

Environmental Assessment Report

Initial Environmental Evaluation
Project Number: 39928
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INO: South Sumatera to West Java Phase 2 Gas Transmission Project

Prepared by PT.Perusahaan Gas Negara Tbk for the Asian Development Bank (ADB).

The Initial Environmental Evaluation is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

CURRENCY EQUIVALENTS

(as of 1 June 2006)

Currency Unit	-	rupiah (Rp)
Rp1.00	=	\$0.000107
\$1.00	=	Rp9,310

ABBREVIATIONS

ADB	-	Asian Development Bank
AMDAL	-	Analisis Mengenai Dampak Lingkungan (Environmental Impact Assessment)
API	-	American Petroleum Institute
ASME	-	American Standard for Mechanical Engineering
ASTM	-	American Society for Testing Material
BAPPEDAL	-	Badan Pengendalian Dampak Lingkungan (Environmental Impact Assessment Agency)
BOD	-	Biochemical Oxygen Demand
CNG	-	Compressed Natural Gas
COD	-	Chemical Oxygen Demand
CO	-	Carbon Monoxide
CO ₂	-	Carbon Dioxide
DO	-	Dissolved Oxygen
DNV	-	Det Norske Veritas
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Monitoring and Management Plan
ESD	-	Emergency Shutdown System
HC	-	Hydro Carbon
HDD	-	Horizontal Directional Drilling
H ₂ S	-	Hydrogen Sulfide
HSD	-	High Speed Diesel
IEE	-	Initial Environmental Evaluation
IP	-	Intersection Point
KP	-	Kilometer Point
LNG	-	Liquefied Natural Gas
MOE	-	Ministry of Environment
NGO	-	Non Government Organization
NO _x	-	Nitrogen Oxides
PGN	-	PT Perusahaan Gas Negara (Persero) Tbk
PKBL	-	Program Kemitraan dan Bina Lingkungan
PERTAMINA	-	Perusahaan Pertambangan, Minyak dan Gas Bumi Nasional
ROW	-	Right of Way
RTUs	-	Remote Terminal Units
SCADA	-	Supervisory Control and Data Acquisition
SNI	-	Standar Nasional Indonesia
SO ₂	-	Sulfur Dioxide
SOP	-	Standard Operation Procedure
SSWJ	-	South Sumatera West Java
TB	-	Thrust Boring
TDS	-	Total Dissolved Solids
TSS	-	Total Suspended Solids

WEIGHTS AND MEASURES

°C	-	degree Celsius
dBA	-	decibel acoustic
ha	-	hectare
J	-	joules, measure of energy
km	-	kilometer
m	-	meter
m ³	-	cubic meter
mg/l	-	milligram/liter
mmscfd	-	million standard cubic feet per day
NTU	-	Nephelometric Turbidity Units
tcf	-	trillion cubic feet
TJ	-	tetra joules, one thousand billion joules
µg/m ³	-	microgram per cubic meter

GLOSSARY

Ambient	-	Referring to existing or predominate conditions
Biochemical oxygen demand (BOD)	-	The amount of dissolved oxygen needed to decompose the organic matter in wastewater
Biodiversity	-	Refers to the number of different species and the associated number of individuals living within a community
Chemical oxygen demand (COD)	-	The amount of dissolved oxygen needed to oxidize organic matter in wastewater, under acidic conditions
Greenhouse gas	-	Any gas that contributes to the "greenhouse effect", which is implicated in global warming
Habitat	-	The place inhabited by a plant or animal species
Hazardous waste	-	Any industrial by-product, especially from the manufacture of chemicals, which is destructive to the environment or dangerous to the health of people or animals
Horizontal directional drilling	-	A technique by which pipelines can be installed beneath an area, without the need for surface disturbance; used to install pipes under rivers, roads, and sensitive environmental areas
Hydrotest	-	A test to ensure pipeline integrity. The hydrostatic test consists of pumping water into the pipeline, "pressuring up" the line to specified test pressures, and holding that pressure for a discrete period of time in accordance with applicable regulations and guidelines. After completion of the hydrostatic test, the pressure is relieved and the water is removed from the pipeline (de-watering).
Phytoplankton	-	Photosynthetic plankton
Pig	-	Typically a small device that is forcibly moved through a pipe in order to inspect it and/or to remove buildup resulting from biological growth or chemical processes
Plankton	-	Passively drifting or weakly swimming organisms in marine and fresh waters; members of this group range in size from microscopic plants to jellyfishes measuring up to 2 meters across the bell, and included the eggs and larval stages of the nekton and benthos

- Salinity – The total amount of dissolved material (salt) in seawater
- Zooplankton – The animal forms of plankton

NOTE

- (i) In this report, “\$” refers to the US Dollar

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I. INTRODUCTION

1. The proposed South Sumatera – West Java Gas Transmission Project (the Project) is one of two gas pipelines that PT Perusahaan Gas Negara (Persero) Tbk (PGN) has planned to transport natural gas from South Sumatera to West Java. The Project will transport gas from the production field of Conoco Phillips in Grissik in South Sumatera Province to Rawa Maju in West Java Province (SSWJ – Phase II) where rising energy demand has resulted in a growth in the market for natural gas. The capacity of the Project is 460 million standard cubic feet per day (mmcsfd). The Project pipeline will run from Grissik to Labuhan Maringgai and continue under the Java Sea to Muara Bekasi in West Java then onto Rawa Maju. The Project pipeline will run in the same corridor from Pagardewa to Labuhan Maringgai with the other gas pipeline (SSWJ-Phase I)¹. The two projects require separate gas pipelines as the gas from the Pagardewa gas field is different in quality from that of the Grissik gas field.

2. In conformance with Indonesia's environmental impact analysis (AMDAL) regulation², the Project needs environmental approval of the Ministry of Environment (MOE) before implementation. In carrying out the environmental assessment, PGN has divided the project pipeline into three sections: section 1-the onshore pipeline from Grissik to Pagardewa in South Sumatera; section 2-the onshore pipeline from Pagardewa to Labuhan Maringgai also in South Sumatera; and section 3-the undersea pipeline from Labuhan Maringgai to the shore at Muara Bekasi in West Java and the onshore pipeline from Muara Bekasi to Rawa Maju (Map 1). Environmental assessment of each section was conducted separately and separately approved by the responsible ministries over the period from 1999 to 2005 (see Table 1).

3. The AMDAL studies in 1999 for Grissik – Pagardewa and Pagardewa – Labuhan Maringgai listed areas designated as degraded forests that would be traversed by the pipeline corridor. However the land compensation data from the land acquisition for the Project, together with the latest available land use map clearly indicate that these areas no longer exist as forests due to changes of land use that have occurred during the 1990s. The land acquisition data shows that less than 40 ha of land used for agriculture remain classified as forest by the Ministry of Forestry. The potential large and significant environmental impacts to wildlife, identified in the AMDALs, no longer exist in those areas because of the loss of their habitats. PGN will monitor the actual environmental impacts of the Project and ensure the mitigation plans from all the AMDAL monitoring and mitigation documents (RKL and RPL) are implemented.

4. PGN has requested financial assistance from the Asian Development Bank (ADB) for implementing the Project. This Initial Environmental Evaluation (IEE) has been prepared based on the AMDALs and updated information collected in 2006 during due diligence by PGN environmental staff together with consultants, in accordance with ADB's environmental safeguard policy,. The IEE consolidates all the findings of the three AMDALs and updates the original assessments based on latest available information on land use and forest along the proposed pipeline corridor. No attempts have been made, in the preparation of the IEE, to update the AMDAL data on water and air quality. The reason is AMDAL water and air quality data would provide conservative benchmarks for evaluating environmental impacts of the Project.

¹ The pipeline under SSWJ-Phase I will run from Pagardewa to Labuhan Maringgai and continue onto Cilegon in West Java.

² Decree of the Minister for the Environment no. 17 of the year 2001.

Table 1: Chronology of Project AMDAL

Year	Event	Clearance	Support Document	Remarks
Pagardewa-Labuhan Marringgai				
1999	AMDAL was completed.	By the Ministry of Mining and Energy	Approval Letter : No.2623/31/SJN.T/1999, 9 August 1999 Approval letter: MOE No. B-6429/Dep.IV.4/LH/12/2003; 4 December 2002	The 1999 approval letter was confirmed in the 2002 MOE approval letter as "still applicable"
Grissik-Pagardewa				
1999	AMDAL was completed.	By the Ministry of Mining and Energy	Approval Letter: No. 2594/31/SJN.T/1999, 4 August 1999.	The approval expired in 2002 because PGN had not implemented the project.
2005	Review of the previous AMDAL documents and submission of a report confirming the validity of the previous findings.	By the Ministry of Environment	Approval Letter: No. B-384/Dep.IV-4/LH/01/2005, 25 January 2005	The review was needed for renewing the approval. The consultant did not update the information on forests and wildlife.
Labuhan Marringgai-Muara Bekasi-Rawa Maju				
2005	AMDAL was completed.	By the Ministry of Environment	Approval Decree: No. 282 year 2005, 26 August 2005	

II. DESCRIPTION OF THE PROJECT

A. Project Facilities

5. The Project cost is estimated at about \$652.5 million. Table 2 below summarizes major facilities to be constructed under the Project.

