5.2 Principal Environmental and Social Impacts that are potentially assumed and to be mitigated

5.2.1 Assessment on Compliance of Proposed Project Site with Existing Spatial Plans

(1) Bojonegara Site as a part of Special Development Area for Industry and Port

The Government of Indonesia (GOI) has been using regional development approach to accelerate economic development. Through the Mid Term Development Plan 2009-2014, GOI designated 76 National Strategic Areas (KSN) which spread all over Indonesia. Among the 76 KSNs, five are for the Special Economic Zones (KEK). KEKs have been set out with Law No. 26/2007 on the National Spatial Plan and elaborated in the Mid Term National Development Plan (RPJM) 2009-2014. One of the KEK established by GOI is the Special Economic Zones (KEK) Bojonegara.

Bojonegara has several advantages and meet some requirements to serve as the KEK. Bojonegara has been promoted as the location for the International Port Hub in the western part of Java island by Ministry of Transportation (MOT) Decree No. 53/2002. It is promoted as a complementary system to the Port of Tanjung Priok in Jakarta because the port had reached maximum capacity and resulted in a degradation of port services as multi-functional port, especially in speed cargo transit time due to the high level of traffic disruption. According to the MOT Decree, the Port Bojonegara will serves for trans-shipment cargo, while the Port Tanjung Priok for passenger and cargo containers.

By the provincial government, Bojonegara was first determined as KEK in 2007 with the Spatial Plan of Banten Province (RTRWP), for which the RTRWP (2011-2031) is currently effective with the Provincial Regulation (PERDA) of Banten Province No. 2/2011. As for the district, KEK Bojonegara was confirmed through the Spatial Plan of Serang District in 2009 and is effective with District Regulation No 10/2011 for the period of 2011-2013.

In the development plan of Bojonegara KEK, the Bojonegara International Port is accompanied with Industrial Zones, namely Jababeka and Ex Golden Key Industrial Areas. Thus, the KEK Bojonegara will be developed for the two activities that are large-scale industries and trade harbor activities. The area for trade and industry has been partially managed by the private sector (Jababeka Industrial Estate) with the total area of 6,400 ha, where the site for the assumed PLN Power Plant is located. In 2008, the large industrial companies who joined in the Industrial Jababeka reached 37, and increased to 147 companies in 2011.

Thus, the proposed site for power plant development is already in line and compliance with the detailed spatial plans of both central and local governments concerned with Bojonegara, with the location being within Jababeka Industrial Area, the KEK Bojonegara. The status of Bojonegara site as a candidate site for power plant development has been confirmed with Serang District Officer in-charge in Spatial Planning, Development Planning Board (Bappeda) of Serang District. Not been Informed to the Local Government so far, the power plant development plan is not yet covered both in the provincial and district spatial plans.

Table 5.2.1-1 presents the Matrix of assessment results over the compliance of the potential development site of Bojonegara with existing spatial plans.

Table 5.2.1-1 Assessment on Compliance of Site Selection for the Bojonegara Plan with Existing Spatial Plans

The Item of Assessment	National Spatial Plan	Banten Spatial Plan	Serang Spatial Plan	Detailed Spatial Plan Bojonegara Sub District	Detail Spatial Plan Pulo Ampel	Conclusion
Structure of the Existing Spatial Plan	National Strategic Development Area, Jembatan Selat Sunda (KSN JSS)	included into the WKP II Kab.Serang with Main Events tourism, agriculture, mining, industry, forestry and education Develop their harbor as a center of commerce	As the area include the District Bojonegara Bojonegara KEK, Pulo Ampel and District Kramatwatu with the main focus as a center of international ports, services and trade, forestry, dry land agriculture and settlement In systems Attack district towns serve as the FGM with functions developed in the Area Bojonegara is the port, industry, trade and services.	Including BWK A directed as the central development center for the city to the level of service throughout the city Bojonegara, districts and industrial areas	Including BWK A directed as supporting port development center Bojonegara, warehousing, settlement and trade service center	Power Plants Development Site has compliance with the existing structure of National, Province, District, and Sub District Spatial Plans
Spatial Action Plan	Toll Road will go through a dial-in networks with Cilegon Bojonegara Bojonegara International Port will be developed which is a unity with the Port of Tanjung Priok, Jakarta	Efforts related to the development of harbor (dock, terminal) fishing activities can continue to be implemented with due regard to coastal and river areas commensurate	As the area of mineral mining category C, industry, and region that support the port activities	Direction development as an area downtown that is the center of CBD office facilities, general trading, public service and social as well as residential areas, industrial zones	Direction development as an area downtown that is the center of CBD office facilities, general trading, public service and social as well as residential areas, industrial zones	Not to include the development of electricity as one of the referral patterns of space utilization

5.2.2 Initial Scoping of the Environmental and Social Considerations for the Bojonegara Plan

A	Potentially large scale of adverse impacts will be projected.
B	Potentially medium or small scale of adverse impacts will be projected.
C	There is possibility of adverse impacts, the scale and mode of which are yet unknown.
D	Adverse impacts with the project will be minimal or negligible.

Table 5.2.2-1 Initial Scoping ESC study for the Plan

Criteria	Check Items	Potential Impacts	Points to check
Compliance with spatial plan	☐ Land use and utilization of local resources	C	• The site is located in Jababeka industrial estate, located in industrial area designated as special economic zone by Serang district and Banten province spatial plans. • The site is owned by PLN. • Before PLN's acquisition, there used to be fish ponds widely. • Material for land reclamation will be brought from operating borrowing sites in the Peninsula.
	☐ Poor, indigenous, or ethnic people	C	• Minorities and indigenous people do not reside in the neighbor area. • Fishermen and farmers from outside the site currently continue their activity in the PLN site and industrial area, with temporary houses and boats, fish ponds and farmlands. However, those are unauthorized and temporal activities.
	☐ Protected area	B	• Land area around the site is no protected area. • Offshore bay area is designated as marine conservation area by the provincial spatial plan, but not by district spatial plan.
	☐ Cultural heritage	C	• Will be studied around the site. A religious pilgrimage site located in a neighbor hilltop.
	☐ Other (Items prescribed in local spatial plan)	C	• Need to check compliance with district, provincial and national spatial plans. • Those spatial plans are not always in agreement with each other. For example, the Banten Bay is conservation area in the provincial plan, but not in district plan.

Criteria	Sub-criteria	Check Items	Potential Impacts	Points to check
Environmental Impacts	Terrestrial impact	☐ Naturally sensitive or fragile area	B	• Low-lying wetland • Small scale mangrove around the mouse of the river neighboring to the south border of site
		☐ Geographical features	B	• Site area is around 160 – 170 ha • Land filling of 2-3 m for site reclamation (with material transported from nearby borrowing areas)
		☐ Biota and ecosystems	B	• Site is inside an industrial estate and owned by PLN • Site is covered with ex-paddy field and old fish ponds, with no primary natural forest remaining • Small-scale fishery and dispersed small community of birds around the mouth of adjacent river and offshore
		☐ Ground subsidence	C	• Currently unknown • Water usage by the project and civil survey will be studied and referred to
	Marine impact	☐ Coastal & offshore hydro-geography	B	• Site is located at close d-off section of mildly-curved bay, and facing sea with a long shoal, so offshore current might be disrupted
		☐ Biota and ecosystems	B	• 3 ha of coral reef around 2 km offshore from the mouth of river on the southern border of the site, according to local fishermen
		☐ Reclamation and dredging	C	• 3-4 km of jetty for coal unloading need to be stuck out to offshore • Small-scale dredging for jetty is needed
		☐ Bottom sediment	B	• Sea bottom is sandy
		☐ Water pollution	B	• Thermal wastewater might be slow to disperse because of hydro-geographic conditions • Outlet of thermal wastewater need to stick out distant offshore
	Coal and ash pollution	----------	C	• Shield of ash pond as mitigation required • Elongation (keep-distance) of ash pond from river and shore line with greenbelt is necessary

Criteria	Sub-criteria	Check Items	Potential Impacts	Points to check
Social Impacts	Resettlement and land acquisition	☐ Involuntary resettlement (scale: households)	C	• Site is owned by PLN for power plant facility, no authorized residents in the site • Currently, unauthorized former local farmers and fish pond activities are sighted on site • A few hundreds of temporary houses and fishing boats for unauthorized dwellers on the south of adjacent river, where the area is also inside an industrial estate.
	Existence of residential area in vicinity and pollution impacts	☐ Air pollution	B	• Ciregon City (4 km from the site and population of 3 hundred thousand), Jakarta (80 km from the site) • Assumed stack height is 250∓30m • Distance of maximum ground concentration is between 10 and 50 km away
		☐ Noise and vibrations	B	• Around 100s of temporary houses on the south bank of the adjacent river • Those houses are with no legal status, and will be required to move out.
		☐ Offensive odors	D	• Offensive odor is not expected, with reference to the case of existing plant at Sulalaya coal-fired power plant.
	Adverse impacts on local economies, resources and infrastructures	☐ Water usage	C	• Source of cooling water is under study whether taken from groundwater or seawater desalination
		☐ Local economies, such as employment, livelihood, etc.	D	• Impact on local economy, specifically fishery, need to be studied
		☐ Land use, local industry and utilization of local resources such as agriculture and-fishery	B	• Impacts on small-scale gill-net or set-net fisheries, fishpond and aquaculture • The site and surrounding areas are widely designated as industrial areas by district spatial plan. Temporally unauthorized framing activities will need to close down.
		☐ Existing social infrastructures and services	C	• A local paved arterial road is passing along the site. Specific access road to the site is not necessary. • Impacts on existing infrastructure and public services are not expected • Basic regulation regarding maritime transport and nearby port facility will be studied
		☐ Misdistribution of benefits and damages	C	• Local livelihood will be studied.

5.2.3 Advice of JICA Advisory Committee for ESCs on Scoping

The Committee issued advisory on the following points to consider at the above scoping phase in 5 December 2011;

- Environmental impacts
  - of borrowing soil material for land reclamation
  - of site reclamation and dredging on mangrove, fish and marine resources, and coral reefs
  - of coal ash treatment and its method
- Compensation policy on temporary farmers and small-scale fishermen in the proposed project site and surroundings
- Impacts on ambient air by transport of coal around the project site
- Existence of religious facility and graveyard adjacent to the site and project's impacts on them

Above advices are considered in the Main Report of this Study, 'Final Report, The Project for Promotion of Clean Coal Technology (CCT) in Indonesia, July 2012', Chapter 6, 6.2 (5); 2) Environmental and Social Impacts; 3) Mitigation Measures and 4) EIA for Currently Unknown Impacts and Environmental Monitoring Policy.

5.2.4 Baseline Study for the Plan

(1) Climate

a. Rain Season: November - April
b. Dry Season: May – October
c. Temperature: min = 20.90 ^{o}C, max = 33.80 ^{o}C
d. Wind velocity 2.80 knot, arrow from west

1) Temperature

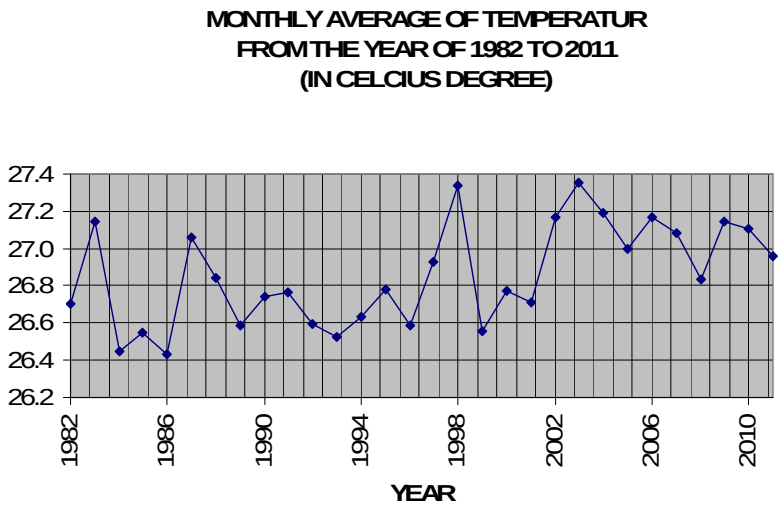


Figure 5.2.4-1 Annual Average Temperature from Year 1982 to 2011

Source: Data analysis by study team based on the data of Meteorology, Climatology and Geophysical Agency, Serang

Table 5.2.4-1 Average Monthly Temperature from Year 1982 to 2011

METEOROLOGY, CLIMATOLOGY AND GEOPHYSIC AGENCY
METEOROLOGY STATION OF SERANG
Jalan Raya Taktakan 27, Serang, Banten 42101, Telepon: 0254 200185, Facsimile: 0254 224325, e-mail: stamet_serang@yahoo.co.id

ANNUALLY AIR TEMPERATURE DATA FROM THE YEAR 1982 TO 2011 (in °C)

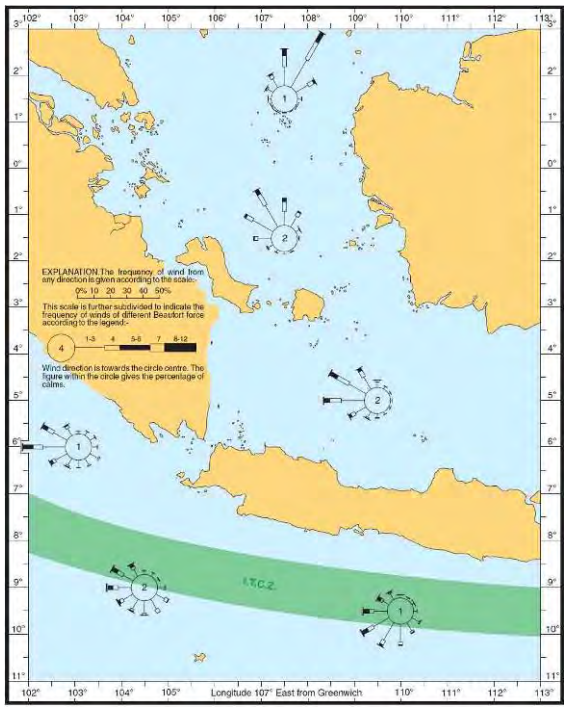
MONTH / YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOF	DEC	MONTHLY AVERAGE OF AIR TEMPERATURE
1982	25,6	26,5	26,4	26,7	27,1	26,6	25,9	26,2	26,4	27,7	27,9	27,4	26,7
1983	26,8	27,1	27,5	27,8	27,5	27,5	26,6	26,8	27,3	27,5	26,7	26,6	27,1
1984	25,9	26,3	26,1	26,9	26,7	26,4	26,3	26,3	26,1	27,2	26,9	26,3	26,5
1985	26,3	26,9	26,6	26,5	27,1	26,1	25,6	26,4	26,4	26,7	27,4	26,6	26,6
1986	25,7	26,2	26,5	27,1	27,0	26,7	26,2	26,0	26,3	26,6	26,1	26,8	26,4
1987	26,0	26,1	26,8	27,2	27,0	27,1	27,0	27,0	27,3	28,2	28,1	26,9	27,1
1988	26,9	26,6	26,9	27,2	27,1	26,7	26,8	26,7	27,3	27,1	26,8	26,0	26,8
1989	26,3	25,3	26,7	26,9	26,9	26,4	26,7	26,6	26,7	27,1	26,9	26,5	26,6
1990	25,7	26,5	26,6	27,4	27,1	26,8	26,3	26,5	27,0	27,3	27,5	26,2	26,7
1991	26,5	26,2	26,6	26,7	27,1	27,1	26,8	26,7	27,2	27,5	26,5	26,3	26,8
1992	26,3	26,3	27,0	27,0	27,0	27,2	26,7	26,4	26,4	26,3	26,2	26,3	26,6
1993	26,0	26,0	26,5	26,5	26,8	27,0	26,5	26,4	26,3	27,0	26,7	26,6	26,5
1994	26,1	26,3	26,2	26,5	26,6	26,5	26,0	26,5	26,8	27,4	27,3	27,4	26,6
1995	26,5	26,3	26,4	27,0	29,2	26,9	26,4	26,6	26,6	26,9	26,4	26,2	26,8
1996	25,8	26,1	26,6	27,0	27,0	27,0	27,0	26,7	26,9	26,6	26,5	25,8	26,6
1997	26,0	26,3	27,0	26,7	27,2	27,0	26,4	26,4	26,9	27,8	27,9	27,5	26,9
1998	28,0	27,3	27,6	27,7	28,0	27,9	27,2	27,0	27,3	26,8	26,7	26,6	27,3
1999	26,2	26,2	26,8	27,2	26,8	26,5	26,5	26,1	26,4	27,2	26,6	26,2	26,6
2000	26,1	26,3	26,8	27,2	27,2	26,4	26,5	26,2	27,6	27,1	26,8	27,1	26,8
2001	26,4	26,2	26,6	27,3	27,3	26,5	26,5	26,7	26,9	26,8	26,7	26,6	26,7
2002	26,6	26,4	27,3	27,1	27,3	27,0	26,7	26,8	27,4	28,2	27,9	27,3	27,2
2003	27,7	26,8	27,2	27,8	27,7	27,5	27,0	27,4	27,5	27,5	27,6	26,5	27,4
2004	26,8	26,6	27,1	27,7	27,4	27,0	26,8	26,9	27,4	28,1	27,6	26,9	27,2
2005	26,5	26,8	27,2	27,7	27,4	27,0	26,6	26,6	27,3	27,3	27,1	26,5	27,0
2006	26,5	26,9	26,9	27,1	27,1	26,8	26,9	26,6	27,2	28,1	28,4	27,5	27,2
2007	27,3	26,7	27,1	27,3	27,3	26,8	26,8	26,9	27,3	27,5	27,3	26,7	27,1
2008	27,1	26,0	26,5	27,0	27,0	26,7	26,6	26,9	27,3	27,4	26,8	26,7	26,8
2009	26,3	26,3	26,9	27,1	27,1	27,2	26,9	27,1	28,1	28,2	27,2	27,3	27,1
2010	27,0	27,5	27,6	28,2	27,9	26,9	26,7	27,0	26,2	26,6	26,9	26,8	27,1
2011	26,5	26,7	26,5	27,0	27,2	27,0	26,7	26,7	27,2	27,3	27,2	27,5	27,0
TOTAL	793,4	793,7	804,5	814,5	817,1	806,2	797,6	799,1	809,0	819,0	812,6	801,6	805,7
AVERAGE	26,4	26,5	26,8	27,2	27,2	26,9	26,6	26,6	27,0	27,3	27,1	26,7	26,9

Source : Meteorology,Climatology and Geophysic Agency, Serang

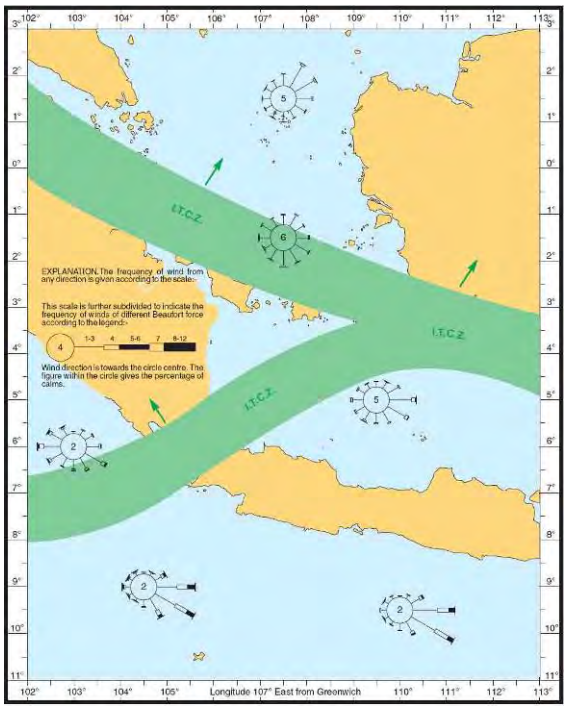
Based on temperature data from the Meterology Climatology and Geophysic Agency for 30 years from 1982 to 2011 showed that monthly lowest temperature of 26 ^{o}C occurred in 1986 and monthly highest temperature of 27.4 ^{o}C occurred in 2003.

2) Wind

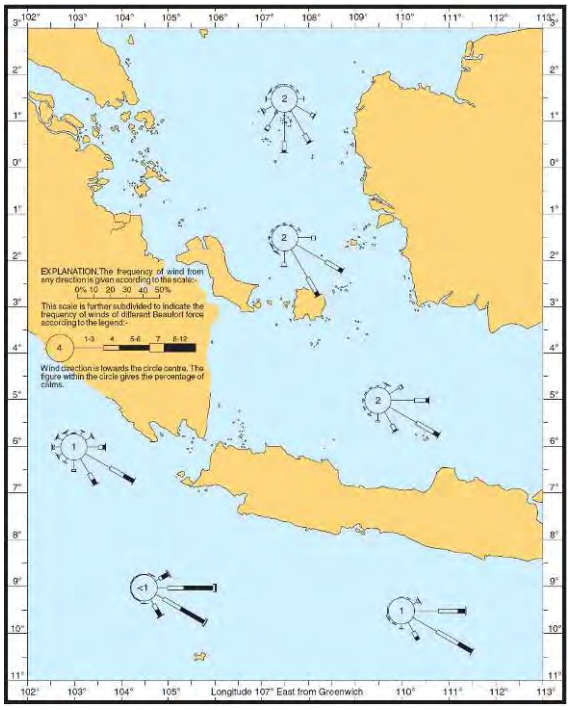
Assets by the overall wind data show the dominant winds blow from the North with an average speed of 1.5 to 4.0 m / s. Wind data was obtained from Meteorology, Climatology and Geophysics Agency (BMKG), for year 2000 – 2010. Recapitulation of overall wind data show the dominant winds blow from the North with an average speed of 1.5 to 4.0 m / s.



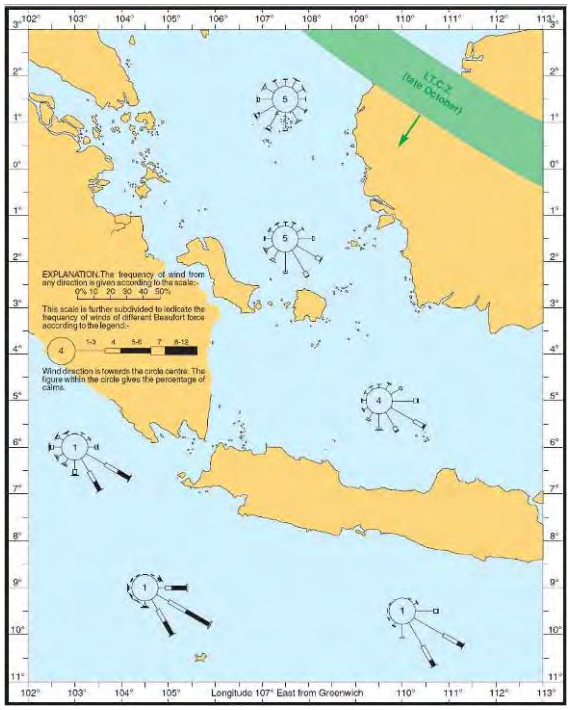
Wind distribution in January



Wind distribution in April



Wind distribution in July



Wind distribution in October

Figure 5.2.4-2 Wind Distribution in January, April, July and October and mean position of ITCZ

Source: Indonesia Pilot Volume I

3) Precipitation

Measurement data with Climatology and Geophysical Agency for 30 years from 1982 to 2011 show that the lowest rainfall of 1,118 mm occurred in 1997 and highest rainfall of 2,360 mm occurred in 1996.

Table 5.2.4-2 Monthly Precipitation (Rain) for the past 30 years (1982 – 2011) around

YEAR	JAN	FEB	MAR	APR	MEI	JUN	JUL	AUG	SEP	OCT	NOP	DEC
1982	443	136		135	89	24	41	7	-	4	92	112
1983	224	171	135	276	53	44	101	15	3	139	243	120
1984	284	229	302	80	86	84	51	166	103	197	78	180
1985	155	124	134	190	56	196	161	12	182	57	58	114
1986	451	260	96	95	69	75	186	87	154	79	304	211
1987	389	237	132	108	248	22	19	18	3	4	50	254
1988	206	343	163	197	242	88	18	68	25	112	182	254
1989	198	582	62	157	122	50	61	154	61	25	93	259
1990	488	151	213	140	82	136	79	111	8	74	79	304
1991	311	311	181	237	50	13	0.1	-	-	78	133	141
1992	348	344	189	170	35	86	31	88	159	148	261	184
1993	354	231	52	246	173	103	33	150	71	44	224	87
1994	214	315	266	125	35	36	-	-	11	39	126	85
1995	393	266	262	221	102	92	166	22	59	90	248	205
1996	292	341	193	261	212	93	9	133	78	233	230	285
1997	295	171	147	199	143	33	2	-	-	-	39	89
1998	170	209	243	114	222	113	60	94	43	231	133	166
1999	329	238	96	100	40	53	55	15	20	151	76	248
2000	383	336	95	127	132	29	101	22	24	117	134	72
2001	222	330	143	85	62	164	64	49	96	136	190	74
2002	292	348	118	260	88	86	125	3	5	8	97	176
2003	83	253	128	47	78	11	50	5	41	44	117	320
2004	221	348	176	86	174	4	51	0	58	33	81	235
2005	305	287	192	87	41	163	185	44	66	147	70	182
2006	224	234	345	85	152	31	10	8	0	6	11	150
2007	207	301	250	92	152	68	48	2	8	118	73	204
2008	209	349	133	89	95	54	0.2	73	33	71	245	125
2009	339	306	131	113	102	29	3	2	17	20	279	45
2010	322	195	166	72	113	167	208	123	328	186	148	109
2011	242	91	204	107	85	38	79	0	32	71	79	112

Source : BMKG, Serang Meteorology Station

4) History of Natural Disaster

Recorded natural disasters in surroundings of Bojonegara area are landslide and flood. History of natural disaster is as follows. On 9 January 2011 landslide occurred at Pakuncen and Pangarengan village at the distance of approximately 7 km from Model Power Plant. The land slide is caused by heavy rainfall. Earthquake and tsunami disasters are not recorded here.

