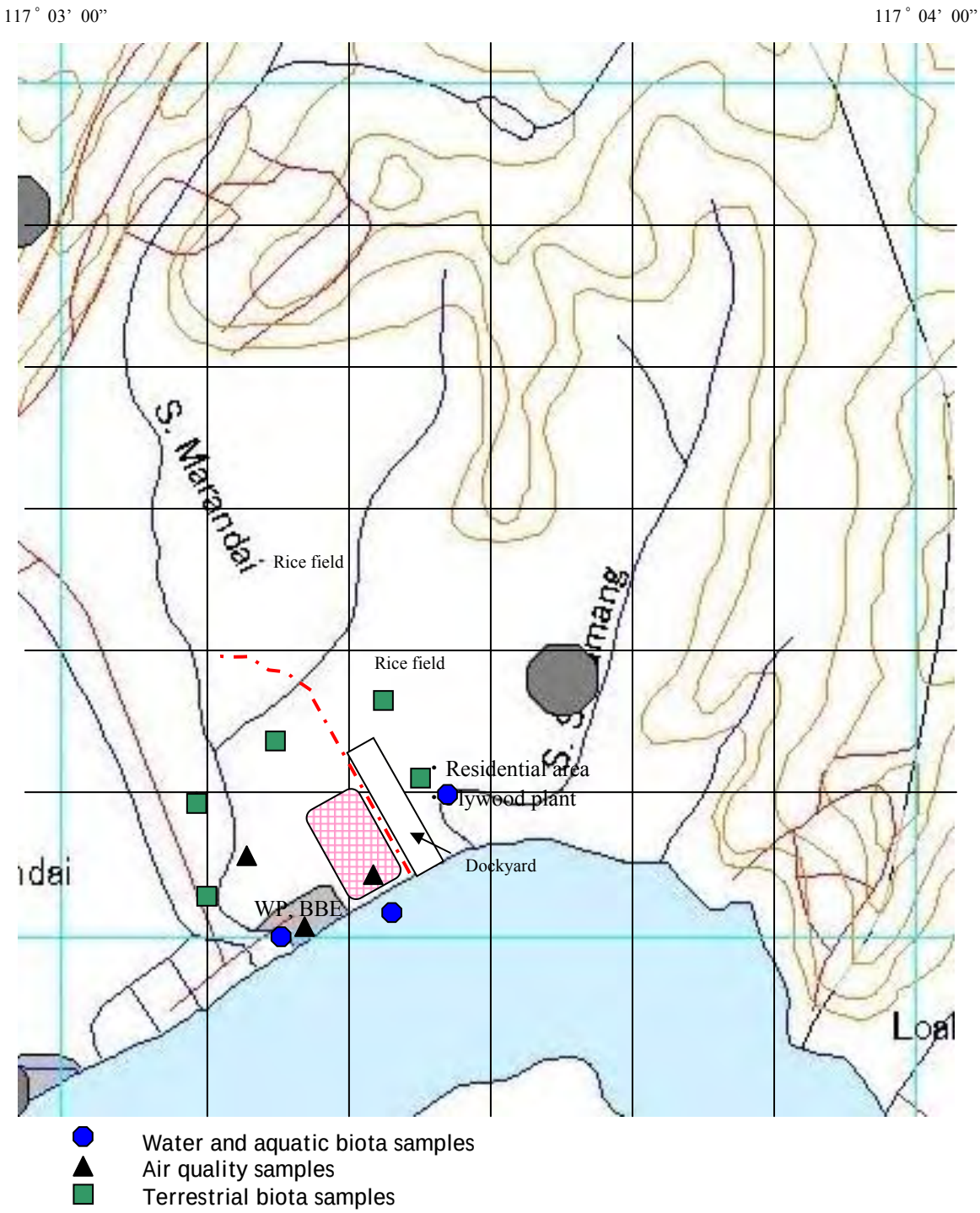
Sampling locations are presented in the following **Table 3-1**.

Table 3-1 Number of Samples and Consideration of Sampling Locations

Type of Sample	Number of Sampling Points	Sampling Location	Consideration for Selecting Sampling Location
Air quality and noise	3	Port of PT BBE, Loa Duri Ulu Village and planned site for the power plant	Associated with: Environmental condition, company's activities and settlement location
Water quality and aquatic biota	3	Benamang river, Merandai river, and Mahakam river	Associated with: Outlet and inlet of river-catchment system and the planned activities
Terrestrial biota	5	Around the planned power plant site	Associated with: Type of ecosystems and land coverage
Socio-economic, culture and public health	2	Loa Duri Ulu Village	Associated with: Village location close to the planned project site

The sampling locations of air quality and noise, water, and flora & fauna are presented in **Figure 3-1**.

Figure 3-1 Sampling Locations



3.2 Climate, Air Quality and Noise

3.2.1 Climate

Macro scale meteorological data of the study area was assembled by compiling secondary data from the Meteorology & Geophysics station.
Statistical data analysis was done to seek average climatological conditions for the last ten years. In addition, micro scale meteorological data measurement was carried out simultaneously with the air sampling. They included ambient temperature, (air) barometric pressure, humidity, wind direction and velocity.

3.2.2 Air Quality

Data on air quality will be collected by utilizing secondary data from previous studies, and by field measurement for primary data.

3.2.3 Noise

Secondary data were obtained through environmental studies done previously by PT Bukit Baiduri Energy in areas near the study site. Primary data collection was conducted through direct measurement in the field, and refering to Governor of East Kalimantan Regulation Number 339 Year 1988 on Air Quality Standard and Noise Level Standard. A Sound Level Meter was used for noise measurement and the noise level is presented in dBA units. Sampling locations for noise measurement were the same as the sampling points for air quality measurements.

3.2.4 Physiography and Geology

The analysed physiography and geology components include topography, geology, geo-hydrology, and seismic information. Both secondary data and primary data from on-site field observations were used.
Primary and secondary data of physiography, geology and geo-hydrology were collected using survey methods and review of literature in these aspects. Field surveys of the physiography and topography were aimed at obtaining data about specific parameters such as slope angle and topographic relief. Geology and hydrogeology data include lithological (soil and rock) parameters, geological structure, soil and rock characteristics which involve the technical nature of the soil/rocks in general.

3.2.4.1 Water Resource Potential

Both primary and secondary data were collected to build hydrological data of the study site. Primary data included parameters of river physical characteristics, water surface elevations, sedimentation levels, and water quality. Secondary data, among others, included river debit, flow patterns, and existing condition during the field survey.

3.2.4.2 Water Quality

The water quality data were collected through secondary data acquisition of previous studies and direct measurements in the field for primary data. Water samples were collected using water samplers.

Water quality primary data was derived from composite samples taken in certain sampling points in Mahakam River, Merandai River, Benamang River, and from some wells surrounding the proposed project site.

Results of river water sample analysis were compared to the Governor of East Kalimantan Decree Number 16 Year 2005 on Water Standard Quality for Rivers in East Kalimantan Province. For water sampled from wells, the evaluation referred to the Minister of Health Regulation Number 146/MENKES/PER/IX/1990.

3.2.4.3 River Sediment

Heavy metals measured in river sediment were mercury (Hg), cadmium (Cd), lead (Pb), and zinc (Zn). Sediment samples were only taken in Mahakam River, i.e. at a sampling point before, within and after the planned site for the power plant. These positions are aimed to collect sediment baseline data before the actual power plant operation is taking place.

3.2.5 Space, Land and Soil

Secondary data were used for spatial and land-use data, particularly current space and land uses, and ownership status of land that will be affected by the construction of the power plant and transmission network. Sources of data include reports on spatial planning of Kutai Kartanegara Regency and East Kalimantan Province. In addition, land-use map analysis was also conducted using data from the National Land Administration Agency (BPN) and Central Bureau of Statistics (BPS). Direct observations were employed to appraise the current situation of land and ownership status along the route of planned transmission lines.

For soil physical and chemical properties both secondary and primary data were used. Soil sampling was done to identify soil profile and soil physical and chemical contents particularly those related to fertility.

Soil analysis was carried out using standard methods recommended by the Centre for Soil Research in Bogor (1981).

3.3 Biological Resources

3.3.1 Flora

Collection of both natural and cultivated vegetation data which includes community types, and plant species and distribution, were carried out employing methods commonly used by the Directorate General of Forest Protection and Nature Conservation (Ditjen PHKA), the cruising method.

Every plant species found was recorded and its significance grade according to the modified Braun & Blanquet rule was calculated.
Designation of protected plant species was done by referring to the list of protected plants published by the Directorate General of Forest Protection and Nature Conservation (Ditjen PHKA).

3.3.2 Fauna

Primary data were gathered through the cruising method, and the observation parameters were species, distribution and frequency. Primary data were also collected through interviews with local people, and secondary data were collected from nearby protected area offices. The observed terrestrial animals were mammals, birds, reptiles and amphibia.
Using the data obtained, the habitat, distribution patterns, migration patterns, abundance, species composition, status and territoriality of animals were assessed. Designation of protected, threatened, endemic and specific animal species was done by referring to the list of protected animals published by the Directorate General of Forest Protection and Nature Conservation (Ditjen PHKA).

3.3.3 Aquatic Biota

3.3.3.1 Plankton and Benthos

Plankton were sampled by passing 50 liters of water, taken at specific sampling points, through a Wisconsin net (plankton net number 25) to obtain a 20 ml concentrated water sample, and preserved with 4% formaldehyde.
Samples of benthos were collected using an Eckman Dredge with coverage of 0.15 x 0.15 m^2. The samples were then passed through a standard sieve number 30 (US standard, 250 micron mesh-size) to separate the benthos from mud substrates. Sieve-retained benthos were transferred to plastic bottles and preserved with 4% formaldehyde.
Plankton and benthos analysis is aimed to understand taxa (family, genus or species) composition, abundance and diversity. The diversity of both plankton and benthos was determined using the Shannon-Wiener diversity index.

3.3.3.2 Nekton

Nekton animals or fishes recorded in every sampling location were primarily those caught by local people either for consumption or for selling. Interviews were also carried out to get additional data on local fisheries. Unknown or unidentified species were collected for further systematic identification and determination at a Biological Laboratory.

3.4 Society, Economy and Culture

3.4.1 Public Health

Public health studies were done with reference to the Head of Environmental Impact Control Agency (BAPEDAL) Decree Number 124 Year 1997 on Guideline for the Study of Public Health Aspects in Compilation of EIA. Data were obtained through direct observation, secondary data acquisition, and interviews with the local community. The collected data were health resources, environmental sanitation, and community nutrition status, among others.
Public health surveys were carried out in sub-districts and/or villages found within a three kilometers radius from the planned project site, particularly those living around the Mahakam Rivers, and near the planned transmission network. The analysis method was the environmental health impact analysis/assessment method.

3.5 Extensive and Significant Impact Assessment Method

3.5.1 Air Quality

Measurement of ambient air pollutant concentrations will be analysed using the Gaussian equation.

3.5.2 Noise

To assess impacts caused by noise, two aspects should be considered, i.e. (1) noise level accumulation resulting from a variety of sound sources, and (2) variation of noise level due to different distances to the source of noise being examined.

3.5.3 Water Quality

Assessment of the impacts on water quality will be done using a non-formal method, by comparing the present water quality with changes that occur throughout the pre-construction, construction, operational (post-construction) and post-operational stages. To measure the increase of water parameter concentration caused by an activity, the approach proposed by the Metcalfe formula will be implemented.

3.5.4 Electric Field and Magnetic Field Induction

Estimation of the magnitude of magnetic and electric fields was calculated. The results of the calculations were compared to standard quality published in 1998 by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) which is also referred to by the World Health Organization (WHO).

Chapter 4 INITIAL ENVIRONMENTAL SETTING

The planned activity will take place in PT Bukit Baiduri Energy area. The power plant will be constructed in a vacant 20-hectares area. The lands for the proposed transmission lines' towers are covered by poorly maintained cultivated plants, particularly palm trees.