Table 2: Summary of Major Project Facilities

Facilities	Particulars
Gas pipeline	
- design capacity	400-700 mmscfd
- design gas pressure	1,150 psi
- operational life	20 years
- total length	661 km
- Grissik to Pagardewa section	196 km, diameter 36 inches, onshore
- Pagardewa to Labuhan Maringgai section	270 km, diameter 32 inches, onshore
- Labuhan Maringgai-Muara Bekasi section	161 km, diameter 32 inches, offshore
- Muara Bekasi-Rawa Maju section	34 km, diameter 32 inches, onshore
- pipe material	Steel, covered with internal and external coatings against corrosion, with cathodic corrosion protection
Receiving stations	
- Grissik station	Total site area about 65 m x 85 m
- Pagardewa	Total site area about 110 m x 100 m
Delivery station	
- Rawa Maju	Total site area about 20 m x 13 m
Gas compressor stations	
- Pagardewa	Total site area about 130 mx155 m
- Terbanggi Besar	Total site area about 400 m x 400 m
Instrumentation and control system	
- SCADA system	Control Center will be located at Bojonegara, 10 remote terminal units

6. Each receiving station will have the following facilities: pig launcher/receiver, insulating joint, ultra sonic metering, sump tank, gas filter, regulator device, fire hydrant, and diesel engine generators. The gas compressor station will be equipped with centrifugal gas compressors, gas turbines, gas engine and diesel engine generators, suction scrubbers, after coolers, air instrument, sump tank and pump, fuel gas conditioning unit, metering, and emergency shutdown system.

7. The operations of the pipeline and support facilities will be automatically controlled for safety and operational efficiency. The control system, known as supervisory control and data acquisition (SCADA) system, will be installed at Bojonegara, about 90 km from Jakarta with back up master control in Pagardewa and 10 remote terminal units along the pipeline.

B. Design and Construction

1. Design

8. The design and construction of the pipeline as well as its supporting facilities will strictly adhere to international as well as national standards.³ The pipeline is designed for an operational period of at least 20 years. The pipes will be coated internally and externally for corrosion protection. In addition, cathodic corrosion protection will be installed along the pipeline.

9. The PGN has Standard Operation Procedures (SOP) for construction and maintenance that fully comply with the international and national standards. The SOP requires the following:

- (i) use of class 4 pipes for densely populated areas and locations with wire networks;
- (ii) installation of underground pipes at a minimum depth of 1.5 m below ground surface;
- (iii) formulation of design and engineering plans that cover all aspects of the pipe system, including the location and placement of block valves, pressure observation, purge points (gas venting), pressure points with diagrams and schematics;
- (iv) utilization of the SCADA system to monitor gas flow. This system can automatically detect leaks from pressure drops and will automatically close valves, isolating the leaking section.

2. Construction of the Onshore Sections

10. The onshore pipeline sections in South Sumatera and in West Java will be constructed on relatively flat land with 0 - 3% slope and with elevations ranging from 10 to 38 m above mean sea level. The 466 km section from Grissik to Labuhan Maringgai in Sumatera will traverse plantations, areas designated as forests⁴, farm lands, paddy fields and settlements. The 34 km Project RoW section in West Java is not in productive use as it is within the Right of Way (RoW) for a drainage canal.

11. The pipeline (diameter 36 inches and 32 inches) will be laid in a 25 m wide corridor for both Phase I & II pipelines. Each pipe will be laid at about 9 m from the boundaries of the pipeline corridor right of way. The pipeline corridor will be cleared of vegetation and debris. The pipes will be buried in trenches at least 1.5 m deep below ground surface. The pipe trench will be excavated using mechanical trenchers. The trenches will be about 1.5 m wide and about 2 m deep. Pipe sections will be placed end to end and welded together to form a pipe string. The welded joints will be subjected to radiography to determine leaks. It will then be lowered into the trench and will be hydro-tested for leaks and integrity at the design pressure. The trench will be backfilled with the excavated soil. Except for the top 0.25 m, the excavated soil will be backfilled, leveled, and compacted in layers of 0.2 m to prevent subsidence and stress on the

³ International standards refer to the API – American Petroleum Institute, ASTM – American Society for Testing Material, ASME – American Standard for Mechanical Engineering (ASME B-31.8) and Det Norske Veritas (DNV-OS-F101). National standards refer to SNI (Standar Nasional Indonesia or National Standard of Indonesia) 13-3474-2002 and Decree of the Minister for Mining and Energy of the Republic of Indonesia no. 300.K/38/MPE/1997 on Safety for Natural Gas Transmission Pipeline

⁴ During the survey for land compensation, officers from the Ministry of Forestry identified land used for agriculture as land still owned by Ministry of Forestry. The compensation was paid to that ministry so the designation is still “Forest land”

buried pipe. For the top 0.25 m, the excavated topsoil will be used for backfilling up to a height 0.1 m above the natural ground. The topsoil will not be compacted mechanically. After the pipeline is completed, markers will be placed along the pipeline at 1 km intervals.

12. The pipeline in South Sumatera will cross 21 major rivers; seven between Grissik and Pagardewa and 14 between Pagardewa and Labuhan Maringgai. The Muara Bekasi-Rawa Maju section in West Java will cross three major rivers. The major rivers in South Sumatera upstream and downstream of the pipeline crossings are mainly used for transportation. In West Java, the rivers are mainly used for irrigation.

13. Pipeline construction across small water courses will be done using an open cut method. The open cut method is similar to the trenching method previously described except that embankments will be provided to prevent flooding of the trenches. Flows in all small water courses along the pipeline route are seasonal, thus, the pipeline crossing construction will be done during the dry season. At major river crossing, pipes will be laid using a horizontal directional drilling (HDD). These construction methods will ensure that the pipe laying operation will not have significant impacts on river flows or river ecosystems. At major road crossings, a thrust boring (TB) method will be used to avoid traffic disturbances. For small road crossings, an open cut method will be used.

14. Routine inspection and maintenance of the pipeline during the project operation will be done by foot patrols and the use of vehicles. For annual inspections, helicopters may be used.

3. Construction of the Offshore Section

15. The offshore pipeline will cross the Java Sea and the Jakarta Bay. Generally, the pipe will be laid on the sea bed for water depths greater than 13 m. For water depths less than 13 m, the pipe will be buried. In areas with heavy sea traffic, the pipe will be covered by rock armour to protect the pipeline from ship anchors. For crossing with other undersea facilities, such as fiber optic cables and other undersea pipes, the pipes will be laid on concrete mattress supports.

C. Land Acquisition and Resettlement

16. The Project requires about 1,222.76 ha of land consisting of 1,137.76 ha acquired land in South Sumatera and 85 ha leased land in West Java. As of June 2006, PGN has acquired about 89% of land for the pipeline corridors in Province of South Sumatera and Lampung. PGN expects to complete the land acquisition by August 2006. The Project will affect 4,315 land owners along the 500 km land corridor. The main impact will be due to the loss of income earned from crops and trees on the acquired land. Only 40 structures, including rudimentary farm field shelters and semi-permanent wooden houses, will be physically affected. After the pipeline is laid, cultivation and building construction on the corridor will be prohibited. PGN has prepared a resettlement plan and is currently updating the plan in line with the ADB's guidelines on involuntary resettlement.

D. Project Schedule and Contracts

17. The pipeline design has been completed. For contracting purposes, the pipeline is divided into four segments. The construction will be carried out under 17 contracts including the installation of a gas management system. The stations and other support facilities will be constructed under one contract. Project completion is expected in the first quarter of 2007.

E. Project Management and Operations

18. PGN will be responsible for overall management of the Project, including construction and operations. Project implementation will be under the responsibility of the Director of Development. After project completion, operations of the pipeline system will be under the responsibility of the Director of Operations. About 176 persons will be required for the operations of the gas pipeline system.

III. DESCRIPTION OF THE ENVIRONMENT

A. Physical Environment

1. Climate

19. The areas in South Sumatera and West Java where the pipeline will traverse have tropical climates characterized by fairly uniform temperatures and relative humidity throughout the year. The rainy season begins in October and continues towards the end of April of the following year. May to September is the dry period.