(2) Flora and Fauna

Kind of flora at study area is banana, mango, Lute, bark, pineapple, papaw, peanut, parsnip, cassava, coconut. Kind of fauna at study area is flamingo, snake on water, various bird, squirrel, chicken, cat, mouse, and goat. There is no protected fauna and flora in/around the project site. However, based on the literature study of Serang District, there is a sea grass in the Banten Bay, which has been designated as marine conservation area for a total of 50 ha (Banten Provincial Spatial Plan Law No 2 Year 2011).

(3) Social-Economy and Cultural Issues

1) Inhabitants and Workers in the Model Power Plant inside of a boundary

There is no permanent residential, no permanent house in the Model Power Plant inside of a boundary however, there are some shelter belong to illegal and/or fisherman. Around the Model Power Plant site, inhabitant work as farmer, fisherman, merchant and factory employees. Regarding existing conditions in the Model Power Plant site, there are fishponds, farming lands, paddy fields, bush, swampy, open area (bare land). The fishponds and farmlands are managed by fisherman and yeoman (independent farmer), who are listed in the below table.

Table 5.2.4-3 List of Yeoman and Fisherman at Model Power Plant area

No.	FARMER	AREA	ADDRESS
1	SANIIN	4 Area Block for farm	Ragas, Bojonegoro
2	MARKAN	1 Area Block for farm	Ragas, Bojonegoro
3	JUMIAH	2 Area Block for farm	Ragas, Bojonegoro
4	JAMIN	1 Area Block for farm	Ragas, Bojonegoro
5	SAHIB	2 Area Block for farm	Ragas, Bojonegoro
6	SAMBUDI	6 Area Block for farm	Ragas, Bojonegoro
7	YANI	1 Area Block for farm	Ragas, Bojonegoro
8	IBU MUN	1 Area Block for farm	Ragas, Bojonegoro
9	HARUJI	1 Area Block for farm	Ragas, Bojonegoro
10	MASKE	3 Area Block for farm	Ragas, Bojonegoro
11	DAIMAN	1 Area Block for farm	Ragas, Bojonegoro
12	MASDAM	1 Area Block for farm	Ragas, Bojonegoro
13	MASKE	2 Area Block for farm	Ragas, Bojonegoro
14	SATIM	1 Area Block for farm	Ragas, Bojonegoro
15	FADIL	2 Area Block for farm	Ragas, Bojonegoro
16	H. MISBAK	3 Area Block for farm	Ragas, Bojonegoro
17	RAHIM	2 Area Block for farm	Ragas, Bojonegoro
18	SAHIM	3 Area Block for farm	Kp. Kentir, Pakuncen
19	MADINAH	2 Area Block for farm	Kp. Kentir, Pakuncen
20	MARBAI	1 Area Block for farm	Kp. Kentir, Pakuncen
21	BASUNI	3 Area Block for farm	Kp. Kentir, Pakuncen
22	JASIR	1 Area Block for farm	Kp. Kentir, Pakuncen
23	YUTI	1 Area Block for farm	Kp. Kentir, Pakuncen
24	RAHMANI	3 Area Block for farm	Kp. Kentir, Pakuncen
25	KASMIN	3 Area Block for farm	Kp. Kentir, Pakuncen
26	JAMARI	1 Area Block for farm	Kp. Kentir, Pakuncen
27	SUKRI	2 Area Block for farm	Kp. Kentir, Pakuncen
28	ASMANI	2 Area Block for farm	Kp. Kentir, Pakuncen
29	AHMAD	2 Area Block for farm	Kp. Kentir, Pakuncen
30	KEMEDIN	1 Area Block for farm	Kp. Kentir, Pakuncen
31	SARWITE	3 Area Block for farm	Kp. Kentir, Pakuncen
32	RIDWAN	1 Area Block for farm	Ragas, Bojonegoro
33	KAMID	1 Area Block for farm	Ragas, Bojonegoro
34	AMAMI	1 Area Block for farm	Ragas, Bojonegoro
35	KASMAD	3 Area Block for farm	Kp. Kranden, Teratai
36	ARMADI	6 Area Block for farm	Kp. Kranden, Teratai
37	FADLUN	9 Area Block for farm	Kp. Kranden, Teratai
38	ENI	3 Area Block for farm	Kp. Kranden, Teratai
39	RIMAN	2 Area Block for farm	Kp. Kranden, Teratai
40	MAKARI	1 Area Block for farm	Kp. Kranden, Teratai
41	JUKI	1 Area Block for farm	Kp. Kranden, Teratai
42	AURIF	2 Area Block for farm	Kp. Kranden, Teratai
43	ROHIMI	1 Area Block for farm	Kp. Kranden, Teratai
44	EMEN	21 Area Block for fishpond	Kp. Walikukun, Teratai
45	MUSA	14 Area Block for fishpond	Kp. Walikukun, Teratai
46	JANUDIN	3 Area Block for fishpond	Kp. Mengger, Kertasana
47	ZAENUDIN	8 Area Block for fishpond	Kp. Semendaran, P. Rawi
48	MARJUKI	5 Area Block for fishpond	Kp. Semendaran, P. Rawi
49	RIDWAN	7 Area Block for fishpond	Kp. Kranden, Teratai
50	MASKIN	10 Area Block for fishpond	Link. Karang Tengah, Cibeber
51	DEDI	11 Area Block for fishpond	Kp. Taktakan, Ranca Talas
52	SABIHIS	17 Area Block for fishpond	Link. Karang Tengah, Cibeber
53	MAWARDI	11 Area Block for fishpond	Kp. Walikukun, Teratai
54	KHUSEN	8 Area Block for fishpond	Kp. Mengger, Kertasana
55	FATAMI	5 Area Block for fishpond	Kp. Kranden, Teratai
56	ZAKARIA	6 Area Block for fishpond	Kp. Kranden, Teratai
57	KHAERUDIN	14 Area Block for fishpond	Kp. Kronjo, Muncung

2) Administrative Status of the Study Area

The proposed Bojonegara Model Power Plant Site is administratively located in Kramat watu Sub-district, which was formerly under Bojonegara Sub-district. Since the Bojonegara Sub-district was split into three sub districts, which became Pulo Ampel, Bojonegara and Kramatwatu Sub-district. These sub districts are become a Special Economic Zones of Indonesia. Demographic, socio and economic data cover the three sub districts. All demographic, social and economic data are secondary data collected from Central of Statistical Bureau of Bojonegoro, Kramatwatu and Pulo Ampel Sub-district.

3) General Condition of the Study Area.

Bojonegara, Pulo Ampel and Kramatwatu Sub-district are located in Serang District, which is the biggest district in the Banten Province. The sub district consists of 10, 9 and 14 villages respectively which extends to the area of 29.8, 41 .1 and 48.6 km^2 and have altitude less than 500 m. Most of the land has the slope less than 30% and only a small part of the area has 30-60% slope, which is mainly found in Pulo Ampel Sub-district.

The people in Bojonegara, Kramatwatu and Pulo Ampel are in a unity of Sundanese ethnic group with mix of Malay more of whom live in Bojonegara. Almost all people in those sub districts are muslim, so the role of religious figure is very strong. However, religious figures and government officers can work together. In some villages the head of village is also religious figure. Kyai and Ulama is consider as a figure with high knowledge in socio-religious life context that they can give guidance to community in the world and after world. For agricultural matters, farmers community usually have farmer figures who have better experience and skill compared with other farmers, especially young farmers, so this skilled and most experienced farmer is respected and followed for all their words. Community of the sub districts are the same as other Muslims who have obedience in conducting religion order and celebrate every muslim-big-day. There are even, in Ramadhan, some fisherman who stop their every economic activity.

4) Demography

The most populated sub-district in the study area is Kramatwatu Sub-district with total population of about 86,000 as of 2008, the number of household is 22,700 and the density is 1,769 inhabitants per sq km , followed by Bojonegara with 39.000 inhabitans, 10,400 households and density 1,321 inhabitants per sq km . The population profile of the study area is presented in Tabel 5.2.4-4.

Most of the inhabitants in Bojonegara Sub-district work as farmers, while most of Kramatwatu inhabitants work as trader and Pulo Ampel as farmer, fishermen and labor.

Table 5.2.4-4 Population in Kramatwatu, Bojonegara, and Pulo Ampel Sub-districts as of Year 2008

Sub-district/ Villages	Popula-tion	Sub-district/ Villages	Popula-tion	Sub-district/ Villages	Popula-tion
Kramatwatu	**85.963**	Bojonegara	**39.423**	Pulo Ampel	**33.178**
1. Lebakwana	5.800	1. Wanakarta	2.611	1. Argawana	6.411
2. Pelamunan	7.237	2. Kertasana	4.154	2. Banyu-wangi	3.269
3. Margasana	3.569	3. Mangkunegara	2.981	3. Margasari	3.307
4. Kramat-watu	11.131	4. Karangkepuh	4.684	4. Puloampel	2.273
5. Pejaten	8.577	5. Lambangsari	3.248	5. Sumuranja	3.991
6. Wanayasa	3.848	6. Bojonegara	4.191	6. Kedung Soka	4.213
7. Harjatani	19.052	7. Margagiri	5.705	7. Mangun-reja	3.559
8. Serdang	5.398	8. Ukirsari	2.699	8. Salira	3.773
9. Toyomerto	3.544	9. Pakuncen	2.623	9. Pulo Pan-jang	2.383
10. Pegadingan	4.596	10. Pengarengan	6.528		
11. Pameng-kang	4.352				
12. Tonjong	3.106				
13. Terate	4.034				
14. Teluk Ter-ate	1.718				

Source: BPS of Serang District

Table 5.2.4-5 Population by Age Group of Kramatwatu, Bojonegara and Pulo Ampel Sub-districts as of Year 2008

Sub District/ Age Groups (ages)	KRAMAT WATU			BOJONEGARA			PULO AMPEL		
	Man	Woman	Total	Man	Woman	Total	Man	Woman	Total
	43.892	42.071	85.963	20.487	18.936	39.423	17.374	15.804	33.178
0 – 4	4.125	3.831	7.956	1.925	1.724	3.650	1.633	1.439	3.072
5 – 9	4.275	4.894	9.169	1.995	2.203	4.198	1.692	1.838	3.531
10 – 14	5.906	5.150	11.056	2.757	2.318	5.075	2.338	1.935	4.273
15 – 19	5.513	4.781	10.294	2.573	2.152	4.725	2.182	1.796	3.978
20 – 24	4.035	3.320	7.355	1.883	1.494	3.378	1.597	1.247	2.844
25 – 29	3.435	3.319	6.754	1.603	1.494	3.097	1.360	1.247	2.606
30 – 34	3.250	3.100	6.350	1.517	1.395	2.912	1.286	1.165	2.451
35 – 39	3.227	3.379	6.606	1.506	1.521	3.027	1.278	1.269	2.547
40 – 44	2.808	2.999	5.806	1.310	1.350	2.660	1.111	1.126	2.238
45 - 49	2.083	2.195	4.278	972	988	1.960	825	825	1.649
50 – 54	1.981	1.630	3.611	924	734	1.658	784	612	1.396
55 – 59	1.296	1.108	2.405	605	499	1.104	513	416	929
60 – 64	882	877	1.759	412	395	806	349	329	679
65 +	1.076	1.488	2.564	502	670	1.172	426	559	985

Source : BPS of Serang District

5) Land Use

Table 5.2.4-6 Land Use Type in Kramatwatu, Bojonegara and Pulo Ampel Sub-districts as of Year 2008

Land Utilization Type	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Sub-district	***Kramatwatu***		***Bojonegara***		***Pulo Ampel***	
1. Paddy field						
a. Technical irrigation	2.069	37,4	-	-	- -	
b. Semi-technical irrigation	-	-	-	-	- -	
c. Non-technical irrigation	117	2,1	-	-	- -	
d. Paddy field dependant t on rain	411	7,4	1.557	23	405	11.64
e. Tide, fill up, intrusion and swampy	-	-	-	-	- -	
2. Non Paddy Field						
a. Farm	792	14,3	1.031	15	3.073	88.35
b. Plantation	150	2,7	3.094	46	2.084	59.92
c. Fish pond	387	7,0				
3. Non agriculture land						
a. Yard, building land, farm yard	1.051	19,0	985	15	489	14.06
b. Other			37	1	480	13.80
c. Barren land			-	-	20	0.58
4. Other	443	8,0				
a. State forest	110	2,0				
b. Barren land	-	-				

Source: Agricultural Services Offices of Kramatwatu, Bojonegara and Pulo Ampel Sub-districts

Table 5.2.4-7 Total area, harvested area and production of vegetables in Kramatwatu and Bojonegara as of Year 2008

Type of vegetable/crop	Area (ha)	Harvested area (ha)	Production (Kg)	Area (ha)	Harvested area (ha)	Production (Kg)
Sub-district	Kramatwatu			**Bojonegara**		
1. Red onion	17	17	1,190	-	-	-
2. Garlic	-	-	-	-	-	-
3. Chives	-	-	-	-	-	-
4. Potato	-	-	-	-	-	-
5. Cabbage	-	-	-	-	-	-
6. Mustard	170	170	17,000	-	-	-
7. Carrots	-	-	-	-	-	-
8. Radish	-	-	-	-	-	-
9. Beans	35	35	2,100	46	46	1,150
10. Red beans	-	-	-	-	-	-
11. Cayenne	19	19	760	-	-	-
12. Cayenne pepper	-	-	-	18	18	360
13. Mushroom	-	-	-	-	-	-
14. Tomatoes	9	9	540	14	14	420
15. Eggplant	17	17	2,550	15	15	375
16. Bean (Buncis)	-	-	-	-	-	-

Type of vegeta-ble/crop	Area (ha)	Harvested area (ha)	Production (Kg)	Area (ha)	Harvested area (ha)	Production (Kg)
17. Cucumber	26	26	3,900	18	18	810
18. Squash	-	-	-	-	-	-
19. Spinach (Kang-kung)	186	186	18,600	-	-	-
20. Spinach (Bayam)	185	185	18,500	-	-	-

Source: Agricultural Services Offices of Kramatwatu and Bojonegara Sub-districts

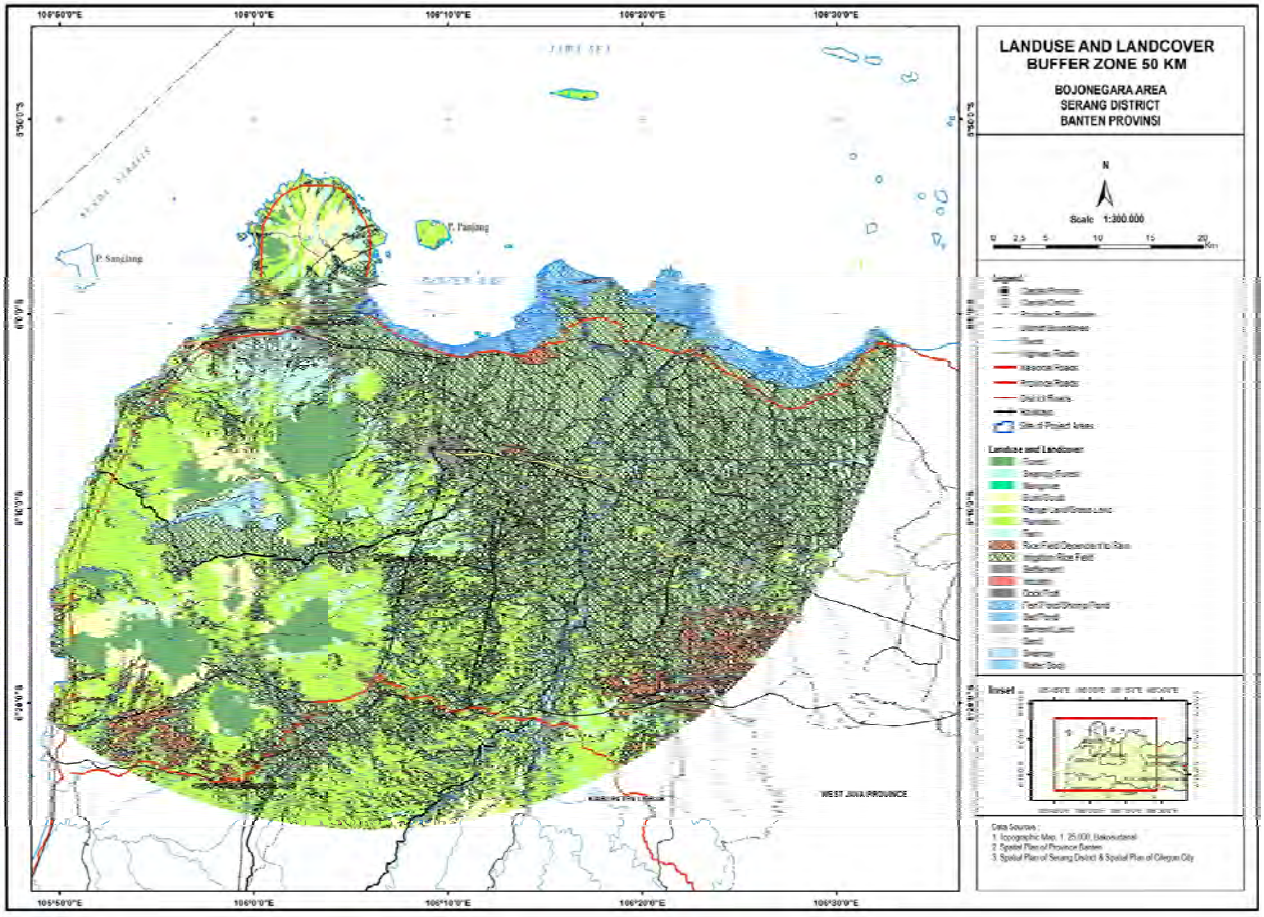


Figure 5.2.4-3 Landuse and Lancover of the Study Area and its surrounding of 50 km radius

Source: The result of data analysis and/or edited by the study team based on data source below;

- Spatial Plan of Province Banten
- Spatial Plan of Serang District & Spatial Plan of Cilegon City
- Topographic Map (RBI), Scale of 1 : 25.000, Bakosurtanal (1999)

6) Religious and Cultural Facilities

As mentioned in the previous section, almost all population in the stud y area are moslem. Therefore, the regious facilities which are record ed are only Islamic facilities as presented in the next table. The culture and cultural her itage in the study are are related to the religion, whereas there is one cultural heritage in the st udy area called "Bukit Santri" in Bojonegara Village, Bojonegara Sub-district. The place is one of relig ious destination for moslem visitors from the regions even from out of Banten Province.

Table 5.2.4-8 Number of Religious Facilities in Kramatwatu, Bojonegara and Pulo Ampel Sub-districts as of 2009

No	Sub District	Place of Worship of Moslem											
		Mosque				Musholla				Langgar			
		2006	2007	2008	2009	2006	2007	2008	2009	2006	2007	2008	2009
1	Kramatwatu	67	66	66	83	6	6	6	6	58	132	132	132
2	Bojonegara	61	104	104	80	1	5	5	5	16	208	208	208
3	Pulo Ampel	44	20	20	96	-	2	2	2	37	58	58	58

Data Source : Serang District in Figures Year 2009

Note: Musholla (Traditional name of Mosque but smaller than Mosque);
Langgar (Traditional name of Mosque but smaller than Musholla)

5.2.5 Questionnaire to Local People at the Assumed Project Site and Surrounding Area

The Study Team has conducted an interview with 5 respondents on February 9, 2012. List of Questionnaire are as below.

Respondent Category
- Local resident
- Fishermen and their families
- Middlemen for fish and sea food
- Fish farmers of aqua culture and fishpond

Questionnaire items
1. Fisheries activity
   - Types of fishes or aquatic resources
   - Annual income of household
   - Income from fisheries, Income from other sources
   - Aquaculture (fish pond, offshore aquaculture) :
     - Period of work, Harvest season
   - Fish or seafood processing industry

2. Utilization of coastal area for livelihood, recreation
   - Land area around the site by men, women, children, aged people
   - Offshore utilization by men, women, children, aged people

3. Their original (inherent) knowledge, belief or views on the following;
   - Livelihood
   - Land use
   - Offshore or marine utilization
   - Religious monument, Graveyard around/near the site

The summary of the interview is presented as follows:

Interviewee 1: Fishermen and their families

Date of hearing: 9 February, 2012

Place of hearing: Teratai Village, Bojonegara Sub district, Banten

Questions	Answers	
1. Activity		
▪ Types of fishes or aquatic resources	Fishing with fishing rod and net	
▪ Annual income of household	Rp. 50.000 – 100.000 / day	
▪ Income from fisheries ▪ Income from other sources	Rp. 50.000 – 100.000 / day -	
▪ Aquaculture (fish pond, offshore aquaculture) : ✓ Period of work ✓ Harvest season	 8 – 9 months / year March/April – November	
▪ Fish or seafood processing industry	Non	
2. Utilization of coastal area for livelihood or recreation		
▪ Land area around the site	men	Recreation
	women	Recreation
	children	Recreation
	aged people	Recreation
	Fisherman some time use this area for re-pairing the ship	
▪ Offshore or marine utilization	men	-
	women	-
	children	-
	aged people	-
	Some fisherman use this area for aquacul-ture, like fish cage, seawe ed (in Pulau Pan-jang)	
3. Their original (inherent) knowledge, belief or views on the following		
▪ Livelihood	Only fisherman, use all of their tim e for fishing. If the weather is not good, they will wait until weather is good.	
▪ Land use	Land use in this area is p addy field, fish pond, agriculture, industry. All o them know that all of area is Jababeka area that will de-velop for industry.	
▪ Offshore or marine utilization	Fishing, marine aquaculture (seaweed, fish cage)	
▪ Religious monument ▪ Graveyard around/near the site	People believe that there is a cem etery in Gunung Santri is believed to be the tomb of a saint (holy people). Commonly visited by pilgrims from outside the area. There is a mosque in the area using or praying.	

Other information: fisherman usually use their own ship or rent or going together with the other. Usu-ally in a boat/ship, there are 3 – 4 people working there, depend on the boat/ship condition. They go to the sea depend on the weather. Usually there is 3 – 4 months/year that not possible to go to the sea. In one trip, they spend about 20 liter of fuel and then can get around Rp. 300.000 minimally. The number of fisherman in this area is over than 100 fishermen.

Interviewee 2: Middlemen for fish and sea food

Date of hearing: 9 February, 2012

Place of hearing: Teratai Village, Bojonegara Sub district, Banten

Questions	Answers	
1. Activity		
▪ Type o resources ▪ Number of middlemen in this area	Middlemen Around 10 people	
▪ Kind of activity	They buy fish from fisherman in special traditional market by auction and or collaboration between them and fishermen. They bring the fish to be sold to main market in Bojonegara.	
▪ Annual income of household	Generally, middleman can get 50 – 300 kg per day and they can make a profit Rp. 3.000 – 5.000 per kg per day	
▪ Income from fisheries	They buy fish around Rp. 15.000 – 30.000 /kg and they sell in Bojonegara with additional price approximately Rp. 3.000 – 5.00	
▪ Income from other sources	From little shop but can't be calculated because of only additional	
▪ Aquaculture (fish pond, offshore aquaculture) : ✓ Period of work ✓ Harvest season	 Everyday Based on the fishermen	
▪ Fish or seafood processing industry	-	
2. Utilization of coastal area for livelihood or recreation		
▪ Land area around the site	men	Recreation
	women	Recreation
	children	Recreation
	aged people	Recreation
▪ Offshore or marine utilization	men	-
	women	-
	children	-
	aged people	-
3. Their original (inherent) knowledge, belief or views on the following		
▪ Livelihood	They do their activities every day. Their livelihood depends on the fish from fishermen. Price of fish is different, depend on type of fish. The biggest fish ever caught was weighing 100 kg at a price of 5 million. Generally, price of fish in this area is very well, so when the stock of fish from local fishermen less, many fishermen from other areas (like Lampung) come to sell the fish here.	
▪ Land use	All of them know that all of area is owned by Jababeka and will develop for industry.	
▪ Offshore or marine utilization	Fishing, marine aquaculture (seaweed, fish cage)	
▪ Religious monument ▪ Graveyard around/near the site	Like as fishermen and other people, they know Gunung santri as a cemetery of holy people.	