4.1 Physio-Chemical

4.1.1 Climate

4.1.1.1 Climate Type and Precipitation

According to the Koppen classification, the area of Kutai Kartanegara and its surrounds can be classified as an Alpha type climate and is known as a "tropical rain area." Schmidt & Ferguson, however, categorized the area as "Type A" climate (heavily wet). The study area has two seasons: rainy (between October and April), and dry (May to September). The annual average precipitation is between 14.6 and 243.8 mm. Total annual precipitation is 1,093.4 mm with daily average of 91.12 mm, and the number of days with precipitation per month ranges between nine and 20 days.

4.1.1.2 Air Temperature and Humidity

Climatologically, the air temperature and humidity in the study area fluctuate between 24.47 and 32.30 ºC and between 81.88 and 89.98%, respectively (data for the year 2005 from the Meteorology and Geophysics Agency (BMG) Station and Office of Agriculture and Food Crops at Samarinda).

4.1.1.3 Sunlight Intensity

Results of data analysis showed that the annual average sunlight intensity was 48.20 % with the sunlight intensity monthly average is ranging between 40.00 and 55.00 %.

Table 4-1 Condition of some climate elements

Month	Climate elements						
	*Precipitation (mm)	Number of day with precipitation (day)	Temperature (oC)			Humidity (%)	* Sunlight Intensity (%)
			Max	Min	Average		
January	124.80	17	31.36	21.88	25.18	85.52	50.60
February	98.40	17	33.03	22.49	26.77	85.11	51.60
March	52.60	16	34.02	22.85	26.82	85.24	51.60
April	14.60	11	32.86	23.28	26.39	88.97	53.20
May	77.20	21	33.03	23.46	26.49	89.98	45.80
June	65.40	20	30.65	21.49	24.47	84.11	42.60
July	37.80	10	31.25	21.55	26.20	86.12	48.00
August	79.00	17	33.30	22.31	26.24	87.10	55.00
September	20.20	9	34.20	21.88	26.34	81.88	48.50
October	243.80	20	33.11	22.56	26.14	84.12	40.90
November	139.80	20	32.68	22.90	26.03	85.45	40.60
December	139.80	20	32.68	22.90	26.03	85.45	40.00
TOTAL	*1,093.4*	*218*	*392.2*	*269.5*	*313.1*	*1,029.0*	
Average	*91.12*	*18*	*32.68*	*22.46*	*26.09*	*85.75*	*48.20*

*Source: Office of Agriculture and Food Crops, 2005, *Temindung Airport, 2006*

4.1.1.4 Wind Velocity and Direction

Secondary data for one decade period (1988-1998) from the Meteorology and Geophysics Agency (BMG) Station at Temindung Airport, Samarinda indicated that the wind speed ranged between 4 and 6 knots.

Data suggest that the dominant wind direction during January-April was from the northeast, during May-October from the south, and generally during November-December was blown to the west direction.

4.1.2 Air Quality

Air quality in the study areas was assessed based on samples collected in three locations: port of PT Bukit Baiduri Energi, Loa Duri Ulu Village of Loa Janan District, and the planned location of the plant.

Results suggest that air quality in the study area was generally good and within tolerable limits or under thresholds of the government's quality standard (Government Regulation 41/1999).

Table 4-2 Results of Air Quality Measurements

No.	Parameter	Unit	Standard Quality	Location 1	Location 2	Location 3
1.	Air Temperature	^{0}C		33	31	29
2.	Humidity	%		61	62	71
3.	Noise	DB		62,4	48	54,3
4.	Average Wind Speed	m/det		1,04	1,44	1,38
5.	Wind Direction (from)	^{o}		200	200	210
6.	Sulphur Dioxide, **SO_2**	mg/m^3	0,9	0,0153	0,0292	0,0431
7.	Nitrogen Oxide, **NO_x**	mg/m^3	0,4	0,0417	0,0783	0,0617
8.	Carbon Monoxide, **CO**	mg/m^3	30	1,3157	0,9208	0,8849
9.	Dust, **TSP**	mg/m^3	0,23	0,0405	0,0756	0,0872

Note: Standard Quality base upon Government Regulation 41/1999

Location 1 : Port of PT Bukit Baiduri Energi,
: 00^{o}35′09.1″ S, 117^{o}03′04.6″ E
: 23 September 2006, 14:34 – 15:34

Location 2 : Loa Duri Ulu Village RT15, District of Loa Janan
: 00^{o}34′53.6″ S, 117^{o}02′54.7″ E
: 23 September 2006, 15:50 – 16:50

Location 3 : Planned plant site
: 00^{o}34′59.7″ S, 117^{o}03′17.8″ E
: 23 September 2006, 17:08 – 18:08

4.1.3 Hydrology (Water Resources)

In order to obtain the general condition of initial river water quality before the planned activity takes place, water samples were collected from three sampling locations at three different rivers close to the planned project site. These rivers are predicted to receive direct impacts and face environmental changes associated with the planned activities. Results of laboratory analysis of the collected water samples are presented in **Table 4-3**.

Table 4-3 Results of Water Quality Measurements

No.	Parameter	Unit	Sample Code			Gov. Quality Standard
			1	2	3	
	Physics					
1	Temperature	^{o}C	30.1	30.2	27.9	Deviation 3
2	TSS	mg/l	48.75	97.50	23.75	50
3	TDS	mg/l	102.50	98.75	123.75	1000
4	Conductivity	uS	95.7	68.8	144.1	-
5	Salinity	$^{o}/_{oo}$	0.1	0.0	0.1	-
	Chemicals					
6	pH		6.49	6.77	6.45	6-9
7	DO	mg/l	2.98	3.11	2.10	6
8	BOD	mg/l	2.18	1.19	1.52	2
9	COD	mg/l	18.47	16.42	11.29	10
10	Iron (Fe)	mg/l	2.53	2.49	2.97	0,3
11	Manganese (Mn)	mg/l	0.051	0.036	0.079	0,1
	Microbiology					
12	Total Coli	MPN/100 ml	21	0	9	1000

Note: Locations

1 Merandai river 14:36 WITA 23/09/2006 00^{o} 35' 08.0" S; 117^{o} 02' 57.5" E
2 Mahakam river 15:02 WITA 23/09/2006 00^{o} 34' 58.0" S; 117^{o} 03' 14.0" E
3 Benamang river 17:11 WITA 23/09/2006 00^{o} 34' 45.7" S; 117^{o} 03' 25.2" E

Standard source : Government Regulation No. 82 / 2001

4.2 Physical characteristics

4.2.1.1 Temperature

The temperature of water in the study area ranged between 27.9 and 30.2ºC. These values reflect natural water temperature in tropical areas.

4.2.1.2 Total Suspended Solids (TSS) and Total Dissolved Solids (TDS)

Suspended solids (TSS) indicate materials retained after filtration with a Millipore membrans (pore opening 0.45 μm). TSS concentrations in the study area ranged between 23.75 mg/l and 97.50 mg/l. Contrasted against the TSS quality standard of 50 mg/l, with the exception of Mahakam River concentration, the concentrations in the study area were under the maximum threshold.

Dissolved solids (TDS) indicate the content of materials that dissolved or lost during evaporation or heating process. Dissolved solids are smaller than suspended solids. They consist of water soluble organic and non-organic elements, minerals and chemical salts. TDS concentrations in the study area ranged between 98.75 mg/l and 123.75 mg/l which are far below the maximum threshold of 1,000 mg/l.

4.2.2 Chemical characteristics

4.2.2.1 Acidity (pH)

Factors affecting pH include cattion and anion species and concentrations, photosynthesis process and rainfall. Water acidity plays an important role in both chemical and biological processes which in turn determine the quality of natural water. Increasing acidity (low pH value) can affect the solubility of iron, copper, calcium, manganese and other metals, and influence the balance between carbon dioxide gas, bicarbonate and carbonate. The pH measured in the study area ranged between 6.45 and 6.77.

4.2.2.2 Dissolved Oxygen, BOD and COD

The dissolved oxygen (DO) concentrations in the study area ranged between 2.10 mg/l and 3.11 mg/l. These values are less suitable for aquatic organisms' life since the recommended DO concentration in Water Quality Standard for Group B is 6.0 mg/l.

The main cause of the decrease of dissolved oxygen is (organic) wastes that consume oxygen in their breakdown process. Such waste can come from various sources such as animal and human faces, dead plants or other organic wastes. This relation has suggested the use of BOD and COD as an approach to assess the incidence of organic pollutants in swamps and ground waters.

Biochemical Oxygen Demand 5 (BOD 5) indicates the amount of dissolved oxygen needed by an organism to breakdown or oxidise organic materials in water for 5 days under constant temperature of 20^{o}C. The values of BOD in the study area ranged between 1.19 mg/l and 2.18 mg/l. These values suggest that generally the BOD values were well below the maximum allowable limit of 3 mg/l (for Class II type of water).

Chemical Oxygen Demand (COD) designates the amount of oxygen required for oxidising organic materials into non-organic materials. The value of COD will increase comparable to the increase of organic waste burden to water bodies. The values of COD in the study area ranged between 11.29 mg/l and 18.47 mg/l. These values were beyond the maximum allowable limit of 10 mg/l as recommended by the Governor of East Kalimantan Decree Number 339 Year 1988 on Environmental Quality Standard of East Kalimantan Province for Group B Water.

4.2.2.3 Manganese and Iron

Manganese (Mn) and iron (Fe) are among the metals that always occur in water bodies as the result of the weathering of soil's main materials. To some level, the concentrations of these metals are not toxic to humans, animals or aquatic biota. The concentrations of Mn and Fe in the study area ranged between 0.036 mg/l and 0.079 mg/l, and between 2.49 mg/l and 2.97 mg/l, respectively.

4.2.2.4 Bacteriology

Escherichia coli is a coliform bacteria that can ferment lactose and produce acid and gasses between the temperatures of 37ºC and 44.5ºC within a period of 48 hours. Laboratory results

showed that the total coliform values of the study area ranged between 0 MPN/100 ml and 21 MPN/100 ml.

4.2.3 Space and Land

Data from the National Land Administration Agency (BPN) (**Table 4-4**) indicated that generally the land-use in Kutai Kartanegara Regency was for forestry, primarily for Production Forest. A half of the available area (50.6 percent or 1,325,198 hectares) was used for production forestry. The Regency still has more than 50 thousands hectares (around 2 percent) planted area.

The location of the planned power plant is in Loa Duri Ulu village, Loa Janan District, and transmission lines will span from Loa Janan to Harapan baru over Mahakam River. The main activity or livelihood of local people is in agriculture or plantation.

Table 4-4 Land-Uses in Kutai Kartanegara Regency

No	Land-Use Types	Area (Hectares)	Percent
1	Settlement	5,037	0.19
2	Twice-harvest annually paddy field	15,055	0.57
3	Rain-fed paddy fields	5,908	0.38
4	Backyard garden	29,795	1.13
5	Palm-coconut plantation	31,412	1.19
6	Primary forest	322,799	12.26
7	Secondary forest	1,325,198	50.33
8	Alang-alang/tall grass	989,960	37.60
9	Swampy areas, small lakes	13,000	0.49
Total		2,632,600	100.00

The total project area planned for is 20 hectares. It is located to the south of Loa Duri Ulu village. In the northern part of the project site is PT Bukit Baiduri Energy Coal Mining.

Rice fields and dry fields could be found in the western part of the project site. Although their coverage was small, rice and other plants act as supplementary crops for local people. Swamps were found in some areas of the project site but the coverage was small as well. So are the bushes that were found particularly on the river embankments in the southern part of the project site.

A number of local people's houses were found with in the boundaries on the west and east of the project site. They were distributed sporadically and located far apart from each other. Additionally, a small community of plywood workers was found near the settlement.

Not unlike the power plant site, the land-use along the transmission line corridor was also dominated by cultivated area.

4.3 Biology (Biological Resources)

The condition of vegetation on the planned project site and surrounding areas mainly consisted of bushes, alang-alang fields, secondary forests, food crops forests, fields, paddy fields and fruit yards.

4.3.1 Terrestrial Flora

Based on the floral composition, climate conditions and geographical position, vegetation in the study area can be categorized as tropical rainforest. Generally, the floristic composition of the vegetation was dominated by agriculture and the plantation's plant species. Floristic forest type was only small part of the whole planned project site. The type was young secondary forest.