2. Land Use

20. The AMDAL approved in 1999 established that the 466 km pipeline corridor in South Sumatera was to traverse agricultural land, including tree and crop plantations, particularly oil palm and rubber, and paddy fields; degraded forests, rural settlements and roads. The terrain is mostly low lying plains. However, the latest satellite images, from Ministry of Forestry, taken in 2000 recently made available to PGN showed that the fragmented forests cited by the AMDAL no longer exist although some of them may still be designated as forest (see Map 2). It can be inferred that the disappearance of the fragmented forests was due to incessant pressure on land resource in South Sumatera. The information used by AMDALs was based on available information at that time.⁵

21. The 34 km pipeline corridor between Muara Bekasi and Rawa Maju in West Java will pass through land of similar terrain to that of South Sumatera, however the corridor in West Java is not in productive use as it is within the Right of Way (RoW) for a drainage canal.

⁵ The AMDAL used maps published in 1991.

3. Air Quality

22. The AMDAL surveys established baseline data on ambient air quality in West Java. Continuous air sampling over a 10 hour period was carried out at 10 points including settlements and road areas close to the pipeline alignment. The air samples were analyzed for methane and hydrocarbon. The hydrocarbon levels were found to range from 23.2 – 105.2 $\mu\text{g}/\text{m}^3$, which is below the safety threshold of 160 $\mu\text{g}/\text{m}^3$.⁶

23. Similar baseline air quality data were also collected in South Sumatera at 14 points including settlements, paddy fields, and road areas proximate to the pipeline alignment. The hydrocarbon levels were found to range from 11.15 - 28.0 $\mu\text{g}/\text{m}^3$.

4. River Water Quality

24. To establish baseline data on river water quality, water samples were collected from the proposed crossing points of some selected major rivers using automatic continuous samplers. In West Java, the sampling was done at the crossing points of three major rivers and also at three irrigation canals flowing into those rivers. In South Sumatera, the sampling covered all the 21 major rivers including tributaries with a total of 28 points. The samples were analyzed for physical, chemical, and biological parameters. The data summarized in Table 3 clearly indicate that the rivers in West Java are grossly polluted by industrial and domestic wastes. The rivers in South Sumatera are relatively less polluted but the quality meets the provincial water quality standard for raw water supply sources.⁷

Table 3: Summary of Water Quality of Major Rivers Crossed by the Pipeline

Quality Parameter	Value Found	Standards
West Java Rivers		
- pH	5.29 - 6.91	5 – 9
- DO, mg/L	2.16 - 5.68 ⁸	>6
- BOD, mg/L	29.5 - 63.6	<6
- COD, mg/L	52.4 - 164.6	<50
- TDS, mg/L	168 - 416	<1,000
South Sumatera Rivers		
- pH	5 - 6	5-9
- DO, mg/L	4 - 8	>6
- BOD, mg/L	0.2 - 10	<6
- COD, mg/L	7 - 31	<50
-TDS, mg/L	14 - 308	<1,000

5. Sea Water Quality

25. To establish baseline data on sea water quality, seawater samples were taken from 23 points between Labuhan Maringgai and Muara Bekasi and analyzed for their physical, chemical and biological parameters. The results show a slight degree of pollution against the standards for marine life, Decree No. 51/2004, Ministry of Environment. The coastal water around Muara

⁶ For work place based on Government Decree (PP) No. 41/1999.

⁷ Governor of South Sumatera Decree No 13 year 2002

⁸ The DO value appears to be too high considering the high BOD values. The data may be subject to errors.

Bekasi was found to be more polluted than that of Labuhan Maringgai due to higher densities of population, industrial and other economic activities.

B. Biological Environment

1. Forest Ecosystems

a. South Sumatera

26. Forests in Sumatera have long been encroached upon by various development activities. Forest clearing on large scale has been done in several places for agricultural use, particularly for large oil palm and rubber plantations. Consequently, the forest cover in Sumatera has declined to about 30% of the total area with most of the healthy and large forests in North and West Sumatera.⁹ Most of the remaining forests in South Sumatera exist in small and isolated patches scattered in the region. The degradation of forests has exacted a heavy toll on biodiversity in the region.

27. The AMDAL studies in 1999 listed seven areas designated as degraded forests that would be traversed by the pipeline corridor. However the latest available land use map clearly indicates that these areas no longer exist as forests but may remain classified as such. The field surveys for land compensation established that only 39.6 ha of land along the corridor in South Sumatera are designated as forest areas, consisting of 37.8 ha in South Sumatera Province and 1.8 ha in Lampung Province.¹⁰

28. The South Sumatera and Lampung Provinces which the pipeline corridor traverses have four protected areas, two in South Sumatera Province and two in Lampung Province (see Table 4). The locations of these protected areas are also indicated in Map 2. Three of the four protected areas are well outside the survey area of the pipeline corridor. Less than seven km of the corridor passes no closer than one km from Way Kambas National Park located in the coastal area of Lampung Province. The corridor is narrow, unfenced, and far from the national park, so will have no significant impacts on wildlife. As the corridor does not create employment along its length, it will not induce encroachment into the national park.

Table 4: Protected Areas in South Sumatera and Lampung Provinces

Name	IUCN Categorization	Area, ha
South Sumatera Province		
Sembilang Wildlife Reserve	Proposed	380,000
Padang Sugihan Wildlife Reserve	IV	75,000
Lampung Province		
Bukit Barisan Selatan National Park	II	365,000
Way Kambas National Park	II	130,000

Source: www.nature-conservation.or.id/ last updated: 04 March 2005

Note: Category IV: Managed nature reserve/ wildlife sanctuary

Category II: national park

29. A list of wildlife along the pipeline corridor was identified during the AMDAL surveys. At that time the existing degraded forests provided habitats for a number of wildlife species including five protected mammal species and five protected bird species (see Appendix 1). At

⁹ Source: <http://www.nature-conservation.or.id/> Last updated: 04 March 2005

¹⁰ Source: PGN Land Compensation data as of April 2006

this time none of the degraded forest areas exist and therefore, with the loss of their habitats, the wildlife identified in the AMDALs most likely no longer exists in those areas. The Sumatran tigers cited in AMDALs were from anecdotal evidence from local residents. The entire Sumatera Island may have no more than 350 Sumatran tigers remaining in the wild, down from around 1,000 in the 1980s. In 1992, the Indonesian Department of Forest Protection and Nature Conservation (PHPA) estimated that about 400 Sumatran tigers were living in five National Parks and two Game Reserves and another 100 in unprotected areas that would soon be lost to agriculture. The largest population is estimated to be about 110 tigers in Gunung Leuser National Park in West Sumatera.¹¹

b. West Java

30. The forest condition in West Java is worse than that in South Sumatera due to high population densities and land demand largely for farming. Existing forests are small and so degraded that they no longer serve an ecological function. Forests exist around the foot of mountains and are usually protected areas. The onshore pipeline corridor in West Java will not pass through any forests.

2. Marine Ecosystems

31. The coast around Labuhan Maringgai is mostly sandy and abundant with bivalves such as *Katelysia opima*, *Donex cunniatus*, and *Cardium sp.*, and with gastropods. Crabs are found in muddy intertidal areas. The mangrove forests along the coasts of Labuhan Maringgai and Muara Bekasi vary in density and expanse. They have been subjected to considerable stress by human activities. The width of the Labuhan Maringgai coastal area mangrove zones has been reduced and is generally less than 20 m. In Muara Bekasi there is very little left of the mangrove forests as most of the areas are now being used for fishponds.

32. Most of the fish species where the pipeline will pass have economic value. They include *canidae*, *hemirhampidae*, *scomberidae*, *stromatedidae* and *trygonydae*. There are also coral fish in the Kepulauan Seribu Area, which include *Acanthurus sp.*, *Caesio sp.*, *Chaerodon anchorago* and *A. Lorentzi*, and are not classified as rare species.

33. The offshore pipeline alignment has been selected to avoid the coral reefs around the Seribu Islands. However, the sea areas around Labuhan Maringgai and Muara Bekasi have no coral reef or marine mammals of ecological importance.

C. Sociocultural Environment

34. There are 113 villages near the pipeline corridor between Grissik – Labuhan Maringgai in South Sumatera and Muara Bekasi – Rawa Maju in West Java. These villages have populations ranging from 508 to 27,297. Most of the villages in South Sumatera have low population densities ranging from 48 to 401 per km². The villages in West Java in general have higher population densities, ranging from 72 to 7,205 per km².

35. In South Sumatera, the villagers are mostly farmers and laborers employed in rubber and palm oil plantations, paddy fields, farm lands, fishponds and fishing activities. In West Java, the majority of the villagers work as farmers, fishermen, and fishpond farmers. Some are self-employed micro entrepreneurs in the informal economic sectors, such as vendors and small traders. Some are also employees of private sector enterprises.

¹¹ Source: www.tigertrust.info, last updated 9 March 2006

36. Education infrastructure in South Sumatera is inadequate and schools are only available up to the elementary level. Higher education is only available in cities of sub-districts/ regencies. In West Java, infrastructure for education is generally adequate. Elementary schools and senior high schools are available and accessible to local communities. Informal vocational courses such as language, computer, accounting, and sewing skills courses, are also available.