Interviewee 3: Fish farmers of aqua culture and fish pond

Date of hearing: 9 February, 2012

Place of hearing: Teratai Village, Bojonegara Sub district, Banten

Questions	Answers	
1. Activity		
▪ Types of fishes or aquatic resources	Fish pond	
▪ Number of ponds	6 ponds	
▪ Number of fish farmers	Around 16 people	
▪ Kind of activity	Planting seed of fish, keeping fish to mature, harvest the fish and sell to the market. Seeds of fis h obtained from Karang Antu. Keeping fish is around 3 month and they can grow fish 3 times per year	
▪ Annual income of household	Rp. 7.000.000/ 6 ponds/1 harvest season. The price is Rp. 17.000/kg with 7-8 fish /kg.	
▪ Income from fisheries ▪ Income from other sources	All income from fisheries -	
▪ Aquaculture (fish pond, offshore aquaculture) : ✓ Period of work ✓ Harvest season	 3 months After 3 month	
▪ Fish or seafood processing industry	-	
2. Utilization of coastal area for livelihood or recreation		
▪ Land area around the site	men	Recreation
	women	Recreation
	children	Recreation
	aged people	Source of sea water
▪ Offshore or marine utilization	men	-
	women	-
	children	-
	aged people	-
3. Their original (inherent) knowledge, belief or views on the following		
▪ Livelihood	They get seed of fish from Karang antu with price Rp. 70/seeds and numb er of fish is around 10.000 seeds per pond.	
▪ Land use	All of t hem know that all of area is owned by PLN under Jababeka area and will de-velop for industry.	
▪ Offshore or marine utilization	Fishing, marine aquaculture (seaweed, fish cage)	
▪ Religious monument ▪ Graveyard around/near the site	Like as o ther people, they know Gunung santri as a cemetery of holy people.	

Interviewee 4: Farmer (agriculture – paddy field)

Date of hearing: 9 February, 2012

Place of hearing: Teratai Village, Bojonegara Sub district, Banten

Questions	Answers	
1. Activity		
▪ Types of agriculture	Paddy filed	
▪ Number of field	3 fields	
▪ Kind of activity	Planting seed of rice, clean grass, fertilize, and harvest rice. Keeping rice is around 3 months. After each harvest, they alternately with the rice crop, that is peanut. Such as rice, peanut growth and will harvest in 3 months. They can harvest paddy/crops 3 times per years	
▪ Annual income of household	He can produce paddy is around 1 – 1,5 ton per site/field/harvest. The price of rice is around Rp. 7.000 – 9.000/kg, but he doesn't sell all of the paddy/rice in one time, but he sell it according to the needs.	
▪ Income from agriculture ▪ Income from other sources	All income from agriculture. -	
▪ Agriculture (paddy, crop) : ✓ Period of work ✓ Harvest season	 3 months, alternately between paddy and peanut (crop) After 3 month	
▪ Fish or seafood processing industry	-	
2. Utilization of coastal area for livelihood or recreation		
▪ Land area around the site	men	Recreation
	women	Recreation
	children	Recreation
	aged people	Recreation
▪ Offshore or marine utilization	men	-
	women	-
	children	-
	aged people	-
3. Their original (inherent) knowledge, belief or views on the following		
▪ Livelihood	They plant paddy or crop depend on the season. Usually he can't plant in dry season. To keep the soil is fertile, they alternately between paddy and crop and gave the land fertilizer.	
▪ Land use	He and all of farmer know that all of area is owned by PLN under Jababeka area and will develop for industry.	
▪ Offshore or marine utilization	Fishing, marine aquaculture	
▪ Religious monument ▪ Graveyard around/near the site	Like as other people, they know Gunung santri as a cemetery of holy people.	

Interviewee 5: Farmer (agriculture – crop: peanut)

Date of hearing: 9 February, 2012

Place of hearing: Teratai Village, Bojonegara Sub district, Banten

Questions	Answers	
1. Activit y		
▪ Types of agriculture	Crop : peanut	
▪ Number of field	1 site (field) The location is utilizing the existing yard of Jababeka office	
▪ Kind of activity	Planting seed of crop, clean grass, harvest and will sell it to market. (the condition when survey was harvesting of peanut)	
▪ Annual income of household	Unknown, because its first time	
▪ Income from agriculture ▪ Income from other sources	All income from agriculture. -	
▪ Agriculture (crop) : ✓ Period of work ✓ Harvest season	 3 months After 3 month	
▪ Fish or seafood processing industry	-	
2. Utilization of coastal area for livelihood or recreation		
▪ Land area around the site	men	Recreation
	women	Recreation
	children	Recreation
	aged people	Recreation
▪ Offshore or marine utilization	men	-
	women	-
	children	-
	aged people	-
3. Their original (inherent) knowledge, belief or views on the following		
▪ Livelihood	She was earning a living and good luck for this growing crop, because she knows that Jababeka can take the land any time. Other crop in this area is soya, cassava, papaya, corn.	
▪ Land use	She known that land is owned by Jababeka and can be taken any time when Jababeka develop this area.	
▪ Offshore or marine utilization	-	
▪ Religious monument ▪ Graveyard around/near the site	Just only knows about Gunung Santri.	

(1) Local people in the assumed project site

Based on the interviews in the assumed project site, in general all local people who conduct faming and fishing activities in the site have known that the concerned land is owned by PLN and Jababeka Industrial Estate Company. They are informed that the land will be developed for any industrial activities, therefore, they are ready to move from the location since basically they just use the land that is idle. However, they do hope that they are notified in advance before the land will be used and that they could dismiss their activities after the harvest.

The interview survey, conducted at Teratai village on the south bank of a river that flow down along the south border of the Project Site, revealed that the villagers are constituted with more than 100 households of fisher men and 10 middlemen for fish trade, owning 50 to 60 outboard-motored fishing boats. A family has 5 to 9 family members in average. According to them, they can work for roughly 9 months of coastal fishing, except for 3 or 4 months of rainy season. Fishermen can make fish catch of at least 300 thousand Rp per one trip per boat and earn one (1) to two (2) million Rp per a family month. Middlemen can earn eight (8) to ten (10) million Rp per month in average.

(2) Communities around the Site

Based on the results of interview, the local communities on the south border of the PLN site across the river are exactly aware of the status of land and housing that they belong to and are owned by Jababeka. They have been staying in that area without any lease at any time and will move from the place where the Jababeka want and will develop into industrial area.

Generally, their farming activities dependent on the season, farmers will use and grow paddy and crops, while the fisher men are off on fishing during the rainy season because of high wind velocity, which is dangerous for fishing in the sea. In the dry season, farmers are not able to grow and can not do farming acitvities, while the fishermen can go for fishing and this season is favored by fishermen because they can go to sea every day. Middlemen are closely dependent on the fishermen.

Generally, the income of farmer as well as fishermen depends only on their livelihood, without any additional income from other sources.

Result of questionnaire also showed that coastal areas are generally used for re creation. Part of them knows that the sea areas used for aquaculture, such as seaweed, especially around the Pulau Panjang area. Fishermen are well understanding the functions of the coral reefs that protect and be the source of the fish. They know that the quality and abundance of coral reef and fish in the area is reduced due to the possible damage to coral reefs either from other fisher men or possiblely due to the presence of industry.

5.2.6 Measurements of Environmental Backgrounds

For obtaining the baseline data for future monitoring of environmental impacts by the concerned project, environmental measurement has been conducted as follows. The dry season data collection was carried out during the period of 7-12 October 2011, while the wet/rainy season data collection was

carried out in 26-31 December 2011. The type of data measurements includes Air Quality, Noise and Vibration and Water Quality (surface, seawater).

(1) Sampling Locations for Measurements

1) Air Quality

Number of samples for air quality is 2 samples and taken in 5 different locations. The locations are Serang Barat area, Jab abeka area, Wanayasa Area, Cilegon area, near PLTU Cilegon. The next table shows sampling codes, locations and coordinate of sampling point regarding 'Assumed Project Site'.

Table 5.2.6-1 Locations for Air Quality Samples shown by Coordinates

Code	Location	Coordinate	
		Y	X
U – 1	PLTU Cilegon	- $05^0$59' 40"	106^0 05.52"
U – 2	Wanayasa	- 05^0 57' 09"	106^0 00.35"
U – 3	West Cilegon	- 06^0 08' 31"	105^0 51' 53"
U – 4	Jababeka Area	- 06^0 01' 22"	106^0 03.10"
U – 5	West Serang	- 06^0 03' 03"	106^0 09.57"

2) Surface Water Quality (river, swampy, fishpond)

Samples for surface water quality were taken in 5 different locations with total 3 samples for each location. The sample was taken at river boundary PLN area, swampy in PLN area, fishpond in PLN area. The following table shows sampling codes, locations and coordinates of sampling point of 'Assumed Project Site'.

Table 5.2.6-2 Locations for Surface Water Quality Samples shown by Coordinates

Code	Location	Coordinate	
		Y	X
AP - 01	PLN Area (in site)	- 06^0 00' 21"	106^0 05' 26"
AP - 02	PLN Area (in site)	- 06^0 00' 01"	106^0 06' 00"
AP - 03	Jababeka Area	- 05^0 59' 44"	106^0 05' 55"
AP - 04	Jababeka Area	- 05^0 59' 21"	106^0 06' 05"
AP - 05	Jababeka Area	- 05^0 59' 49"	106^0 05' 46"

3) Sea Water Quality

Samples for sea water quality were taken at 4 locations with 3 numbers of samples. The locations were offshore near coastal line and around river mouse, coastal seawater around PLN site, the assumed point of head of Jetty . The below table shows sampling codes, locations and coordinates of the sampling points.

Table 5.2.6-3 Locations for Sea Water Quality Samples shown by Coordinates

Code	Location	Coordinate	
		Y	X
AL - 01	Sea	- 06^0 00' 07	106^0 07' 01"
AL - 02	Sea	- 05^0 59' 37	106^0 06' 30
AL - 03	Sea	- 05^0 59' 16"	106^0 06' 19"
AL - 04	Sea	- 05^0 58' 59"	106^0 07' 48"

4) Noise and Vibration

The noise and vibration measure ments were taken one in the da ytime and one in the nighttime, however, the locations of the samples are the same locations as air quality locations.

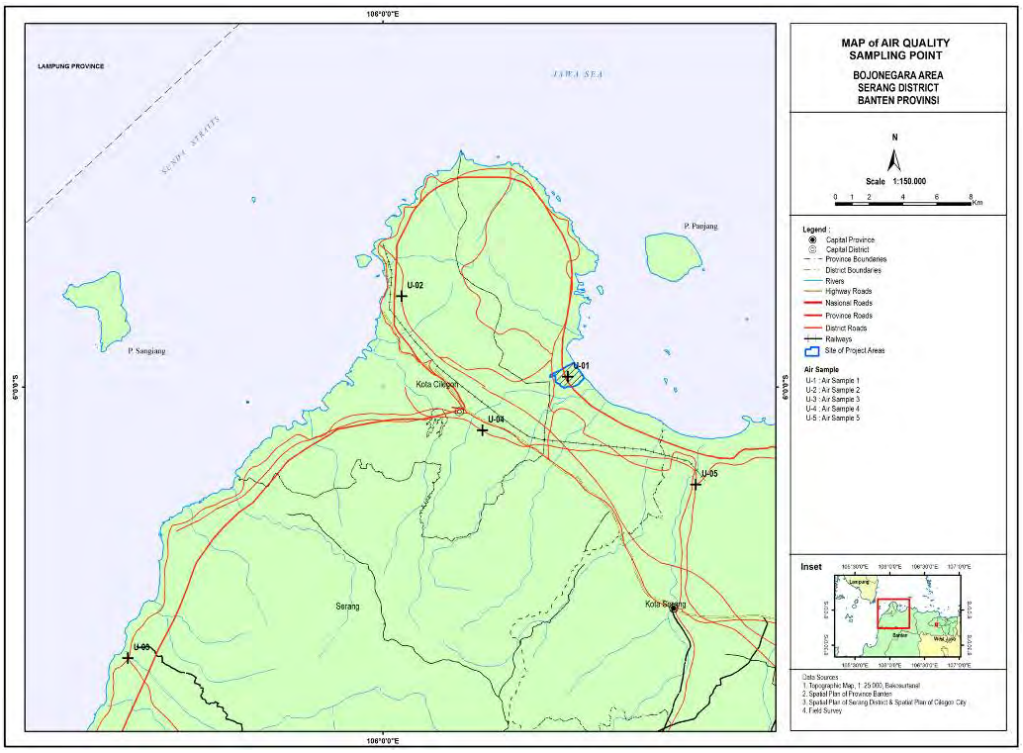


Figure 5.2.6-1 Map of Air Quality Sampling Points

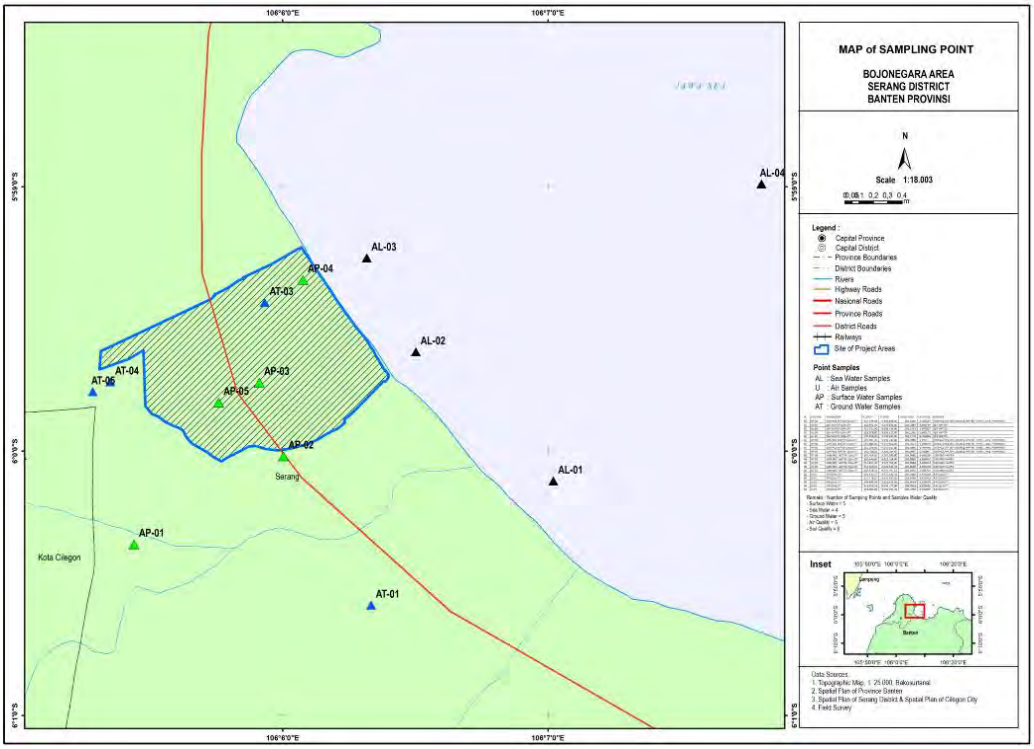


Figure 5.2.6-2 Map of Sampling Points for Water Quality (Surface and Sea Water)

(2) Dry Season Data

1) Air Quality Samples

Equipment commonly used in air quali ty sampling equipment is impinging for sampling gases and high volume air samplers for sampling particulates in the air.

The gases and particulates are still showing the values under the threshold, given by Government Regulation No. 41/ 1999 for SO_2, NO2, TSP, HC and O_3; and MOE-De cree No. Kep-50/MENLH/1996 for NH_3 and H_2S.

Table 5.2.6-4 Result of Measurements for Air Quality in Dry Season

No	Parameters	Unit	Standard	Result and Location					Method
				J.043-24	J.043-25	J.043-26	J.043-27	J.043-28	
				U - 01	U - 02	U - 03	U - 04	U - 05	
1	Sulfur Dioxide (SO_2)	µg/Nm^3	900	34.25	32.28	42.18	39.56	38.65	Pararosanilin
2	Nitrogen Dioxide (NO_2)	µg/Nm^3	400	2.35	2.45	4.18	3.28	3.75	Saltzman
3	Ammoniak (NH_3)	ppm	2	0.001	0.001	0.001	0.001	0.001	Indophenol
4	Hydrogen Sulfide (H_2S)	ppm	0.02	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	Methilen Blue
5	Carbon Monoxide (CO)	µg/Nm^3	30000	142	152	218	152	139	Pentoksida
6	Hydrocarbon (HC)	µg/Nm^3	160	< 1	< 1	< 1	< 1	< 1	GC
7	Oxydant (O_3)	µg/Nm^3	235	20.45	20.54	19.95	22.20	21.54	Chemiluminescent
8	Dust (TSP)	µg/Nm^3	230	35	35	65	40	40	Gravimetric
9	Temperature	°C		28.6	29.2	30.2	29.4	29.3	Thermometer
10	Humidity	%		71.4	69.2	64.2	71.2	70.9	Hygrometer
11	Wind Speed	cm/detik		0	0	0	0 - 0,8	0 - 0,5	Anemometer
12	Wind Direction			West	West	West	West	West	Compass
13	Solar Radiation	Lux		15790	9510	10253	14328	9543	Lux meter

2) Noise and Vibration

The sample noise levels are slightly under the standard values that were determ ined by MOE-Decree No.48 in 1996 for the region of trading the service and industry at 70 dB, except in the taking point of the sam ple U-04, where the noise level reached 71.4 dB. This was caused with the sampling location in industrial area at Wanayasa, which are in active area of so me large scale industry and high mobility of trailers. The vibration levels sampled and measured do not cause the disturbance of comfort in the surrounding environment on the whole study area.

Table 5.2.6-5 Result of Measurements for Noise in Dry Season

No	Location of sampling		Unit	Standard	Measured Results	Method
1	J.043-24	U - 01	dB	70	60.8	SLM
2	J.043-25	U - 02	dB	70	69.2	SLM
3	J.043-26	U - 03	dB	70	61.2	SLM
4	J.043-27	U - 04	dB	70	71.9	SLM
5	J.043-28	U - 05	dB	70	69.5	SLM

Table 5.2.6-6 Result of Measurements for Vibration in Dry Season

No	Location of sampling		Unit	Standard	Measured Results	Method
1	J.043-24	U - 01	Hz (RMS)	< 10 Hz	4	Vibration meter
2	J.043-25	U - 02	Hz (RMS)	5 Hz	5	Vibration meter
3	J.043-26	U - 03	Hz (RMS)	< 10 Hz	3	Vibration meter
4	J.043-27	U - 04	Hz (RMS)	< 10 Hz	4	Vibration meter
5	J.043-28	U - 05	Hz (RMS)	5 Hz	3	Vibration meter

3) Surface Water Quality

Physical Parameters

- Temperature

The temperature of the river water in the study area were between 28.5ºC-28.7ºC

- TSS

Total Suspended Solid of all samples of river water showed no disorderly values by using the method of APHA, ed.21, 2001, 2540-D with an allowed threshold of 1000 mg/l.

- TDS

Total Dissolved Solids of surface water are in the range between 416 mg /l and 32,200 mg /l, which exceed the normal threshold at 50 mg /l, according to Government Regulation No. 82/2001. This is supposedly caused by the number of solute sedimentation in streams and activities around the area of the river community activities such as rivers and mining.

Chemical Parameters

- pH and Salinity

The pH values of the measured waters have not exceeded the permitted threshold. The ranges of pH values obtained are 6.58 to 8.28 while the threshold value is between 6 and 9.

- Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

DO values were between 2.5mg/l- 5.4mg/l compared to the standard of > 6mg/l, meaning the amount of oxygen in river water is in short of that required by life of the river water biota.

BOD Values between 3.90mg/l and 6.50mg/l are above the allowed threshold standard of 2 mg/l. COD Values between 95.11 mg /l and 97.12 mg/l are well over the quality standard of 10 mg/l. The results illustrate the high content of total organic matter in river water samples.

- Ammonia (NH3-N), nitrite (NO2-N) and nitrate (NO3-N)

The values of Ammonia at 0.46 to 5.87 mg/l exceeded its standard at 0.5mg/l in three of five samples. The values of Nitrite of 0.009 to 0.024mg/ l are well below its standard of 0.06mg/l while the values of Nitrate contents are 0.068 to 0.155mg/ l are also below the standard 10 mg/l for Nitrate.

With the analyses of three compounds above, ammonia level is dominant, which indicates the supply

of waste containing organic nitrogen compounds (N-organic) going into the water stream and may be derived from the food industry and households.

- Total phosphate

Total phosphate in samples of river water showed 0.064 to 0.084 mg / l, which are below the qualit y standard of less than 0.2 mg / l.

- Sulfate Ion

All river water sa mples except one indicated the num bers of <1 m g / l which are below the norm al threshold of 1 mg/l. One exception is sample AP-05, which showed the1.034mg/ l. This indicates that its reduction by heterotrophic bacteria is very hi gh, due to the amount of organic waste deposited in the body of the river at the location of the AP-05.

- Heavy Metal

The levels of most heavy metals (As, Co, Se, Cd, Cr, Mn, Hg, Ni and Sn) in the sample waters are still below the threshold. However, Cu, Fe, Pb, and Zn are near or over the thresholds of standards in some samples. For those heavy metals, careful monitoring will be required.

- Total Nitrogen

Total Nitrogen was linked with the existence of the phosphate compound in the river water, as indicator to know the big lost with especially artificial fertilizer like urea and TSP fertilizer to the rice cultivation land and the plantation.

Table 5.2.6-7 Results of Measurements for Surface Water Quality in Dry Season

No	Parameters	Unit	Standard	Result and Location					Method
				J.043-5	J.043-6	J.043-7	J.043-8	J.043-9	
				AP-01	AP-02	AP-03	AP-04	AP-05	
I	**Physics**								
1	Temperature	^{0}C	Deviation <3	28.5	28.6	28.8	28.7	28.7	APHA, ed. 20, 1998, 2550-B
2	Suspended solids	mg/l	1000	23	23	28	25	25	APHA, ed. 21, 2005,2540-D
3	Dissolved solids	mg/l	50	31600	31600	32200	32200	416	APHA, ed. 21, 2005,2540-C
4	Odor			4	6	Neutral	Neutral	Neutral	
II	**Chemical**								
1	pH *)		6 s/d 9	7.5	6.58	7.62	8.28	7.55	APHA, ed.21, 2005,4500-H+-B
2	BOD_5 *)	mg/l	2	16.50	13.00	4.20	4.80	3.90	APHA, ed.20, 1998, 510-B/Winkler
3	COD +	mg/l	10	95.11	96.62	95.61	97.12	97.12	APHA, ed.21,2005,5220-D
4	Dissolved Oxygen (DO)	mg/l	6	2.5	4.4	5.1	5.4	5.4	APHA, ed. 14, 1975, 422-F
5	Total Phosphate (PO_4-P)	mg/l	0.2	0.084	0.075	0.064	0.070	0.067	APHA, ed. 14, 1975, 425-E
6	Total Ammonia (NH_3-N)	mg/l	0.5	5.873	1.047	0.462	0.488	2.224	APHA, ed.21, 2005,4500-F
7	Nitrate (NO_3-N)	mg/l	10	0.1	0.068	0.107	0.155	0.132	APHA, ed.14, 1989,4500-NO_3-B
8	Nitrite (NO_2-N) +	mg/l	0.06	0.013	0.012	0.009	0.024	0.013	APHA, ed. 21, 2005,4500-B
9	Chloride (Cl^-)	mg/l	600	17.35	17.35	21.2	17.35	19.45	APHA, ed.20, 1998, 4500 clF
10	Arsenic (As)	mg/l	0.005	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	APHA, ed.20, 1998,3114-As-A

No	Parameters	Unit	Stan-dard	Result and Location					Method
				J.043-5	J.043-6	J.043-7	J.043-8	J.043-9	
				AP-01	AP-02	AP-03	AP-04	AP-05	
11	Cobalt Co)	mg/l	0.2	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	APHA, ed.20, 1998; 3113-B/AAS
12	Barium (Ba)	mg/l	1	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	APHA, ed.20, 1998, 3111-B/AAS
13	Selenium (Se)	mg/l	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	APHA, ed.20, 1998, 3111-B/AAS
14	Cadmium (Cd)	mg/l	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	APHA, ed. 20, 1998, 3111-B/AAS
15	Chrome (Cr)	mg/l	0.05	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	APHA, ed. 20, 1998, 3111-B/AAS
16	Copper (Cu)	mg/l	0.02	0.025	0.029	0.015	0.045	0.039	APHA, ed. 20, 1998, 3111-B/AAS
17	Iron (Fe) +	mg/l	0.3	0.285	0.145	0.183	0.118	0.944	APHA, ed. 21, 2005; 3500-Fe-B
18	Lead (Pb)	mg/l	0.03	0.065	0.043	0.039	0.041	0.029	APHA, ed. 20, 1998, 3111-B/AAS
19	Manganese (Mn)	mg/l	0.1	0.095	0.047	0.032	0.056	0.056	APHA, ed.20, 1998, 3500-Mn/AAS
20	Mercury (Hg)	mg/l	0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	APHA, ed. 20,1998,3500-Hg
21	Zinc (Zn)	mg/l	0.05	0.049	0.052	0.061	0.049	0.052	APHA, ed.20, 1998, 3111-B/AAS
22	Nickel (Ni)	mg/l		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
23	Tin (Sn)	mg/l		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
24	Cyanide (CN)	mg/l	0.02	0.004	0.002	0.004	0.003	0.005	APHA, ed. 20, 1998,4500-CN-E
25	Fluoride (F)	mg/l	0.5	0.107	0.099	0.1	0.104	0.123	APHA, ed. 20, 1998,4500-F-D
26	Sulfate (SO_4 -S)	mg/l	1	< 1	< 1	< 1	< 1	1.034	APHA, ed. 14, 1975, 427-C
27	Free Chlorine (Cl_2)	mg/l	0.03	0.18	0.05	0.04	0.03	0.08	APHA, ed. 20, 1998,4500-Cl-B
28	Sulfide (H_2S)	mg/l	0.002	0.012	0.008	< 0.001	< 0.001	< 0.001	APHA, ed. 20, 1998,4500-S2-F
29	Oil and Grease	mg/l	1	12	10	< 1	< 1	< 1	APHA, ed.20, 1998,5520-B-C
30	Phenol	mg/l		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	
31	Total Nitrogen (TN)	mg/l		3.25	3.25	4.20	4.35	4.2	
III	**Microbiology**								
1	Fecal coli	sum/100 ml	0	0	0	0	4	4	APHA, ed.20, 1998, 9221 A-F/MPN
2	Total Coliform	sum/100 ml	0	4	23	9	43	43	APHA, ed.20, 1998, 9221 A-F/MPN

4) Sea Water Quality

- Brightness, Turbidity and Suspended Solids

The level of brightness of sea water at sample location showed the figure >5 - >10 m as compred with the required standard at > 5 m. The level of brightness depends on the season and the level of sedimentation that came from the river that entered seawaters. Turbidity levels measured were at 0.5 ntu which are well below the required level at <5 ntu. Total Suspended Solids in sea water sa mples were also at sufficiently lower level than the required standard.