4.3.1.1 Bush

This vegetation was found in the abandoned fields in the study area. It includes alang-alang (Imperata cilindrica) fields mixed with bush species such as bilam (Euporatorium palescens), karamunting (Melastoma sp.), fern (Pieredhopyilia sp.), and natural secondary forest species such as Homalanthus populneus, and betel (Piper aduncum) grow intermittently. Altogether, the variability of these vegetation types suggests that the genuine natural forests in the study area were already disturbed by either natural causes or human activities with high intensities.

4.3.1.2 Secondary forests

Secondary forests were characterized by pioneer plants in which the vegetation structure was mainly dominated by plants with three growth levels: seedlings, sapling and poles. Trees with stem diameter more than 50 cm were very rare. Plant species of these secondary forests are presented in the following table.

Table 4-5 Type of Vegetation in Secondary Forests

No	Scientific Name	Local Name	Frequency
1.	*Piper aduncum*	Sirih-sirih	Abundant
2.	*Macaranga converta*	Mahang	Infrequent
3.	*Pieredhopyilia sp.*	Paku-paku	Infrequent
4.	*Vernonia sp.*	Merembung	Infrequent
5.	*Milletia sp.*	Mali hutan	Infrequent
6.	*Trema orientalis*	Trema	Infrequent
7.	*Vitex pubescens*	Laban	Infrequent
8.	*Homalanthus populneus*	Balik angin	Infrequent
9.	*Artocarpus elasticus*	Terap	Infrequent

Source: Primary data, 2006

4.3.1.3 Food crop forests

Food crop forests were found in the reclaimed lands of PT Bukit Baiduri Energi (PT BBE). The plants were fast growing species such as sengon (Paraserianthes falcataria) and acaccia spp. (Acacia mangium and Acacia auriculiformis) that do not need serious maintenance. In addition, plants planted by local people were found in areas surrounding the planned project site (i.e. in Loa Duri Village RT 14). They are jabon (Neolamarckia cadamba), jati (Tectona grandis), waru (Hibiscus sp.), and sonokembang (Pterocarpus sp.) among others.

4.3.1.4 Fields, paddy fields and fruit yards

Identification of crops cultivated by the local community, both at the planned project site and in the surrounding areas can be used as reference to manage and develop socio-economic aspects for improving the wellbeing of the local people. To the west and the north of the planned project site, paddy fields with total areas around 7 and 20 hectares, respectively, were found. While to the east, there was a 7 hectare land parcel that had been fenced by the owner with a pond, plantation and forestry vegetation, and a cow grazing area. The planted plants included among others, jabon, sengon, jati, and petai cina. In addition, various fruit trees planted by local people were also found in the study area.

Table 4-6 Plant Species Found in the planned Project Site and Surrounds

No	Local Name	Scientific Name
Fruited plants		
1	Pisang – banana	*Musa paradisiaca*
2	Nangka - jackfruit	*Artocarpus heterophyllus*
3	Jeruk - orange	*Cytrus sp.*
4	Pepaya – Papaya	*Carica papaya*
5	Mangga - mangoes	*Mangifera indica*
6	Sirsak – soursop	*Annonia murricaia*
7	Jambu air - watery guava	*Eugenia sp.*
8	Rambutan - hairy fruit	*Nephelium lappaceum*
9	Jambu batu/biji – guava	*Psidium guajava*
10	Petai Cina -	*Farchia marginallis*
11	Belimbing – star fruit	*Averhoe carambola*
12	Wanyi	*Mangifera sp.*
13	Jarak – bush castor	*Jatropha curcas*
14	Durian	*Durio zibhetinus*
15	Kelapa – coconut	*Cocos nucifera*
16	Mempelam	*Mangifera sp.*
17	Kemiri – candle nut	*Aleurites mollucana*
18	Jengkol	*Pithecelobium dulce*
19	Salak - snakeskin fruit	*Salacca* sp.
20	Nanas – pineapple	*Ananas comosus*
21	Langsat – lanseh fruit	*Aglaia* sp.
22	Sawo – sapodilla	*Achras zapota*
23	Kedondong -	*Spondias cytherea*
Seasonal crops/vegetables		
1	Padi – paddy/rice	*Oryza sativa*
2	Tebu – sugarcane	*Sacharum sp.*
3	Kacang Panjang – long bean	*Vigna sinensis*
4	Bayam – spinach	*Amaranthus hybridus*
5	Jahe – ginger	*Zingiber* sp.
6	Jagung – corn	*Zea mays*
7	Labu Putih – white pumpkin	*Lagenaria siceraria*
8	Labu Merah – red pumpkin	*Cucurbita moschata*
9	Singkong – cassava	*Manihot esculenta*
10	Mentimun – cucumber	*Cucumis sativus*
11	Lombok – hot chilli	*Capsium sp.*
12	Merica/sahang – black pepper	*Piper nigrum*
13	Kunyit	*Curcuma longa*

14	Langkuas - galangale	*Lenguas galangal*
15	Serai – lemon grass	*Andropogon nordus*
16	Gambas	*Cucurbita sp.*
17	Buncis – string bean	*Phaseolus vulgaris*
18	Terong – eggplant	*Solanum melongena*
19	Sawi – green mustard	*Brassica rugosa*
20	Kangkung	*Ipomea aquatica*
Natural/Forestry/Plantation Plants		
1	Sono kembang	*Pterocarpus sp.*
2	Waru	*Hibiscus sp.*
3	Akasia	*Acacia mangium, Ac. Auriculiformis*
4	Laban	*Vitex pubescens*
5	Pulai	*Alstonia scholaris.*
6	Perupuk	*Lophopetalum sp.*
7	Jati	*Tectona grandis*
8	Kelapa sawit	*Elais guinensis*
9	Jabon	*Neolamarckia cadamba*
10	Sengon	*Paraserianthes falcataria*
11	Keluwih	*Artocarpus integra*
12	ketapang	*Terminolia Cattapa*
13	Beringin	*Ficus benyamina.*
14	Aren	*Arenga pinnata*
15	Bambu	*Bambusa sp.*
16	Simpur	*Dillenia reticulata*
17	Jambu-jambu	*Eugenia sp*
18	Karamunting	*Melastoma sp*
19	Medang	*Litsea sp*
20	Kopi hutan	*Nauclea sp.*
21	Nanasian	*Callicarpa sp.*
22	Kedang belung	*Milletia sirisia*
23	Mali-mali	*Leea indica*
24	Jengkol	*Pithecelobium dulce*
25	Kapuk	*Ceiba petandra*
26	Bungur	*Langerstroemia speciosa*

Source: Primary data, 2006

4.3.2 Terrestrial Fauna

Observation of faunal occurrence in the planned project site was carried out through direct inventory and indirectly through interviews with local people. Direct observation was done by visual counting with or without binocular aid, and based on animal footprints and faeces. Interviews were conducted with the assistance of an animal identification guidebook to facilitate discussions.

The following table presents the results of the observations on wildlife species diversity in the planned project site.

Table 4-7 Diversity of Wildlife Species in the planned Project Site

No.	Group/Animal Name	Scientific Name	Remarks
I. Mammals			
1.	Kalong besar	*Pteropus vampyrus*	PTL
2.	Trenggiling	*Manis javanica*	PTL/DL
3.	Tikus ladang	*Rattus exulans*	PL
4.	Tikus belukar	*Rattus tiomanicus*	PL
5.	Tikus rumah	*Rattus tanezumi*	PL
6.	Musang	*Martes* sp.	PTL
7.	Babi hutan	*Sus barbatus*	PTL
8.	Tupai	*Tupai gracilis*	PL
9.	Landak	*Hystrix brachyura*	PTL/DL
II. Primate			
1.	Monyet	*Macaca nemestrina*	PTL
III. Reptiles			
1.	Biawak	*Varanus salvator*	PL
2.	Ular sawah	*Phyton molurus*	PTL/DL
3.	Ular kobra	*Ophiophagus* sp.	PTL
4.	Ular air	*Enhydris enhydris*	PTL
5.	Ular cincin	*Boiga dendrophila*	PTL
6.	Ular hijau	*Dryphia* sp.	PTL
7.	Kadal	*Mabonya multifasciata*	PL
IV. Amphibians			
1.	Kodok tegalan	*Fejervarya limnocharis*	PL
2.	Kodok kongkang	*Rana* sp.	PTL
V. Aves			
1.	Belibis	*Aythya fuligula*	PTL
2.	Belibis batu	*Dendrocygna javanica*	PTL
3.	Puyuh	*Caturnix chinensis*	PL
4.	Punai besar	*Treron capellei*	PTL
5.	Punai kecil	*Treron olax*	PL
6.	Punai gading	*Treren vernans*	PTL
7.	Bubut	*Eudynamis scolopacea*	PL
8.	Bubut alang-alang	*Centropus sinensis*	PL
9.	Pelatuk	*Halcyon pileata*	PTL
10.	Kutilang	*Setorais criniger*	PTL
11.	Gelatik batu	*Parus major*	PTL
12.	Kacer	*Copsychus saularis*	PTL
13.	Murai batu	*Copsychus malabaricus*	PTL
14.	Murai	*Chloropsis sonnerati*	PTL
15.	Pipit	*Anthus* sp.	PL
16.	Tiung	*Gracula religiosa*	PTL/DL
17.	Jalak	*Sturnupostor jalla*	PTL
18.	Tekukur	*Streptopelia bitorquata*	PL
19.	Elang	*Gyps bengalensis*	PL
20.	Burung hantu	*Otus spilocephalus*	PTL

Remarks:

PL : Direct observation

PTL : Indirect observation

DL : Protected species

The diversity of wildlife in the study area was also enriched by the great number of insect's species. During the fieldwork, the following insects were observed: butterflies and moths (Lepidoptera), dragonflies (Odonata), wasps and ants (Hymenoptera), crickets and grasshoppers (Orthoptera), ladybugs (Hemiptera), ciccadas (Homoptera), flies (Diptera), and various beetles (Coleoptera). However, the diverse faunal species encountered during the fieldwork does not reflect the actual abundance and density of animals in the study area because it was impossible to do such detailed survey which usually needs long-term continuous observations employing different observation methods that are specific to the kind of animals studied.

Results presented in **Table 4-7** suggest that some species were protected. However, the actual existence of these species needs further examination/research because the data were collected from indirect observations (i.e. through interviews) and there was no species/habitat compatibility study. Furthermore, it needs to be resolved whether these protected species were only migrating or were inhabitants.

4.3.3 Aquatic Biota

4.3.3.1 Plankton

Plankton is aquatic biota which live floating or slowly moving in the water column. They can be distinguished into phytoplankton (i.e. tiny planktonic plants) and zooplankton (i.e. tiny planktonic animals). In aquatic ecosystems, phytoplankton plays the role of the primary producer for all living creatures in the aquatic food chain. Phytoplankton utilizes nutrients and transforms them into energy with the help of sunlight through the photosynthesis process. Zooplankton acts as secondary producers or primary consumers that link phytoplankton with various animals occupying higher tropic levels.

Results suggest that two classes of phytoplankton (Chrysophyceae and Cyanophyceae), and two classes of zooplankton (Mastigophora and Ciliata) dominated the samples collected in all three sampling locations. The number of taxa in each location vary, with the highest recorded in Mahakam river (7 taxa). Plankton abundance ranged between 279 and 372 individuals per liter, with the highest recorded in Mahakam river and the lowest in Benamang river.

The Diversity Index (H') was moderate with values between 1.52 and 1.91; while the Equity Value (E) ranged between 0.95 and 0.98 suggesting a good proportional diversity index. In other words, no particular plankton species was dominant even though the Diversity Index was low. Furthermore, the measured H', E'and D' suggest that the water in the sampling locations was relatively free of pollutants.