37. Health facilities are inadequate in South Sumatera. Most villages are served only by small health clinics providing only basic medical care. Patients requiring further medical treatment must be referred or transferred to sub-district or district level hospitals. In West Java, health clinics at village level in Muara Bekasi are adequately equipped. Despite this, environmental sanitation in both areas is poor.

IV. ALTERNATIVES

A. Without the Project

38. The Project was conceived to fill the existing demand-supply gap of natural gas in West Java. In the Government of Indonesia's National Energy Management Blueprint, the share of natural gas in the national energy mix will be increased from the current level of 20% to 40% by 2025. Gas from Sumatera is the most preferred option to meet the gas demand in industrialized West Java considering that: (i) Sumatera is one of the largest natural gas resources of the country; (ii) gas supply from existing production in Java is declining; and (iii) supply from large reserves in East Java will not be commercially available in the near future. Currently, Sumatera's supply of natural gas to West Java is only 173 mmscfd of the estimated 802 mmscfd demand.

B. Alternative Transport Mode

39. Alternatives for transporting natural gas from the onshore production sources in South Sumatera to markets in West Java include: (a) pipeline; (b) land and sea transport of liquefied natural gas (LNG), and (c) land and sea transport of compressed natural gas (CNG). In general, the LNG alternative would be economical if the distance is greater than 1,000 km, much higher than the 681 km distance under the Project. The CNG alternative is also not suitable for transporting a large volume of natural gas. Therefore, the pipeline alternative is most preferred and is obviously the least cost alternative. In addition to the cost aspect, the pipeline option is within the expertise and experience of PGN in gas pipeline engineering and operations. PGN successfully completed the 536 km Grissik – Duri gas pipeline in 1998 and the 470 km gas pipeline from Grissik to Singapore through Batam in 2003.

C. Alternative Pipeline Alignments

40. The selected onshore pipeline alignment has been selected to minimize impacts of the pipeline within the two km wide AMDAL survey area. The criteria used to determine the alignment were the: (i) minimum number of affected structures and people; (ii) geological stability; (iii) proximity to natural gas fields; (iv) minimum impacts upon the forest ecosystems; and (v) closest distance to the markets including industries and power plants. The offshore pipeline alignment has been selected to minimize impacts of the pipeline within the four km wide AMDAL survey area to minimize sea traffic disturbances and to avoid coral reefs.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Environmental Impacts during Construction

1. Overview of the Impacts and General Mitigation Measures

41. Construction activities under the Project that could create adverse environmental impacts are: (i) movement of heavy equipment for trenching, transport of pipes and movement of personnel; (ii) clearing of vegetation within the corridor; (iii) trenching activities including storage of excavated materials; (iv) laying of pipes under the rivers; (v) laying of pipes under the sea; and (vi) construction of the gas receiving and compressor stations. The impacts would include: (i) noise; (ii) dust; (iii) loss of vegetation in the corridor; (iv) emissions from vehicles and heavy equipment used in the construction; and (v) increased turbidity of the river and sea water during pipe laying. In general, the impacts would not be significant and they will be transient in nature since (i) the pipeline is a linear structure and the construction activities are confined to short sections along a narrow corridor for a maximum of 5 days; (ii) the onshore corridor is mostly within sparsely populated areas; and (iii) the offshore section is within areas which are not ecologically sensitive.

42. PGN will ensure through contracts that the contractors will implement best environmental management practices in their construction to minimize normal environmental disturbances unavoidably associated with civil works construction. In addition, the contractors will also be required to be responsible for providing basic facilities such as temporary housing, water supply, basic health care, and sanitation facilities for the work force. Heavy construction machinery and equipment will be moved only along the right of way. The machinery will be removed from the sites as soon as the work is completed. Any wastes or surplus materials will be properly disposed. Transport of materials such as pipes will be scheduled to minimize traffic disturbances. PGN will closely monitor the contractors' environmental performance as covenanted under the contracts.

2. Onshore Pipeline Construction

43. The trenching works could create environmental impacts such as vegetation clearing along the corridor, and environmental disturbances as well as public nuisances normally associated with civil work construction.

a. Clearing of Vegetation

44. The pipeline corridor will be cleared of shrubs, undergrowth, and trees to enable trenching and pipe laying. PGN will adhere to the Ministerial Decree number 126/KPTS-II/2003, which prohibits the cutting of trees greater than a diameter of 0.3 m. Contractors will be under instructions to minimize tree cutting, where possible to leave trees on the edges of the right of way. PGN will rehabilitate the corridor soon after the construction is completed in that area with suitable shallow-root plants. PGN will work with the Ministry of Forestry to select the plants and monitor their survival.

b. Impact on wildlife

45. The pipeline corridor in South Sumatera will pass through only small isolated areas of degraded forest. It will not have any significant impact on wildlife. Although the corridor will be one km from Way Kambas National Park, it will not impede the movement of any wildlife to and from the park. Construction workers will be prohibited from hunting of wildlife and tree cutting.

c. Noise and Emissions

46. Operation of heavy equipment and vehicles in the construction of trenches and pipe laying can create localized noise and air pollution caused by exhaust emissions containing carbon monoxide, nitrogen oxides, and sulfur dioxide. However, the problems at each site will be experienced over a short duration, only 3-5 days, before the pipe layout is completed and the construction moves on to new sites along the corridor.

47. The noise level of heavy equipment such as generators and air compressors can reach 80-90 audible decibels (dBA) at 1 m from the equipment. The noise level will drop to 60-70 dBA at 100 m in open fields, and lower if thick vegetations exist to absorb the noise.

48. Noise and emissions from heavy equipment will not have any significant impact since: (i) the pipe laying operation will be carried out mostly in open areas, thus the emissions will be rapidly dispersed and diluted; (ii) the problems will last only 3-5 days at any one site as mentioned above; and (iii) the construction sites are in sparsely populated areas.

49. Notwithstanding the low level of impact, PGN will still attempt to minimize the dust and localized air pollution problems by requiring the contractors and their subcontractors to implement the following mitigation measures; (i) conducting routine maintenance of heavy equipment and transportation vehicles to minimize the levels of noise and emissions; and (ii) in areas where houses or occupied buildings are within 100 from the corridor, noisy equipment will be operated only during day time hours.

d. Dust

50. Dust can be generated during the trench excavation. Excavated materials piled near the trenches can also generate wind-induced dust. PGN will suppress dust by requiring the contractors and subcontractors to periodically spray water on dry soil.

e. Water Turbidity

51. The pipeline will cross several rivers and streams. The following measures will be taken in pipeline crossing to avoid or minimize the problem of increased water turbidity; (i) for streams with seasonal flows, the pipeline will be laid by the open cut method during the dry season; (ii) for major rivers such as Batanghari, Lubai, Cikarang and CBL River, the HDD will be used; (iii) use TB technique to avoid disturbances to primary irrigation or drainage canal water flows; (iv) the river banks at the pipeline crossing will be reinforced with concrete; and (v) the water required for the hydro-testing will be carefully discharged without causing significant turbidity increase in the receiving waters.

f. Soil Erosion

52. PGN will carry out most of the trenching work during the dry season to minimize soil erosion thus ensuring minimum turbidity of the nearby water bodies. No spoils will remain since all of the soil displaced by the pipe will be used to cover the trench. The covered trench will then be planted with grass. In addition, PGN will also require its contractors and subcontractors to implement the following good practices in environmental management in the construction; (i) place excavated materials close to the excavations sites for ease of backfilling the trench after the pipe is installed; (ii) use the HDD technique to minimize the amount of backfill soil creeping back into the rivers. (iii) reuse the excavated soil to cover the pipe. Backfill piles in each location will only remain for a maximum 3 days; and (iv) plant grass as soon as possible after the trench is backfilled.

g. Mangrove Disturbance

53. At the entry and exit areas of the undersea pipe, at Labuhan Maringgai and Muara Bekasi, it will be necessary to clear mangroves within the corridor. Presidential Decree no.32/1990 on Management of Protected Areas indicates that all shoreline in Indonesia must be protected. At Labuhan Maringgai, the site no longer has mangroves. At the exit of the undersea gas pipe at Muara Bekasi, the mangrove area is degraded due to fish ponds. The Project will clear about one ha of shoreline and will not cause a significant ecological impact, considering the small area and the poor condition of the existing mangroves.

54. PGN will rehabilitate the mangrove areas damaged by the Project. PGN will undertake this task in collaboration with Fisheries and Marine Agency, Forestry Agency, and other related institutions to obtain mangrove seeds and to make arrangements for the maintenance of the replanted mangrove areas.