- Temperature and Oil Layer

The sea water temperature in the sample layers were homogeneous at around 29.2- 29.3 ^{0}C, which are classified to be normal within the range of given standard. Oil content was not found in the all locations of the sample points.

Table 5.2.6-8 Results of Measurements for Sea Water Quality in Dry Season

No	Parameters	Unit	Standard	Result and Location				Method
				J.043-01	J.043-02	J.043-03	J.043-04	
				AL-01	AL-02	AL-03	AL-04	
I	**Physics**							
1	Brightness	meter	> 5	> 5	> 5	> 10	> 5	Secchi disk
2	Odor		Neutral	Neutral	Neutral	Neutral	Neutral	Chemical sense
3	Turbidity	ntu	< 5	0.5	0.5	0.5	0.5	Turbidimeter
4	Suspended solids	mg/l	80	5	5	6	5	APHA ,20th 1998, 2540 D/Gravimetri
5	Waste	-	No	No	No	No	Nihil	-
6	Temperature	^{0}C	28 - 32	29.2	29.2	29.3	29.2	APHA ,20th 1998, 2540 D
7	Oil layer	-	No	No	No	No	Nihil	-
II	**Chemical**							
1	pH		7-8,5	7.86	7.83	7.8	7.89	APHA,20th 1998, 4500-H^+-B/pH meter
2	Salinity	ppt	33 - 34	30	29	31	32	APHA ,20th 1998, 2520-B/Refraktometrik
3	Dissolved Oxygen (DO)	mg/l	> 5	7.50	7.15	7.8	7.40	APHA ,20th 1998, 2520-O-B/Winkler/ DO meter
4	BOD_5	mg/l	20	2.45	2.3	2.2	2.38	APHA ,20th 1998, 2520-OX-B/Winkler/ DO meter
5	COD	mg/l		10.50	10.75	9.25	9.35	
6	Total Ammonia (NH_3-N)	mg/l	0.3	0.285	0.345	0.140	0.261	APHA, 20th 1998 4500F/Spektrofotometer
7	Total Phosphate (PO_4-P)	mg/l	0.015	< 0.005	< 0.005	< 0.005	< 0.005	APHA,20th 1998, 4500-PE/Spektrofotometer
8	Nitrate (NO_3-N)	mg/l	0.008	0.281	0.116	0.173	0.141	APHA 20th 1998, 4500-NO3-B/Spektrofotometer
9	Cyanide (CN)	mg/l	0.5	0.003	< 0.002	< 0.002	0.002	APHA,20th,1998 4500-CN-E/Spectrofotometer
10	Sulfide (H_2S)	mg/l	0.01	< 0.001	< 0.001	< 0.001	< 0.001	APHA, ed. 20, 1998,4500-S2-F/Iodometrik
11	Phenol	mg/l	0.002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	APHA, ed. 20, 1998,5530-C/Amino Antifirin
12	Detergent	mg/l MBAS	1	< 0.005	< 0.005	< 0.005	< 0.005	APHA, ed. 20, 1998,5540-C/MBAS
13	Oil and Grease	mg/l	1	< 1	< 1	< 1	< 1	APHA, ed.20, 1998,5520-B-C / Gravimetrik
14	Total Nitrogen (TN)	mg/l		2.45	2.75	2.54	2.50	
III	**Heavy Metals**							
1	Mercury (Hg)	mg/l	0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	APHA,20th,1998 3500-Hg
2	Chrome (Cr)	mg/l	0.005	< 0.001	< 0.001	< 0.001	< 0.001	APHA,20th,1998 3111-B/AAS
3	Arsenic (As)	mg/l	0.012	< 0.0002	< 0.0002	< 0.0002	< 0.0002	APHA,20th,1998 3114-As-A
4	Cadmium (Cd)	mg/l	0.001	< 0.001	< 0.001	< 0.001	< 0.001	APHA,20th,1998 3111-B/AAS
5	Copper (Cu)	mg/l	0.008	0.012	0.014	0.012	0.010	APHA,20th,1998 3111-B/AAS
6	Lead (Pb)	mg/l	0.008	0.009	0.008	0.008	0.007	APHA,20th,1998 3111-B/AAS
7	Zinc (Zn)	mg/l	0.05	0.023	0.024	0.023	0.027	APHA,20th,1998 3111-B/AAS
8	Nickel (Ni)	mg/l	0.05	0.031	0.034	0.032	0.030	APHA,20th,1998 3111-B/AAS
9	Tin (Sn)	mg/l		< 0.001	< 0.001	< 0.001	< 0.001	
10	Manganese (Mn)	mg/l		0.023	0.028	0.021	0.019	

No	Parameters	Unit	Standard	Result and Location				Method
				J.043-01	J.043-02	J.043-03	J.043-04	
				AL-01	AL-02	AL-03	AL-04	
IV	**Microbiology**							
1	Total Coliform	MPN/100 ml	1000	0	0	0	0	APHA,20th,1998,9221-A-F
2	Fecal coli	sel/100ml	nihil	0	0	0	0	APHA,20th,1998,9221-A-F

(3) Wet Season Data

1) Air Quality Samples

The sample locations taken for am bient air are the sa me for dry and wet season. The values of SO_2 and NO_2 measurement are still lower, co mpared with the standard values of Government Regulation.

Table 5.2.6-9 Result of Measurements for Air Quality in Wet Season

No	Parameters	Unit	Stan-dard	Result and Location								
				J.055-24	J.055-25	J.055-26	J.055-27	J.055-28	J.055-29	J.055-30	J.055-31	J.055-32
				U - 01	U - 02	U - 03	U - 04	U - 05	U - 06	U - 07	U - 08	U - 09
1	Sulfur Dioxide (SO_2)	µg/N m^3	900	32.5	30.15	38.50	32.3	35.2	34.29	45.12	28.15	36.12
2	Nitrogen Dioxide (NO_2)	µg/N m^3	400	2.1	2.05	3.85	2.15	2.39	2.76	3.12	1.27	2.18
3	Ammoniak (NH_3)	ppm	2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001
4	Hydrogen Sulfide (H_2S)	ppm	0.02	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
5	Carbon Monoxide (CO)	µg/N m^3	30000	132	142	195	143	136	156	176	98	169
6	Hydrocarbon (HC)	µg/N m^3	160	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<1	< 1
7	Oxydant (O_3)	µg/N m^3	235	22.20	22.35	21.85	22.90	22.10	22.45	21.19	23.65	22.85
8	Dust (TSP)	µg/N m^3	230	30	30 50		30	30 35 45 25 40				
9	Temperature	°C		28.4	29	30.1	29.3	29.4	29.1	30.2	29.1	29.5
10	Humidity	%		52.9	54.3	38.6	59.5	60.5	63.5	57.45	62.1	59.5
11	Wind Speed	cm/det ik		0.20	0.50	0.90	1.5	1.2	1	1.3	0.8	0.6
12	Wind Direction			West	West	West	West	West	West	West	West	West
13	Solar Radiation	Lux		12873	11726	10251	10564	9261	9145	10265	8965	9653

Sampling Location

Code	Location	Coordinate	
U - 1	Jababeka Area	106°5'24.47"	5°59'44.07"
U - 2	PLTU Cilegon	106°6'32.49"	5°56'4.07"
U - 3	Wanayasa	106°05'55.31"	6°02'40.33"
U - 4	Jababeka Area	106°3'10.8"	6°1'21.72"
U - 5	Serang Barat	106°9'57.6"	6°3'3.6"
U - 6	Settlement	106°5'9.93"	6°06'27.14"
U - 7	Anyer	105°57'5.97"	6°1'27.06"
U - 8	Cadasari	106°07'21.90"	6°14'19.45"
U - 9	Village Sukamaju Kragilan	106°18'22.6"	6°08'29.5"

2) Noise and Vibration

The measured noise levels were below the standa rds for the region of commerc e and the servic e and industry at 70 dB, exc ept in the sam ple U-02, where the noise level reached 77 dB. The exceeding at the location of U-02 was given with th e sample taken in the existing PLTU (Ther mal Power Plant).

The measured vibration levels would not cause the disturbance of comfort in the surrounding environment, where the results of vibration meter showed the figures between 3 and 5 Hz.

Table 5.2.6-10 Result of Measurements for Noise in Wet Season

No	Location of sampling		Unit	Standard	Result of measurement
1	J.055-24	U - 01	dB	70	60
2	J.055-25	U - 02	dB	70	77
3	J.055-26	U - 03	dB	70	61
4	J.055-27	U - 04	dB	70	59.9
5	J.055-28	U - 05	dB	70	65.7
6	J.055-29	U - 06	dB	70	65
7	J.055-30	U - 07	dB	70	69.35
8	J.055-31	U - 08	dB	70	59.45
9	J.055-32	U - 09	dB	70	69

Table 5.2.6-11 Result of Measurements for Vibration in Wet Season

No	Location of sampling		Unit	Standard	Result of measurement
1	J.055-24	U - 01	Hz (RMS)	< 10 Hz	4
2	J.055-25	U - 02	Hz (RMS)	< 10 Hz	5
3	J.055-26	U - 03	Hz (RMS)	5 Hz	3
4	J.055-27	U - 04	Hz (RMS)	< 10 Hz	4
5	J.055-28	U - 05	Hz (RMS)	5 Hz	3
6	J.055-29	U - 06	Hz (RMS)	5 Hz	3
7	J.055-30	U - 07	Hz (RMS)	5 Hz	4
8	J.055-31	U - 08	Hz (RMS)	5 Hz	2
9	J.055-32	U - 09	Hz (RMS)	5 Hz	3

3) Surface Water Quality

Physical Parameters

- Temperature

The temperature of the river water in the study area were between 28.5ºC-28.6ºC, with the deviation below 3 ºC of the standard.

- TSS

Total Suspended Solid of all samples of river water showed the values of 19 to 23 mg/l well below the threshold standard of 1000 mg/l.

- TDS

Total Dissolved Solids of surface water are in the range between 410 and 31,200 mg /l, which exceed by several hundred times the normal threshold at 50 mg /l. This is supposedly caused by the number of solute sedimentation in streams and activities around the area of the river community activities such as rivers and mining.

Chemical Parameters

- pH and Salinity

The pH values of the measured waters have not exceeded the permitted threshold. The ranges of pH values obtained are 6.52 -7.98 while the threshold value is between 6 and 9.

- Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

DO values between 3.53 mg/l- 5.62 mg/l were a little higher compared to the results of the dry season, probably due to rain water babbles, though the values still showed the shortage of oxygen in water with comparison to the standard of > 6mg/l.

BOD Values between 3.45 mg/l- 10.50mg/l, which are no less than dry season, are above the allowed threshold standard of 2 mg/l. COD Values between 84.45 mg/l and 89.45 mg/l, slightly lower than dry season, though those are still well over the quality standard of 10 mg/l.

- Ammonia (NH3-N), nitrite (NO2-N) and nitrate (NO3-N)

The values of Ammonia at 0.33 to 4.43 are slightly lower than dry season, but exceeded its standard at 0.5mg/l in three of five samples, where the results are not much different between seasons. The values of Nitrite of 0.009 to 0.01 mg/ l are well below its standard of 0.06m g/l while the values of Nitrate contents are 0.058 to 0.098 mg/ l are also below the standard 10 mg/l for Nitrate. Both nitrite and nitrate levels were a little lower than dry season, though the differences are not very significant.

- Total phosphate

Total phosphate in samples of river water showed 0.059 to 0.072, a little lower values of dry season at 0.064 to 0.084 mg / l, which are below the quality standard of less than 0.2 mg / l.

- Sulfate Ion

All river water samples showed the permissible levels below the standard in wet season, even including the one exception for sample AP-05, which exceeded the standard in dry season.

- Heavy Metal

The levels of most heavy metals (As, Co, Se, Cd, Cr, Mn, Hg, Ni and Sn) in the sample waters are still below the threshold. However, Cu, Fe, Pb, and Zn are near or over the thresholds of standards in some samples. For those heavy metals, careful monitoring will be required.

- Total Nitrogen

Total Nitrogen levels at 2.50 to 4.1 m g/l were a little lower than those of dry season, for which the standard is not designated yet.

Table 5.2.6-12 Results of Measurements for Surface Water Quality in Wet Season

No	Parameters	Unit	Standard	Result and Location				
				J.055-5	J.055-6	J.055-7	J.055-8	J.055-9
				AP-01	AP-02	AP-03	AP-04	AP-05
I	**Physics**							
1	Temperature	^{0}C	Deviation 3	28.6	28.5	28.6	28.6	28.5
2	Suspended solids	mg/l	1000	19	20	22	22	23
3	Dissolved solids	mg/l	50	29900	30100	31100	31200	410
4	Odor			2	3	Neutral	Neutral	Neutral
II	**Chemical**							
1	pH *)		6 s/d 9	7.35	6.52	7.48	7.98	7.45
2	BOD_5 *)	mg/l	2	10.50	9.25	4.10	4.20	3.45
3	COD +	mg/l	10	85.2	89.45	87.2	86.45	84.45
4	Dissolved Oxygen (DO)	mg/l	6	3.53	4.65	5.23	5.62	5.60
5	Total Phosphate (PO_4-P)	mg/l	0.2	0.072	0.068	0.059	0.062	0.062
6	Total Ammonia (NH_3-N)	mg/l	0.5	4.425	0.987	0.329	0.387	1.098
7	Nitrate (NO_3-N)	mg/l	10	0.098	0.058	0.094	0.095	0.092
8	Nitrite (NO_2-N) +	mg/l	0.06	0.01	0.009	0.007	0.019	0.01
9	Chloride (Cl^-)	mg/l	600	15.26	15.95	20.45	14.98	17.45
10	Arsenic (As)	mg/l	0.005	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
11	Cobalt Co)	mg/l	0.2	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
12	Barium (Ba)	mg/l	1	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
13	Selenium (Se)	mg/l	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
14	Cadmium (Cd)	mg/l	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
15	Chrome (Cr)	mg/l	0.05	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
16	Copper (Cu)	mg/l	0.02	0.021	0.024	0.012	0.032	0.031
17	Iron (Fe) +	mg/l	0.3	0.234	0.120	0.165	0.102	0.768
18	Lead (Pb)	mg/l	0.03	0.052	0.039	0.028	0.035	0.021
19	Manganese (Mn)	mg/l	0.1	0.065	0.021	0.019	0.031	0.029
20	Mercury (Hg)	mg/l	0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
21	Zinc (Zn)	mg/l	0.05	0.042	0.047	0.054	0.042	0.051
22	Nickel (Ni)	mg/l		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
23	Tin (Sn)	mg/l		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
24	Cyanide (CN)	mg/l	0.02	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
25	Fluoride (F)	mg/l	0.5	0.085	0.074	0.089	0.085	0.097
26	Sulfate (SO_4 -S)	mg/l	1	< 1	< 1	< 1	< 1	< 1
27	Free Chlorine (Cl_2)	mg/l	0.03	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
28	Sulfide (H_2S)	mg/l	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
29	Oil and Grease	mg/l	1	8	6	< 1	< 1	< 1
30	Phenol	mg/l		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
31	Total Nitrogen (TN)	mg/l		2.50	3.10	3.65	4.1	3.95
III	**Microbiology**							
1	Fecal coli	jumlah/100 ml	0	0	0	0	0	0
2	Total Coliform	jumlah/100 ml	0	4	14	7	21	21

4) Sea Water Quality

- Brightness, Turbidity and Suspended Solids

The level of sea water brightness of sample locations in rainy season showed the same figure of >5 to >10 m as that in dry seas on. Turbidity levels measured were at 1 ntu which are well below the required level at <5 ntu, though the values in wet sea son were a little higher than dry season at 0.5 ntu. Total Suspended Solids in sea water sa mples were also at sufficiently lower level than the required standard, though they also showed slightly higher values than measured in dry season.

- Temperature and Oil Layer

The sea water temperature in the sam ple layers were slightly lower than that in dry season at around 28.5 - 29.1 ^{0}C, however they are classified to be normal within the range of given standard. Oil content was not found in the all locations of the sample points.

Table 5.2.6-13 Results of Measurements for Sea Water Quality in Wet Season

No	Parameters	Unit	Standard	Result and Location				Method
				J.043-01	J.043-02	J.043-03	J.043-04	
				AL-01	AL-02	AL-03	AL-04	
I	**Physics**							
1	Brightness	meter	> 5	> 5	> 5	> 10	> 5	Secchi disk
2	Odor		Neutral	Neutral	Neutral	Neutral	Neutral	Chemical sense
3	Turbidity	ntu	< 5	1	1	1	1	Turbidimeter
4	Suspended solids	mg/l	80	7	7	10	6	APHA ,20th 1998, 2540 D/Gravimetri
5	Waste	-	No	No	No	No	No	-
6	Temperature	^{0}C	28 - 32	28.5	28.6	29.1	29	APHA ,20th 1998, 2540 D
7	Oil layer	-	No	No	No	No	No	-
II	**Chemical**							
1	pH		7-8,5	7.37	7.45	7.37	7.45	APHA,20th 1998, 4500-H^+-B/pH meter
2	Salinity	ppt	33 - 34	30	29	30	31	APHA ,20th 1998, 2520-B/Refraktometrik
3	Dissolved Oxygen (DO)	mg/l	> 5	7.40	6.89	7.4	7.40	APHA ,20th 1998, 2520-O-B/Winkler/ DO meter
4	BOD_5	mg/l	20	2.30	2.20	2.10	2.10	APHA ,20th 1998, 2520-OX-B/Winkler/ DO meter
5	COD	mg/l		9.35	10.1	9.1	9.05	
6	Total Ammonia (NH_3-N)	mg/l	0.3	0.198	0.218	0.110	0.216	APHA, 20th 1998 4500F/Spektrofotometer
7	Total Phosphate (PO_4-P)	mg/l	0.015	< 0.005	< 0.005	< 0.005	< 0.005	APHA,20th 1998, 4500-PE/Spektrofotometer
8	Nitrate (NO_3-N)	mg/l	0.008	0.256	0.102	0.143	0.119	APHA 20th 1998, 4500-NO3-B/Spektrofotometer
9	Cyanide (CN)	mg/l	0.5	< 0.002	< 0.002	< 0.002	< 0.002	APHA,20th,1998 4500-CN-E/Spectrofotometer
10	Sulfide (H_2S)	mg/l	0.01	< 0.001	< 0.001	< 0.001	< 0.001	APHA, ed. 20, 1998,4500-S2-F/Iodometrik
11	Phenol	mg/l	0.002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	APHA, ed. 20, 1998,5530-C/Amino Antifirin

No	Parameters	Unit	Standard	Result and Location				Method
				J.043-01	J.043-02	J.043-03	J.043-04	
				AL-01	AL-02	AL-03	AL-04	
12	Detergent	mg/l MBAS	1	< 0.005	< 0.005	< 0.005	< 0.005	APHA, ed. 20, 1998,5540-C/MBAS
13	Oil and Grease	mg/l	1	< 1	< 1	< 1	< 1	APHA, ed.20 1998,5520-B-C / Gravimetrik
14	Total Nitrogen (TN)	mg/l		2.25	2.42	2.3	2.10	
III	**Heavy Metals**							
1	Mercury (Hg)	mg/l	0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	APHA,20th,1998 3500-Hg
2	Chrome (Cr)	mg/l	0.005	< 0.001	< 0.001	< 0.001	< 0.001	APHA,20th,1998 3111-B/AAS
3	Arsenic (As)	mg/l	0.012	< 0.0002	< 0.0002	< 0.0002	< 0.0002	APHA,20th,1998 3114-As-A
4	Cadmium (Cd)	mg/l	0.001	< 0.001	< 0.001	< 0.001	< 0.001	APHA,20th,1998 3111-B/AAS
5	Copper (Cu)	mg/l	0.008	0.009	0.012	0.01	0.008	APHA,20th,1998 3111-B/AAS
6	Lead (Pb)	mg/l	0.008	0.008	0.008	0.006	0.006	APHA,20th,1998 3111-B/AAS
7	Zinc (Zn)	mg/l	0.05	0.019	0.021	0.02	0.024	APHA,20th,1998 3111-B/AAS
8	Nickel (Ni)	mg/l	0.05	0.025	0.021	0.027	0.021	APHA,20th,1998 3111-B/AAS
9	Tin (Sn)	mg/l		< 0.001	< 0.001	< 0.001	< 0.001	
10	Manganese (Mn)	mg/l		0.019	0.021	0.018	0.010	
IV	**Microbiology**							
1	Total Coliform	MPN/100 ml	1000	0	0	0	0	APHA,20th,1998,9221-A-F
2	Fecal coli	sel/100ml	nil	0	0	0	0	APHA,20th,1998,9221-A-F

5.3 Mitigation Measures to be taken

5.3.1 Policy of Mitigations

Mitigation is a critical component of the environmental impact assessment. It aims to prevent adverse impacts from happening and to keep those that do occur within an acceptable level. Opportunities for impact mitigation will occur throughout the project cycle.

The objectives of mitigation are to:

- find better alternatives and ways of doing things;
- enhance the environmental and social benefits of a proposal;
- avoid, minimize or remedy adverse impacts; and
- ensure that residual adverse impacts are kept within acceptable levels.

Early links should be established between the environmental assessment and project design teams to identify mitigation opportunities and incorporate them into consideration of alternatives and design options. In practice, mitigation is emphasized in the environmental assessment process once the extent of the potential impact of a proposal is reasonably well understood. This typically takes place following impact identification and prediction, and recommended measures for mitigation will be an important part of the environmental assessment report. Usually, these measures will be incorporated into the terms and conditions of project approval and implemented during the impact management stage of the environmental assessment process.

The objectives of impact management are to:

- ensure that mitigation measures are implemented;
- establish systems and procedures for this purpose;
- monitor the effectiveness of mitigation measures; and

The adverse impacts and consequences of a proposal can occur far beyond the site boundaries of a project. In the past, many of the real costs of development proposals were not accounted for in economic analyses of project feasibility, particularly in the operational and decommissioning phases of the project cycle. As a result, these costs were borne by the community affected or the public at large rather than by the proponent.

Stricter requirements are now being imposed on proponents to:

- mitigate impacts through good project design and environmental management;
- prepare plans for managing impacts so these are kept within acceptable levels; and
- make good any residual environmental damage.

In the section for mitigation measures is often located after the evaluation section, that is after the analysis and comparison of alternatives has been reported. This gives the impression that first a preferred alternative has been selected, then second mitigating measures have been added to the project. This process may seem to be appropriate, but unless there has been a subsequent review of the alternatives the chosen one, with mitigation measures, may be a worse option. In particular the mitigation measures will add costs to the preferred alternative. In this situation the second alternative would have been preferable to the one chosen having both less impact and being less cost.

Consequently, the stage for thinking about mitigation measures should be before there has been a comparison of the alternatives. The point of considering safeguards before comparison is to encourage the analyst to think about the "extras" that may have to be added onto the basic proposal, before the evaluation of the proposal is undertaken. This will help to ensure that the comparison, or evaluation, of alternatives is conducted when all the relevant information and costs are included.

The figure on the next page shows the direction of spatial utilization and conservation designed in Serang District and Banten Province with their spatial plans. The directions of mitigations regarding the Bojonegara model power plant plan should comply with those.