Table 4-8 Results of Plankton Sampling

No.	Plankton Species	SAMPLE CODE		
		1	2	3
A.	**Phytoplankton**			
1	**Chrysophyceae**			
	Navicula cancellata	-	31	62
	Frustulia rhomboids	62	62	31
	Surirella robusta	31	62	-
2	**Cyanophyceae**			
	Oscillatoria sp	62	-	62
B.	**Zooplankton**			
1	**Mastigophora**			
	Eudorina elegans	-	62	-
	Euglena oxyuris	31	62	93
	Phacus undulates	62	-	31
2	**Ciliata**			
	Vorticella sp	-	31	-
	Colpoda cucullus	62	62	-
Number of plankton individual per litre		310	372	279
Number of taxa		6	7	5
Diversity Index (H')		1.75	1.91	1.52
Equity Index (E')		0.98	0.98	0.95
Dominance Index (D')		0.18	0.15	0.23

Note:

1 Merandai river
2 Mahakam river
3 Benamang river

4.3.3.2 Benthos

Benthos is both plant and animal species that live in sediment (bed of the water body). Their existence are often influenced by, and thus associated with, water quality changes. This has made benthos often used as an indicator of water quality.

Table 4-9 Results of Benthos Sampling

No.	Parameter	Kode Sample		
		1	2	3
A	**Gastropoda**			
	Bratia sp	-	26	-
	Compeloma integrum	13	-	13
	Neritina reclivata	26	-	-
	Pleurocera acuta	832	-	-
	Pomatiopsis lapidaria	182	13	169
	Litorira angulitera	-	-	78
	Epitonium dalianum	-	13	-
B	**Pelecypoda**			
	Arcidens confragosus	39	-	-
C	**Oligochaeta**			
	Tubifex sp	130	-	364
D	**Insecta**			
	Chironomus	26	-	13
Number of benthos individuals per square-metres		195	52	546
Number of taxa		7	3	5
Diversity Index (H')		0.42	1.04	0.75
Equity Index (E')		0.22	0.95	0.47
Dominance Index (D')		0.48	0.38	0.41

Note:

1 Merandai river
2 Mahakam river
3 Benamang river

4.4 Society, Economy and Culture

4.4.1 General Description of the Study Area

The study area was Loa Duri Ulu Village, Loa Janan District, with a total village area of 12,225 hectares. The specification of the study location is as follows.

Merandai village: RT IV and V

Pimping village: RT VII

Number of respondents was 12 and they were pre-determined particularly prominent local prominent persons.

Table 4-10 Population of Loa Duri Ulu Village

Year	Loa Duri Ulu Village			
	Male	Female	Total	# household
2004	4,579	3,228	7,807	4,072
2005	4,727	3,334	8,061	4,435
2006	4,819	3,357	8,176	4,701

Source: Office of the Head of Loa Duri Ulu Village, Kutai Kartanegara Regency

The village boundaries are:

North : Loa Buah village : Loa Buah village
South : Purwajaya village : Purwajaya village
East : Loa Duri Ilir village : Loa Duri Ilir village
West : Bakungan village : Bakungan village

Table 4-11 Population according to age-group

Year	Age group	Number		
		Male	Female	Total
1.	Under 15 years	1,167	811	1,978
2.	16 – 55 years	3,472	2,414	5,886
3.	Over 56 years	184	128	312
Total Number		**4,823**	**3,353**	**8,176**

Source: Office of the Head of Loa Duri Ulu Village, Kutai Kartanegara Regency

Table 4-12 Livelihoods

No	Livelihood	Loa Duri Ulu Village
		Number (person)
1	Civil services	56
2	Armed forces	5
3	Private sectors	3,413
4	Entrepreneur/trader	515
5	Farmer	913
6	Craftmanship	25
7	Farm labourer	-
8	Pensioner	32
9	Fishermen	42
10	Service sectors	-
11	Other workers	-
Total Number		**5,001**

Source: Office of the Head of Loa Duri Ulu Village, Kutai Kartanegara Regency

Table 4-13 Population according to religion

No	Religion	Loa Duri Ulu Village
		Number (person)
1	Islam	5,091
2	Christian – Protestant	1,874
3	Christian – Catholic	842
Total Number		**8,176**

Source: Office of the Head of Loa Duri Ulu Village, Kutai Kartanegara Regency

Table 4-14 Population according to education level

No	Education	Loa Duri Ulu Village
		Number (person)
1	Kindergarten	76
2	Elementary School – unfinished	-
3	Elementary School	1,597
4	Junior High School	1,961
5	Senior High School	2,415
6	Diploma (D1 – D3)	493
7	Sarjana (S1 – S3)	79
Total Number		**6,621**

Source: Office of the Head of Loa Duri Ulu Village, Kutai Kartanegara Regency

Table 4-15 Education facilities

No	Education Facilities	Loa Duri Ulu Village	
		Public	Private
1	Child care	-	-
2	Kindergarten	-	2
3	Elementary school	3	1
4	Junior high school	1 (preparation)	1
5	Senior high school	-	-
6	Academy	-	-
7	University	-	-
Total Number		**4**	**4**

Source: Primary data, 2006

Table 4-16 Health facilities

No.	Health facilities	Number
1	Hospital	-
2	Community Health Centre (Puskesmas)	-
3	Auxiliary Centre (Pusban)	1
4	Integrated Service Post (Posyandu)	3
5	Others	-
Total Number		4

Source: Primary data, 2006

Table 4-17 Population growth

No.	Population shift	August 2006			
		Male	Female	Increase	Decrease
1	Born	6	3	9	-
2	Dead	2	-	2	-
3	Come in	28	6	34	-
4	Go out or shifted	8	14	22	-
Total Number		44	23	67	-

Source: Primary data, 2006

Table 4-18 Number of transportation vehicle in the village (2006)

No.	Type of vehicle	Number
1.	Official car	-
2.	Private car	42
3.	Truck	15
4.	Public transport (taxi)	17
5.	Motorcycle	1,079
6.	Motorised-boat	55
7.	Non-motorised boat	25
8.	Bicycle	232

Source: Office of the Village Head, 2006

4.4.2 RESPONDENT'S INCOME LEVEL

The respondents generally worked as employees of the nearby companies, farmers or in service sectors (motorcycle taxi driver, etc.). Their income level was as follows:

Table 4-19 Respondents' identity

Respondent number	Age	Education*	Main job	Additional job	Religion
1	62	Technical SrHS	Hair Salon	Builder	Islam
2	41	JrHS	Employee of Kalamur	-	Islam
3	40	Economic SrHS	Employee of PT OTP	-	Islam
4	28	JrHS	Meatball vendor	Employee of Melapi Timber	Islam
5	25	Islamic SrHS	Mosque caretaker	Employee of Kalamur	Islam
6	40	JrHS			
7	41	SrHS	Company	-	Islam
8	45	SrHS	Farmer	-	Islam
9	50	SrHS	Farmer	-	Islam
10	52	SrHS	Farmer	Company	Islam
11	38	SrHS	Company	-	
12	45	SrHS	Company	Farmer	Islam

Note:

JrHS = Junior High School (SMP/SLTP); SrHS = Senior High School (SMA/SLTA)

Table 4-20 Income of community members

Nomor	Main livelihood	Additional job	RT	Monthly income
1	Hair Salon	Builder	3	1500000
2	Employee of Kalamur	-	5	1000000
3	Employee of PT OTP	-	4	1000000
4	Meatball vendor	Employee of Melapi Timber	3	1300000
5	Mosque caretaker	Employee of Kalamur	5	1500000
6		-	6	2000000
7	Company	-	4	200000
8	Farmer	-		900000
9	Farmer	-	4	130000
10	Farmer	Company		800000
11	Company	-	1	800000
12	Company	Farmer		1800000

Source: Primary data, 2006

4.4.3 Local Traditions

The dominant ethnic groups in the study area were: 1) Javanese, 2) Banjarnese, 3) Buginese, and 4) Kutainese. This ethnic diversity suggests that the culture at the study area was quite heterogenous. Therefore, local traditions reflect all these major ethnic groups. In practice, these ethnic groups have worked together and maintained mutual tolerance.

One community's problem encountered during the study was rampant drinking problems. High intensity drinking problems usually occur during weekends and at an alarming level that cause anxiety among the local community. The causes were probably the high level of unemployment and the region's openness to outside influences that are not necessarily positive.

4.4.4 Social Processes

Generally, the local community could work with other communities. The main reason was that working together is mutually beneficial, and additionally the open outlook of the local society (i.e. being open to newcomers from other areas or parts of Indonesia). In addition, the assimilation process between the resident community and the non-native in the study area has worked well to date, particularly of those working in areas close to the companies. Assimilation could happen smoothly thanks to good communication and behavior, and similar faith/religion.

4.4.5 COMMUNITY'S PERCEPTIONS

Data regarding community's perceptions are as follows:

Table 4-21 Community's attitudes of the construction of power plant

No	Respondent's attitudes	RT 14		RT 15	
		F	%	F	%
1.	Highly agree	-	-	5	83
2.	Agree	4	66	1	17
3.	Disagree	-	-	-	-
4s.	Don't know or not sure	2	33.33	-	-
Total		**6**	**100**	**6**	**100**

Source: Primary data, 2006

The respondents agreed to the plan with the following notes:

The activity must be environmentally-friendly

Air pollution must be managed according to the existing laws and regulations

Table 4-22 Benefits of the planned activity according to the respondents

No	Respondent's opinion	RT 14		RT 15	
		F	%	F	%
1.	Helps local and regional development	3	60	-	-
2.	Opens business opportunity	2	40	2	33
3.	Opens employment opportunity	2	40	3	50
4.	Opens the area/region	2	40	1	17
5.	Increases income	-	-	2	33
6.	Opens communication access (e.g. road)	-	-	2	33
7.	Provides electricity supply	1	20	-	-

Source: Primary data, 2006

In addition, positive perceptions of the respondents were caused by the potential employment opportunities. This was because local people generally do not have secure jobs in terms of time and wages. Respondents reported that wood companies in the area tend to face raw materials deficit making jobs uncertain. With the plan of constructing the power plant, it was expected that the respondents and local community could get jobs from it or build their businesses in association with the plant.

4.5 Public Health

Data regarding public health are as follows:

Table 4-23 Most frequent illness suffered by the respondent's family members

No	Most often suffered illness	RT 14		RT 15	
		F	%	F	%
a.	Respiratory (Asthma, etc.)	3	60	5	83
b.	Skin (Itchy, etc.)	-	-	2	33
c.	Diarrhea	-	-	2	33
d	Malaria	-	-	-	-
e	Influenza, fever, cough, economic pressure	4	80	-	-

Source: Primary data, 2006

Table 4-24 Respondent's toilet

No	Respondent's toilet	RT 14		RT 15	
		F	%	F	%
a.	River	1	17	1	17
b.	In-house	5	83	5	83
Total		**6**	**100**	**6**	**100**

Source: Primary data, 2006

Table 4-25 Respondent's treatment of rubbish

No	Treatment	RT 14		RT 15	
		F	%	F	%
1.	By burning the rubbish	5	83	6	100
2.	By throwing to the river	1	17	-	-
Total		6	100	6	100

Source: Primary data, 2006

Table 4-26 Source of water for cooking

No	Source of water	RT 14		RT 15	
		F	%	F	%
1.	Rain water	-	-	2	33
2.	Well	-	-	1	17
3.	River	1	20	1	17
4.	Company (Samtraco)	4	80	-	-
5.	Company (BBE)	-	-	5	83

Source: Primary data, 2006

Table 4-27 Medication method when member of the family get sick

No	Medication method	RT 14		RT 15	
		F	%	F	%
1.	Going to community health centre (puskesmas)	3	50	6	100
2.	Company's insurance (going to medical doctor)	3	50	-	-
3.	Sometime going to BBE/Company	-	-	2	33

Source: Primary data, 2006

Generally, the local community showed a high awareness of visiting the closest community health centre (puskesmas) to get treatment for their health problems. They also expressed their approval of the center's services and medications, besides the affordable costs.

Chapter 5 ASSESSMENT OF EXTENSIVE AND SIGNIFICANT IMPACTS

The construction of the power plant and its transmission lines is planned to take place in a relatively remote area with limited infrastructure and facilities. It is predicted that the planned activities would create both positive and negative impacts. This chapter presents the assessment of impacts based upon potential impacts and key issues in each stage of development and their effect on the environmental components.

5.1 Pre-Construction Stage

Main activities in this stage include socialization, general survey and mapping, project planning, land acquisition, and construction of a jetty. Most identified impacts are those having effect on the socio-economic and socio-cultural components (**Table 5-1**).