3. Offshore Pipeline Construction

a. Sea Water Turbidity

55. The construction works in the sea and coastal areas could increase water turbidity with adverse consequences on seawater quality and fishpond productivity. PGN will minimize the turbidity problem by; (i) using excavators operated on board ships to carry out excavation in waters with depths over 2 m, and using dredgers for excavation in waters with depths of less than 2 m; (ii) allowing excavators to operate from shore to the sea only up to a certain distance at low tide. The distance will be based on high tide velocity and return time to shore; (iii) collecting and temporarily store water¹² disposed from hydrostatic tests in rented fishponds to diminish the load turbulence in the sea that might initiate turbidity.

b. Marine Ecosystem

56. The laying of the undersea gas pipe will not have any permanent adverse impact on marine life because the pipe laying ships will not be allowed to discharge wastes into the sea, and pipes laying on the sea bed will not obstruct movement of marine animals.

4. Construction of Support Facilities

57. The impact of the construction of two receiving stations, one delivery station, and two gas compressor stations will be similar in nature to those of building construction. Considering the features of the facilities, their construction is not major construction. Environmental disturbances will be small in magnitude and will be controlled using conventional mitigation measures to be implemented by the contractors and subcontractors in integration with the construction works. The remaining problems will not create any significant impact.

B. Environmental Impacts during Operations

58. The operations of the gas pipeline system would not create significant environmental impacts as the system does not generate any wastes. The only issues of attention will be noise from the compressors and operational safety.

⁷ The water used in the hydrostatic test, according to PGN's SOP is fresh-clean water. There will be no additional chemical substances used in the test. After the test, the stored water from hydrostatic test will be slowly discharged to the nearest rivers due to its huge volume. For onshore hydrostatic test (per segment of a maximum of 30km) will need approximately 15,566 m³ water while for offshore (along 161 km) will require approximately 83,034 m³ water.

1. Noise

59. The compressors and generators will generate noise in the range of 90 -100 dBA, even with silencers attached. Operating personnel will be provided with ear protection. The noise level will be reduced by soundproofing the compressors and the buildings, and by planting trees. These measures will reduce the noise level outside the buildings to the 70-80 dBA range, and to 50-60 dBA outside the perimeter. This ambient noise level is well within the acceptable noise standards for an industrial and residential zone in Indonesia.¹³

2. Operational Safety

60. Compressors and generators will be located within a boundary that is at least 100 m from any residential area, as per safety regulations.

61. To ensure the system performance and integrity, a SCADA system will be installed to manage the operations of the gas pipeline, including leak detection. The SCADA system will be operated from the master control station at Bojonegara. In the event of emergency, the SCADA system will automatically isolate the affected pipe section by remotely operated valves.

62. For efficient and satisfactory function of the pipeline system, from both safety and economic aspects, the pipeline will be protected against corrosion and other potential dangers. It will be cathodically protected by an impressed current system as a permanent facility.

63. The corridor will be maintained and inspected regularly to ensure clear visibility and easy access to valve locations and other pipeline facilities. The maintenance and inspection will be in accordance with PGN's SOP¹⁴ which include; (i) regular foot patrols of the pipeline; (ii) routine check and calibration of safety equipment; (iii) periodic inspection, particularly during the monsoon season, of all pipe crossings for foundation stability. The results of such inspection will be recorded for remedial action; (iv) formal communication procedures with related governmental and local agencies about gas pipeline routes and stations; (v) markers and emergency contact numbers placed at strategic locations; (vi) regular public communication; (vii) regular staff training; (viii) regular inspection of cathodic corrosion protection; (ix) regular pipe thickness inspection using intelligent pig; and (x) corrosion monitoring system using Copper Sulphate Electrode.

64. Proper warning signs will be placed to alert the public to the location of the gas pipes and facilities. For the offshore segment, buoys will be placed to define the pipeline corridors. For the onshore segments, markers will be placed every one km along the corridor. Regular patrols will be carried out along the pipeline route.

65. An information sharing and education program for communities near the onshore pipeline routes will be developed. This program will prepare the communities for emergency response and evacuation in the event of accidents. Residents will be cautioned of the hazards associated with such activities as open burning and illegal excavation in the pipeline vicinity.

¹³ The noise level of compressor is compared with industrial level because the source of noise is heavy equipment as like compressor. The Decree of Environmental Minister No. 48 of the year 1996, on standard quality of Noise level, the noise standard for residential area is 55 dB(A), while for industry is 70 dB(A). Based on above degree, the compressor will not be located near residential area to preserve the threshold value for residential area.

¹⁴ Operation and Maintenance of Pipeline Transmission System No. OMT.01/2000

3. Impacts on Marine and Wildlife

66. The pipeline corridor will not obstruct wildlife movement. The onshore corridor will not be fenced and will be replanted to the extent possible. The offshore pipe will be buried where water depth is less than 13 m and lie on the seabed where water depth is greater. It will offer no obstruction to marine life.

4. Risk Analysis

67. Accidental leaks of natural gas from the gas pipeline are the only technical risk of the Project. However, accidental gas releases during operations have a very low probability since high safety standards are strictly enforced in the design, construction and operations. According to the European Pipeline Incident Data Group database, representing almost 2 million kilometer year of pipeline operations, the failure rate reported for on-shore gas pipeline with design pressure greater than 15 bar is 4.76×10^{-4} per km per year. The existing gas transmission pipelines of PGN have so far had no leak incidents. Nevertheless, accidental leaks could be caused by external factors such as vandalism or accidents damaging the gas pipes. If such leaks happen, the control system will detect the leaks instantly and the leaking section will be automatically isolated by sectioning valves.

68. Natural gas released in large quantities in the event of a pipe rupture could create a fire hazard. Computer simulations of leaks estimate that the fire hazard area for the onshore pipe would be confined to a 220 m radius. For the offshore pipe, a flammable gas cloud and flash fire can reach up to 40 m downwind on the surface of the sea and to a height of 95 m.

69. Apart from fire hazard, natural gas accidentally released from the pipeline would not create a toxic hazard as it contains no toxic substances. Because of the quick response by the SCADA control system, the volume of gas released would also be too small to make a significant contribution to the green house effect.

C. Social and Economic Impacts

1. Land Acquisition and Resettlement

70. Detailed surveys of the onshore corridors established that a total of 4,817 land titles would be affected by the Project. The main impact would be loss of income earned from crops and trees in the acquired land. As the gas pipeline corridor is only 25 m wide, only 40 structures including farm shelters and semi-permanent wooden houses would be physically affected.

71. PGN prepared a resettlement action plan in 1998 in line with its general policy for land acquisition, compensation and resettlement. The PGN policy follows the Presidential Decree (Keppres) no.55/1993 and World Bank's Operational Directives (OD) 4.30: Involuntary Resettlement, June 29, 1990. PGN has updated the resettlement action plan to reflect the latest progress of the land acquisition and to follow relevant ADB's guidelines on involuntary resettlement. As of the end of June 2006, the land acquisition progress was about 89% complete for Province of South Sumatera and Lampung. PGN expects to complete the land acquisition by August 2006.

2. Impact on Fishing Activities and Aquaculture

72. During the laying of offshore pipes, fishing activities will be affected within a 500 m radius from the pipeline construction site. To minimize disruption to the operations of offshore fish

pens and fish traps, PGN will disseminate information about the proposed pipe laying activities, including the schedule of pipeline installation.

73. The Project will affect 11 fishpond owners in South Sumatera. Compensation was completed in January 2006 based on terms and conditions agreed between PGN and the affected fish pond owners. Surveys of fishpond owners along the pipeline corridor in West Java started in January 2006 and were expected to complete by February 2006. Compensation is expected to be finalized by June 2006.

3. Impact on Sea Traffic

74. The pipeline installation in the sea will interfere with ship traffic. The Labuhan Maringgai water is regularly used by 1,168 local fishing boats and 8 local transport ships. In the sea area near Muara Bekasi, the sea traffic is dominated by tourism and trading activities between Jakarta Bay (Tanjung Priok) and Seribu Islands, as well as fishing boats. In one week during the AMDAL survey, it was observed that 266 vessels plying the waters between Jakarta and Seribu islands, mainly for tourism purposes, including 17 speedboats, 42 long boats, 162 small-motorized boats and 27 waterbuses. Although Muara Bekasi is not a national port, the undersea pipeline from Labuhan Maringgai to Muara Bekasi will cross the international shipping route at kilometer point (KP) 34 and domestic shipping route at intersection point (IP) - 4 and IP-5A (see Appendix 3).

75. The offshore pipeline laying is not expected to result in significant interference to sea traffic because: (i) the international shipping route will cross the pipeline corridor only at one point; and (ii) the pipe installation along the undersea corridor will be a continuous process with construction vessels remaining in one area for less than one day. While pipe laying is underway, temporary traffic warning buoys will clearly show the pipeline installation locations. Whenever possible, pipe installation will be done at night when traffic load is light, especially in heavy traffic waters.

4. Impact on Indigenous Peoples

76. The onshore pipeline corridor in West Java and South Sumatera will not pass through culturally or socially sensitive areas or territories of indigenous peoples. This was confirmed by representatives of regional government agencies, NGOs and community leaders, and documented at a proceeding of the AMDAL document.