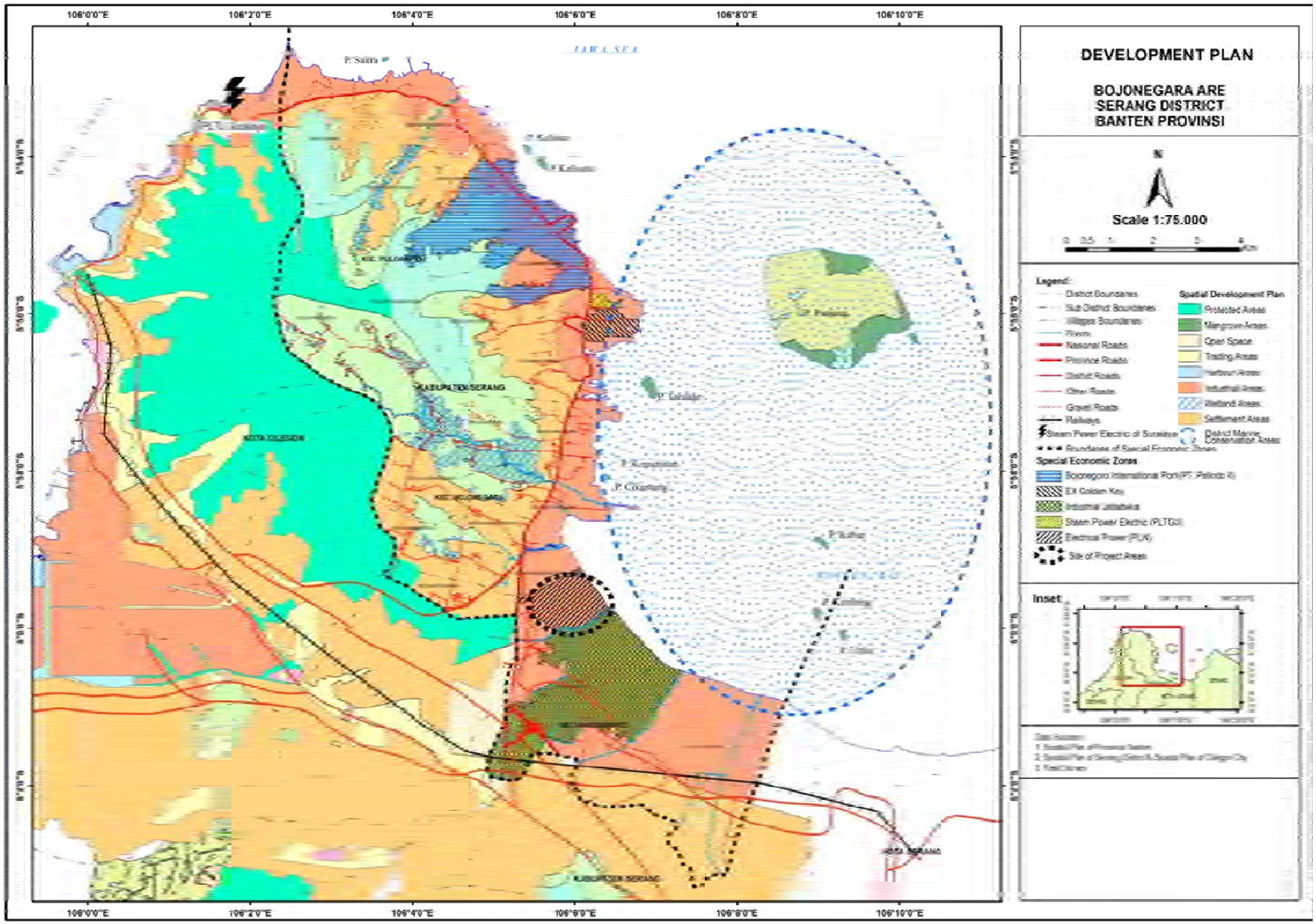


Figure 5.3.1-1 Development Plan of Bojonegara and Serang District Banten Province

Source: Data sources from Spatial Plan of Province Banten, of Serang District & of Cilegon City; Topographic Map (RBI), Scale of 1 : 25.000, Bakosurtanal (1999); and Field Survey

5.3.2 Aspects of Mitigations

Base on the above statement at the IEE study the mitigation plan has been considered several aspect starting from spatial aspect until to encountered several aspect which should be prepared the mitigation plan future development plan.

(1) Spatial Aspects

As mentioned in Chapter 2, that the Bojonegara Model Power Plant site is confirmed and compliance with the spatial plans both province and district spatial plan, however, determination of the Bojonegara as power plant development site has some environmental considerations as follows:

Based on Provincial Law No. 02/2011 that any activities along the coastal shall have environmental assessment (EIA, environmental monitoring and environmental management plant)

(2) Marine Conservation Area

The development site will consist of 2 locations namely onshore and offshore, where the offshore location will overlap with natural marine conservation area of Banten Bay according to the Provincial Law No. 2 Year 2011 regarding Spatial Plan. Therefore, it is necessary to reconfirm with Provincial Government cq. Bappeda of Banten Province in further study of power plant development site.

(3) Local Protected Area

The location of power plant development site has a river border in the eastern part of the site and shore/coastal line in the northern part of the site. According to Banten Provincial Law No.2 / 2011 and Serang District Regulation No. 11 / 2011 on Spatial Plan of Banten Province and Serang District respectively that the shoreline border or the green belt for shoreline of outside urban areas with wave heights < 2 m wide border is 100-200 meters from the highest tide point landward, and the green belt and or river border of river less than 3 m in depth is 50-75 m from the river bank. These coastal and river border areas are considered as local protected area and mangrove conservation, which need to be maintained for sustainable development. Therefore, this condition should be considered in the mitigation plan.

There are many conservation objectives, and priorities regarding with mangrove conservation.

- maintenance of 'reservoirs' for natural restocking of adjacent exploited areas;
- protection of breeding and feeding areas important for fisheries;
- protection of shorelines from erosion; and
- reduced pollutant and hazardous waste from upland areas.

Depending upon the specific objectives for any area, mangrove conservation can be achieved by management on a sustainable basis, or by creating protected areas.

A sustainable protection and management program for mangroves should be undertaken in a balanced manner. The management plan process has the opportunity to follow a strategic and structured planning process, which gathers information (both current and historical) identifies values and threats, develops policy and actions and monitors performance. It is important that the

process involves relevant stakeholders including management agencies and the community.

The objectives of mangrove-forest conservation in the assu med project site a re mainly to promote greenbelt conservation for coastal protection, which shall be carried out through:

- Structuring the benchmark demarcation, especially in areas that have no have benchmark;
- Inventory and evaluation the potential, location and distribution of mangrove ecosystems;
- Rehabilitation through replanting mangrove and provision for de graded mangrove forest areas;
- Monitoring and evaluation of potential mangrove forest area;
- Protection of mangrove ecosystem from destruction, disturbances, threats, and pests and diseases

(4) Natural Disaster Prone Areas

Based on the Provincial Regulation No.2 / 2011 on Banten Spatial Plan, that t he location of th e site along the beach is susp ect for the Natural Disaster Prone Are, which is prone of tsunami disaster, therefore, this condition shoul d be taken into consideration in the m itigation plan a nd emergency preparedness. However, there is no da ta available regarding the history of the tsunami in the study area. This is based on the geological disaster study conducted during the preparation of the Spatial Plan of Banten Province.

(5) Lay out of the Site

The Mode Power Plant will cover on s hore and o ff shore. The onshore structure will be developed for

- power block with turbine and boiler,
- emission gas stack and cooling tower (if necessaries),
- coal storage area, fly ash disposal area, waste water treatment facility, ash disposal area and etc.

According of the government regulation 18/199 9 regarding hazardous waste management, the landfill shall be 500 meters fro m the river while th e size of are onl y 160 ha, therefore, it is not possible to structure the location coal ash pond more than 500 meters fro m the river. Based on consultation with the staff of Ministr y of Environment (Mrs. Haruki Agustina, Head of Hazardous Permit Division and Mr. M. Yunus, Head of Hazardous Management Division), their need of mitigation in the preparation by asking recommendation from Ministry of Environment and prepare appropriate technology to reduce the risk impact of heaving coal ash ponds less than 500 meters from the river.

(6) Social Economic Aspects

Bojonegara has been appointed as a Special Econom ic Development Area (KEK) and as an International Port location. The potential development programs are expected to be followed by various social economic phenomena associated with spatial as follows:

1) As mentioned in Clause 5.2.4 (3)-6) that there is one cultural-religious herita ge called “Bukit Santri” in Bojonegara V illage, near by the assumed project site. The development of the pro-

posed thermal power plant will have an impact to the cultural heritage site such as from air pollution as well as noise. The conserve of this herita ge must be included in the mitigation program of the thermal power plant development program

2) The assumed project site with a total of 160 ha has been purchased by PLN and or the land is belong to PLN, however, based on our field survey, we found illegal shelter belong to 57 famers and or fishermen whose have farming and fishing activities in the assumed project site. Although the land is belong to PLN, however, before the development activities is started there is needed to prepare several mitigation and anticipation for smoothing handed over back the land to PLN. Although, there will be no land acquisition budget for illegal shelter, however, there may need a certain amount of money for compensation of the productive field and tree as the main source of their income.

3) As mentioned in the previous Chapter 2 that there are so many business activities taking place in the study area, some of them involving the sea transportation and developed special sea port for their own purpose. It means that there will be vessel coming in and going out to and from the special seaport through the Banten Bay. Besides, there are also fishing boat sail within the Banten Bay area from local fishing port near by the assumed project site. These two conditions shall be taken into account and therefore, there need to prepare mitigation programs for transport of coal by vessel, barge, and jetty, because there will be a possible interference with marine transportation of local people and private sector from surrounding project site.

4) Increase in-migration of labor in industry and port sector needs land for settlement following urban facilities, in terms of Bojonegara relatively narrow region where the west is bordered by hills and protected forests and the northern and eastern borders with the sea. This will result in a slum. This condition may have a negative impact on the development of thermal power plant and therefore, it needs to be taken into account in the mitigation program.

5) The Development of thermal power plant in the assumed project site, larger scale of industrial activities followed by International Port development in Bojonegara will lead to the highest demand on water supply for the needs of industries, ports and settlements. The demand on water supply shall be subject for further mitigation program which may have a negative impact on the thermal power plant development.

(7) Baseline Assessment

Base on the analysis for wind direction for the last 30 years using wind rose model shows that the flow of wind direction tends to eastern area. Therefore, any disposal of the developed Model Power Plant in the assumed project area will follow wind direction. This condition will lead to significant impact to the environment of the eastern area of the assumed Model Power Plant site. Because the eastern part is the capital of Indonesia and high-populated area, therefore, the mitigation of this potential impact need to be considered during preparation and construction in order to reduce the air pollution impact on the capital area from Sox, NOx, and dust through implementation of appropriate and innovation technology.

Related to the development of ash disposal area in the assumed project site, there will be a possi-

bility for infiltration of the heavy metal to the water body in surrounding site, which closed to marine conservation area of Banten Bay. In the long run, the residual of heavy metal will have negative impact to the marine biota, which influence circle of food chain. Therefore, the mitigation of this potential impact need to be considered during preparation and construction particularly the coal ash pond in order to reduce the potential impact of heavy metal on the surrounding assumed project site.

5.4 Monitoring Policy for the Plan

(1) Monitoring of the Environmental equipment at Design and Implementation Stage

- Monitoring of Electrostatic precipitator, De-nitrification system (If necessary) and Desulfurization system is required not only in design stage but also in implementation.
- PLN used to utilize low sulfur and low ash contents of coal for their power plant. With low rank coals coming up as the potential fuel to be considered at the Model Power Plant and thus the sulfur contents may be higher compared to the previously used coals of higher rank.
- In addition, coal dust dispersion protection system at coal storage area and cooling water thermal effluent measurements will be considered in the FS stage.

(2) Simulation of pollutants impacts

- Simulation of dispersion on air pollutants should be conducted based on the given design at FS Stage.
- Protection of effluent pollution from Ash disposal area such as shield and waste treatment facility should be evaluated in their efficiency quantitatively, using the given design at FS Stage.
- Fly ash treatment and bottom ash recycling should be evaluated qualitatively and quantitatively.

5.5 Stakeholders Consultation

(1) First stakeholders-meeting was held on April 26, 2011.

The purpose of the 1st meeting was to share info about the study scope and method with the he Indonesian implementing agencies, environmental authorities, planning authorities, and Japanese organizations concerned.

(2) Second meeting was held on February 16, 2012.

The purpose of the 2nd meeting was to briefly review the 1st stage of the study (on CCT-introduction roadmap and Site selection of prefeasibility study for a model coal-fired power plant) to share the info on the scope and method of the prefeasibility study at Bojonegara and the related IEE (Initial Environmental Examination) study with the stakeholders of the 1st meeting plus regional government concerned.

(3) Third meeting was held on June 12, 2012.

The purpose of the 3rd meeting is to share the pre-FS result and the IEE results for the plan of model coal-fired power plant and to consult with stakeholders, in collaboration with the MEMR,

PLN and related Indonesian governments, about the cognition of the prospective effects and impacts with the CCT introduction. While BAPPEDA (Planning Agency) and BLHD (Environmental Agency) of Province Banten and District Serang which administers the locality of Bojonegara; Academics, Business and locally active NGOs were invited to the meeting, there were no attendance of them at the meeting.

Therefore, with the consent of MEMR and PLN, PLN and the JICA Study Team visited the concerned organizations and shared the related information on 19 June 2012. Those organizations visited are as follows:

1. BAPPEDA of Banten Province
2. BAPPEDA of Serang District (Kabupaten)
3. BLHD (Regional Environmental Management Agency) of Banten Province
4. BLHD of Serang District

All of the four organizations basically welcomed the visit and explanation about the project plan though they at a time regretted their absence at the Stakeholders Meeting held on 12 June 2012. They also expressed that the concerned plan comply with their spatial plans of province/district. They added that they would expect the project explanation about the tangible plan with an authorization letter of MEMR at an early stage of the following study for the plan, and that those explanations should be conveyed to BAPPEDA, BLHD and Dinas Energy, respectively to the province and district.

5.6 Following Process of Environmental and Social Considerations

If the project proceeds to the feasibility (FS) study, the project proponent should conduct an environmental impact assessment, called AMDAL in Indonesia, as required by Indonesian environmental regulations.

The concerned procedure will be as shown in the below picture. AMDAL also requires stakeholders meetings and consultation to explain about the project and build consensus among concerned people. As premises to have approval in AMDAL, there are several permissions required, such as PLN's site legal status, land certificate, permit from MEMR, permit from Bupati (District Head), location permit from district government and also construction permit from district government, anf finally the approval of AMDAL and environmental permit will be issued.

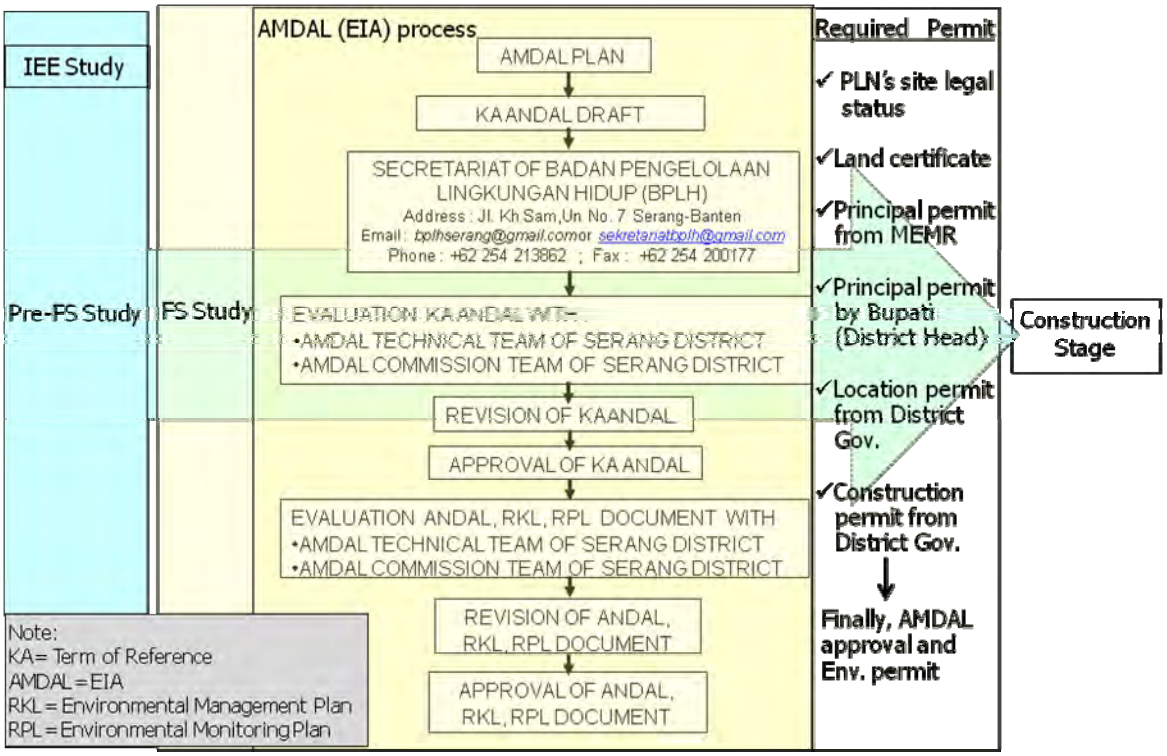


Figure 5.6.1-1 Process of ESC including Flowchart of AMDAL (EIA) in the later stages of the Plan

Source: JICA study team

CHAPTER 6

CONSTRUCTION PLAN OF MODEL POWER PLANT PROJECT

CHAPTER 6
CONSTRUCTION PLAN OF MODEL POWER PLANT PROJECT

6.1 Construction Plan of Model Power Plant Project

This section describes the construction plan for Ultra Super Critical (USC) 1,000 MW × one (1) unit Coal-Fired Thermal Power Plant with additional 1,000 MW × one (1) unit for future plan The Power Plant will be constructed on the land of PLN in Bojonegara, Indonesia.

This Construction plan is Unit-1 1,000 MW Coal-Fired Thermal Power Plant only.

6.2 Preparation Procedure of Model Power Plant Project

The process of the project when implementing under PLN is described to the following.

Refer to Figure 6.2-1 1,000 MW Coal Fired TPP Planning Schedule;

Table 6.2-1 Project Preparation and Bid Stage

No.	Descriptions	Period	Remarks
A.	Basic Agreement on FS for 1,000MW Coal-Fired TPP Project Development Plan	Up to end 2012	
1).	Basic Agreement between PLN and Indonesian Government for FS		
2).	Approval from Indonesian Government for FS		
B.	FS for 1,000MW Coal-Fired TPP Project Development Plan	Within 2013	10 Months
1).	Selection of the Consultant or carryout PLN it self for FS		Based on Pre-FS Report
2).	FS of Onsite & Basic Engineering Design		With EIA Study
3).	FS Report Finalized		
4).	FS Report Approved by Indonesian Government (MEMR)		
C.	Prepare Bid Document and Bidding	With in 2014	13 Months
1).	Approval by Indonesian Government of the Project and Bidding Process		
2).	Selection of the Consultant or carryout PLN it self for Bid Documents		With Local Consultant
3).	Prepare Bid Documents		With Financial Study
4).	Environmental Study Approved (AMDAL)		
5).	Bid Documents Finalized		
6).	Bid Document Approved by Indonesian Government (MEMR)		
D.	International Competitive Bid (ICB) for EPC Contract	Until end of 2016	14 Months
1).	Call Bidder for ICB on EPC Full Turn-key Basis		
2).	Preparation of the Bid Proposal by Bidder		
3).	Evaluation of the Bid Proposal		
4).	Contract Negotiation with Successful Bidder		
5).	Bid Evaluation Report Finalized		
6).	Bid Evaluation Report Approved by Indonesian Government (MEMR)		
7).	Preparation of Contract Documents and Signing		

Source: JICA study team

6.3 Construction Schedule of Model Power Plant

This section describes the construction of execution stage. Please refer to Figure 6.3-1 for 1,000 MW Coal Fired TPP Construction Schedule;

Table 6.3-1 Project Execution Stage

No.	Descriptions	Period	Remarks
A.	1,000 MW Coal Fired TPP Construction	From 2017 until with in 2021	48 Months (4 Years)
1.1	Site Preparation		
1.2	Design and Engineering		
1.3	Procurement of Equipments & Material		
2.1	Civil & Architectural Works		
2.2	Transportation of Equipments & Material		
2.3	Erection Works		
2.4	Instauration of Piping and Cabling		
3.1	Pre-Commissioning and Commissioning Operation		
3.2	Commercial Operation		
B.	500 kV Transmission Line Construction	From 2016 to until end of 2019	30 Months (2.5 Years)
1.0	Contract Signing		
1.1	Design and Engineering		
1.2	Civil & Structural Works		
1.3	Overhead Cabling Works (Approx. 60 km)		
2.1	Commissioning Test		

Source: JICA Study team

6.3.1 Outline of the Construction Works for Model Power Plant

The construction work period of the plan, the period of 48 months will be included all of the test ru n implication power generation equipment construction work complete from the site preparation work

(1) Construction site

The construction site is at the Bojonegara, Banten, Indonesia.

The total construction area is 173.3 ha and its own by PLN.

(2) Site Preparation

1) Soil disposal and backfill

Plant site original soil such as coast al deposit, swamp deposit and volcanic deposit will be disposes to the site area.

2) Shore protection and boundary fence

The seaside and riverside protection of FS site boundary will be constructed by embankment or sheet piling. Then construct site boundary fence and gate.

(3) Construction works

The construction work beg ins after the site preparation completed, and the construction works such as civil works, building construction, equipment erection, piping and cabl ing for all of the plant facilities will be included.

(4) Pre-commissioning and commissioning operation

All facilities and equipment must carry out the pre-commissioning after the mechanical-completion to confirm reliability and the functional test for plant control system and safety equipment are included. Also, the test will be applied international and local regulations. The plant performance test will be carried out during commissioning operation to verify of the guarantee values of the Plant, such as gross power output, plant heat rate, particulate, NOx and SOx under the requirement of contract.

6.4 500 kV Transmission Line Bid and Contract

500 kV Transmission Line is basically separate bid and contract, therefore technical and schedule coordination is necessary by the Consultant.

Completion date of 500 kV Transmission Line must be before pre-commissioning of the power plant.

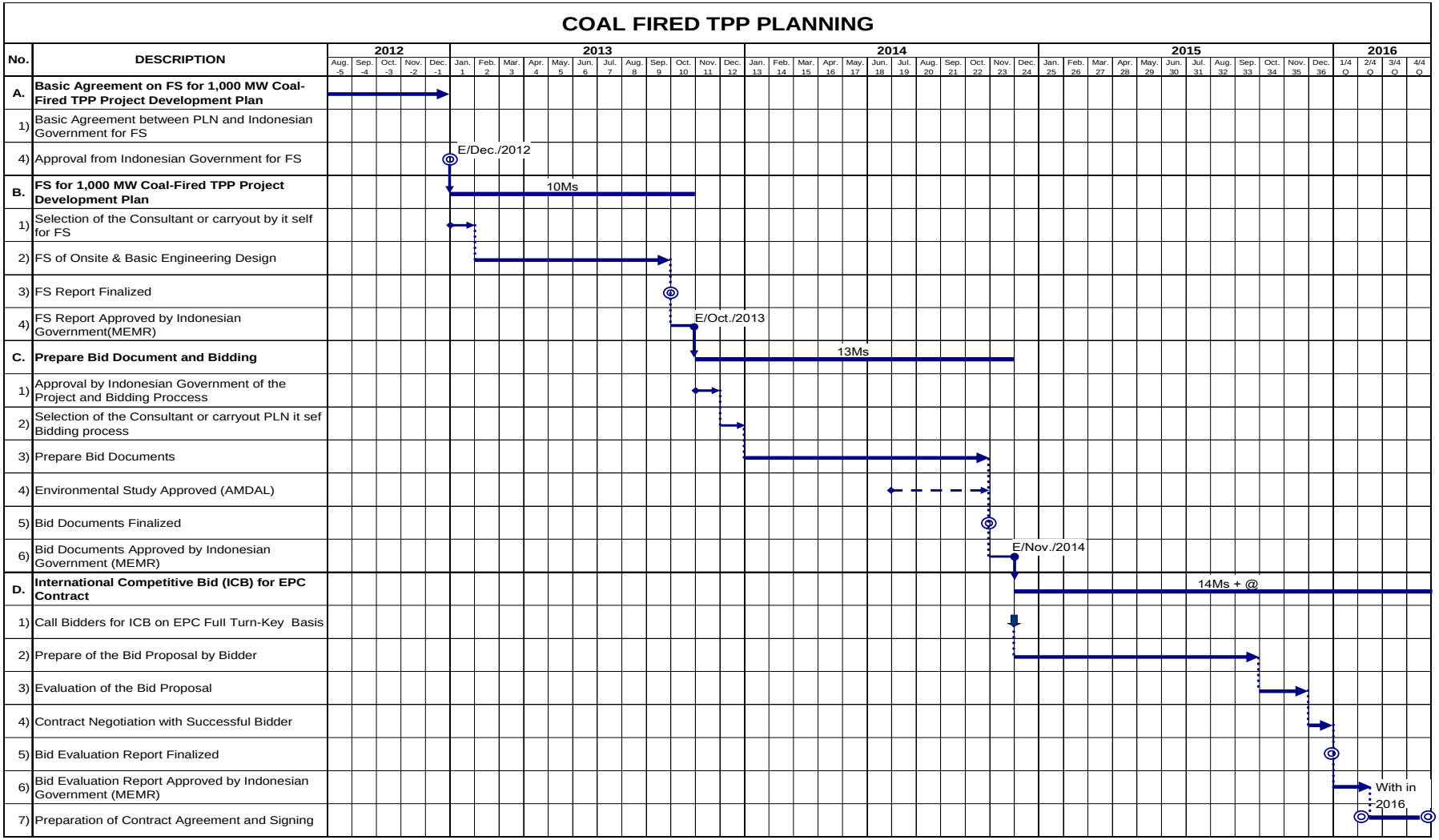


Figure 6.4-1 1,000 MW Coal Fired TPP Planning Schedule

Source: JICA study team

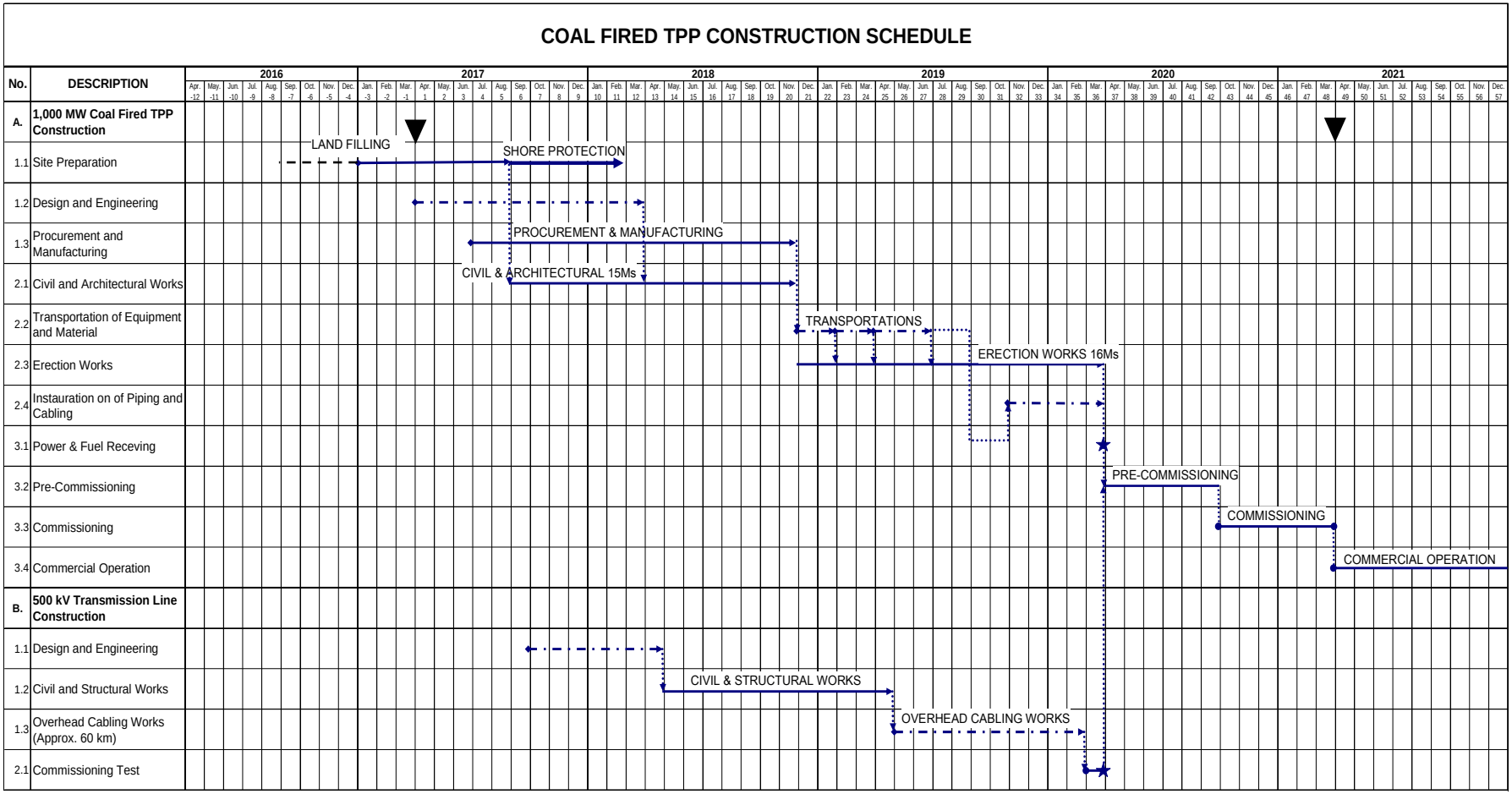


Figure 6.4-2 1,000 MW Coal Fired TPP Construction Schedule

Source: JICA study team

CHAPTER 7

PROJECT COST AND ECONOMIC/ FINANCIAL ANALYSIS

CHAPTER 7
PROJECT COST AND ECONOMIC/FINANCIAL ANALYSIS

7.1. Budget of Total Project Cost

Construction cost for the model power plant and transmission line in this chapter are not actual estimation by EPC contractors. The condition of the cost estimate is as shown in the following.