5.2 Construction Stage

The construction stage is planned to last 24 months with an estimated 1,170 workers. The estimation of worker's number in this stage is dependent on the type of activity. Nearly all activities in this stage are predicted to have impacts on environmental components (**Table 5-2**).

5.3 Operational Stage (Post Construction)

Activities of the operational stage are predicted to affect some environmental components, and the impacts are quantitatively small (**Table 5-3**).

5.4 Post-Operational Stage

The post-operational stage is the phase when the operation of the power plant and the delivery of electric power have ended.

Table 5-1 Matrix Impact Interaction on Preconstruction Phase

	Activity Phase					Preconstruction
Environmental Component	*1*	*2*	*3*	*4*	*5*	*6*
1. Climate, Air Quality and Noisy						
a. Noise and Vibration						-
2. Hydrology						
a. Water Resources Potency						-
b. Water Resources Quality						-
3. Space, Land and Soil						
a. Land Utility Existing				-		
b. Land Using				-		
c. Land Owner Status			-	-		
d. Landscape				-		
4. Biology						
a. Freshwater Composition						-
b. Nekton						-
5. Social, Economic, and Culture						
a. Demography					-	
b. Sex Ratio					-	
c. Demography Dispersal					-	
d. Manpower					+	
e. Livelihood				-	+	
f. Live Style				-		
g. Acceptability			-	-		
h. Perception			-	-		

Note	
1	= General Survey
2	= Activity Planning Socialization
3	= Planning and Mapping
4	= Land Acquisition
5	= Manpower Recruitment
6	= Jetty Construction
-	= Negative Impact
+	= Positive Impact

Table 5-2 Matrix Impact Interaction on Construction Phase

Activity Phase	Construction											
Environmental Component	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
1. Climate, Air Quality, and Noisy												
a. Micro Climate				-								
b. Air Quality				-								
c. Noise and Vibration		-	-	-	-	-	-	-	-	-	-	
2. Physiographic and Geology												
a. Erosion				-								
b. Land Stability				-					-			
c. Ground Water							-					
3. Hydrology												
a. Water Resource Potency	-	-	-	-				-				
b. Water Resources Quality	-	-	-	-				-				
c. Sedimentation				-								
d. Sediment Quality				-								
e. Flood Hazard				-								
4. Space, Land, and Soil												
a. Land Utility Existing				-								
b. Land Space	-			-								
5. Biology												
a. Secondary Forest Community				-								
b. Bushes Community				-								
c. Mand Made Ecosystem				-								
d. Wildlife Home Range				-								
e. Freshwater Biotic Composition		-	-	-								
f. Nekton		-	-	-								
6. Social, Economic, and Culture												
a. DemographyJumlah penduduk	-											-

Note	
7	= Manpower Mobilization
8	= Loading Unloading
9	= Equipment Mobilization
10	= Land Clearing and Land Preparation
11	= Land Preparation for PLTU
12	= Installation Development
13	= Freshwater Facility Installation
14	= Infrastructure Construction
15	= Tower Construction
16	= Tower Setting
17	= Cable Pulling and Setting
18	= Release Manpower
-	= Negative Impact
+	= Positive Impact

b. Sex Ratio	-											-
c. Demography Dispersal	-											-
d. Manpower	+											-
e. Livelihood	+											-
f. Traffic Hazard	-		-									
g. Criminality	-											-
h. Live Style	-											-
i. Acceptability	-											
j. Perception									-	-	-	
k. Acculturation	-											
7. Health												
a. Health Infrastructures	-											
b. Sanitation Hazard	-											

Table 5-3 Matrix Impact Interaction on Operational Phase

Activity Phase	Operation										Pasca Oprs			Note	
Environmental Component	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*		
1. Climate, Air Quality, and Noisy														19	= Manpower Recruitment on Operational Phase
a. Air Quality		-	-		-	-	-	-			-			20	= Coal Delivery
b. Noise and Vibration				-	-				-					21	= Coal Pilling
2. Hydrology														22	= Water Intake and Water Outlet
a. Water Resources	-		-	-	-			-			+			23	= Coal Combustion
b. Water Resources Quality	-		-	-	-			-						24	= Fly-Ash Pilling
c. Sediment Quality			-	-										25	= Ash Delivery
3. Space, Land, and Soil														26	= Bottom-Ash Pilling
a. Landscape												+		27	= Power Distribution
4. Biology														28	= Power Plant & Transmission Line Maintenance
a. Secondary Forest Community					-									29	= Equipment and Material Maintenance
b. Bushes Community					-									30	= Asset Deliverieable
c. Man Made Ecosystem					-									31	= Manpower release on Operational Phase
d. Wildlife Home Range					-									-	= Negative Impact
5. Social, Economic, and Culture														+	= Positive Impact
a. Manpower	+														
b. Livelihood	+												+		
c. Perception	-								-						
6. Health															
a. Sanitation Hazard					-				-						

Chapter 6 EVALUATION OF EXTENSIVE AND SIGNIFICANT IMPACTS

Development could result in both positive and negative changes. However, not all changes are followed by extensive and significant impacts. This chapter presents evaluation of changes associated with the construction of the power plant and its transmission lines, and is aimed to determine whether or not the changes would cause extensive and/or significant impacts. Moreover, the management guidelines to mitigate these impacts are described.

6.1 Analysis of Extensive and Significant Impacts

Description of impact evaluation is presented consecutively and corresponds to each development stage.

6.1.1 Pre-Construction Stage

6.1.1.1 Measurement, Mapping and Other Data Collection

These activities are aimed to collect data and information pertinent to the project site. The impacted environmental components are land ownership status, manpower affairs, community's perceptions, and livelihood and production activities.

6.1.1.1.1 Land Ownership Status

As indicated in the previous chapter, the lands for the power plant are locally government-owned and have been used for coal mining.

6.1.1.1.2 Manpower Affairs

Pre-construction stage causes a positive impact on manpower issues but it will be insignificant in nature. This is because only 5-10 people local people will be involved and only for a short period of time. Involvement of the few select local people is not expected to create jealousy among the others.

6.1.1.1.3 Community Perceptions

Generally, local people were supportive toward the planned project. Visitations of the study team have increased positive perceptions and higher expectation for the realization of the project. However, the positive impact on local community's perceptions is considered trivial since the project has not been realized yet and local involvement is relatively limited.

6.1.1.1.4 Livelihoods and Production Activities

The planned activities will have positive impacts on local people's livelihood particularly to those working in the transportation sector. The use of river transportation vehicles by the study team has directly increased the boat's owners' and/or operators' income since they received

higher than usual payment. However, the profits were temporary and short-lived, only for 5-10 days, and local involvement was limited, hence the impact is considered as insignificant.

6.1.1.2 Land Acquisition

6.1.1.2.1 Land Ownership Status

From the land ownership perspective, land acquisition could cause negative impacts. The transfer of land rights from existing owners to the project owner with necessary compensation could potentially provoke conflicts. Unsettled land compensation issues could cause vertical conflicts between local owners and the project owner, while unclear land boundaries could induce horizontal conflicts among local land owners.

Concerning land acquisition for the transmission lines, different perceptions on land compensation issues between land owners and the project owner could also cause negative impacts as it potentially creates vertical conflict. Besides, the existence of transmission towers and prohibitions on cultivating the land underneath would devalue the price of land.

6.1.1.2.2 Land-Use

Construction and operation of the power plant would make the project site inaccessible to local people. The cut off of access could trigger conflicts with local communities. Impacts on land-use are cumulative and long-term, hence they are considered as negative, extensive and significant.

6.1.1.2.3 Spatial Planning

Land acquisition would impact spatial planning of the area as it will change the existing space pattern and structure, especially in Loa Janan District. However, such impact is not expected to take place in districts where transmission towers will be installed (i.e. in Harapan Baru Districts). According to the revised Spatial Planning of Kutai Kartanegara Regency Year 2002, the area of the project site was designated for coal mining. The construction of the power plant and the transmission lines will change the area function, i.e. for energy industry purposes. Nevertheless, such changes are possible as long as they abide by the prevailing government regulations. The impact, therefore, is not considered to become negative, not considered to become extensive and is considered to be insignificant.

6.1.1.2.4 Livelihood and Production Activities

Change of land ownership status will have negative impact on livelihood and production activities.

Since only a few people would be affected, the negative impact on livelihood and production activities is considered as insignificant.

6.1.1.2.5 Lifestyle

Land acquisition would probably negatively affect local people's lifestyles as compensations would trigger consumptive behaviour and increase unnecessary spending. The magnitude and the nature, however, are small and temporary. Thus, the impact would be negative but not extensive and it will be insignificant.

6.1.1.2.6 Community Perceptions

Local communities were very supportive toward the planned project, and land acquisition did not create negative perceptions but it must be executed transparently.

On lands for the transmission lines, the acquisition would probably create different perceptions between local people and the project owner, especially in compensation issues. The prevailing perception of the local communities was that all the land within the free-space corridor of the transmission lines will be acquired and compensation given. The Minister of Mining and Energy Regulation No. 0.1.P/47/MPE/1992 and Decree No. 975.K/47/MPE/1999 specifically stipulates that only land for the tower sites will be compensated for and no compensation will be given for lands under the free-space corridor of the transmission lines except for the places where cultivated plants that are considered to interrupt the electric conductor system could no longer be raised and there will be no transfer of land ownership for these areas. These different perceptions could cause vertical conflict between the project owner and local land owners, particularly those having land along the transmission lines. Since lots of people will be affected, the impact is considered negative, extensive and significant.

6.1.1.3 Manpower Recruitment

6.1.1.3.1 Demography

The planned activities would result in the increase of population in areas surrounding the project site, and would take place continuously until the end of the construction stage. This would affect the population structure, gender ratio and workforce structure in the area, particularly in Loa Janan District. However, the impact is considered as insignificant since it has not been realized yet.

6.1.1.3.2 Manpower Affairs

The employment opportunities during the pre-construction phase would be limited since workers are only needed for jetty construction. Around 200 unskilled laborers are needed for the 3-month construction. Involvement of local unskilled people will have a positive impact on employment opportunities but because the duration is short the impact is considered insignificant.

6.1.1.3.3 Livelihood and Production Activities

Construction jobs would be more attractive to local young people than opportunities in the agricultural sector. The expectation was that working in construction projects would give higher

income and better employment conditions. The impact, however, would be insignificant and not extensive since the opportunities are few and only a small number of outsiders are to be involved.

6.1.1.4 Construction of the Jetty

6.1.1.4.1 Noise

Construction of the jetty would produce noise with intensity reaching 74 dB (A) especially during the dredging, and installation of the jetty's foundation and piles. That value exceeds the threshold value for an inhabited settlement but since the closest settlement is located about 500 meters away from the project site, the negative impact is considered to be insignificant.

6.1.1.4.2 Potential and Quality of Water Resources

Construction of the jetty will have an impact on water quality as it would stir and release the river's sediment to the water column during dredging and pile installation. It was estimated that the concentration of total suspended solids (TSS) would increase 30% more than the current concentration. Besides, there are possibilities that other contaminants would also be released to the water column. The increase of TSS is predicted to decrease dissolved oxygen concentration by 0.5 to 2 mg/l in certain areas near the location of the jetty construction but this would return to normal (i.e. it is reversible) within a radius 10 meters of the activities. The increase of TSS would not affect local people as the jetty will be constructed in the lower reaches. The impact, therefore, is considered to be negative but not extensive and it is considered to be insignificant.

6.1.1.4.3 Aquatic Biota Resources

Construction of the jetty will have a negative impact on aquatic biota especially to the bottom dwelling organisms, the benthos. The impact will be temporary --only during construction activities-- and the benthos would recover once the construction is ended.

Changes in water quality associated with the jetty construction would have an impact on species composition of plankton and nekton (fishes) but the impact is expected to be short-term and insignificant as they are mobile organisms (i.e. could avoid the impacted area and move to other areas). Similarly, the impact is reversible and plankton and nekton would easily recover once the construction is ended.

The impact on benthos, plankton and nekton is considered to be negative but insignificant and not extensive.