5. Induced Development

77. The construction of the onshore pipeline will require approximately 580 workers, 40% or 232 of whom will be recruited from local areas. Priority will be given to the recruitment of villagers living along the pipeline route for the construction and also for the operations. In the operational phase, PGN will train and hire about 70 local villagers as pipeline checkers for foot patrolling. These employment strategies will minimize any conflict between local people and workers from other areas.

78. As the construction crew will be dispersed along the long pipeline corridor for just a short duration, the Project will not induce haphazard development of communities or economic activities during the construction.

D. Decommissioning

79. The pipeline is designed to have an economic life of 20 years. However, technically the working life of the pipeline can be as long as 40 years. After its useful life, the pipeline will be decommissioned to make it free from fire hazard. The decommissioning of both the onshore and offshore sections of the pipeline will use the same procedure. The residual natural gas in the pipeline will be purged with nitrogen gas, followed by water. The abandoned pipes will stay buried filled with water.

VI. ECONOMIC ASSESSMENT

A. Cost of Environmental Protection

80. The project capital cost includes the costs of impact mitigation measures and environmental safeguards such as: (i) HDD for pipeline crossing major rivers to avoid impacts on the water turbidity; (ii) compressor silencers; (iii) sound-proof compressor houses; and (iv) impact mitigation measures built into the work management in the construction of trenches and buildings. These costs are normally included in the bid price on a lump sum basis. The expenses for monitoring activities during the construction and operations have not yet been estimated but would be small compared to the operation and maintenance expenses of the gas pipeline system.

B. Economic Benefits

81. The construction and operations of the Project will yield direct economic benefits to the national economy in the forms of taxes, saving in subsidies on fuels to be replaced by the natural gas, and employment. However, the local economies may not directly benefit from the employment under the Project as the employment will not be concentrated in one place. The Project is financially viable and economically sound. The Project's financial-internal-rate of return which is about 12% could serve as a rough gauge of the economic-internal-rate of return.

C. Environmental Costs and Benefits

82. In addition to conventional economic costs and benefits the Project will also have environmental costs and benefits.

1. Environmental Costs

83. The Project will use or contribute to the following environmental degradation, resources or services; (i) exclusion of about 1,182.76 ha of the land corridor in agricultural areas from economic production; (ii) loss of about 40 ha of the land corridor in the degraded forest areas; (iii) discharge of small quantities of exhaust pollutants from construction equipment and vehicles; (iv) tree felling in the land corridor; and (v) temporary disturbances to wildlife during the construction of the pipeline and corridor.

84. It is difficult to estimate monetary value of the above items of environmental costs. However, for item (i) the compensation paid to the affected people can be used as proxy to the environmental cost. The total amount of compensation is tentatively estimated at about \$17.3 million equivalent. For the remaining cost items in paragraph 83, the following observations should be noted; (i) the cost item (ii) above is not possible to estimate as its nature is intangible; (ii) the cost item (iii) above would be insignificant considering the small magnitude of construction and insignificant impacts; (iii) the cost item (iv) above would be offset as PGN will

carry out a tree planting program to compensate for the trees that will be felled; and (iv) the cost of item (v) above is not possible to estimate as its nature is intangible and temporary.

2. Environmental Benefits

85. The major environmental benefits of the Project will be the reduction of gaseous pollutants by replacing fossil fuels with natural gas supplied by the Project. The Project will supply natural gas to replace high speed diesel oil (HSD) used by industries and power plants in West Java. Currently, the committed supply of the Project's natural gas is 576 mmscfd, of which about 32% will be used by PLN, the state-owned power company, and 68% by industries. It is expected that the demand will reach the supply capacity of 700 mmscfd.

86. Diesel generator sets using HSD emit sulfur dioxide (SO₂), nitrogen oxides (NO_x), carbon dioxide (CO₂) and particulates. Combustion of natural gas also generates the same pollutants but much less in quantities per unit energy. An estimate of emissions of the four pollutants under the scenarios "Without Project" and "With Project" shows the use of the natural gas of the Project would reduce by 99% the emissions from using HSD with equivalent amount of natural gas supplied under the Project, if the existing HSD equipment is converted to use natural gas. (Appendix 2).

87. The economic value of carbon dioxide, sulfur dioxide, and nitrogen oxides can be estimated from past data on trading prices. As particulates are not traded, their economic value has to be estimated using the removal cost or avoidable cost.

88. Apart from carbon dioxide which is the main greenhouse gas, the other three pollutants have adverse effects on the health of the population with consequences on the economy. Therefore, the economic value of these three pollutants can also be estimated from the total cost of: (i) cost of medical care; (ii) loss of income; (iii) cost to the economy due to productivity loss; and (iv) cost of increased welfare related to the illness of the affected populations.

89. The economic value of the environmental benefits of the Project was estimated at about \$6.89 million per year at the gas supply rate of 700 mmscfd. The net present value of the total environmental benefits over the project life of 20 years is estimated at about \$74.52 million using a discount rate of 8% per annum.

VII. ENVIRONMENTAL MANAGEMENT PLAN

A. Mitigation Measures

90. In line with the findings, the AMDALs include preparation of RKL (environmental management plan (EMP)) and RPL (environmental monitoring plan). The EMP contains mitigation measures for all identified major impacts during the construction and operations phases, and monitoring activities to be carried out during the construction and operations. The consolidated EMP is summarized in Appendix 4.

91. PGN has incorporated within each construction contract environmental management requirements to be complied with by the contractor and subcontractors. Examples of such requirements include proper maintenance of work areas, proper storage in suitable containers of waste oil and grease for returning to the service stations, proper disposal of sanitary wastes in worker camps, and wetting of trenching areas to minimize dust. The construction contracts will include provisions for penalties and disciplinary actions for the contractors or their

subcontractors if they fail to comply with the environmental management requirements. In addition, the contractors will also be briefed on the conditions imposed by the MOE on the Project, the potential problems and mitigation measures as outlined in the AMDAL reports, and their obligations in meeting those requirements. The mitigation cost is integrated in the construction cost and therefore not able to be shown separately.

92. As a good corporate citizen, PGN has a policy to promote environmental conservation and social development. In this regard, although the Project will not have significant impacts on wildlife, PGN will explore opportunities to cooperate with the Ministry of Forestry in conservation programs, including the planting of an additional 10,000 saplings in addition to replacing each tree removed and the erection of signs to encourage forest and wildlife preservation.

B. Monitoring and Auditing

1. During Construction

93. PGN will ensure effective environmental management and monitoring through close monitoring and evaluation, including monthly assessments, of the contractors' environmental performance as prescribed in their contracts. If non-compliance is found, the contractors will be notified to take corrective actions. Formal notification will be sent to contractors if non-compliance persists.

94. The implementation of the EMP by PGN will involve the following activities; (i) maintaining coordination with the environmental regulatory agencies and contractors for effective project environmental management; (ii) monitoring and inspection activities of the Project, including project sites; and enforcing reporting requirements by the contractors as stipulated in the contracts; (iii) coordination with the local agencies and communities to ensure cooperation and effective execution of the EMP; (iv) submission of six-monthly environmental monitoring reports as required by BAPPEDAL (Badan Pengendali Dampak Lingkungan, Environmental Impact Assessment Agency) and the local governments during both construction and operation phases.¹⁵

2. During Operations

95. In the operations phase, the gas pipeline performance will be monitored by the SCADA system supplemented by foot patrolling.

C. Organization for Environmental Management

96. During the construction, the construction staff under the construction manager will supervise the contractors to ensure that the environmental management requirements are strictly implemented. About 38 environmental staff under the manager of Quality Assurance and Health, Safety and Environment (HSE) will be responsible for regular monitoring and monthly evaluation of the environmental management results. During operations 83 HSE staff will be employed. Bapedalda (*Badan Pengendali Dampak Lingkungan Daerah*, Local Environmental Impact Assessment Agencies) and ESDM Department (*Energi dan Sumber Daya Mineral*, Energy and Mineral Resources) will monitor Project environmental performance. PGN will allocate approximately \$50,000 annually for environmental monitoring.

¹⁵ The reports would also be required by ADB.

VIII. PUBLIC CONSULTATION AND DISCLOSURE

97. PGN has carried out extensive public consultation and disclosure with the Project's stakeholders since the early stage of the AMDAL process. The Project's stakeholders include affected people, all levels of local governments, villages and NGOs.

98. Public consultations have been carried out through various means, including; (i) dissemination of project information through mass media including local broadcasting. Community members who wished to give input and opinions were given 30 days (after the announcements were broadcasted/published) to make submissions to the local BAPEDALDA or PGN; (ii) surveys of public attitudes towards the Project; and (iii) public meetings held in nine regencies and sub-districts along the entire Project area from November 2003 to August 2005 with an average of 100 people attending each meeting. These meetings provided information on the Project and its impacts on community members.