7.1.1 Construction cost for 1000 MW Power Plant

(1) Basic condition for cost estimate of Baseline Construction Cost for the model power plant

- The estimate for Baseline Construction Cost for the model power plant ("Baseline Cost for Power Plant") is based on the "Figure 7.1.1-1 General Arrangement of 1,000 MW Coal Fired Power Plant".
- The estimate for Baseline Cost for Power Plant assumes use of 3,700 kcal/kg to 4,300 kcal/kg coal.
- The land cost is not included in Baseline Cost for Power Plant.
- Transmission line cost is not included in Baseline Cost for Power Plant.
- Baseline Cost for Power Plant doesn't include the tax and duty of Indonesia.
- Baseline Cost for Power Plant for 2 units is assumed to construct 2 units at once (2nd unit's construction is scheduled half year later after 1st unit's construction commencement.
- Environmental measures to observe the environment standard (e.g. waste water treatment, sound insulation facilities, flue gas treatment facilities etc [1]) are included in the following cost estimate, but the cost for safeguard mitigation measures outside the power plant is not included, since these measures cannot be specifically assumed and their cost cannot be estimated at this stage.

(2) Baseline Cost for Power Plant (1,000 MW)

The estimated Baseline Cost for Power Plant includes the cost of the site preparation, civil works for 1st unit and common facilities to be used by 1st and 2nd units. Baseline Cost for Power Plant is based on the recent bid results of the 1,000 MW and 800 MW class of the USC coal-fired power plants.

The estimated Baseline Cost for Power Plant is in Table 7.1.1-1.

[1] The applied technologies are discussed in Chapter 3.

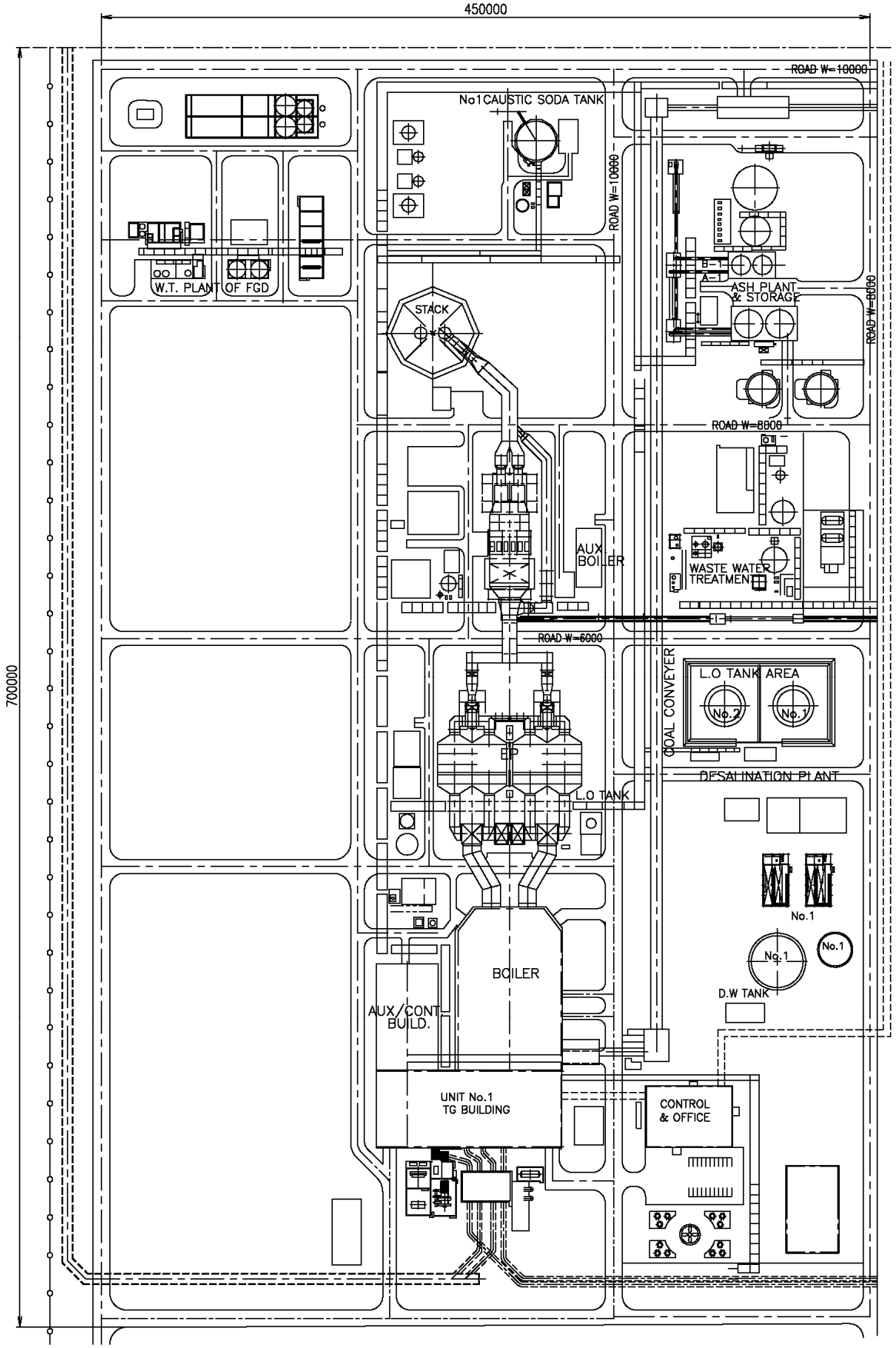


Figure 7.1.1-1 General arrangement of 1,000 MW Coal Fired Power Plant

Source: JICA study team

Table 7.1.1-1 Construction cost for Power Plant (1 unit of 1,000MW)

No.	Description	Total (US$)
A	**Baseline Cost for Power Plant**	
1.	**Power Plant Installation and Related Works**	
(1)	**Civil Work**	US$ 362,400,000
	a. Site Preparation & Infrastructure	
	b. Seawater Intake & Outfall	
	c. Unloading Jetty	
	d. Foundation Works for Power Plant Facilities	
	e. Architectural Works for Power Plant (including Building Services)	
(2)	**Steam Generator and Auxiliary Plants**	US$ 430,400,000
	a. Steam Generator	
	b. Steam Generator Associated Facilities	
	c. Fans, Ducting and Structural	
	d. FGD and FGD Associated Facilities	
(3)	**Steam Turbine Generator**	US$ 282,000,000
	a. Steam Turbine and Associated Facilities	
	b. Generator and Associated Facilities	
	c. Steam Turbine Auxiliary Plants	
	d. Seawater Intake Facilities	
(4)	**Power Plant Facilities**	US$ 104,000,000
	a. Fuel Handling and Storage (Coal & Distillate Oil)	
	b. Ash Handling and Storage	
	c. Auxiliary Boiler	
(5)	**BOP (Balance of Plant)**	
(5a)	**BOP Mechanical**	US$ 122,000,000
	a. Desalination and Water Treatment Plants	
	b. Cooling Water & Auxiliary Water System	
	c. Instrument & Service Air System	
	d. Fire Protection and Fire Fighting System	
	e. Waste Water Treatment System	
(5b)	**BOP Electrical**	US$ 57,800,000
	a. 500 kV Electrical System	
	b. Transformer and Associated Facilities	
	c. Auxiliary Distribution System	
	d. Emergency Power Supply System	
	e. Plant Facilities Electrical Systems	
(6)	**Control and Instrumentation**	US$ 22,700,000
	a. DCS and CP Systems	
	b. BOP & Auxiliary Control and Instrumentation	
(7)	**Administration and Plant Service**	US$ 26,800,000
	a. No technical Building and Facilities	
	b. O&M Training	
	c. Spare Parts	
	Estimated Baseline Cost for Power Plant	**US$ 1,408,100,000**
2.	**Physical Contingency (10% of EPC Cost)**	
	Total Contingency	US$ 140,810,000
	Construction Cost for Power Plant	**US$ 1,548,910,000**

Source: JICA study team

(3) Consulting service cost

The condition and estimated consulting service cost are as follows:

- The estimated cost and the period of the consulting service are based on Figure 6.4-1 and 6.4-2 of 1,000 MW coal fired TPP construction schedule.
- Consulting service of Feasibility Study includes the site survey cost by local survey companies.
- The estimated cost for local consultant's service includes the tax and duty of Indonesia.

Table 7.1.1-2 Consulting Service Cost for model power plant (1 unit of 1,000 MW)

B	Consulting Services for Project	Total
1.	**Consulting Services**	
	a. Consulting Services F/S Stage	US$ 2,500,000
	b. Consulting Services-1 Bidding Stage	US$ 14,080,000
	c. Consulting Services-2 Execution Stage	US$ 28,160,000
	Sub-Total	US$ 44,740,000
2.	**Non-Eligible Portion**	
	a. Administration Cost	US$ 2,540,000
	b. Tax and Duty	US$ 330,000
	Sub-Total	US$ 2,870,000
	Consulting Service Cost	**US$ 47,610,000**

Source: JICA study team

(4) Construction Cost for Power Plant and the consulting service cost

10 % of Baseline Cost for Power Plant was added as the contingency cost. Thus, the sum of Baseline Cost for Power Plant (A.1) and Project contingency cost (A.2) is estimated as Construction Cost for Power Plant.

A.1 Baseline Cost for Power Plant; US$ 1,408,100,000

A.2 Project contingency cost (10% of EPC cost) ; US$ 140,810,000

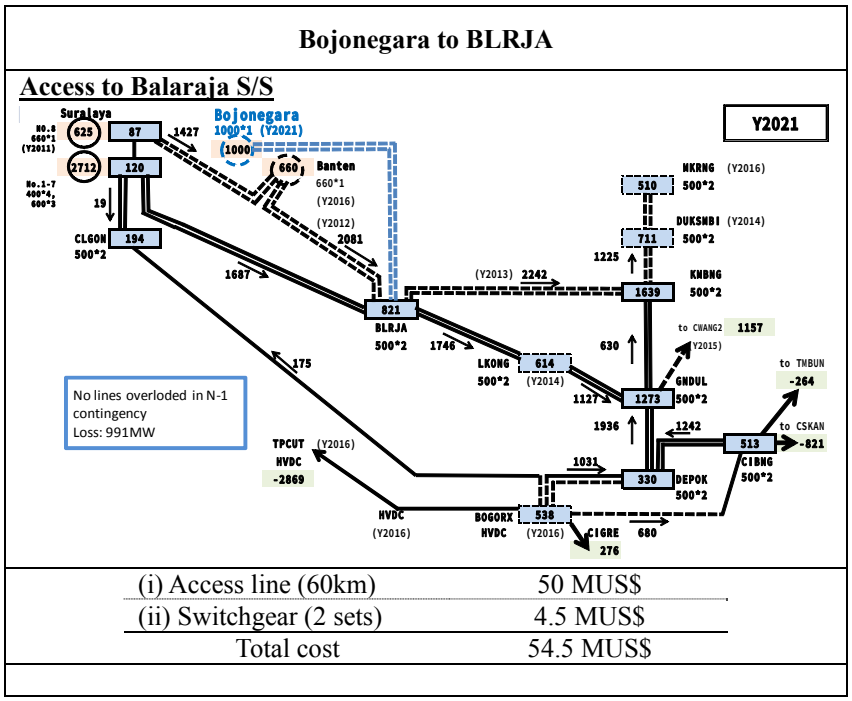
B.1 & B2 Consulting service cost; US$ 47,610,000

7.1.2 Construction Cost for 500 kV Transmission Line

The Baseline Construction Cost for Transmission line for the model power plant (Baseline Cost for T/L) is based on the data from RUPTL 2011-2020.

(1) Basic condition for Baseline Cost for T/L

- The estimate for Baseline Cost for T/L is based on the "Figure 7.1.2-1 500 kV Transmission line Route Plan".
- The land cost is not included in Baseline Cost for T/L.
- Baseline Cost for T/L includes design, civil works, transmission towers, overhead cabling and installation works.



(i) Access line (60km)	50 MUS$
(ii) Switchgear (2 sets)	4.5 MUS$
Total cost	54.5 MUS$

Figure 7.1.2-1 500 kV Transmission line Route Plan

Source: JICA study team

(2) Construction Cost for 500 kV Transmission Line

- Baseline Cost for T/L; US$ 50,000,000. .....(a)
- Transmission line connecting cost to BLRJA SS; US$ 4,500,000. ..... (b)
- 10% of (a) + (b) above as contingency cost; US$ 5,450,000.

Construction Cost for 500 kV Transmission Line is US$ 60,000,000.

7.1.3 Project cost

Based on 7.1.1 and 7.1.2 above, the project cost is estimated as follows. The estimation below is based on the assumption that the construction will start in 2017 and the plant's commercial operation will start in 2021. Therefore, the price escalation was added to the construction cost. Also, 5% of Baseline Project Cost was added as "project contingency cost". In other words, it is the contingency cost for the project as a whole.

Table 7.1.3-1 Pr oject Cost

(US$ million)

Breakdown of Project cost		1 Unit × 1,000MW	2 Units × 1,000MW
(A)	Construction cost for power plant (EPC)	1,548.9	2,788.0
(B)	Construction cost for transmission line	60.0	60.0
(C)	Price escalation for (A)& (B) [i)]	163.6	289.5
(D)	***Sub-Total: Construction cost: sum of (A) to (C)***	***1,772.4***	***3,137.5***
(E)	Consulting service cost	47.6	85.7
(F)	***Sub-Total: Baseline Project Cost: (D)+(E)***	1,820.0	3,223.2
(G)	Project contingency cost: (F)*5%	91.0	161.2
(H)	**Budget for Total Project Cost:** (F)+(G)	**1,911.0**	**3,384.4**

i) $((A)+(B)) \times (1.0245^4 - 1)$: Based on the assumption that it will tak e 4 years to start construction and increase of 2.45% per year which is the 10 year average of US CPI.

Source: JICA study team)

They are the basis for the economic and financial analysis in the following sections.

7.1.4 Disbursement Schedule

The following simplified disbursement schedule is applied in the economic and financial analysis:

Table 7.1.4-1 Assumption for Disbursement Schedule

	Year1	Year2	Year3	Year4	Year5	Year6	
						H1	H2
1 Unit	15%	40%	30%	5%	0%	10%	0
2 Units	15%	40%	30%	5%	0%	5%	5%

Source: JICA study team

7.2 Economic and Financial Analysis

7.2.1 Financial Analysis

In the previous section, the validit y of the model power plant project was conf irmed in terms of the impact on the country' s economy. At the same time, the financial analy sis is im portant in order to confirm the financial vi ability and sustainability of the m odel power plant project from the perspective of the pr oject owner, PLN, and I ndonesian government who provides the subsidies to PLN. Financial outflows include the expenditures for investment, operation and maintenance an d taxes. Financial inflows include the revenue from the electricity sales and cash from the loan. The net cash flow was constructed and financial IRR was estimated. The model was run for the two cases of (i) Case 1: Construction of 1 unit only (including the common facilities) and (ii) Case 2: Construction of 2 units at once (including the common facilit ies). (In the assu mption table below, (i) and (ii) correspond to these cases.)

(1) Assumption

At this stage, financers of the project are not decided. Therefore, the applied assumptions related to finance are based on the conditions for multilateral development agencies.

Table 7.2.1-1 Assumption for financial Analysis (Base case)

	Assumption in the model	Notes
Initial investment		
Total project cost	(i) US$1,911.0 million (ii) US$3,384.4 million	Discussed in 7.1 above
O&M costs		
O&M cost for plant	(i) US$51.16mil/year (ii) US$92.09mil/year	(i) US$7.30/MWh (ii) US$6.57/MWh
O&M cost for transmission line	US$1.1mil/year	
Increase in O&M cost	4.41%	See 1) below
Fuel	(i) US$400.72 mil/year (ii) US$801.43 mil/year	US$57.18/MWh
Increase in fuel cost	5%	See 2) below
Output		
Plant capacity factor	80%	
Auxiliary power consumption ratio	8%	Conservative estimate from USC's records in the world
Electricity generated	(i) 7,008GWh (ii) 14,016GWh	
Project duration	30 years	
Electricity sales		
Initial tariff as of 2017	US$0.089	The PLN's average sales price in 2010[2] multiplied by the historical tariff increase rate[3]
Increase in tariff	5.00%	See 3) below
Finance		
Equity	(i) US$286.66 mil (ii) US$507.66 mil	15% of total project cost
Loan	(i) US$1,757.41mil (ii) US$3,109.21 mil	
Repayment period	25 years	
Grace period	6 years	During construction (including guarantee period)
Interest rate per year	4.03%	Swap rate[4] + 0.5% margin to be paid to MOF
Frequency of int. payment	Semi-annual	

[2] Rp. 699.09 (Source: PLN statistics 2010)

[3] ((1+3.47%)^5). 3.47% is CAGR(compound annual growth rate) of tariff increase after 2003.

[4] Multilateral development agencies' condition (LIBOR 6 month plus 0.4%) is assumed to be converted to the fixed interest rate.

	Assumption in the model	Notes
Commitment fee	0.15% to undisbursed amount	Multilateral development agencies
Depreciation		
Depreciation	20 years	
Remaining value	0%	
Depreciation method	Fixed amount	
Tax and duties		
Corporate tax	25%	

Source: JICA study team

1) Increase in O&M costs

At this stage, O&M costs could not be divided into the foreign currency and local currency precisely. Therefore, 50:50 expenditure was assumed for the foreign and local currencies, respectively. For the foreign currency, US CPI for the past 10 year seems to be relatively stable, so its past 10 year average was used in the model. (2.45%/year)

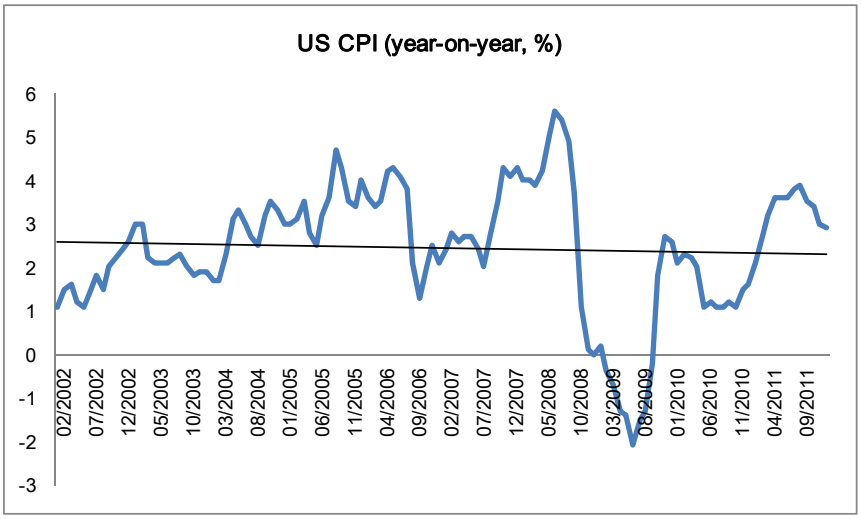


Figure 7.2.1-1 US CPI

Source: The Study Team based on the data from Bloomberg

For the local currency, the volatility of CPI is extremely high and the 10 year average for Indonesian CPI is 7.95%, while the great efforts by Indonesian government are made recently to keep the inflation low and its 1 year average is as low as 4.82%. The operation duration is 30 years and not easy to predict whether the inflation will be controlled as low as the current level. In order to make the conservative estimate, the 5 year average of 6.37% was used for the assumption.

Figure 7.2.1-2 Indonesia CPI

Source: The Study Team based on the data from Bloomberg

Based on the above, the weighted average of these two CPIs was used for O&M cost in crease during the operation.

Table 7.2.1-2 CPI used

Currency	Weight	CPI
US$	50%	2.45%
IDR	50%	6.37%
Weighted average		4.41%

S ource: JICA study team

2) Increase in fuel cost

The future coal price is not certain and it is di fficult to forecast its fluctuation. Therefore, the model incorporated the conservative assu mption to increase the fuel price at the rate of 5% annually. This increase rate is based on the a pproximate growth rate after 2008 in which ICI-4 was first published.

3) Increase in the tariff

In order to reduce the fiscal burden for the g overnment, the governm ent is making the great efforts to increase electricity tariff, but this process is politically sen sitive and challenging. Therefore, as the model's assumption, the historical record was used. The average tariff has been increasing for the last 10 years as the graph shows. Therefore, the compound average growth rate ("CAGR" hereinafter) was calculated based on th ose data. The calculated CAGR since 2001 is approximately 8.5%. However, as reported in t he media, it is challenging to achieve such a high tariff increase. Therefore, by taking both of th e government's efforts to increase the tariff and its difficulty in the short term into account, 5% tariff increase per year was assumed after 2017.

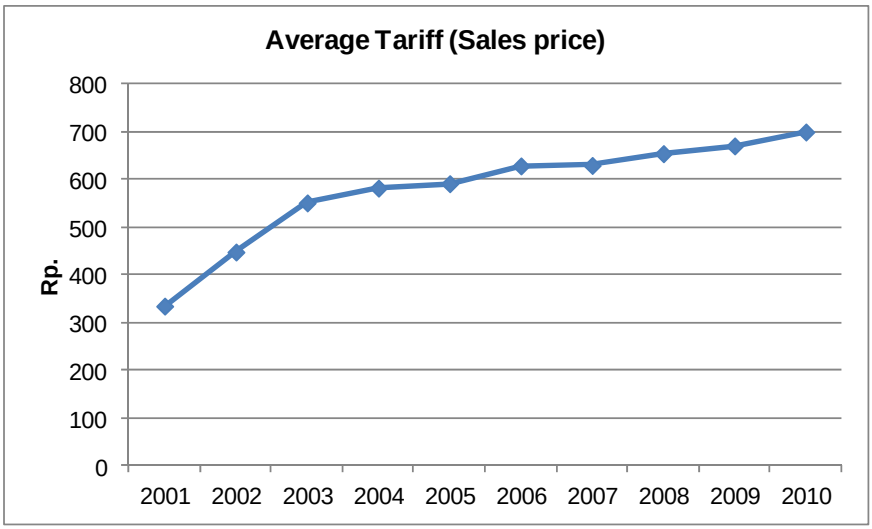


Figure 7.2.1-3 Electricity Sales Price

Source: The Study Team based on the data from PLN statistics 2009, 2010

(2) Estimation results

Often, the hurdle rate for the project is the weighted average cost of capital (WACC). For example, PLN's WACC in 2011 is 8.34%[5]. However, LIBOR was quite low throughout 2011, the debt cost may increase in the future. Therefore, 12% was set as the hurdle rate. This 12% is based on the round number of the sum of PLN's debt cost and the inflation rate in Indonesia and PLN refers to this figure upon its investment decision.