Table 6-1 Matrix Interaction of Extensive and Significant Impact on Preconstruction Phase

Activity Phase	Preconstruction					
Environmental Component	*1*	*2*	*3*	*4*	*5*	*6*
1. Climate, Air Quality, and Noisy						
a. Noise and Vibration						☐
2. Hydrology						
a. Water Resources						☐
b. Water Resources Quality						☐
3. Space, Land, and Soil						
a. Land Utility Existing				■		
b. Land Using				☐		
c. Land Owner Status			☐	■		
e. Landscape				☐		
4. Biology						
f. Freshwater Biotic Composition						
g. Nekton						☐
5. Social, Economic, and Culture						
a. Demography					☐	
b. Sex Ratio					☐	
c. Demography Dispersal					☐	
d. Manpower					⊙	
e. Livelihood			☐	☐	⊙	
f. Life Style				☐		
g. Acceptability				☐		
h. Perception			☐	■		

Note

1 = General Survey
2 = Activity Planning Socialization
3 = Planning and Mapping
4 = Land Aquisation
5 = Manpower Recruitment
6 = Jetty Construction
■ = Important Negative
☐ = Unimportant Negative
● = Important Positive
⊙ = Unimportant Positive

6.1.2 Construction Stage

6.1.2.1 Manpower Recruitment and Mobilisation

6.1.2.1.1 Potential and Quality of Water Resources

Recruitment and mobilization of manpower would produce 77,760 liters per day or 0.90 liters per second of domestic wastes containing BOD, COD and TSS. Direct discharge of domestic wastes to Mahakam River would increase BOD, COD and TSS concentrations by 10 percent and would have a negative impact on the river's water quality. The impact would be temporary in nature and would only occur during the early phase of the construction stage when facilities are correspondingly limited. When the facilities are improved and the wastes are channeled to a waste treatment pond first before discharge, the impact would diminish. The impact on water resource's potential and quality is considered as negative but insignificant.

6.1.2.1.2 Spatial Planning

Influx of a large number of workers to the project site and surrounding areas will have an indirect impact on the spatial structure. It was estimated that the number of project workers would reach 1,170 with around 200 induced workers. They need relevant infrastructure and facilities such as housing/accommodation, clean water and environmental sanitation facilities, and vehicles/transportation.

The induced workers are expected to create their own housing which predictably will be of poor quality, sporadically dispersed around the project site, and with poor sanitation systems as well. These will deteriorate the spatial condition as the housing will create a slum area.

Limited supply of clean water would increase direct usage of the river water and this would have public health implications, i.e. potential as a source of diseases for both local communities and project workers.

The absence of proper land transport infrastructure and facilities such as public transport terminals would create congestion, especially in Loa Duri Ulu Village.

The impacts on spatial planning are considered to be negative, extensive and significant.

6.1.2.1.3 Demography

With the inflow of outsiders during the construction stage, it is predicted that the population of Loa Duri Ulu village will be increased as well. The number will drastically increase if the workers also bring along their families This would affect the population structure, gender ratio and manpower affairs at the local level. In addition, the existing insufficient infrastructure and facilities in the study area would be impacted by the population increase in terms of housing, clean water facilities, etc. The increase, however, would be temporary and the local population is expected to be back to 'normal' when this stage has ended. The impact is considered as negative, insignificant and not extensive.

6.1.2.1.4 Transportation

An increase in the volume and frequency of both land and water transportation is expected to take place in the Loa Janan to Samarinda route.

Currently, the water transportation between Loa Janan and Samarinda is limited: the average frequency was 5 boats per day. With the project in progress, the frequency is predicted to increase by 10 boats per day. Similarly, land transportation would increase as well and it is expected the service would becoming regular to accommodate the increasing influx of people to the project site and surrounding areas.

The impact on transportation is considered to be positive, extensive and significant.

6.1.2.1.5 Manpower Affairs

Construction of the power plant and transmission lines would absorb manpower. It was estimated that 1,170 workers, with different education levels and skills are needed for a 24-month length project. The opportunities for local people, therefore, are quite ample.

The availability of employment opportunities for local people suggests that the impact is positive, significant and extensive.

6.1.2.1.6 Livelihoods and Production Activities

The construction stage would create both direct and induced employment, and it was estimated that a total of 300 types of production activities will be created. These activities are those related with trade, transportation, service (accommodation, restaurants, etc.) and telecommunications. Overall, the increase of activity in Loa Janan District will induce the growth and improvement of development services' system for other districts (i.e. Harapan baru) where the construction of transmission lines is taking place. The impact on local community's livelihood and production activities is considered as positive, significant and extensive.

6.1.2.1.7 Acceptability, Lifestyle and Acculturation

The existing lifestyle of the local people is predicted to change in which they become consumptive. The changes will be caused either by windfalls associated with the land compensation scheme or by a significant increase in income associated to working with the project. Another major concern is the emergence of prostitution which could provoke social problems both for local communities and the project workers. These suggest that the impact on local acceptability, lifestyle and acculturation is negative, significant and extensive.

6.1.2.1.8 Crime

It is predicted that the increased influx of people to the project site and the surrounding areas would be accompanied with increasing criminal activities such as burglary and brawling. The increase of criminal incidents, which could be linked to the emergence of prostitution and rampant presence of liquor-serving shops, also could create discomfort among local people and the workers. The impact is considered as negative, significant and extensive.

6.1.2.1.9 Public Health

A drastic population increase and the presence of a large number of workers are predicted to affect public health indirectly as indicated by (a) increasing risks of both local people and project workers to contract diseases; (b) Increasing risks of the outbreak of diarrhea and malaria; and (c) insufficient public health infrastructure and facilities to cope with health problems associated with the planned activities. These suggest that the impact of manpower recruitment and mobilization on public health component is negative, significant and extensive.

6.1.2.2 Equipment and Material Loading-Unloading

6.1.2.2.1 Noise

Noise produced by the loading and unloading of materials and equipment is predicted as not having an impact on local communities since the nearest settlement is situated quite distant from the jetty. Besides, the loading and unloading will be conducted at regular intervals and mainly during the early period of the construction stage. The impact is categorized as negative but insignificant.

6.1.2.2.2 Potential and Quality of Water Resources

The possibility of oil spills during loading and unloading has the potential to cause deterioration of Mahakam River's water quality but the situation will be temporary and short-term. The impact is considered to be negative but insignificant.

6.1.2.2.3 Aquatic Biota Resources

The loading and unloading of materials and equipment will have an indirect impact on aquatic biota. Oil spills that are likely to occur would first affect water quality before having any impact on aquatic biota such as plankton, benthos and nekton (fishes). Besides, the impact would also be temporary and reversible (i.e. when the water quality is improved corresponding to the termination of loading and unloading, the biota would quickly recover). The impact is categorized as negative but insignificant.

6.1.2.3 Equipment Mobilisation

6.1.2.3.1 Noise

The mobilization of equipment is predicted to amplify noise levels at the project site to a maximum average between 65 and 74 dB(A) at a the distance of 15 meters and vehicle speed of 30 km per hour. Presently, the noise intensity at the project site is 48 dB(A), and in the surrounding areas are 62 dB(A). The impact is considered to be negative, but insignificant, and temporary in nature and would only affect project workers on the jetty and in areas nearby.

6.1.2.3.2 Quality of Water Resources

Equipments mobilization will have an impact on Mahakam River by deteriorating its water quality temporarily and for a short-term. The impact is considered to be negative but insignificant.

6.1.2.3.3 Aquatic Biota Resources

Similar to the loading and unloading of materials and equipment, the impact of equipment mobilization will have an indirect impact on aquatic biota. Oil spills that are likely to occur during the mobilization would first affect water quality before having an impact on aquatic biota such as plankton, benthos and nekton (fishes). Besides, the impact is not permanent and as reversible (i.e. when the water quality is improved corresponding to the termination of equipment mobilization, the biota would quickly recover). The impact is considered to be negative but insignificant.

6.1.2.3.4 Transportation

Equipment mobilization will have an indirect impact on transportation. This will be a consequence of the increasing influx of job-seekers and/or manpower from the surrounding areas to Loa Janan District, especially to Loa Duri Ulu villages. The increase of the traffic volume of river transportation would only happen on the route between Loa Janan and Samarinda (Loa Janan-Samarinda) but this is not necessarily caused by equipment mobilization. The impact is considered as negative but insignificant.

6.1.2.4 Land Clearing and Preparation

6.1.2.4.1 Micro-Climate and Air Quality

Change of micro-climate is primarily caused by increase of temperature due to loss of vegetation cover. Increase of temperature would affect soil surface evaporation causing soil to become dry and dusty. The impact is temporary and only in areas where land clearing and preparation takes place thus it is also reversible and not cumulative. The impact is therefore considered as negative, insignificant and not extensive.

6.1.2.4.2 Noise

The intensity of noise produced by land clearing and preparation exceeds the maximum allowable level of 45 dB(A) (during the day) and 40 dB(A) (during the night) for an inhabited settlement. The impact is temporary but the intensity will potentially have an impact on those exposed to it such as the workers and local people. The impact is categorized as negative and significant.

6.1.2.4.3 Quality of Water Resources

Land clearing and preparation will have an impact on the potential and quality of water resources and reduce water soil infiltration capacity of the soil. Increasing run-off would follow with an increase of suspended solids in the runoff water and because of the high rainfall in the

area, increase turbidity by 40 percent over the present ambient value. The magnitude is expected to be quite extensive, as far as 200 meters from the project site. However, the impact is temporary will end with the construction of relevant facilities (e.g. run-off control system) and would not affect water use of local communities upstream. The impact, therefore, is considered as negative but insignificant.

6.1.2.4.4 Sediment

Increase of run-off associated with land clearing and preparation is predicted to increase sedimentation (i.e. increasing influx of total dissolved solids [TDS]) in Merandai River and is considered as a temporary, negative, significant and extensive impact. With the advent of relevant facilities and drainage systems in the operational stage, it is expected that the impact would be controlled and mitigated hence the sedimentation process could be minimized.

6.1.2.4.5 Erosion and Land Stability

Land clearing and preparation will have a negative impact on erosion and land stability but this is expected to be insignificant and not extensive as the process will be conducted gradually, and land preparation would be carried out immediately after clearing to reduce the erosion level.

6.1.2.4.6 Spatial Planning

Land clearing and preparation will have a direct impact on spatial planning as it would change the land use/function of the project site, from agricultural purposes with no buildings to non-agricultural uses with significant buildings and other constructs. This will accordingly change the land designation that was suggested in the Spatial Planning of Kutai Kartanegara Regency, particularly in Loa Janan District. Such impact, however, would not occur for the transmission lines. The existing Spatial Planning is apparently accommodative toward change in the land use/function hence the change in spatial planning is allowable as long as it is in agreement with the prevailing (local) government regulations. The impact, therefore, is considered as negative but insignificant.

6.1.2.4.7 Soil

Land clearing and preparation will have a negative impact on soil conditions because it will cause loss of the fertile topsoils. The impact is considered as insignificant as the land of the project site was not fertile or productive.

6.1.2.4.8 Flora & Fauna Resources

Land clearing and preparation will have a negative, significant and extensive impact on flora and fauna resources because (a) it would make vegetation disappear which is a habitat for wildlife; (b) there were 3 protected wildlife species in the study area that would be affected; and (c) uncontrolled migration of wildlife would create a disturbance in on local communities and settlements.

6.1.2.4.9 Aquatic Biota Resources

Land clearing and preparation will have an indirect negative but insignificant impact on aquatic biota. Land clearing and preparation would increase turbidity and sedimentation which in turn would deteriorate water quality. The impact is temporary because the aquatic biota would recover once the activity is ended. Nekton (fishes) are mobile animals and could avoid the impacted areas, whilst benthos are quite tolerant toward the effect of turbidity and sedimentation. Plankton, especially phytoplankton, are passive and this will cause them to receive an impact but the effect will be tolerable.

6.1.2.5 Construction of the Power Plant

Construction of the power plant will produce an impact in the form of an increase in noise. The source of the noise will come particularly from heavy equipment for land leveling and compacting, and from the activities to install the turbines, generators, etc. Literature suggests that the noise intensity of heavy equipment ranges between 70 and 90 dB(A) at a distance of 15-20 meters, and this will affect the project workers directly. At the distance of 170 meters from the source, the intensity will decrease to 55 dB(A). Therefore, there will be no noise impact to the general population as the nearest settlement is located around 200 meters from the source. The impact is considered as negative but insignificant.