99. In these public consultations, PGN described the Project and its possible impacts on the communities, solicited views on the impact mitigation, and sought cooperation of the communities and all related parties. These discussions generally supported the Project but some concern was expressed regarding the adequacy of compensation for land acquisition.

100. A survey of the attitudes of local communities towards the project reveals the following; (i) of those interviewed along the Grissik – Pagardewa section, 78% expressed support for the project, 5% stated otherwise and 17% abstained; (ii) in West Java, attitudes towards the project show 47% expressed support, 39% stated otherwise and the balance abstained; and (iii) in Labuhan Maringgai, 40% expressed support, 45% stated otherwise and the balance abstained. The survey in Labuhan Maringgai was carried out before 1999 prior to any public consultations held to explain the benefits of the project. PGN will carry out further public consultations before October 2006 to gauge current attitudes for the Pagardewa-Labuhan Maringgai segment, and take proper measures to address local communities' concern about the project.

101. Based on field findings from community involvements activities, PGN has prepared a Community Development Program (CDP) and Program Kemitraan dan Bina Lingkungan (PKBL) for local communities, which complies with government regulations. The CDP and PKBL will provide social infrastructure (including religious activities, medical equipment and supply, renovation of school buildings and supply of handbooks), consultation and counseling, Partnership Programs with small scale business enterprises and include small scale credit schemes, and additional community services based on specific needs for the communities. The CDP and PKBL aim to create sense of ownership of these facilities including the project pipeline in their area. Funding for the programs is allocated from PGN's profit. In 2006 total fund allocated for CDP and PKBL is Rp12.9 billion, or 1.5% of the 2005 profit.

102. PGN will continue public consultations including the disclosure of relevant information for the duration of the Project.

IX. CONCLUSIONS

103. The Project is the most practical way to increase the share of natural gas in the energy profile of West Java. Pipeline transport is the only viable option to bring natural gas from the onshore production fields in Sumatera to industrial and residential consumers in West Java.

104. During construction, the Project will create transient disturbances to environmental quality. However, the disturbances common to all civil work construction would not create significant impacts considering the short construction period over a section of the corridor before the construction progresses to other sections of the narrow construction area. The construction, based on the latest information on land use along the corridor, will not have significant impacts on wildlife and forest. The Project will acquire only 39.6 ha of designated forest land. During operation, the pipeline will not pollute the environment as it does not generate wastes. The corridor will be covered with grass and shallow-root vegetation to minimize soil erosion. The unfenced pipeline corridor will offer no impediment to animal crossing.

105. The land acquisition for the corridor will inevitably affect the users of that land. PGN has implemented a compensation program to the full satisfaction of the affected households.¹⁶ The amount of compensation is tentatively estimated at about \$17.3 million equivalent.

106. During construction and operation, PGN will monitor the actual environmental impacts of the Project and ensure the implementation of the mitigation plans from all the AMDAL monitoring and mitigation documents (RKL and RPL) as approved by the MOE. PGN will appoint a HSE manager to monitor, evaluate and manage any environmental impacts of the Project. PGN will submit six-monthly environmental monitoring reports to both BAPPEDAL and ADB.

107. The Project will create environmental benefits by replacing more polluting fuels such as HSD and coal, with natural gas. Based on the estimates of natural gas use, the net present value of the environmental benefits is estimated at about \$74.52 million for the operating life of 20 years and a discount rate of 8% per annum. The Project can be justified on environmental grounds because its benefits exceed its Environmental costs.

¹⁶ Details are presented in the resettlement action plan.

FAUNA SPECIES IDENTIFIED IN THE AMDAL SURVEYS

No	Tropical Grade	Family /Type Name	Locations/Individual Abundance				Status	Remarks
			LMRG	AUB	MIL	WKM		
FAUNA SPECIES WITNESSED DURING SURVEY								
Observed during survey or identified from tracks, calls or fasses								
A	MAMMALIAN							
1	CARNIVORE	VIVERIDAE						
		Civet (pharadoxurus hermaphroditus)	-	+	+	-		W/TL
2	HERBIVORE	CERCOPITHECIDAE						
		Monkey (Presbytis cristata)	-	+	-	-		W/PL
3	HERBIVORE	SCIURIDAE						
		Coconut Squirrel (Callosciurus notatus)	-	++	++	-		PL
4	OMNIVORE	CERCOVITHEDEAE						
		Long tailed monkey (Macaca fascicularis)	+	++	+			PL/W
5	OMNIVORE	SUIDAE						
		Boar (Sus scrofa)	-	++	+	-		W/TL
C	BIRDS							
1	FISCIVORE	ARDEIDAE						
		Pond Heron (Ardeola speciosa)	++	-	-	-		PL
		Buffalo Egret (Bubulcus ibis)	+	-	-	-		PL
2	FISCIVORE/ CARNIVORE	RALLIDAE						
		Tikusan (Porzana sp)	+	-	-	-		PL
		Kareo (Auornis phoenicurus)	+	-	-	-		PL
3	FISCIVORE / CARNIVORE	SCOLOPACIDAE						
		Swamp Trinil (Tringa stagnatilis)	+	-	-	-		PL
		Bush Trinil (Tringa glareola)	+	-	-	-		PL
4	FISCIVORE	ALCEDINIDAE						
		Cekakak Kingfisher (Halcyon chloris)	+	-	-	-	D	PL
5	CARNIVORE	ACCIPITERIDAE						
		Alap-alap Eagle (Accipiter sp)	-	+	-	-	D	PL
		Bondol Eagle (Heliastur Indus)	-	+	+	-	D	PL
6	GRANOVORE	COLUMBIDAE						
		Tekukur Dove (Streptopelia chinensis)	-	++	++	+		PL
		Pigeon (Geopelia striata)	-	+	-	-		PL
		Punai Pigeon (Treron vermans)	-	++	++	-		PL
		Puter Dove (Streptopelia bitorquata)	-	+	+	-		PL
7	GRANOVORE	PLOCEIDAE						
		White Belly Bondol (Lonchura leucogastroides)	-	++	++	+		PL
8	GRANOVORE	PSITTACIDAE						

No	Tropical Grade	Family /Type Name	Locations/Individual Abundance				Status	Remarks
			LMRG	AUB	MIL	WKM		
		Betet Parrot (<i>Psittacula alexandri</i>)	-	+	+	-		PL
9	GRANOVORE/ INSECTIVORE	CUCULIDAE						
		Bubut (<i>Centropus bengalensis</i>)	-	++	++	-		PL
		Tuwu (<i>Eudynamys scolopaea</i>)	-	+	-	-		PL
10	INSECTIVORE	APODIDAE						
		House swallow (<i>Apus alfinis</i>)	++	-	++	+		PL
		White breast swallow (<i>Collocalia esculenta</i>)	-	+	+	-		PL
11	INSECTIVORE	MEROPIDAE						
		Kirik-Kirik (<i>Merops viridis</i>)	-	+	+	-		PL
12	INSECTIVORE	HIRUNDINIDAE						
		Swallow (<i>Hirundo rustica</i>)	++	++	++	+		PL
13	INSECTIVORE	DICRURIDAE						
		Srigunting (<i>Dicrurus macrocercus</i>)	-	+	+	-		PL
14	INSECTIVORE	TURDIDAE						
		Kucica (<i>Copsycus saularia</i>)	-	+	+	+		PL
15	INSECTIVORE	SYLVIDAE						
		Cinenen (<i>Orthotomus ruficeps</i>)	-	+	+	-		PL
		Prenjak Prinias (<i>Prinia flaviventris</i>)	-	+	+	-		PL
16	INSECTIVORE	MUSCICAPIDAE						
		Kipasan (<i>Rhyphura javanica</i>)	-	+	+	+		PL
17	INSECTIVORE	LANIIDAE						
		Bentet (<i>Lanius schach</i>)	-	-	+	+		PL
18	INSECTIVORE / GRANOVORE	PYCNONOTIDAE						
		Kutilang (<i>Pycnonotus atriceps</i>)	-	++	++	+		PL
19	NECTIVORE	NECTARINIDAE						
		Coconut Honey Bird (<i>Nectarinia jugularis</i>)	-	++	++	+		PL
FAUNA SPECIES NOT WITNESSED DURING SURVEY*								
Identified from interviews with local residence only								
A	MAMMALIAN							
1	CARNIVORE	FELIDAE						
		Tiger (<i>Panthera tigris sumatrae</i>)	-	+	-	-	D	W
		Alley Cat (<i>Felis bengalensis</i>)	-	+	+	-	D	W
2	CARNIVORE	URSIDAE						
		Honey Bear (<i>Helarctos malayanus</i>)	-	+	+	-	D	W
3	CARNIVORE	VIVERIDAE						
		Mongoose (<i>Herpestes Hosei</i>)	-	+	+	+		W
4	HERBIVORE	CERVIDAE						
		Deer (<i>Cervus timorensis</i>)	-	+	-	-	D	W
5	HERBIVORE	TRAGULIDAE						
		Mouse deer (<i>Tragulus javanicus</i>)	-	+	+	-	D	W