Based on the assumption in (1), financial IRRs were estimated. The results are: both of Case 1 and Case 2 exceeded the hurdle rate. NPV is calculated using the hurdle rate of 12% as the discount rate, so it is positive for both Cases. Debt Service Coverage Ratios (DSCR) were also estimated and their minimum exceeded 1.0.

Table 7.2.1-3 Results of Financial Analysis: Base case

	(i) Case 1 Unit 1 + Common facilities	(ii) Case 2 Unit 1 & 2 + Common facilities
Financial IRR	12.55%	13.84%
NPV (US$ million)	93.73	570.46
DSCR (minimum)	1.52	1.72

Source: JICA study team

(3) Sensitivity analysis

The financial viability in the base case was confirmed in (2), but the possibilities cannot be denied that the variables deviate from the assumption. Therefore, the sensitivity analysis was conducted to assess the risks surrounding the project and changes in the financial indicators due

[5] Hearing from PLN

to the changes in the variable's assumption. NPV was calculated using the hurdle rate discussed in (2).

1) Tariff

In the base case, the tariff at 2012 level is expected to be increased at the conservative rate of 3.47% until 2017. Therefore, in this scenario, the tariff was assumed to remain the same (without the subsidy from the government) at US$0.075/kWh until 2017.

Table 7.2.1-4 Impact of Initial Tariff

Initial Tariff ($/kWh)		Case 1: 1,000MW × 1 units			Case 2: 1,000MW × 2 units		
		FIRR	NPV (US$ mil)	DSCR Min	FIRR	NPV (US$ mil)	DSCR Min
Base	0.089	12.55%	93.73	1.52	13.84%	570.46	1.72
	0.075	8.21%	-555.91	0.93	9.35%	-708.87	1.09

Source: JICA study team

In this scenario, FIRR is far lower than the hurdle rate and NPV is negative. In other words, the project is hard to be financially viable for PLN in case that the tariff remains at US$0.075/kWh.

2) Tariff increase rate

The government is making the great efforts to increase the tariff in order to reduce the government subsidy. The impact of the tariff increase rate on the project is as follows:

Table 7.2.1-5 Impact of Tariff Increase Rate

Tariff increase rate		Case 1: 1000MW X 1 units			Case 2: 1,000 MW × 2 units		
		FIRR	NPV (US$ mil)	DSCR Min	FIRR	NPV (US$ mil)	DSCR Min
Base	5.00%	12.55%	93.73	1.52	13.84%	570.46	1.72
CACR after 2003	3.47%	5.72%	-639.17	0.93	7.26%	-894.82	1.17
+1%	6.00%	15.31%	682.89	1.73	16.63%	1,748.79	1.95

Source: JICA study team

If the tariff increase rate remains as low as 3.47% (the historical CAGR from 2003 to 2010), FIRR is extremely low and NPV is negative for both of Case 1 and Case 2. The thresholds of tariff increase rate to exceed the hurdle rate are approximately 4.82% and 4.44% for Case 1 and Case 2, respectively. Therefore, it is critical for PLN that the tariff will be increased at least at these threshold rates in order to ensure the project's financial viability.

3) Construction cost

The construction cost discussed in 7.1 includes the price escalation until 2016. In case that the

price escalation components become lower than the present expectation (e.g. 50%), FIRR for both Cases will be higher. On the other hand, if the total project cost is increased, FIRR for Case 1 will be worsened and will be lower than the hurdle rate in case of 10% cost increase. However, FIRR for Case 2 can still exceed 12% even if the total project cost is increased by 10%. FIRR for Case 2 will be lower than the hurdle rate when the total project cost is increased by 24.5% approximately.

Table 7.2.1-6 Impact of Change in Construction Cost (Case 1)

Construction cost (mil US$)	Case 1: 1,000 MW × 1 units		
Total Project cost	FIRR	NPV (US$ mil)	DSCR Min
1,911.0 (Base case)	12.55%	93.73	1.52
1,739.3 (Price escalation ▲100%)	13.37%	215.89	1.65
1,825.2 (Price escalation ▲50%)	12.95%	155.01	1.58
2,006.6 (Total project cost 5% increase)	12.15%	25.57	1.46
2,102.2 (Total project cost 10% increase)	11.77%	-42.03	1.41

Source: JICA study team

Table 7.2.1-7 Impact of Change in Construction Cost (Case 2)

Construction cost (mil US$)	Case 2: 1,000 MW × 2 units		
Total Project cost	FIRR	NPV (US$ mil)	DSCR Min
3,384.4 (Base case)	13.84%	570.46	1.72
3,080.4 (Price escalation ▲100%)	14.72%	785.80	1.86
3,232.4 (Price escalation ▲50%)	14.26%	678.14	1.79
3,553.6 (Total project cost 5% increase)	13.40%	450.68	1.65
3,722.8 (Total project cost 10% increase)	13.00%	330.92	1.59

Source: JICA study team

4) Fuel cost increase rate

In the base case, fuel cost is assumed to be increased by 5% based on the historical record after 2008. However, the commodity price such as the coal tends to be highly volatile. Therefore, the simulation was run in case of fuel cost's increase at 6% (1% higher) and 4% (1% lower).

Table 7.2.1-8 Impact of Fuel Cost Increase Rate

Fuel cost increase rate		Case 1: 1000MW × 1 units			Case 2: 1,000 MW × 2 units		
		FIRR	NPV (US$ mil)	DSCR Min	FIRR	NPV (US$ mil)	DSCR Min
Base	5.00%	12.55%	93.73	1.52	13.84%	570.46	1.72
-1%	4.00%	13.62%	299.65	1.56	14.89%	982.29	1.76
1%	6.00%	11.02%	-144.38	1.48	12.35%	94.23	1.67

Source: JICA study team

In the base case, the fuel cost increase and tariff increase are the same rate. On the other hand, if the fuel cost increase is higher than the tariff increase rate by 1%, FIRR for Case 1 is lower than the hurdle rate. For Case 2, FIRR still exceeds the hurdle rate. FIRR for Case 2 will be lower than the hurdle rate if the fuel cost increase is higher than the tariff increase rate by more than 1.19% approximately. On the other hand, the fuel cost increase is lower than the tariff increase rate, FIRR will improve.

(4) Tariff required for the capital cost recovery

For the reference purpose, the tariff required to recover the capital cost of the power plant (excluding the cost for transmission line), interest during construction and tax was estimated roughly, while ensuring the financial IRR of 10% and 12%. For this estimation, 2 unit construction was assumed.

The assumptions remain the same as Table 7.2.1-1 in principle. However, for the purpose of this estimation only, the following assumptions were made. Firstly, the plant capacity factor is assumed to be 75%. Further more, while the financing costs in the financial analysis in (2) and (3) above are based on the current conditions, the current interest rate level is extremely low compared with the historical record after 2008. Therefore, the following interest rates for Concessional and Commercial borrowings were assumed respectively in this estimation considering the normal financial environment based on PLN's request. It is hard to precisely estimate the interest rate in the "normal" financial environment. Thus, the historical benchmark rate was obtained and the simple adjustment was made as below:

Table 7.2.1-9 Assumption for interest rates

(i) Commercial borrowing (Repayment period: 14yrs including 4yr grace period)		
(a)	PLN's spread to USD swap rate[6]	3.13%
(b)	14 year USD swap rate (past 10 year average)	4.43%
(c)	***(a) + (b) : Interest rate used in estimation***	***7.56%***
(ii) Concessional borrowing (Repayment period: 25yrs including 6yr grace period)		
(a)	Interest rate in Table 7.2.1-1	4.03%
(b)	USD 6 month LIBOR applied in (a)	0.74%
(c)	USD 6 month LIBOR (past 10 year average)	2.38%
(d)	Difference between (b) and (c)	1.64%
(e)	***(a)+ (d) : Interest rate used in estimation***	***5.67%***

Based on the assumptions above, the tariffs required for the capital cost recovery were estimated for 10% and 12% of the financial IRR and the results are as follows:

[6] Data from Bloomberg on 26 June 2012

Table 7.2.1-10 The tariff required to recover the capital cost (except the transmission lines)

Financial IRR	10%	11.19%	12%
(i) Commercial borrowing	Cash shortage	5.37 cents	5.82 cents
(ii) Concessional borrowing	4.60 cents	5.15 cents	5.55 cents

The difference in the tariff between (i) Commercial borrowing and (ii) Concessional borrowing looks small in 12% of FIRR at glance. However, in "Commercial borrowing", the tariff below 5.37 cents is not sufficient to cover the principal repayment and interest payment, while 4.60 cents can cover these payments in "Concessional borrowing" in 10% of FIRR.

(5) Conclusion

FIRR for Case 1's base case will be higher than the hurdle rate if 12% which PLN uses as the investment decision criteria is the hurdle rate. FIRR for Case 2 in the base case is higher than Case 1 by more than 1% and it is easier to ensure the profitability. However, as examined in the sensitivity analysis, the tariff revenue increase in the same rate as the fuel cost increase is the premise in order to ensure this profitability for Case 1. (This is the same structure as the existing Indonesian government's policy. Under the current Indonesian law, the government provides the subsidies to PLN for the difference between PLN's supply cost plus margin and the revenue collected from end users. Therefore, the fuel increase will be covered by the electricity sale revenue actually.)

The fluctuation of the total project cost also affects the profitability of Model Power Plant. For example, if the total project cost exceeds the base case's assumption by 10%, FIRR for Case 1 will be lower than the hurdle rate, but FIRR for Case 2 can exceed the hurdle rate. In this way, 2 unit construction (Case 2) will be easier to ensure the profitability than 1 unit construction (Case 1), even if there are changes in the assumptions.

7.2.2 Economic Analysis

In this section, the impact of the Model Power Plant under consideration is examined using the cost-benefit analysis. Its limitation is that coverage of the analysis is limited to qualitative impacts to the possible extent. The impact on environment was incorporated as far as possible, but non-qualitative impacts on environment and surrounding society were examined in Chapter 5, alternatively. The data is based on the value used in the financial analysis, but the adjustment was made where necessary.

(1) Assumptions

In order to estimate the impact of the Model Power Plant, the cost benefit analysis was

conducted and Economic Internal Rate of Return (Economic IRR) and Net Present Value (NPV) were estimated. For this purpose, the benefits and costs of this project need to be identified. Since the purpose of the economic analysis is to evaluate the impacts in the economy, the non-monetary cost/benefit items, which do not accompany the tangible cash flow but are mobilized as resources for the project, are included in the analysis (e.g. the land in this project). Also, economic distortions such as taxes and subsidies are excluded, since they are transfers within the economy. Financing flows are also excluded, since they are not real resource transfer. Based on the same principles, the prices of the items are adjusted as discussed below.

The items are divided into tradable goods and non-tradable goods. It is hard to obtain the information for these components precisely at this stage, so the rough assumption was made by items. Based on this category, the value of non-tradable goods was adjusted considering the shadow exchange rate using the conversion factor (the reciprocal of 1.108 [7]). All costs and benefits are expressed in 2011 price level unless they are expressed otherwise. The exchange rate between USD and IDR is assumed to be Rp 9,290/ USD, which is 10 year average of USD-IDR exchange rate. The model was run for the two cases of (i) Case 1: Construction of 1 unit only (including the common facilities) and (ii) Case 2: Construction of 2 units at once (including the common facilities). (In the following discussion, (i) and (ii) correspond to these cases.)

1) Costs

As for the cost, the following adjustment was made.

(a) Project cost and cost related to the operation

Following the principle of cost-benefit analysis, the financial cost described in 7.2.1 is converted to economic cost.

- Non-tradable goods are adjusted using the conversion factor.
- Price escalation is excluded. Therefore, the project allowance in the financial cost is adjusted accordingly.
- The land is owned by PLN and the project does not need to bear the land cost. However, from the perspective of the society, the land is used as the resource; therefore, it is included in the model. The neighboring area's price from NJOP (Nilai Jual Objek Pajak) is used as proxy and the land cost is assumed as follows:

USD 3.73 million ≒ Rp. 20,000 × 1,733,000 m^2

[7] Source: Project Appraisal Document for Geothermal Clean Energy Investment Project, World Bank 2011

(i) Case 1: 1 unit with the common facilities (all in million US$)

Table 7.2.2-1 Conversion from financial cost to economic cost: Case 1

Cost	Financial Cost	Conversion Factor	Economic Cost
Initial capital investment (Tradable)	1,427.42	1.000	1,427.42
Initial capital investment (Non-tradable)	251.90	0.903	227.34
Initial Capital investment (Transmission Line (T/L), tradable)	51.00	1.000	51.00
Initial Capital investment (T/L, non-tradable)	9.00	0.903	8.12
Land purchase (Non-tradable)	3.73	0.903	3.37
Annual O&M cost for plant(Tradable)	23.23	1.000	23.23
Annual O&M cost for plant (Non-tradable)	23.23	0.903	20.97
Annual O&M cost for T/L (Non-tradable)	1.10	0.903	0.99
Annual Fuel Cost (Tradable)	200.36	1.000	200.36

Source: JICA study team

(ii) Case 2: 2 units with the common facilities (all in million US$)

Table 7.2.2-2 Conversion from financial cost to economic cost: Case 2

Cost	Financial Cost	Conversion Factor	Economic Cost
Initial capital investment (Tradable)	2,567.41	1.000	2,567.41
Initial capital investment (Non-tradable)	453.07	0.903	408.91
Initial Capital investment (T/L, tradable)	51.00	1.000	51.00
Initial Capital investment (T/L, non-tradable)	9.00	0.903	8.12
Land purchase (Non-tradable)	3.73	0.903	3.37
Annual O&M cost for plant(Tradable)	41.84	1.000	41.84
Annual O&M cost for plant (Non-tradable)	41.84	0.903	37.76
Annual O&M cost for T/L (Non-tradable)	1.10	0.903	0.99
Annual Fuel Cost (Tradable)	400.72	1.000	400.72

Source: JICA study team

(b) Local externality

The model power plant under consideration emits less pollutant (i.e. SO_2, NOx, Total Suspended Particulate) compared with sub-critical power plants commonly used in Indonesia at present, since it will consume less coal to produce the same output. Yet, the pollutant is still emitted to the certain extent; therefore, the analysis incorporated the impact from this emission. BATAN's study and the World Bank appraisal document estimated the local external cost of coal-fired plants stemming from emission of SO_2, NOx and TSP emission. This estimation is for the power plants using the sub-critical boilers in Sularaya. Depending on the design coal used and location, there are differences for the pollutant's emission quantity and external costs. However, due to difficulty to obtain those details, this external cost is used as proxy, since it can be the rough indication to show the impact in monetary term. The external cost was estimated in the range in the studies mentioned above,

so the most conservative data was applied in this economic analysis (0.00646 US$/kWh in 2,000 US$). This cost is adjusted to 2010 price level[8]. As the result, 0.00812 US$/kWh was used for the analysis.

$C_{Local} = Q_i \times P_i$

Where

C_{Local} : Local external cost

Q_i : The generated electricity

P_i : 0.00812 US$/kWh

(i) Case 1 (1 unit with the common facilities): US$56.9 million /year

(ii) Case 2 (2 units with the common facilities): US$113.8 million/year

(c) Global externality

Like the pollutant discussed in (b) above, the model power plant produces less CO_2 compared with conventional power plants in Indonesia during the operation, but still the model plant emits CO_2 (5,652,000 tons-CO_2 equivalent/unit). This emission is estimated as follows:

$E\ CO_2$ (ton/year) = $Ac \times (Cw/100) \times CO_2/C$

Where:

$E\ CO_2$: Annual CO2 Emission (ton/year)

Ac : Annual Coal Consumption (ton/year)

Cw : Carbon weight in coal as received 40.92% (From the design coal's characteristic)

CO_2/C : Exchange factor of Carbon to CO_2 44/12

$\therefore$ Annual CO_2 Emission 5, 652,000(t/year) $\cong$ 3,767,000 $\times$ 0.4092 $\times$ (44/12)

This CO_2 emission is incorporated as the external cost in the model. The unit cost is assumed to be US$5.80[9].

$C_{Global} = Q_i \times P_i$

Where

[8] Neither the 2011's inflation nor GDP deflator by WB, which are used in WB study, are available yet. Therefore, the data was adjusted to 2010 price level where the latest data was available.

[9] The average of EU ETS CER spot price over the past three months, 3 Euros, is converted to US$ as of the exchange rate on 30th March 2012.

C_{Global} : Global external cost
Q_i : CO_2 emission from the project
P_i : US$5.80 ton/$CO_2$-equivalent

The external cost from CO_2 emission is estimated as follows:

(i) Case 1 (1 unit with the common facilities): US$32.8 million/year
(ii) Case 2 (2 units with the common facilities): US$65.6million/year

2) Benefits

In the cost-benefit analysis, benefits are divided into incremental and non-incremental benefits. In this model power plant project, incremental benefits are to meet the demand to catch up with future increase of electricity consumption. On the other hand, non-incremental benefits are to replace the existing electricity supply to cover the shortage of electricity supply from PLN with electricity supply from this project. When the electricity supply from PLN is in shortage, the commercial/industrial sectors often cover this shortage by own generators using diesel fuel. The generation cost using diesel fuel is much more expensive than the electricity supply from PLN as shown in Table 7.2.2-3. If the supply from PLN increases, companies will replace own power generation using diesel fuel with the purchase from PLN; therefore, this shift can be incorporated in the cost benefit analysis. The concept of incremental and non-incremental benefits is illustrated in Figure 7.2.2-1.

Table 7.2.2-3 Generation Cost (Rp./kWh)

Source	Generation cost
Diesel	4,315.43
Average including all sources	795.59

Source: PLN statistics 2010

Therefore, the benefits which can be incorporated in the cost-benefit analysis are illustrated in the diagram below. The light blue part is for non-incremental benefit, while the gray part is incremental benefit.

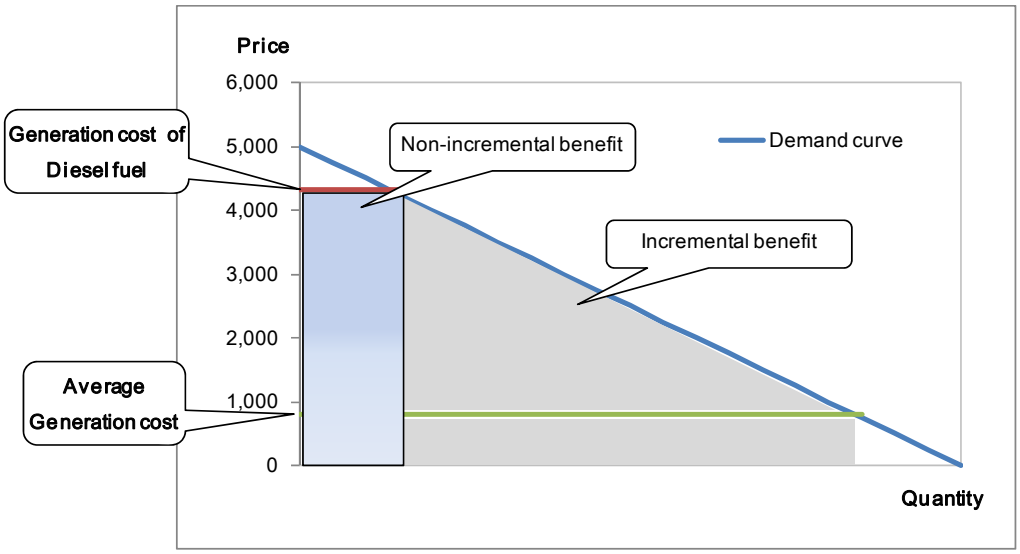


Figure 7.2.2-1 Non-incr emental Benefit and incremental Benefit (Concept Based)

Source: JICA study team

In order to include the non-incremental benefit in the cost-benefit analysis, the statistic to shift from own g enerator use to PLN electricity Supply is neces sary, but it is not available. Accordingly, estimation of the demand curve is also not possible. Therefore, it is not possible to quantify the area surrounded by light blue in Figure 7.2.2-1. Alternatively, the benefit used in the analysis is based on the average generation co st in the countr y (The area surrounded by the dotted line in Figure 7.2.2-2 below). In other words, the benefit in analysis is the conservative estimate to analyze the project impact.

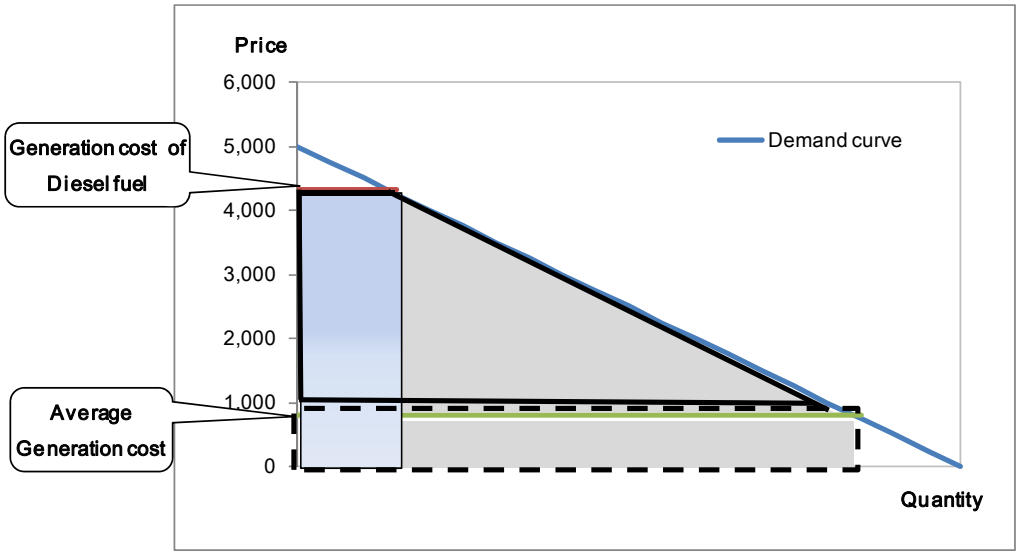


Figure 7.2.2-2 Benefit used in the Analysis

Source: JICA study team

As discussed in the m ain report, the tariff which the consum ers pay is lower than PLN' s generation cost. For example, PLN's generation cost is Rp. 795.59, while the average tariff for

consumers is Rp. 699.09[10] in 2010. The difference between (i) this generation cost in addition to the transmission/distribution cost and PLN's margin and (ii) the tariff for consumers is subsidized by the government. However, the subsidy is excluded in economic analysis, so PLN's cost for power supply is used as the benefit's unit price instead of the tariff which the consumers actually pay. The average supply cost including the transmission and distribution is estimated as 979 Rp./kWh[11]. Furthermore, this PLN's supply cost is adjusted based on the tradable and non-tradable component, using the same conversion factor as the economic cost. Practically, it is difficult to divide tradable and non-tradable components in the cost. Therefore, out of the estimated supply cost, the breakdown of the cost is roughly allocated to tradable and non-tradable component. (Table 7.2.2-4) For maintenance and depreciation (i.e. capital investment), the same ratio used in the model power plant was used to divide the cost. The remaining after deduction of the generation cost from the total supply cost (i.e. transmission/distribution cost) is converted as non-tradable.

Table 7.2.2-4 Conversion from financial Price to economic Price: Tariff

	Financial Price (Rp.)	Conversion Factor	Economic Price (Rp.)	Economic Price (US$)
Fuel (Tradable)	681.84	1.000	681.84	0.0734
Maintenance (Tradable)	21.775	1.000	21.78	0.0023
Maintenance (Non-tradable)	21.775	0.903	19.65	0.0021
Depreciation (Tradable)	48.484	1.000	48.48	0.0052
Depreciation (Non-tradable)	8.556	0.903	7.72	0.0008
Others (Non-tradable)	3.09	0.903	2.79	0.0003
Personnel (Non-tradable)	10.08	0.903	9.10	0.0010
Cost for transmission/distribution (Non-tradable)	183.40	0.903	165.52	0.0178
Total	979.00		956.88	0.1030

Source: JICA study team
(Except cost for transmission/distribution, the breakdown of "Financial Price" is obtained from PLN statistics 2010.)

Based on the data above, the benefits are quantified based on the following formula.

Benefit = $Q_i \times P_i$.....(1)

Q_i: Electricity sold by the project

P_i: Electricity tariff (PLN's supply cost in US$)

Accordingly, the benefits of the project are estimated as follows:

(i) Case 1: 1 unit including the common facilities (Capacity of 1,000 MW)

US$ 664.1 mil ≅ 6,447,360,000 kWh × $ 0.103

[10] Source: PLN statistics 2010

[11] JICA study team's estimate using "PLN investor update 2010 H1" and "PLN statistics 2010"

(ii) Case 2: 2 units including the common facilities (Capacity of 1,000 MW × 2 units)

US$ 1,328.2 mil ≅ 12,894,720,000 kWh × $ 0.103

(2) Result summary and sensitivity analysis

1) Base case

Based on the assumptions above, the economic IRR and NPV were estimated using the net benefit and the results are summarized in Table below. 10-12% is typically used by development agencies as the minimum hurdle rates for economic IRR. Considering 12% as the hurdle rate, the results exceed the hurdle rate even with the cost with local and global externalities. At the same time, NPV are all positive. That means, the project offers net positive impact to the country.