6.1.2.6 Construction of Clean Water Facilities

6.1.2.6.1 Noise

The noise would primarily come from the use of heavy equipment to build the water reservoir. The presently noise level in the project site is 45 dB(A) and is predicted to increase to 70-90 dB(A) at a distance of 20 meters with the use of heavy equipment. The noise will only affect the project workers and wildlife, and not the settlements since their locations are quite far from the project site. The impact is considered as negative but insignificant.

6.1.2.6.2 Groundwater

Groundwater within a radius of 200 meters from the location of the water reservoir would be affected by the activity but those wells used by local people would not. So are the vegetations within the same radius as they would be cut down. Beyond that radius the impact would be minimal because of the low soil permeability. The constrained impact on groundwater is reversible, temporary and not cumulative suggesting a negative but insignificant impact.

6.1.2.7 Discharge of Construction Workers

6.1.2.7.1 Demography

The end of the construction stage would be followed by a significant decrease of local population as terminated workers would migrate to other places to look for new jobs. The decrease would change the structure of the local demography such as population distribution,

gender ratio and manpower affairs. The changes would not have an impact on the demographic component but will have further impact on other environmental components.

6.1.2.7.2 Livelihood and Production Activities

The discharge of workers will have a negative impact on local people's livelihoods and production activities especially to those having direct dependence upon the construction of the power plant. To some extent, the impact will also be experienced by those having indirect relationships with the project. Workers from outside are predicted to return to their origin while local workers would look for other jobs.

Loss of livelihood and production activities could create social anxiety among the local people but it would be happen temporary particularly if they are absorbed in the subsequent operational stage. The impact is considered as negative but insignificant.

6.1.2.7.3 Lifestyle

The discharge of construction workers would have a negative impact on the local lifestyle. Gradual release of workers would help to prevent the potential social anxiety and make the impact short and not cumulative. It is expected that the potential impact would not be permanent, but rather fade away accordingly. The impact is considered as negative but insignificant.

6.1.2.7.4 Crime

The discharge of construction workers might trigger criminal activities that create social anxiety in local communities particularly if unemployment is not addressed immediately. The intensity is expected to be small and last for only a short period of time. The impact is considered as negative but insignificant.

Table 6-2
Matrix Interaction of Extensive and Significant Impact on Construction Phase

Activity Phase	Construction											
Environmental Component	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
1. Climate, Air Quality, and Noisy												
a. Micro Climate				■								
b. Air Quality				■								
c. Noise and Vibration		□	□	■	□	□	□	□	□	□	□	
2. Physiographic and Geology												
a. Erosion				□								
b. Land Stability				□					□			
c. Ground Water							□					
3. Hydrology												
a. Water Resources	□	□	□	■				□				
b. Water Resources Quality	□	□	□	■				□				
c. Sedimentation				□								
d. Sediment Quality				□								
e. Flood Hazard				□								
4. Space, Land, and Soil												
a. Land Using Existing				□								
b. Landscape	■			□								
5. Biology												
a. Secondary Forest Community				■								
b. Bushes Community				■								
c. Man Made Ecosystem				■								
d. Wildlife Home Range				■								
e. Freshwater Biotic Composition		□	□	□								
f. Nekton		□	□	□								
6. Social, Economic, and Culture												
a. Demography	□											□
b. Sex Ratio	□											□
c. Demography Dispersal	□											□

Note	
7	= Manpower Mobilization
8	= Loading Unloading
9	= Equipment Mobilization
10	= Land Clearing and Land Preparation
11	= Land Preparation For PLTU
12	= Installation Development
13	= Freshwater Facility Installation
14	= Infrastructure Construction
15	= Tower Construction
16	= Tower Setting
17	= Cable Pulling and Setting
18	= Manpower Release
■	= Important Negative
□	= Unimportant Negative
●	= Important Positive
⭘	= Unimportant Positive

d. Manpower	●											□
e. Livelihood	●											□
f. Traffic Hazard	■		□									
g. Criminality	■											□
h. Live Style	■											□
i. Acceptability	■											
j. Perception									□	□	□	
k. Acculturation	■											
7. Health												
a. Health Infrastructure	■											
b. Sanitation Hazard	■											

6.1.3 Operation Stage (Post-Construction Stage)

6.1.3.1 Manpower Recruitment and Mobilisation

6.1.3.1.1 Quality of Water Resources

Daily water requirements in the operational stage are 52,500 liters or equivalent to 31 percent of total requirements of the power plant. The production of domestic waste is estimated to be 42,000 liters per day and will contain organic pollutants such as BOD, COD and TSS. The domestic waste is planned to be sent to either a septic tank or an activated-sludge waste water treatment installation. The use of waste water treatment to maintain water quality in the receiving water body (in this case, Mahakam River) suggests that the impact should be considered as negative but insignificant.

6.1.3.1.2 Manpower Affairs and Livelihoods

It was estimated that a total of 350 workers with different educational backgrounds and skills would be employed to operate the power plant. Of this figure, 100 are to be allocated for non-skilled workers. This suggests opportunities for local people are limited since the majority of local people are only equipped with an elementary or secondary level education. Besides, locals are trained for agriculture related activities more than for industry especially electric energy supply. Nevertheless, although the employment opportunities are rather limited the net impact of the 100 new jobs for the local people is considered as positive, significant and extensive.

6.1.3.1.3 Community Perceptions

Limited employment opportunities with the power plant would create negative perceptions among the local people, and might create intra-community friction (i.e. horizontal conflict) and dislike toward the project owner (i.e. vertical conflict) because the project could not accommodate local aspirations as the number of job-seekers exceed the available openings. The impact, therefore, is considered as negative, significant and extensive.

6.1.3.2 Coal Transportation

Transportation of coal using a belt conveyor system and combined with selection of an optimum roadway is aimed to minimize the release of dust to the environment, hence it is expected to work well and negate the negative impact.

6.1.3.3 Coal Storage

6.1.3.3.1 Air Quality

The storage of coal at the project site would impact air quality in the surrounding areas since the open storage is prone to release dust when the wind blows. To minimize the likelihood of ash

escaping into the environment, it is planned to spray the storage area with water regularly. The impact is considered as negative but insignificant.

6.1.3.3.2 Potential and Quality of Water Resources

The storage of coal would indirectly affect water resource quality since the leachate waters would deteriorate the quality of the receiving water bodies. It is planned that the storage yard will be equipped with a drainage system that channels leachate waters to a sedimentation pit to settle down minerals and metals. Subsequently, the supernatant will be sent to an activated-sludge pond for further treatment. The use of specialized drainage and treatment systems suggests that the impact on water resource quality is considered as negative but insignificant.

6.1.3.4 Water Uptake and Discharge

6.1.3.4.1 Noise

The main source of noise is the operation of the pump station which is estimated to create a noise level with an intensity of 70 dB(A). The noise would create an impact throughout the operational stage but the extent is rather confined as the location of the pump station is far from the nearest settlement. Possibly, only the operators that would be exposed to the effect of the constantly high intensity noise but the damaging effect could be minimized or avoided with the use of appropriate gear such as hearing protection. The impact is considered as negative but insignificant.

6.1.3.4.2 Quality of Water Resources

The total daily water requirements of power plant during the operational stage of 9,100 m^3 per day is considered to have a minor impact on the Mahakam River debit of 477,451 liters per second since the average water uptake is equivalent to a mere of 0.88 percent of the River's average debit. The impact is therefore considered as negative but insignificant.

Liquid wastes produced by the power plant will be treated first using activated-sludge to meet standard effluent criteria outlined in the Governor of East Kalimantan Regulation No. 339 Year 1988 on Liquid Waste Quality Standard (LWQS) for Industry, Hotels, Hospitals, Domestic Activities and Coal Mining. The concentration of effluents is not predicted to contribute significantly to initial concentrations of pollutants in Mahakam River since the increase of concentration is 0.3 percent for BOD, 0.057 percent for COD, and 0.2 percent for TSS. Continuous discharge of effluent to Mahakam River throughout the operation of the power plant is predicted to increase the concentration of some pollutants, hence the concentration of those pollutants in the effluent of the waste treatment must always be monitored and managed to prevent it from exceeding the effluent standards. Otherwise, it could deteriorate water quality in the long run. The impact is considered as negative significant and extensive.

6.1.3.4.3 Sediment

It is planned that the daily water uptake for the power plant will reach 9,100 m3 per day and it will be pumped using 2 pumps with a capacity of 2,500 m3 per day per unit. The suction mechanism is purposefully designed to be free from dirt and sediment; hence it will not stir the sediment and thus cause sediment quality deterioration. The impact is considered as negative but insignificant.

6.1.3.4.4 Aquatic Biota Resources

The uptake and discharge of water during the operational stage would not have any direct or extensive impact on aquatic biota such as plankton, nekton and benthos. This is because the water will be taken from the reservoir, and treated first before being discharged back to Mahakam River. The treatment is aimed to control the water temperature and acidity so the value will be at the ambient level of 27oC and neutral pH. It is expected that the treatment would significantly reduce the potential for accumulation of the impact thus it will not be harmful to aquatic biota although the discharge will take place for the entire period of operation. The impact is considered as negative but insignificant.

6.1.3.5 Burning of Coal (Operation of the Turbines)

6.1.3.5.1 Air Quality

The burning of coal will deteriorate air quality in the areas surrounding the project site and cause discomfort for local communities, especially those living in Loa Janan and II villages. Additionally, the deteriorating air quality might also affect local vegetations both natural and cultivated.

The combination of the use of Low-NOx Burner technology, low sulphur content coal, and ash entrapment using the electrostatic precipitator (EP) is expected to minimize the negative impact of deteriorating air quality due to the operation of the power plant. However, the long period of continuous burning of the coal (it was estimated that the length of the power plant will be around 100 years) means that it is not possible to warrant that such negative impact would not occur in the long term even though the intensity is expected to be minor. The impact is considered as negative, significant and extensive.

6.1.3.5.2 Noise

Noise intensity of the turbine operation is estimated to be 70 dB(A), and the cooling system is estimated to be around 80 dB(A) (L10) at a distance of 25 meters from the sources and decrease to 74 dB(A) at 100 meters. These intensities would affect the workers; hence they must be equipped with relevant work safety gear to avoid harm, e.g. hearing impairment. The noise would not impact the local communities as the settlements are located quite far from the generator, hence the impact is considered as negative but insignificant.

6.1.3.5.3 Quality of Water Resources

The burning of coal will have an indirect impact on water quality. Ash and exhaust gases produced by the combustion would increase rain water acidity (decrease pH) and potentially create acid rain. Calculations predicted that the rain pH at the highest ash and exhaust gas concentrations will be 5.7 or well below neutral (pH 7). Field surveys indicated that the present Mahakam River water pH samples are between 5 and 6. The impact of the burning of the coal on the quality of the water resources is considered as negative, significant and extensive.

6.1.3.5.4 Flora and fauna Resources

Coal burning could cause deterioration of air quality in the areas surrounding the project site. The most probable cause of this would be if the electrostatic precipitator (EP) was not working effectively allowing some ashes to be released through the stack. The ashes would cover plant leaves, gradually altering the photosynthesis capacity and this could result in the demise of the plants. Although rain and wind would naturally provide help to mitigate the impact, a well-maintained EP is of paramount importance to minimize the negative impact on local flora. For animals, the ashes could cause respiration problems which could kill them in the long term but their mobility would help them to avoid the impacted areas, hence the impact of the ash is rather minor on fauna.

Coal burning also produces gases such as NOx and SOx which are could potentially create acid rain and cause deterioration of water and soil quality in the surrounding areas. For plants, acid rain would make soil pH decrease hampering their growth or resulting in death. For animals, such acid rain would not affect the mobile animals but could fatally affect slow-moving animals. Since the effects of the burning of the coal could extend to a radius of 3 km from the project site, the impact is the burning of coal will have an indirect impact on water quality. Ash and exhaust gases produced by the combustion would increase rain water acidity (decrease pH) and potentially create acid rain. Calculations predicted that the rain pH at the highest ash and exhaust gas concentrations will be 5.7 or well below neutral (pH 7). Field surveys indicated that the present Mahakam River water pH samples are between 5 and 6. The impact of the burning of the coal on the quality of the water resources is considered as negative, significant and extensivecategorized as negative, significant and extensive.