No	Tropical Grade	Family /Type Name	Locations/Individual Abundance				Status	Remarks
			LMRG	AUB	MIL	WKM		
7	HERBIVORE	MURIDAE						
		House Mouse (<i>Rattus rattus</i>)	-	+	+	+		W
		Fields Mouse (<i>Rattus argentiventer</i>)	+	-	-	+		W
B	REPTILIAN							
1	CARNIVORE	VARANIDAE						
		Lizzard (<i>varanus salvator</i>)	+	-	-	-		W
		BIODAE						
		Phyton Snake (<i>Phyton reticulates</i>)	+	+	+	-		W

Source: EIA Pagardewa – Labuhan Maringgai 1999; and EIA Grissik – Pagardewa 2005

Legend :

LMRG = Labuhan Maringgai (Fresh water swamp)

AUB = Air Ubai (Secondary Forest/Bushes)

MIL = Mesir Ilir (Secondary Forest/Bushes)

WKM = Way kambas (National Park Forest/ Cultivated Vegetation)

+ = Found in this location/habitat, with frequency of finding 10 times during observation period

++ = Found in this location/habitat, with frequency of finding >10 times during observation period

- = Not found in this location

D = Protected by the Wild Animal Laws/Regulation

PL = Field Observation

W = Interview (with local people)

TL = Indirect Observation (Foot track, voice, left over feces)

Calculations of the Amount of Pollutants that would be Reduced by the Project

Units of Energy Measurements

1 joule (J)	=	0.2388	cal
1 kilo calories (kcal)	=	4,188	J
1 giga joule (GJ)	=	10 ¹²	J
1 tera joule (TJ)	=	1,000	GJ
	=	10 ¹⁵	J

Basic Data

Fuel to be replaced	=	high speed diesel oil (HSD)
Gas consumption	=	700 mmscfd
Heating value of natural gas	=	8,899 kcal/m ³
Heating value of HSD	=	9,063 kcal/l
Carbon content of natural gas	=	75 % by weight

Emission Factors, Generators

		Diesel Generators 1/				Natural Gas 2/
		500	1,000	5,000	Average	
Capacity, kw	500	1,000	5,000	Average		
Efficiency, %	38	39	40	39		60
SO ₂ (kg/TJ)	700	700	583	661		0.30
NO _x (kg/TJ)	4,822	4,220	3,914	4,319		43
Particulates (kg/TJ)	1,206	905	753	955		2
CO ₂ (kg/TJ)	276,100	276,100	230,150	260,783		63,416

Source: Sudhir C. Rajan and Antoneete D'Sa, Captive Power Generation-Air Pollution Impacts due to Increased Capacity Utilization, Energy for Sustained Development, Vol.IV, No.1, June 2000; WEC Survey of Energy Resources 2001 - Natural Gas.

Calculations

Natural gas consumption	=	700 mmscfd
	=	19,821,606 m ³ /d
Total energycontent of natural gas	=	176,392,467,790 kcal/d
	=	0.7387 TJ/d
Assume thermal efficiency of gas	=	60%
Assume thermal efficiency of HSD	=	39%
Total energy of HSD to be replaced	=	1.1364 TJ/d

Amounts of Pollutants, t/year	HSD	Natural Gas	Reduction
SO ₂	274	0.081	274.09
NO _x	1,791	11.593	1,779.73
Particulates	395.98	0.539	395.44
CO ₂	108,170	17,098	91,072

C. Economic Benefits**Data**

SO ₂ trading price	=	700.00	\$/ton in 2005
	=	1,475.00	\$/ton on 30 November 2005
	=	1,087.50	\$/ton used in the calculation (average of two values)
CO ₂ trading price	=	31.80	\$/ton on 24 February in EU market
NO _x	=	1,900.00	\$/ton average in 2005
Particulate	=	784.00	\$/ton, avoidable cost, 1997 price

Benefits

SO ₂	=	0.30	m\$
NO _x	=	3.38	m\$
CO ₂	=	2.90	m\$
Particulates	=	0.31	m\$
Total	=	6.89	m\$
NPV at 8% discount, 20 years	=	74.52	m\$

Data Sources

Emission of pollutants	WEC Survey of Energy Resources 2001 – Natural Gas
Heating value of LNG	PGN
CO ₂ trading price	http://www.pointcarbon.com , accessed on 27 February 2006
SO ₂ trading price	http://www.environmental-finance.com/2005/0512dec/surv2.htm
NO _x trading price	http://www.environmental-finance.com/2005/0512dec/surv2.htm
Particulate removal cost	Captive Power generation-Air Pollution Impacts due to Increased Capacity Utilization Sudhir C. Rajan and Antoneete D'Sa, Energy for Sustained Development, Vol. IV, No. 1, June 2000 The figure used is the lowest figure advanced technology coal plant estimated for India.

D. Calculation of NPV

Year	DCF	NPV
0	1	6.89
1	0.925926	6.38
2	0.857339	5.91
3	0.793832	5.47
4	0.735030	5.06
5	0.680583	4.69
6	0.630170	4.34
7	0.583490	4.02
8	0.540269	3.72
9	0.500249	3.45
10	0.463193	3.19
11	0.428883	2.95
12	0.397114	2.74
13	0.367698	2.53
14	0.340461	2.35
15	0.315242	2.17
16	0.291890	2.01
17	0.270269	1.86
18	0.250249	1.72
19	0.231712	1.60
20	0.214548	1.48
Total NPV		74.52

SUMMARY OF ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Project Activity	Impact Control and Mitigation			Monitoring		
	Issues and Potential Impacts	Mitigation Measures	Means of Implementation	Responsible Org.	Parameters to be Monitored	Monitoring Period
I. Construction						
A. Onshore Sections						
Acquisition of land for the pipeline corridor.	Loss of about 957 ha of agricultural land affecting 4,980 households in the form of income loss and 125 houses will be physically affected. Loss of about 293 ha of forest areas in several locations along the corridor	Pay fair compensation to the affected households and land owners for the loss in livelihood and land, and for physical impacts on 125 houses.	Public consultation, preparing a resettlement plan to implement, and negotiations with the affected persons on the forms and amount of compensation.	PGN	Number of complaints of affected persons. Time taken to compensate the affected persons after reaching agreements on the compensation.	During the land acquisition process
Clearing of vegetation in the pipeline corridor	Loss of agricultural crops and trees	Minimize trees to be cut and revegetate the land corridor to the possible fullest extent.	Including this requirement in the contracts. Close supervision of the contractors.	Contractors supervised by PGN	Number of large trees that have been cut.	During the construction period.
Trenching works and pipe laying	Minor and transient environmental disturbances such as dust, noise, soil erosion and exhaust emissions of heavy construction equipment and vehicles.	Implement good environmental management practices in the construction to address these problems	Include good environmental management practices in the contracts	Contractors supervised by PGN	Air quality, noise and dust in the communities nearest the construction sites.	
Hydrotesting of laid pipes	Abstraction of water from local sources and disposal of the water after the tests.	Minimize the volume of water. Storage of the water and slowly release to the receiving waters.	Including this requirement in the contracts. Close supervision of the contractors.	PGN		
River crossings	Increase in water turbidity	Use HDD for crossing large rivers Use open cut method for crossing small streams, construction will be confined to only dry season.	Incorporate in the design and bid documents.	PGN		
Major road crossing	Traffic disruption.	Use Thrust Boring Method	Incorporate in the design and bid documents.	PGN		
B. Offshore Section						
Laying pipes in mangrove areas	Clearing of about 1 ha of mangrove at Muara Bekasi. No mangrove trees at Labuhan Maringgai	Plantation of mangrove at Labuhan Maringgai and Muara Bekasi	Agreement between PGN and the Ministry of Forestry.	PGN		
Laying undersea pipes	Obstruction to sea traffic.	Laying the pipe during low traffic time, put warning signs clearly along the corridor.	Incorporate in the design and bid documents.	Contractors supervised by PGN		
II. Operations						
Operations of gas pipeline system.	Fire hazard caused by pipe leak or rupture. Disturbance to wildlife Noise of compressor station	Automatic leak detection and isolating the leak section Routine inspection and check for pipe thickness and leak. Public information on pipeline operations, fire hazard and emergency response Wildlife conservation Use low noise compressors, noise contained in the building using sound proof materials.	Include the SCADA system in the design and bid documents. Routine land patrol along the corridor. Use "smart pig". Clear warning signs along the pipeline Prepare emergency response plan Cooperate with the Ministry of Forestry in implementing wildlife conservation programs. Incorporate in the design and bid documents.	PGN PGN, Min.of Forestry and local governments Contractors supervised by PGN	Number of gas leak incidents, pipe thickness, pressure Number of public complaints Periodic forest and wildlife surveys. Noise level inside and outside the compressor station.	Continuous as part of the system control Through out the operational period. Through out the operational period.