Table 7.2.2-5 Result of Economic Analysis: Base Case

Cost used in estimation	Case 1 1 unit with common facilities		Case 2 2 units with common facilities	
	Economic IRR (%)	NPV (mil US$)	Economic IRR (%)	NPV (mil US$)
Cost without externalities	18.59%	1,343	20.77%	3,066
Cost with local externalities	16.48%	976	18.50%	2,333
Cost with local/global externalities	15.20%	765	17.13%	1,911

NPV: 10% discount rate

Source: JICA study team

2) Sensitivity analysis

In the base case, Economic IRR and NPV were examined based on the most likely scenario. However, there are possibilities that the assumption in costs in real term (i.e. economic cost) may fluctuate in the future and it is not possible to predict precisely. Therefore, tolerance of the project toward the economic cost fluctuation was examined by changing the construction cost and fuel cost, of which portion is high in expenses.

(a) Increase of construction cost (in real term)

Economic IRR and NPV will be affected in case that project cost in real term is increased. When the project cost (plant and transmission line) is increased by 10%, Economic IRR with local/global externalities for both of Case 1 and 2 exceeds the hurdle rate (even with higher hurdle of 12%) and their NPVs are positive.

Table 7.2.2-6 Result of Economic Analysis: Change in Construction Cost (Case 1)

Construction cost	Base case		10% increase	
	Economic IRR (%)	NPV (mil US$)	Economic IRR (%)	NPV (mil US$)
Cost without externalities	18.59%	1,343	17.20%	1,208
Cost with local externalities	16.48%	976	15.20%	841
Cost with local/global externalities	15.20%	765	13.98%	630

Source: JICA study team

Table 7.2.2-7 Result of Economic Analysis: Change in Construction Cost (Case 2)

	Base case		10% increase	
	Economic IRR (%)	NPV (mil US$)	Economic IRR (%)	NPV (mil US$)
Cost without externalities	20.77%	3,066	19.25%	2,828
Cost with local externalities	18.50%	2,333	17.11%	2,094
Cost with local/global externalities	17.13%	1,911	15.81%	1,672

Source: JICA study team

In case that the construction cost is increased by more than 29.1% and 48.8% in Case 1 and Case 2 respectively, Economic IRR with local/global externalities will be less than the hurdle rate of 12%.

(b) Increase of fuel cost (in real term)

Economic IRR and NPV will be affected in case that fuel cost in real term is increased. When the fuel cost (the unit price) is increased by 5%, Economic IRR will be lower, but Economic IRR with local/global externalities still exceed the hurdle rate and NPV is positive for both of Case 1 and Case 2.

Table 7.2.2-8 Result of Economic Analysis: Change in Fuel Cost (Case 1)

	Base case		5% increase	
	Economic IRR (%)	NPV (mil US$)	Economic IRR (%)	NPV (mil US$)
Cost without externalities	18.59%	1,343	18.23%	1,278
Cost with local externalities	16.48%	976	16.09%	912
Cost with local/global externalities	15.20%	765	14.80%	700

Source: JICA study team

Table 7.2.2-9 Result of Economic Analysis: Change in Fuel Cost (Case 2)

	Base case		5% increase	
	Economic IRR (%)	NPV (mil US$)	Economic IRR (%)	NPV (mil US$)
Cost without externalities	20.77%	3,066	20.38%	2,937
Cost with local externalities	18.50%	2,333	18.09%	2,204
Cost with local/global externalities	17.13%	1,911	16.70%	1,782

Source: JICA study team

In case that the fuel cost is increased by more than 37.5% and 55.1% in Case 1 and Case 2 respectively, Economic IRR with local/global externalities will be less than 12%.

3) Conclusion

In financial analysis, FIRR in Case 1 is lower than the one in Case 2 and its profitability is limited. However, its Economic IRR is higher than the hurdle rate and the construction of Model Power Plant is economically rational in terms of the national economy even in Case 1. Furthermore, Case 1 can accommodate fluctuation of construction cost and fuel cost to the certain extent, too. Economic IRR for Case 2 is even higher than Case 1 and the net benefit for the society is higher accordingly.

7.3 Financial Scheme

At present, PLN plans to implement this Model Power Plant by itself. Under this circumstance, the financial source for it needs to be considered. PLN has the capacity to procure the finance from the market such as the commercial banks and issuance of the bonds. For example, PLN procured US$ 2,000 million by issuing the bonds in December 2011 with the tenor of 10 years. Their coupons were 5.5%. However, the finance from development agencies has the advantages, in terms of the lower interest rates and the longer repayment period. Therefore, the large project like this Model Power Plant is preferable for PLN to be financed by development agencies. (For example, a multilateral development bank offers LIBOR+0.4%.)

This Model Power Plant has the room for expansion to the 2nd unit, of which construction will be financially rational by sharing the cost for the common facilities as discussed in 7.2. On the other hand, there is the uncertainty whether PLN will be able to mobilize all necessary capital costs by itself, since the required capital cost is large (for 2 units, the estimated project cost is US$3,384.4 million). To address this constrain, the following approach can be the option: the concessional loans from a development agency is utilized to finance the 1st unit including the common facilities (i.e. the project is implemented by PLN itself) and the 2nd unit is implemented by IPP.

Also, there is another approach for PLN to construct the 2nd unit after several years are passed (after the 1st unit construction). Compared with finding finance for two units at once, this approach will be

easier to find finance in ter ms of PLN' s borrowing capacity. However, the number of l abor and equipment for construction and the overhead cost are disadvantageous in case of thi s phased construction compared with the simultaneous construction for 2 units, so the construction cost per kW tends to be higher in this phased approach. Howeve r, this is not new construction but expansion, so the cost for t he common facilities of 1 st and 2 nd units can be s aved. Also, by applying the same specification for equipment as 1st unit, the project cost for 2nd unit can be reduced.

Appendix

Economic Analysis

Base case for Case 1 (1 unit with the common facilities)

				-4	-3	-2	-1	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
Benefit																																					
Expected sale of electricity				0.0	0.0	0.0	0.0	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1
Total Benefit				0.0	0.0	0.0	0.0	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1	664.1
Cost			**Allocation for loan and capital cost**	15%	40%	30%	5%		10%																												
Initial capital investment				307.3	661.9	496.4	82.7	0.0	165.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Land purchase				3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O&M cost				0.0	0.0	0.0	0.0	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2
Fuel				0.0	0.0	0.0	0.0	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4	200.4
Assumption: 30 years operation																																					
Economic Opportunity Cost of Capital	**10%**	Cost																																			
Cost without Externalities (a)		2,933	mil US$	310.7	661.9	496.4	82.7	245.6	411.0	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6	245.6
Cost with Local Externalities (b)		3,300	mil US$	310.7	661.9	496.4	82.7	302.5	468.0	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5
Cost with Local / Global Externatlities '(c)		3,511	mil US$	310.7	661.9	496.4	82.7	335.3	500.8	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3	335.3
Benefit - Cost		**EIRR**	**NPV**																																		
Cost without Externalities (a)		18.59%	1,343	-310.7	-661.9	-496.4	-82.7	418.6	253.1	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6	418.6
Cost with Local Externalities (b)		16.48%	976	-310.7	-661.9	-496.4	-82.7	361.6	196.2	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6	361.6
Cost with Local / Global Externatlities '(c)		15.20%	765	-310.7	-661.9	-496.4	-82.7	328.8	163.4	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8	328.8

Source: JICA study team

Base case for Case 2 (2 units with the common facilities)

				-4	-3	-2	-1	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
Benefit																																					
Expected sale of electricity				0.0	0.0	0.0	0.0	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2
Total Benefit				0.0	0.0	0.0	0.0	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2	1,328.2
Cost			**Allocation for loan and capital cost**	15%	40%	30%	5%		10%																												
Initial capital investment				505.6	1,190.5	892.9	148.8	0.0	297.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Land purchase				3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O&M cost				0.0	0.0	0.0	0.0	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6	80.6
Fuel				0.0	0.0	0.0	0.0	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7	400.7
Assumption: 30 years operation																																					
Economic Opportunity Cost of Capital	**10%**	Cost																																			
Cost without Externalities (a)		5,486	mil US$	508.9	1,190.5	892.9	148.8	481.3	778.9	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3	481.3
Cost with Local Externalities (b)		6,219	mil US$	508.9	1,190.5	892.9	148.8	595.2	892.8	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2	595.2
Cost with Local / Global Externatlities '(c)		6,642	mil US$	508.9	1,190.5	892.9	148.8	660.8	958.4	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8	660.8
Benefit - Cost		**EIRR**	**NPV**																																		
Cost without Externalities (a)		20.77%	3,066	-508.9	-1,190.5	-892.9	-148.8	846.9	549.3	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9	846.9
Cost with Local Externalities (b)		18.50%	2,333	-508.9	-1,190.5	-892.9	-148.8	733.1	435.4	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1	733.1
Cost with Local / Global Externatlities '(c)		17.13%	1,911	-508.9	-1,190.5	-892.9	-148.8	667.5	369.8	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5	667.5

Source: JICA study team

Financial Analysis

Base case for Case 1 (1 unit with the common facilities)

	-4	-3	-2	-1	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
PL																																		
Revenues																																		
Expected sale of electricity	0.0	0.0	0.0	0.0	699.4	734.4	771.1	809.7	850.2	892.7	937.3	984.2	1,033.4	1,085.1	1,139.3	1,196.3	1,256.1	1,318.9	1,384.8	1,454.1	1,526.8	1,603.1	1,683.3	1,767.4	1,855.8	1,948.6	2,046.0	2,148.3	2,255.8	2,368.5	2,487.0	2,611.3	2,741.9	2,879.0
Total Revenues	0.0	0.0	0.0	0.0	699.4	734.4	771.1	809.7	850.2	892.7	937.3	984.2	1,033.4	1,085.1	1,139.3	1,196.3	1,256.1	1,318.9	1,384.8	1,454.1	1,526.8	1,603.1	1,683.3	1,767.4	1,855.8	1,948.6	2,046.0	2,148.3	2,255.8	2,368.5	2,487.0	2,611.3	2,741.9	2,879.0
Operating Expenses																																		
O&M Expense	0.0	0.0	0.0	0.0	52.3	54.6	57.0	59.5	62.1	64.8	67.7	70.7	73.8	77.1	80.5	84.0	87.7	91.6	95.6	99.8	104.2	108.8	113.6	118.6	123.9	129.3	135.0	141.0	147.2	153.7	160.5	167.5	174.9	182.6
Fuel	0.0	0.0	0.0	0.0	400.7	420.8	441.8	463.9	487.1	511.4	537.0	563.8	592.0	621.6	652.7	685.4	719.6	755.6	793.4	833.1	874.7	918.5	964.4	1,012.6	1,063.2	1,116.4	1,172.2	1,230.8	1,292.4	1,357.0	1,424.8	1,496.1	1,570.9	1,649.4
Depreciation	0.0	0.0	0.0	0.0	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Operating Expenses	0.0	0.0	0.0	0.0	555.2	577.5	601.0	625.6	651.4	678.5	706.9	736.7	768.0	800.9	835.4	871.6	909.5	949.4	991.2	1,035.1	1,081.1	1,129.5	1,180.2	1,233.4	1,187.1	1,245.7	1,307.2	1,371.8	1,439.5	1,510.7	1,585.3	1,663.6	1,745.8	1,832.0
< Income from Operations >	0.0	0.0	0.0	0.0	144.3	156.9	170.2	184.1	198.8	214.2	230.4	247.4	265.3	284.2	303.9	324.7	346.6	369.5	393.6	419.0	445.6	473.6	503.1	534.0	668.7	702.9	738.8	776.5	816.2	857.9	901.7	947.7	996.1	1,046.9
Other revenues	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other expenses	3.4	20.4	47.3	61.4	63.7	67.1	69.9	66.1	62.5	58.7	55.0	51.3	47.5	43.8	40.1	36.3	32.6	28.9	25.1	21.5	17.7	14.0	10.3	6.5	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest expense	0.9	19.1	46.9	61.1	63.4	67.1	69.9	66.1	62.5	58.7	55.0	51.3	47.5	43.8	40.1	36.3	32.6	28.9	25.1	21.5	17.7	14.0	10.3	6.5	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Commitment charge	2.5	1.3	0.4	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Business tax	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Income (Charge)	-3.4	-20.4	-47.3	-61.4	-63.7	-67.1	-69.9	-66.1	-62.5	-58.7	-55.0	-51.3	-47.5	-43.8	-40.1	-36.3	-32.6	-28.9	-25.1	-21.5	-17.7	-14.0	-10.3	-6.5	-2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
< Current Account >	-3.4	-20.4	-47.3	-61.4	80.6	89.8	100.3	118.0	136.3	155.5	175.4	196.1	217.8	240.4	263.8	288.4	314.0	340.6	368.5	397.5	427.9	459.6	492.8	527.5	665.9	702.9	738.8	776.5	816.2	857.9	901.7	947.7	996.1	1,046.9
Income before Tax	-3.4	-20.4	-47.3	-61.4	80.6	89.8	100.3	118.0	136.3	155.5	175.4	196.1	217.8	240.4	263.8	288.4	314.0	340.6	368.5	397.5	427.9	459.6	492.8	527.5	665.9	702.9	738.8	776.5	816.2	857.9	901.7	947.7	996.1	1,046.9
Tax expense	0.0	0.0	0.0	0.0	20.1	22.4	25.1	29.5	34.1	38.9	43.9	49.0	54.5	60.1	66.0	72.1	78.5	85.2	92.1	99.4	107.0	114.9	123.2	131.9	166.5	175.7	184.7	194.1	204.1	214.5	225.4	236.9	249.0	261.7
Net Income	-3.4	-20.4	-47.3	-61.4	60.4	67.3	75.2	88.5	102.2	116.6	131.6	147.1	163.4	180.3	197.9	216.3	235.5	255.5	276.4	298.1	321.0	344.7	369.6	395.6	499.5	527.2	554.1	582.4	612.2	643.4	676.3	710.8	747.1	785.2
CF																																		
Cash flows from Operating Activities																																		
Net cash provided by Operating activities	-3.4	-20.4	-47.3	-61.4	60.4	67.3	75.2	88.5	102.2	116.6	131.6	147.1	163.4	180.3	197.9	216.3	235.5	255.5	276.4	298.1	321.0	344.7	369.6	395.6	499.5	527.2	554.1	582.4	612.2	643.4	676.3	710.8	747.1	785.2
Depreciation	0.0	0.0	0.0	0.0	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	102.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cash flows from Investing Activities																																		
Initial capital investment (excl. IDC)	-345.7	-736.7	-552.5	-92.1	0.0	-184.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Land purchase	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cash flows from Financing Activities																																		
Proceeds from long-term borrowing	78.9	789.9	592.4	112.0	0.0	184.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Payment of long-term borrowing	0.0	0.0	0.0	0.0	0.0	0.0	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	-92.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paid-in capital	286.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dividends paid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net increase in cash and cash equivalents	16.5	32.8	-7.4	-41.4	162.6	169.5	84.9	98.2	111.9	126.3	141.3	156.8	173.1	190.0	207.6	226.0	245.2	265.2	286.1	307.8	330.7	354.4	379.3	405.3	407.0	527.2	554.1	582.4	612.2	643.4	676.3	710.8	747.1	785.2
Cash and cash equivalents at beginning of year	0.0	16.5	49.3	41.9	0.4	163.1	332.6	417.5	515.7	627.7	754.0	895.3	1,052.1	1,225.2	1,415.2	1,622.7	1,848.7	2,093.9	2,359.1	2,645.2	2,953.0	3,283.7	3,638.1	4,017.4	4,422.8	4,829.7	5,356.9	5,911.0	6,493.4	7,105.6	7,749.0	8,425.3	9,136.1	9,883.1
Cash and cash equivalents at end of year	16.5	49.3	41.9	0.4	163.1	332.6	417.5	515.7	627.7	754.0	895.3	1,052.1	1,225.2	1,415.2	1,622.7	1,848.7	2,093.9	2,359.1	2,645.2	2,953.0	3,283.7	3,638.1	4,017.4	4,422.8	4,829.7	5,356.9	5,911.0	6,493.4	7,105.6	7,749.0	8,425.3	9,136.1	9,883.1	10,668.3
Profitability																																		
FIRR	-366	-790	-592	-112	226	52	247	257	267	278	289	301	313	326	340	355	370	387	404	422	441	461	482	504	502	527	554	582	612	643	676	711	747	785
Repayment Capacity																																		
DSCR					nil	nil	1.52	1.62	1.72	1.84	1.96	2.09	2.24	2.39	2.57	2.75	2.96	3.18	3.43	3.70	4.00	4.33	4.69	5.09	5.27	nil	nil	nil	nil	nil	nil	nil	nil	nil

Source: JICA study team

Base case for Case 2 (2 units with the common facilities)

	-4	-3	-2	-1	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
PL																																		
Revenues																																		
Expected sale of electricity	0.0	0.0	0.0	0.0	1,398.9	1,468.8	1,542.3	1,619.4	1,700.3	1,785.4	1,874.6	1,968.4	2,066.8	2,170.1	2,278.6	2,392.6	2,512.2	2,637.8	2,769.7	2,908.2	3,053.6	3,206.2	3,366.6	3,534.9	3,711.6	3,897.2	4,092.1	4,296.7	4,511.5	4,737.1	4,973.9	5,222.6	5,483.8	5,758.0
Total Revenues	0.0	0.0	0.0	0.0	1,398.9	1,468.8	1,542.3	1,619.4	1,700.3	1,785.4	1,874.6	1,968.4	2,066.8	2,170.1	2,278.6	2,392.6	2,512.2	2,637.8	2,769.7	2,908.2	3,053.6	3,206.2	3,366.6	3,534.9	3,711.6	3,897.2	4,092.1	4,296.7	4,511.5	4,737.1	4,973.9	5,222.6	5,483.8	5,758.0
Operating Expenses																																		
O&M Expense	0.0	0.0	0.0	0.0	93.2	97.3	101.6	106.1	110.7	115.6	120.7	126.0	131.6	137.4	143.5	149.8	156.4	163.3	170.5	178.0	185.9	194.0	202.6	211.5	220.9	230.6	240.8	251.4	262.5	274.0	286.1	298.7	311.9	325.7
Fuel	0.0	0.0	0.0	0.0	801.4	841.5	883.6	927.8	974.1	1,022.9	1,074.0	1,127.7	1,184.1	1,243.3	1,305.5	1,370.7	1,439.3	1,511.2	1,586.8	1,666.1	1,749.4	1,836.9	1,928.7	2,025.2	2,126.4	2,232.8	2,344.4	2,461.6	2,584.7	2,713.9	2,849.6	2,992.1	3,141.7	3,298.8
Depreciation	0.0	0.0	0.0	0.0	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Operating Expenses	0.0	0.0	0.0	0.0	1,075.5	1,119.6	1,166.0	1,214.7	1,265.7	1,319.3	1,375.6	1,434.6	1,496.5	1,561.5	1,629.8	1,701.4	1,776.5	1,855.4	1,938.1	2,025.0	2,116.1	2,211.8	2,312.2	2,417.6	2,347.3	2,463.4	2,585.2	2,713.0	2,847.2	2,988.0	3,135.8	3,290.9	3,453.6	3,624.5
< Income from Operations >	0.0	0.0	0.0	0.0	323.4	349.2	376.3	404.7	434.6	466.0	499.1	533.8	570.2	608.6	648.9	691.2	735.7	782.4	831.6	883.2	937.4	994.5	1,054.4	1,117.3	1,364.3	1,433.8	1,506.9	1,583.7	1,664.3	1,749.1	1,838.2	1,931.8	2,030.1	2,133.5
Other revenues	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other expenses	5.7	34.8	83.2	108.4	112.5	115.3	123.7	117.1	110.5	103.9	97.3	90.7	84.1	77.5	70.9	64.3	57.7	51.1	44.5	37.9	31.3	24.7	18.1	11.5	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest expense	1.2	32.4	82.4	107.9	112.0	115.3	123.7	117.1	110.5	103.9	97.3	90.7	84.1	77.5	70.9	64.3	57.7	51.1	44.5	37.9	31.3	24.7	18.1	11.5	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Commitment charge	4.5	2.4	0.8	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Business tax	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Income (Charge)	-5.7	-34.8	-83.2	-108.4	-112.5	-115.3	-123.7	-117.1	-110.5	-103.9	-97.3	-90.7	-84.1	-77.5	-70.9	-64.3	-57.7	-51.1	-44.5	-37.9	-31.3	-24.7	-18.1	-11.5	-4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
< Current Account >	-5.7	-34.8	-83.2	-108.4	210.9	233.9	252.6	287.6	324.1	362.1	401.8	443.1	486.1	531.1	578.0	626.9	678.0	731.3	787.1	845.3	906.1	969.8	1,036.3	1,105.8	1,359.4	1,433.8	1,506.9	1,583.7	1,664.3	1,749.1	1,838.2	1,931.8	2,030.1	2,133.5
Income before Tax	-5.7	-34.8	-83.2	-108.4	210.9	233.9	252.6	287.6	324.1	362.1	401.8	443.1	486.1	531.1	578.0	626.9	678.0	731.3	787.1	845.3	906.1	969.8	1,036.3	1,105.8	1,359.4	1,433.8	1,506.9	1,583.7	1,664.3	1,749.1	1,838.2	1,931.8	2,030.1	2,133.5
Tax expense	0.0	0.0	0.0	0.0	52.7	58.5	63.1	71.9	81.0	90.5	100.4	110.8	121.5	132.8	144.5	156.7	169.5	182.8	196.8	211.3	226.5	242.4	259.1	276.5	339.9	358.5	376.7	395.9	416.1	437.3	459.5	482.9	507.5	533.4
Net Income	-5.7	-34.8	-83.2	-108.4	158.2	175.4	189.4	215.7	243.1	271.6	301.3	332.3	364.6	398.3	433.5	470.2	508.5	548.5	590.3	634.0	679.6	727.3	777.2	829.4	1,019.6	1,075.4	1,130.2	1,187.8	1,248.3	1,311.8	1,378.6	1,448.8	1,522.6	1,600.1
CF																																		
Cash flows from Operating Activities																																		
Net cash provided by Operating activities	-5.7	-34.8	-83.2	-108.4	158.2	175.4	189.4	215.7	243.1	271.6	301.3	332.3	364.6	398.3	433.5	470.2	508.5	548.5	590.3	634.0	679.6	727.3	777.2	829.4	1,019.6	1,075.4	1,130.2	1,187.8	1,248.3	1,311.8	1,378.6	1,448.8	1,522.6	1,600.1
Depreciation	0.0	0.0	0.0	0.0	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	180.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cash flows from Investing Activities																																		
Initial capital investment (excl. IDC)	-566.6	-1,326.0	-994.5	-165.7	0.0	-331.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Land purchase	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cash flows from Financing Activities																																		
Proceeds from long-term borrowing	93.9	1,419.0	1,064.2	200.6	0.0	331.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Payment of long-term borrowing	0.0	0.0	0.0	0.0	0.0	0.0	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	-163.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paid-in capital	507.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dividends paid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net increase in cash and cash equivalents	29.2	58.2	-13.4	-73.5	339.0	356.2	206.6	232.9	260.3	288.8	318.5	349.5	381.8	415.5	450.7	487.4	525.7	565.7	607.5	651.2	696.8	744.5	794.4	846.6	855.9	1,075.4	1,130.2	1,187.8	1,248.3	1,311.8	1,378.6	1,448.8	1,522.6	1,600.1
Cash and cash equivalents at beginning of year	0.0	29.2	87.4	73.9	0.4	339.4	695.7	902.3	1,135.2	1,395.5	1,684.3	2,002.8	2,352.3	2,734.1	3,149.6	3,600.3	4,087.7	4,613.3	5,179.0	5,786.5	6,437.7	7,134.5	7,879.0	8,673.4	9,520.0	10,375.9	11,451.3	12,581.5	13,769.2	15,017.5	16,329.3	17,708.0	19,156.8	20,679.4
Cash and cash equivalents at end of year	29.2	87.4	73.9	0.4	339.4	695.7	902.3	1,135.2	1,395.5	1,684.3	2,002.8	2,352.3	2,734.1	3,149.6	3,600.3	4,087.7	4,613.3	5,179.0	5,786.5	6,437.7	7,134.5	7,879.0	8,673.4	9,520.0	10,375.9	11,451.3	12,581.5	13,769.2	15,017.5	16,329.3	17,708.0	19,156.8	20,679.4	22,279.5
Profitability																																		
FIRR	-602	-1,419	-1,064	-201	451	140	494	514	534	556	579	604	630	657	685	715	747	780	816	853	892	933	976	1,022	1,024	1,075	1,130	1,188	1,248	1,312	1,379	1,449	1,523	1,600
Repayment Capacity																																		
DSCR					nil	nil	1.72	1.83	1.95	2.08	2.22	2.37	2.54	2.72	2.92	3.14	3.37	3.63	3.92	4.23	4.57	4.95	5.37	5.83	6.08	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil

Source: JICA study team