6.1.3.5.5 Public Health

Coal burning would affect and decrease air quality in the areas surrounding the power plant, which in turn would impact the public health. The most vulnerable humans would be the older people, toddlers and children. Analysis indicated that the pollution would be concentrated in Loa Duri Ulu village. The impact is cumulative and indirect, suggesting chronic effects in the long-term, and therefore is considered as negative and significant.

6.1.3.6 Coal Ash Collection

Fly ash and bottom ash produced by the burning of the coal will be collected and stored in covered hoppers. The cover would only be opened when the transport trucks are ready for

deployment in order to minimize emission of ashes into the environment. Since the effect would be minor and localized, the impact is considered as negative but insignificant.

6.1.3.7 Coal Ash Transportation

Transportation of coal ash will be done by covered trunks but the exact route has not been decided yet. Emission of pollutant gases is possible during transportation and would impact air quality negatively but is predicted to be minor if the route does not pass near any settlements. However, the impact could be negative and significant if the route passes near the settlements.

6.1.3.8 Coal Ash Storage

The bottom ash of from the burning of the coal is planned for other uses, such as a component of building materials or for other industrial purposes. However, the plan has not yet been finalized. If the bottom ash is unusable, it will be sent and stored in the disposal site of the PT Bukit Baiduri Energy coal mine located around 10 kilometers to the north of the project site. The bottom ash is suspected to still have remains of pyrite (FeS2) and other metals and minerals.

6.1.3.8.1 Air Quality

The storage of coal ash would have a negative but insignificant and not extensive impact. This is because the ashes will be stored in an old mine quarry and thus protected from blowing wind. The impact on air quality is predicted to be insignificant since the length of time that it takes for coal ash removal from the trucks is very short and the extent will be limited to the mine area, which is far from settlements and other local activities.

Table 6-3
Matrix Interaction of Extensive and Significant Impact on Operational Phase

Activity Phase	Operational										Pasca Oprs			Note	
Environmental Component	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*		
1. Climate, Air Quality, and Noisy														19	= Manpower Recruitment
a. Micro Climate														20	= Coal Delivery
b. Air Quality		□	□		■	□	□	□			□			21	= Coal Pilling
c. Noise and Vibration				□	□				□					22	= Water Intake and Water Outlet
2. Hydrology														23	= Coal Combustion
a. Water Resources	□		□	■	□			□			⊙			24	= Fly-Ash Pilling
b. Water Resources Quality	□		□	■	□			□						25	= Fly-Ash Transportation
d. Sediment Quality			□	□										26	= Bottom-Ash Pilling
3. Space, Land, and Soil														27	= Power Distribution
a. Landscape												●		28	= Power Plant & Transmission Line Maintenance
4. Biology														29	= Equipment and Material Maintenance
a. Secondary Forest Community					■									30	= Asset Deliverieable
b. Bushes Community					■									31	= Manpower Release
c. Man Made Ecosystem					■									■	= Important Negative
d. Wildlife Home Range					■									□	= Unimportant Negative
5. Social, Economic, and Culture														●	= Important Positive
a. Manpower	●													⊙	= Unimportant Positive
b. Livelihood	●												□		
c. Perception	■								■						
6. Health															
a. Sanitation Hazard					■				■						

6.1.4 Post-Operation Stage

6.1.4.1 Handling of Equipment and Constructed Facilities

6.1.4.1.1 Air Quality

Demobilization of equipment that is no longer unusable would create a negative impact on air quality but the nature is temporary and the extent is limited to the project site only. The impact therefore is considered as negative but insignificant and not extensive.

6.1.4.1.2 Water Resource Potential

The existence of a water reservoir would have a positive impact on local communities as it could function as a clean water source and as a tourism spot as well.

6.1.4.2 Hand Over of Assets and Equipment

6.1.4.2.1 Spatial Planning

The handing-over of assets and equipment, particularly for transmission lines, will give the land-owners the opportunity to manage the 'abandoned' lands and use them for more productive activities. One obvious possibility would be the increase of land price. Besides, the hand-over of assets and equipment would ease the spatial planning of the area. The impact is considered as positive but insignificant.

6.1.4.3 Discharge of Manpower

6.1.4.3.1 Livelihood and Production Activities

At the end of the operational stage, a number of workers will be discharged. This situation will have been long been predicted and would be anticipated by meeting the prevailing government regulations on manpower affairs to minimize or eliminate unnecessary conflicts. Special attention, however, needs to be taken for workers indirectly linked to the project as they would lose their livelihoods and income accordingly. If not handled properly this would create social tensions and unease. The discharge of workers obviously would create a negative impact, but because the extent and the number of affected people will be relatively few the impact is considered as negative but insignificant.

6.2 Impact Analysis for Environmental Management and Monitoring

6.2.1 Environmental Component – Air Quality

6.2.1.1 Extensive and Significant Impact – Coal Burning (Turbine Operation)

Air quality would be impacted negatively, significantly and extensively by the burning of the coal to operate the turbines and it would provoke discomfort and increase the incident of respiration disease among the local people.

Management Guideline

- Concentrations of dust and exhaust gases must be managed and monitored, both at the emission source and in the surrounding areas, so that they meet local government requirements

6.2.2 Environmental Component – Noise

6.2.2.1 Extensive and Significant Impact – Land Clearing and Preparation

Noise intensity in the project site would be impacted negatively, significantly and extensively by the land clearing and preparation during the construction stage.

Management Guideline

- Relevant and strict regulations and procedures for civil construction should be established to minimise the impact
- Construction activities should be scheduled to minimise the effect of noise intensity, e.g. by not doing construction jobs during the night

6.2.3 Environmental Component – Water Resources and Quality

6.2.3.1 Extensive and Significant Impact – Land Clearing and Preparation

Land clearing and preparation would create a negative, significant and extensive impact on the environmental component of the quality of the water resources.

Management Guideline

- Run-off should be controlled, e.g., managing land contour
- Run-off should not be channelled directly to Mahakam River but dispersed to relevant facilities first
- Preserve vegetation in unused lands in the project site

6.2.4 Environmental Component – Space, Land and Soil

6.2.4.1 Extensive and Significant Impact – Land Acquisition

Components of space, land and soil, particularly of land ownership, land-use and community perceptions would be impacted by land acquisition.

Management Guideline

- A socialisation program must be carried out in order to make local people aware of the land acquisition mechanism and compensation process. Special attention should be emphasised for owners of the land under the transmission lines to achieve a common agreement that the compensation scheme is different than for those in the project site
- As far as possible, land acquisition should involve local formally and informally prominent persons, land owners and local government officials
- The land compensation process must be conducted as transparently as possible and include the disclosure of cost components of land status legalisation and involve the local people, the project owner and the local government
- The value and provision of land compensation should be negotiated through consultations and decided proportionally

6.2.4.2 Extensive and Significant Impact – Spatial Planning

Land acquisition would also impact the spatial planning component, extensively and significantly.

Management Guideline

- Detailed spatial planning for Loa Janan is necessary to reduce the negative impacts
- The capacity of the village and district government apparatus must be improved to cope with the insufficient public service systems and facilities

6.2.5 Environmental Component – Flora and Fauna

6.2.5.1 Extensive and Significant Impact – Flora and Fauna

Flora & fauna would be impacted by land clearing and coal burning. Land clearing would negatively impact terrestrial wildlife, whereas coal burning would negatively impact vegetations and threaten the aquatic/river environment and wildlife habitats.

Management Guideline

- Land clearing should be conducted gradually to enable wildlife to migrate safely.
- Prohibitions on wildlife trapping and hunting must be established.

- Concentrations of dust and exhaust gases from the burning of the coal should be controlled to prevent them from damaging vegetations and wildlife habitats.

6.2.6 Environmental Component – Socio-Economic

6.2.6.1 Extensive and Significant Impact – Socio-Economic

Components of manpower affairs and livelihood and production activities would be impacted positively, significantly and extensively by manpower recruitment and mobilization of manpower.

Management Guideline

- Give priority to the local people, especially those experiencing income loss or decrease due to land acquisition, for the available jobs/positions according to their educational background and skill
- Give priority to the use of local resources and production activities that have direct links with the planned activity

6.2.7 Environmental Component – Socio-Cultural

6.2.7.1 Extensive and Significant Impact – Socio-Cultural

Social-cultural components such as demography, lifestyle and crime rates would be impacted negatively but indirectly by manpower recruitment and mobilization.

Management Guideline

- Both direct and induced workers associated with the project, including their families, must be systematically recorded
- Neighbourhood safety systems involving both the authorities and local communities should be improved

6.2.8 Environmental Component – Public Health

6.2.8.1 Extensive and Significant Impact – Public Health

The public health component would be impacted either by (a) potential for disease outbreak due to poor environmental sanitation as a consequence of a drastic increase in population/workers and insufficient facilities, or by (b) poor air quality due to burning coal for the turbine operation.

Management Guideline

- Quantity and quality of public health facilities must be improved
- Environmental sanitation must be developed and improved

Chapter 7 STAKEHOLDER MEETINGS

7.1 The objective of the stakeholder meetings

After the AMDAL study had been implemented, stakeholder meetings (Public Consultancy) were executed for the local communities around the planned power plant construction site. The Public Consultancy was executed in two places assumed to be especially influenced by the power plant construction.

These were executed according to the "JICA environment and society consideration guideline". Residents, NGOs, the provincial government, city organizations, county organizations, the village mayors, the army, the police, and the city council members, etc. participated in these meetings, and there was an active opinion exchange. The remarks regarding the power plant construction were very positive and supportive even though anxiety regarding the possible environmental impacts had risen. This is because electricity shortages and high unemployment continue to be chronic.

7.2 Public Consultancy

7.2.1 Loa Duri Ulu Village

Place: Loa Duri Ulu Village, Loa Janan District, Kutai Kartenegara Province
Date: 11 December 2006
Attendees: Table 7-1

Main questions and requests from the attendees were as follows.

- What kind of industrial waste is produced by the activities?
- What kind of jobs will be produced by the project? I want to demand training so that we have a chance for employment.
- I want to welcome this project because of the chance of finding employment.
- I want you to hire a local builder for the construction of the power plant in order to improve the local economy.
- The proposal to use the unsalable coal is welcomed by the local community.

7.2.2 Sungai Kunjang

Place: Sungai Kunjang, Samarinda City
Date: 12 December 2006
Attendees: Table 7-1

Main questions and requests from the attendees were as follows.

- What will be the impact of the exhaust gases when the fine coal and the low grade coal are used for fuel?
- What impact does the colliery have on the Mahacam River now?
- Which regions would be influenced by the power plant?
- The power plant creates job opportunities. I want you to give me training because we local people don't have the required technology,

Table 7-1 Attendees of public consultancy

No.	Loa Duri Ulu	No.	Sungai Kunjang
1	Camat Loa Janan	1	Camat Sungai Kunjang
2	Babinsan Desa Loa Duri Ulu	2	Polsek S. Kunjang
3	BABIM ICRMTIB MRS LDU	3	Ketua RT. 14 Loa Buah
4	Kades Loa Duri Ulu	4	Ketua RT. 11 Loa Buah
5	Dinas Pertambangan Prop. Kaltim	5	Dinas Pertambangan
6	RT 7/5 LDU	6	--
7	RT 02/1 LDU	7	Loa Buah
8	RT 16/5 LDU	8	Loa Buah
9	Ketua BPP LDU	9	Sungai Kunjang
10	Kapolsek Loa Janan	10	BAPEDALDA Samarinda
11	BPD Anggota	11	Kosi PMK
12	BESSIE	12	Sek Coal
13	Staf Desa	13	Kantor Pertambangan Smd
14	Kadus G LDU		
15	Loa Duri		
16	RT 14 Loa Duri		
17	Wakil RT 14		
18	Staf Desa Loa Duri		
19	Staf Desa		
20	Staf Desa		
21	Staf Desa		
22	BAPEDALDA		
23	RT 16/5 Kutai Baru		
24	Wakil BPD Loa Duri		
25	Kantor Camat Loa Janan		